

Exxaro



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Exxaro Sublime Access Road, Kriel Mpumalanga

J37158

Ecological Assessment

November 2017



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Report Production

Specialist	Role	Project Component	Professional Registration / Qualifications
Robyn Phillips	Senior Ecologist	Ecological assessment of flora and fauna; field work and report compilation	MSc (Zoology) UKZN SACNASP: <i>Pr.Sci.Nat.</i> (Zoology and Ecology)

Specialist Declarations of Independence

I, **Robyn Phillips**, in my capacity as a specialist consultant, hereby declare that I –

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998);
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability;
- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and/or further work in this field; and
- Undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered.

17 November 2017

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Senior Specialist
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Date

Executive Summary

GIBB (Pty) Ltd was appointed Exxaro Coal to undertake an ecological assessment as part of the Environmental Impact Assessment (EIA) Process required for the upgrade of the Sublime Access road at the coal stock pile for Matla Power Station. The existing road used as an exit route is a gravel road that supports heavy traffic in the form of mine trucks transporting coal from the stock pile to the power station. The road is under immense pressure and is in need of constant repair. The road is in need of an upgrade to blacktop with formalised stormwater infrastructure.

The study site is located within the Grassland Biome, and more specifically within Eastern Highveld Grassland, which is considered an Endangered vegetation type. According to the Schedule of Threatened Terrestrial Ecosystems, remaining primary grassveld areas of Eastern Highveld Grassland as well as the Eastern Temperate Freshwater Wetlands are considered as Vulnerable Ecosystems in terms of Section 52 of NEMBA under criterion A1: Irreversible loss of natural habitat.

The study area contained a large wetland area supporting moist grassland and providing important habitat for fauna. This habitat was considered highly sensitive. The surrounding dry grassland was highly disturbed and was considered less sensitive although did support faunal species.

The existing road implies that impacts are already present in the landscape. Most of the proposed activity will occur within transformed or disturbed areas, therefore the construction phase is deemed to have a relatively low impact on the surrounding vegetation. However, the more sensitive wetland habitats will experience higher impacts and indirect impacts are possible. Mitigation measures will need to be applied in these instances.

A positive impact will be that with the road upgrade, a formal storm water drainage system will be installed. This will help alleviate the current impacts experienced by the surrounding environment by the informal trench dug as drainage for the road.

Exxaro Sublime Access Road: Ecological Assessment

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1 Introduction

1.1 Project Description

GIBB (Pty) Ltd was appointed Exxaro Coal to undertake an ecological assessment as part of the Environmental Impact Assessment (EIA) Process required for the upgrade of the Sublime Access road at the coal stock pile for Matla Power Station.

The existing road used as an exit route is a gravel road that supports heavy traffic in the form of mine trucks transporting coal from the stock pile to the power station. The road is under immense pressure and is in need of constant repair. The road is in need of an upgrade to blacktop with formalised stormwater infrastructure.

The following report comprises an investigation of the terrestrial flora and fauna present on the site and an assessment of the ecological sensitivities and possible impacts associated with the proposed development on the ecology pertaining to flora and fauna in the area.

1.2 Terms of Reference

The terms of reference for the ecological assessment were to provide the following:

- Description of the current state of the biodiversity (flora and fauna) in the study area;
- Description and map of the vegetation categories identified during the field surveys;
- Description and mapping of areas of ecological importance including habitats identified during the field surveys and the ecological connectivity and corridors for movement;
- Photographic record of the site characteristics, including major vegetation units and sensitive areas;
- Lists of plant and animal species confirmed to occur and which could potentially occur within the study area as well as conservation status described as per IUCN Database, NEMBA Act and provincial legislation; and
- Professional opinion and assessment of potential impacts of the proposed development on the affected terrestrial habitats and their biodiversity to guide future decisions regarding the proposed project.

1.3 Approach

The field surveys were undertaken on the 25th and 26th of October 2017. The methodology broadly entailed the following:

- Review of all relevant literature including distribution data of fauna, flora and vegetation types expected to occur on the site, as well as the conservation status of the vegetation types and species;
- Review available information layers within the GIS e.g. Land Cover, relevant provincial spatial conservation or biodiversity plan, Important Bird Areas (IBAs);
- Description and map of the vegetation categories currently found on the site;

-
- Field surveys to assess the current ecological state of vegetation units and faunal habitat on site;
 - Field surveys to confirm the presence of threatened, endemic, rare or protected plant and animal species on the study site and to identify suitable habitat for these species.

Appendix A provides in-depth details regarding the methodology employed during the field surveys.

1.4 Conditions and Limitations

The following conditions and limitations pertain to the current study:

- Vegetation unit boundaries usually consist of transitional zones which cannot be captured as distinct lines. Boundaries are therefore approximately defined and not precise.
- Surveys to determine the presence of any threatened plant species must take place during the flowering season of the species historically recorded on site. The current study was undertaken during late spring.
- In order to obtain a comprehensive understanding of the dynamics of the biota on site, including species of conservation concern, studies should include sampling through the different seasons of the year, over a number of years, and extensive sampling of the area. Due to project time constraints, such long-term research was not feasible and the surveys were conducted in one late spring assessment.
- The Mpumalanga Tourism and Parks Agency (MTPA) minimum requirements for biodiversity assessments recommend two seasons' sampling (one early summer and one late summer) to account for species that flower at different times. Due to project time constraints, one survey was conducted in late spring.

1.5 Study Area

1.5.1 Location

The study area is located within the Emalahleni Local Municipality within the Nkangala District Municipality in Mpumalanga. The site is located approximately 13km due west of the town of Kriel, next to the Matla Power Station. The site falls within Quarter Degree Grid Cell (QDGC) 2629AC, between 26°16'21.2"–26°17'06.7" south and 29°07'12.1"–29°07'53.4" east (Figure 1). The study area is relatively flat ranging in elevation from 1615m to 1630m above mean sea level (amsl).

1.5.2 Climate

According to Mucina and Rutherford (2006), the study area experiences a strong seasonal summer rainfall with dry winters. The mean annual precipitation is around 650-900mm. Frost is very common with between 13 and 42 frost days experienced during winter. The monthly average midday temperatures range from 16.6°C in June to 26.2°C in January, while the region is coldest in July when temperatures drop to 0.8°C on average during the night.

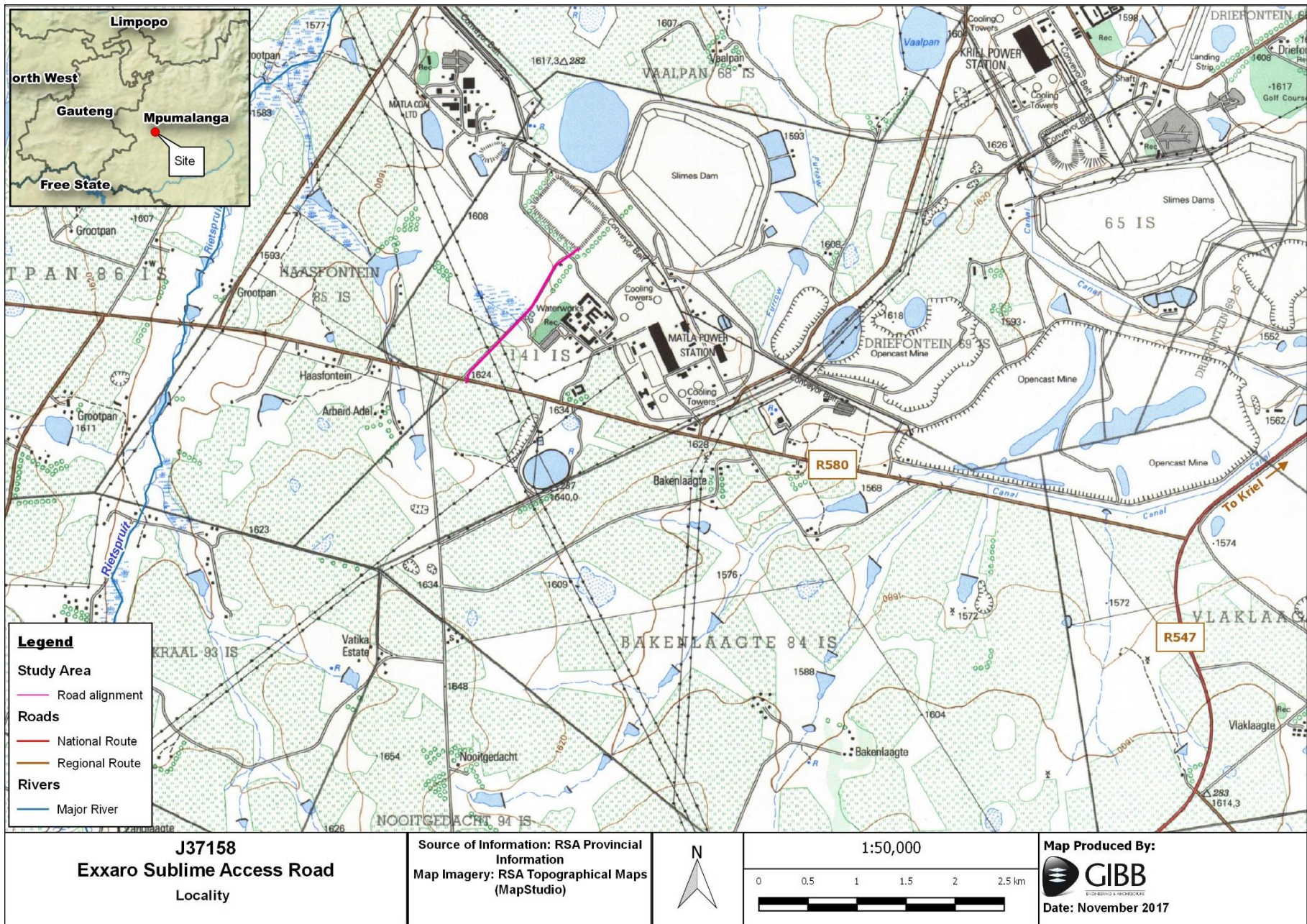


Figure 1: Location of the study area

2 Regional Biodiversity Importance

2.1 Regional Vegetation

The study area is situated within the Grassland Biome (Rutherford and Westfall, 1994). The Grassland Biome comprises mainly of sweet and sour grasses and plants with perennial underground storage organs, such as bulbs and tubers, while trees are restricted to specialised habitats such as rocky outcrops or kloofs. The majority of Rare and Threatened plant species in the summer rainfall regions of South Africa are restricted to high-rainfall grasslands, making this the biome in most urgent need of conservation (Mucina and Rutherford, 2006). It is not generally acknowledged that the majority of plant species in grasslands are non-grassy herbs (forbs), most of which are perennial plants with large underground storage structures. The majority of these species remain dormant during winter or very dry seasons, and re-sprout during early summer if rains are sufficient. Rare and Endangered species in grasslands are mostly small, very localised and visible for only a few weeks in the year when they flower (Ferrar and Lötter, 2007).

The biomes in southern Africa are divided into smaller units known as vegetation types. According to Mucina and Rutherford (2012), the study area is situated within the **Eastern Highveld Grassland** vegetation type (Figure 2) which is restricted to the Gauteng and Mpumalanga Provinces from Belfast in the east, Johannesburg in the west and southwards to Bethal, Ermelo and Piet Retief. Eastern Temperate Freshwater Wetlands also occur in the area but will not be affected by the proposed project. Eastern Highveld Grassland consists of undulating plains, low hills and pan depressions. The vegetation consists of short dense grassland dominated by grasses such as *Aristida*, *Digitaria*, *Eragrostis*, *Themeda* and *Tristachya*. Woody species are limited but include species such as *Celtis africana*, *Diospyros lycioides*, *Parinari capensis*, *Protea caffra* and *Searsia magalismsontanum* (Table 1).

According to Mucina and Rutherford (2006), Eastern Highveld Grassland is classified as **Endangered** with only a small fraction conserved in statutory reserves with more than 44% transformed by cultivation, plantations, mining and urbanisation).

Table 1: Important floral species characteristic of the Eastern Highveld Grassland vegetation type (after Mucina and Rutherford, 2006)

Important Taxa	
Graminoids	<i>Aristida aequiglumis</i> , <i>A. congesta</i> , <i>A. junciformis</i> subsp. <i>galpinii</i> , <i>Brachiaria serrata</i> , <i>Cynodon dactylon</i> , <i>Digitaria monodactyla</i> , <i>D. tricholaenoides</i> , <i>Elionurus muticus</i> , <i>Eragrostis chloromelas</i> , <i>E. curvula</i> , <i>E. plana</i> , <i>E. racemosa</i> , <i>E. sclerantha</i> , <i>Heteropogon contortus</i> , <i>Loudetia simplex</i> , <i>Microchloa caffra</i> , <i>Monocymbium cereiiforme</i> , <i>Setaria sphacelata</i> , <i>Sporobolus africanus</i> , <i>S. pectinatus</i> , <i>Themeda triandra</i> , <i>Trachypogon spicatus</i> , <i>Tristachya leucothrix</i> , <i>T. rehmannii</i> , <i>Alloteropsis semialata</i> subsp. <i>eckloniana</i>
Herbs	<i>Berkheya setifera</i> , <i>Haplocarpha scaposa</i> , <i>Justicia anagalloides</i> , <i>Pelargonium luridum</i> , <i>Acalypha angustata</i> , <i>Chamaecrista mimosoides</i> , <i>Dicoma anomala</i> , <i>Euryops gilfillanii</i> , <i>E. transvaalensis</i> subsp. <i>setilobus</i> , <i>Helichrysum aureonitens</i> , <i>H. caespitium</i> , <i>H. callicomum</i> , <i>H. oreophilum</i> , <i>H. rugulosum</i> , <i>Ipomoea</i>

	<i>crassipes</i> , <i>Pentanisia prunelloides</i> subsp. <i>latifolia</i> , <i>Selago densiflora</i> , <i>Senecio coronatus</i> , <i>Vernonia oligocephala</i> , <i>Wahlenbergia undulata</i>
Geophytes	<i>Gladiolus crassifolius</i> , <i>Haemanthus humilis</i> subsp. <i>hirsutus</i> , <i>Hypoxis rigidula</i> var. <i>pilosissima</i> , <i>Ledebouria ovatifolia</i>
Succulents	<i>Aloe ecklonis</i>
Low shrubs	<i>Anthospermum rigidum</i> subsp. <i>pumilum</i> , <i>Stoebe plumosa</i>

2.2 Listed Terrestrial Ecosystems

The National Environmental Management: Biodiversity Act (NEMBA, Act 10 of 2004) provides for listing threatened or protected ecosystems, in one of four categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Protected (Pr) (DEA, 2011). The main purpose of listing threatened ecosystems is to prevent or reduce the rate of ecosystem degradation or loss and species extinction. Threatened terrestrial ecosystems identified in the NEMBA were delineated using the following:

- The South African Vegetation Map (Mucina and Rutherford, 2006; SANBI, 2012 [beta update]);
- National forest types (Von Maltitz *et al.*, 2003);
- Priority areas identified in a provincial systematic biodiversity plan (in this particular case the Eastern Cape Biodiversity Conservation Plan (Berliner *et al.*, 2007); or
- High irreplaceability forest patches and clusters identified by the Department of Agriculture, Forestry and Fisheries (DAFF; Berliner, 2005).

Extensive stakeholder engagement and the best available information formed the basis of the criteria used to identify threatened terrestrial ecosystems listed in NEMBA. The criteria for thresholds for Critically Endangered, Endangered and Vulnerable ecosystems are summarised in Table 2.

Table 2: Criteria used to identify threatened terrestrial ecosystems (DEA, 2011)

Criterion	Critically Endangered	Endangered	Vulnerable
A1: Irreversible loss of natural habitat	Remaining natural habitat < biodiversity target	Remaining natural habitat < biodiversity target + 15%	Remaining natural habitat < 60% of original area
A2: Ecosystem degradation and loss of integrity	> 60% of ecosystem significantly degraded	> 40% of ecosystem significantly degraded	> 20% of ecosystem significantly degraded
C: Limited extent and imminent threat	-	Ecosystem extent < 3000ha and imminent threat	Ecosystem extent < 6000ha and imminent threat
D1: Threatened plant species associations	> 80 threatened Red List plant species	> 60 threatened Red List plant species	> 40 threatened Red List plant species
F: Priority areas for meeting explicit biodiversity targets as defined in a systematic biodiversity plan	Very high irreplaceability and high threat	Very high irreplaceability and medium threat	Very high biodiversity and low threat

The implication for land management is that any development situated within listed ecosystems will require the following:

- Planning: linked to the requirement in NEMBA for listed ecosystems to be taken into account in municipal Integrated Development Plans (IDPs) and Spatial Development Frameworks (SDFs);
- Environmental Authorisation (EA): in terms of the Environmental Impact Assessment (EIA) Regulations (2014) promulgated under the National Environmental Management Act (NEMA; Act 107 of 1998) as amended;
- Proactive management: in terms of NEMBA; and
- Monitoring and reporting: in terms of NEMBA.

The EIA Regulations include three lists of activities that require EA:

- Listing Notice 1: activities that require a basic assessment (GNR983 of 2014);
- Listing Notice 2: activities that require scoping and environmental impact report (EIR) (GNR984 of 2014); and
- Listing Notice 3: activities that require a basic assessment in specific identified geographical areas only (GNR985 of 2014).

Activity 12 in Listing Notice 3 relates to the clearance of 300 square metres (0.03ha) or more of vegetation, which will trigger a basic assessment within any Critically Endangered or Endangered ecosystem listed in terms of Section 52 of NEMBA. This means any development that involves loss of natural habitat in a listed Critically Endangered or Endangered ecosystem is likely to require at least a basic assessment in terms of the EIA regulations. It is important to note that while the original extent of each listed ecosystem has been mapped, a basic assessment report in terms of the EIA regulations is triggered only when remaining natural habitat within each ecosystem is threatened. A basic assessment report is not required where natural habitat has already been irreversibly lost in listed ecosystems.

According to the Schedule of Threatened Terrestrial Ecosystems, remaining primary grassveld areas of Eastern Highveld Grassland as well as the Eastern Temperate Freshwater Wetlands are considered as Vulnerable Ecosystems in terms of Section 52 of NEMBA (DEA, 2011) under criterion A1: Irreversible loss of natural habitat (Figure 3). Only 55% of the natural area of Eastern Highveld Grassland remains and <1% of the original area of the ecosystem is protected (Figure 3).

2.3 Mpumalanga Biodiversity Sector Plan

A provincial conservation plan aims to build on national plans at the provincial level. It is intended to be used by all who are involved in land-use and development planning, most particularly those specialists who need a comprehensive source of biodiversity information. The plan, and resulting land-use guidelines, are intended to supplement other spatial planning tools such as municipal Integrated Development Plans and Spatial Development Frameworks.

A systematic conservation plan for the Mpumalanga Province, as it is currently delineated, was published as the Mpumalanga Biodiversity Sector Plan (MBSP) by the Mpumalanga Tourism

and Parks Agency was last updated in 2014. This plan aims to conserve as many representative samples of biodiversity patterns (e.g. vegetation types, wetlands, rivers), including species, as well as important ecological and evolutionary processes (e.g. hydrological processes, nutrient cycling, fire, pollination, species migration) as necessary to maintain biodiversity conservation targets as well as ecosystem functionality.

The relevant documentation and associated Geographical Information System (GIS) layers with corresponding development guidelines are available online on the South African National Biodiversity Institute (SANBI) BGIS website. These GIS layers, however, were only verified on the ground to a limited extent. There is thus a requirement, as per NEMBA and Mpumalanga legislation, to investigate every site in detail to evaluate the current on-site ecological state of terrestrial biodiversity, threatened species present and their host ecosystems.

Integral parts of the MBSP are the terrestrial and freshwater Critical Biodiversity Area maps which were developed using systematic biodiversity planning methodology, following the approaches of Margules & Pressey (2000) and Ardron *et al.* (2010). The data were analysed using specialised GIS-based software which calculates the most efficient selection of planning units required to meet all biodiversity targets, while favouring persistence and avoiding areas of competing land-uses. The two key elements of the analysis are (1) identifying the best or optimal selection of planning units to meet targets, and (2) calculating an 'irreplaceability' value which assesses the importance of a particular site for meeting biodiversity targets. These values are used to inform the selection of sites for inclusion in the categories shown on the CBA maps.

The categories used in the CBA maps are as follows:

- **Protected areas (PAs):** Areas that are already proclaimed under national or provincial legislation, including gazetted biodiversity stewardship sites.
- **Critical Biodiversity Areas (CBAs):** Areas that are required to meet biodiversity targets for species, ecosystems or ecological processes. These need to be kept in a natural or near-natural state, with no further loss of habitat or species. This category is split into:
 - **CBA: Irreplaceable** – Areas required to meet targets and with irreplaceability values of more than 80% (i.e. there are little of these features remaining in a natural state). They are also critical linkages in the landscape that must remain natural, and/or Critically Endangered ecosystems below their biodiversity target.
 - **CBA: Optimal** – (Previously called "Important and Necessary") planning units optimally located to meet biodiversity targets and other criteria defined in the analysis. Although these areas are not 'irreplaceable' they are the most efficient land configuration to meet all biodiversity conservation targets and design criteria.
- **Ecological Support Areas (ESAs):** Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs and for delivering ecosystem services such as water provision, flood mitigation, or carbon sequestration. In the terrestrial assessment they support landscape connectivity and strengthen resilience to climate change. ESAs need to be maintained in at least a functional and often natural state, supporting the purpose for which they were identified. They include features such as riparian habitat surrounding rivers or wetlands, corridors etc. Freshwater ESAs may include:

-
- **Wetland Clusters:** these are smaller wetlands such as pans embedded within a landscape to allow for the migration of fauna and flora between wetlands.
 - **Wetlands:** wetlands that are important for supporting the hydrological functioning of rivers, water tables and freshwater biodiversity, as well as providing ecosystem services through the ecological infrastructure that they provide.
 - **Other Natural Areas (ONAs):** Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritised for biodiversity now, they are still an important part of the natural ecosystem.
 - **Moderately or Heavily Modified Areas:** (Sometimes called 'transformed') areas that have been modified by human activity so that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritised for conservation action. Their biodiversity value has been significantly compromised.

According to the MBSP, the road alignment falls across areas classified as Other Natural Areas (ONAs), Moderately Modified and Heavily Modified (Figure 4).

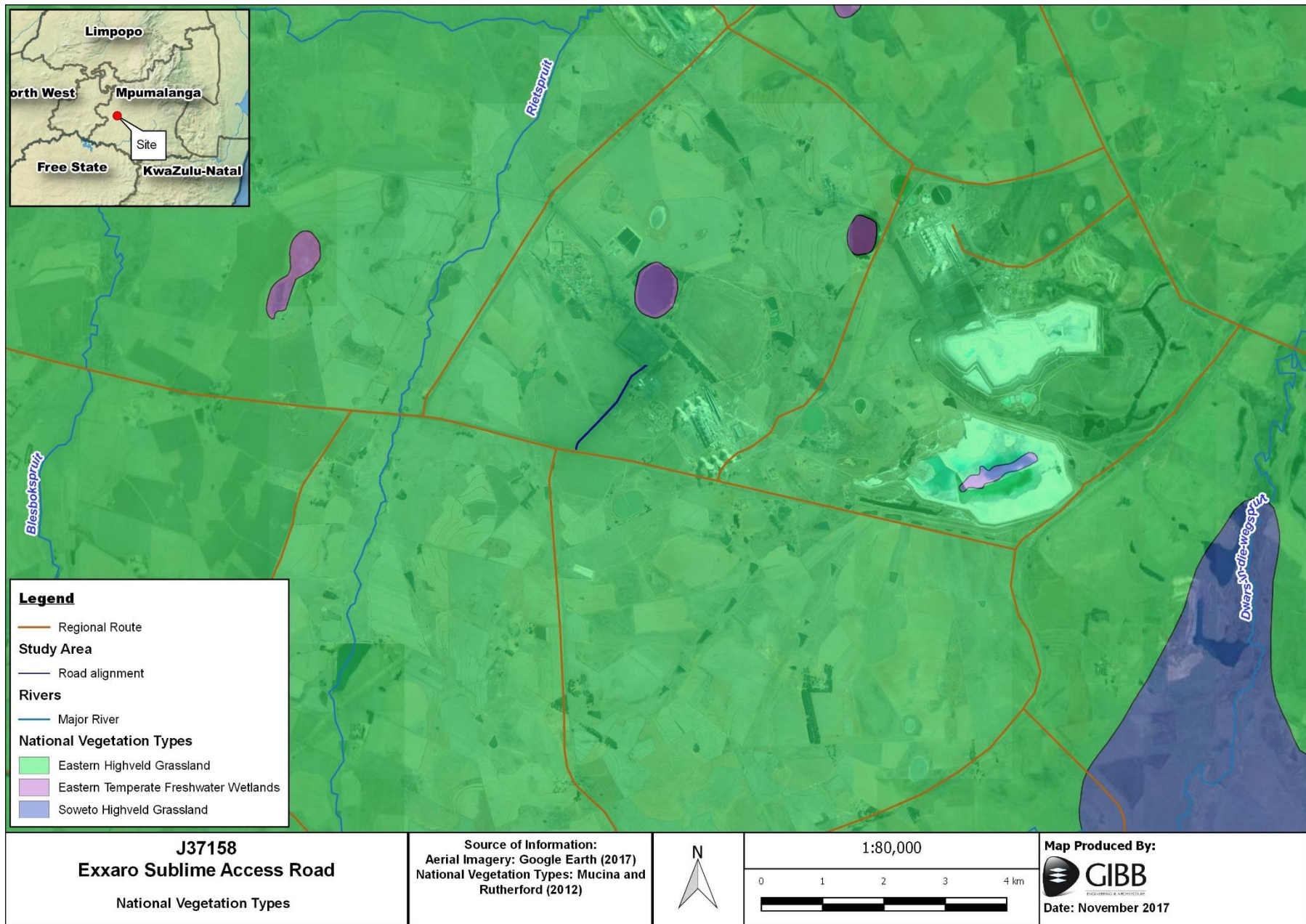


Figure 2: The study area in relation to national vegetation types

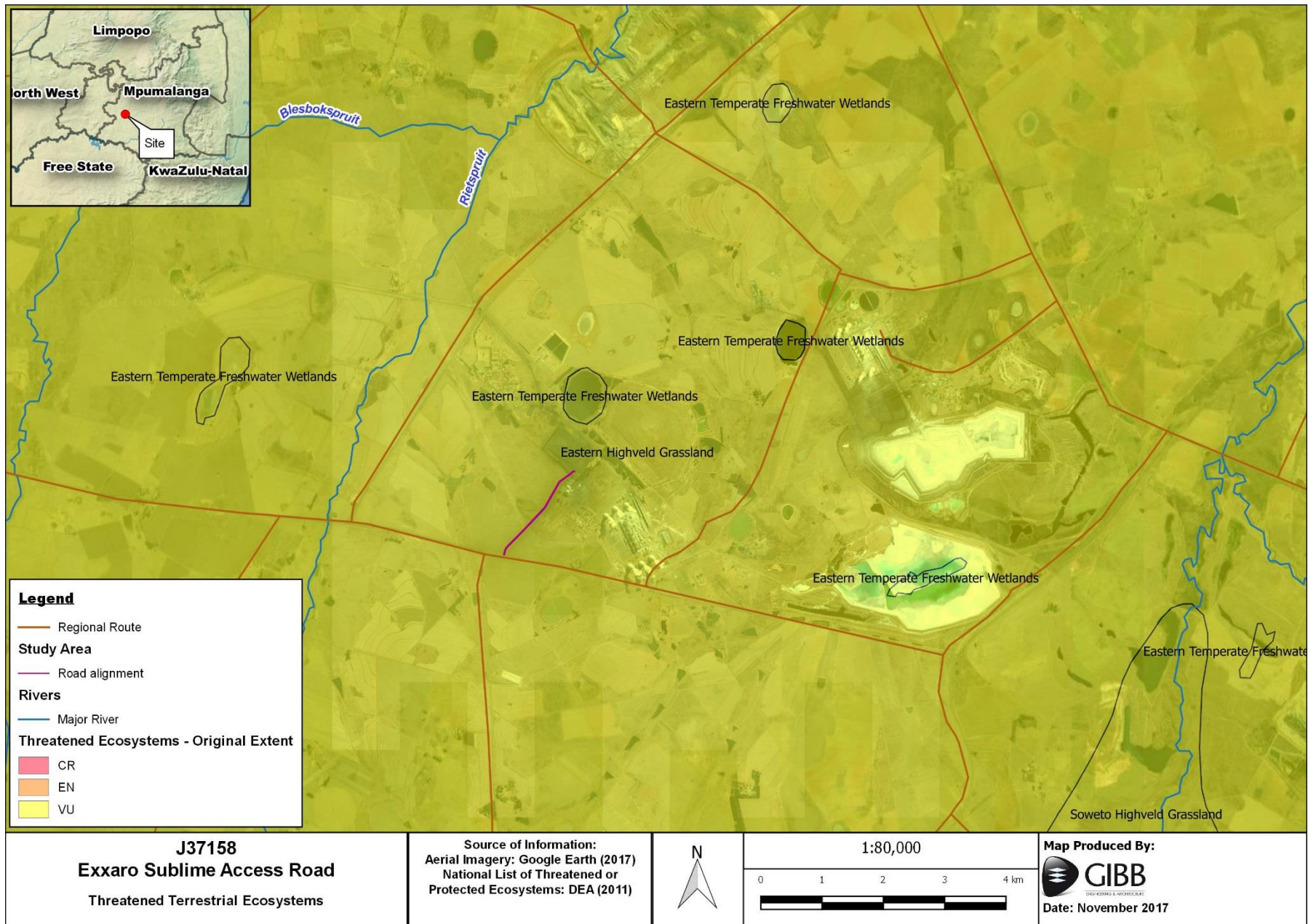


Figure 3: The study area in relation to national threatened ecosystems

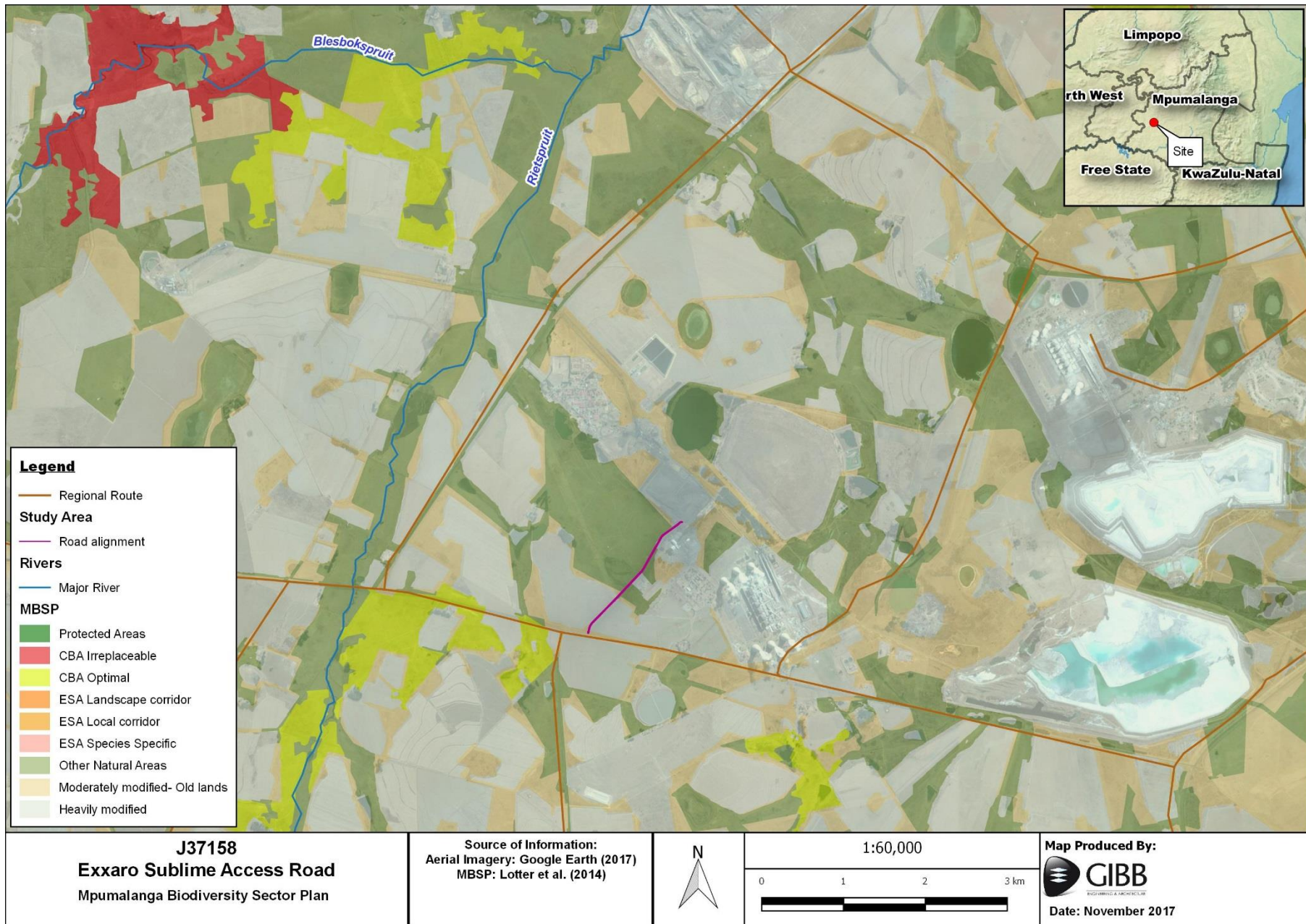


Figure 4: The study area in relation to terrestrial CBAs according to the Mpumalanga BSP

3 Results: Flora

3.1 Vegetation Overview

The study area was characterised by a large wetland area supporting moist grassland, surrounded by disturbed natural dry grassland and agricultural fields. The Exxaro office complex and coal stock pile occurred to the north of the site with the Matla Power Station occurring on the east side. The existing road is used to transport coal from the stock pile to the power station. The Sublime site and offices bordered the road on the east side and a water treatment works occurred next to the road on the east side. High voltage powerline servitudes crossed the agricultural field in the south and the natural grassland heading in a north-westerly direction.

At the time of the survey, natural vegetation on site was still in the early stages of growth, with few species in flower. Most of the grasses were still dry from the winter die-back and did not have inflorescences, thus species identification was limited. Overall diversity could be higher than was recorded during the survey. It is expected that more herbaceous, geophytic species would sprout and flower during December and January after sufficient rains.



Photo Plate 1: Dry grass in the study area

3.1.1 Agricultural Land

Agricultural fields, devoid of indigenous vegetation, occurred in the southern part of the study area and bordered the road on either side for approximately a third of its length (Figure 5).



Photo Plate 2: Agricultural fields in the southern part of the study area

3.1.2 Moist Grassland / Wetland

Moist grassland supporting hygrophilous vegetation occurred in the central portion of the study area on either side of the road, where the vegetation was influenced by the presence of moist substrate. Larger reed species occurred where there was standing water on the east side of the road, while perennial grasses and sedges were more common on the west side. Common grass species included *Juncus effusus*, *Cyperus spp.*, *Hyparrhenia sp.*, *Eragrostis chloromelas*, *Leersia hexandra*, *Pennisetum clandestinum*, *Typha capensis*, *Cynodon dactylon*, *Imperata cylindrica*, *Phragmites australis*, and *Paspalum distichum*. Few herbaceous species were observed. Common species included *Homeria pallida*, *Limosella major*, and *Arctotis arctotoides*. Table 3 summarises the common species found in the vegetation unit.

Table 3: Summary of the vegetation recorded in the moist areas

Category	Taxonomic Name
Common indigenous plant species at the time of the survey	<i>Juncus effusus</i> <i>Cyperus sp.</i> <i>Schoenoplectus corymbosus</i> <i>Eleocharis limosa</i> <i>Eragrostis chloromelas</i> <i>Leersia hexandra</i> <i>Typha capensis</i> <i>Cynodon dactylon</i> <i>Imperata cylindrica</i> <i>Phragmites australis</i> <i>Paspalum distichum</i> <i>Sporobolus africanus</i> <i>Homeria pallida</i> <i>Limosella major</i> <i>Arctotis arctotoides</i>
Confirmed plant species of conservation concern	None
Additional plant species of conservation concern likely to occur	<i>Crinum bulbispermum</i> <i>Disa woodii</i>
Confirmed provincially protected plant species	None

Additional provincially protected plant species likely to occur	<i>Crinum bulbispermum</i> <i>Disa woodii</i>
Confirmed nationally protected tree species	None
Additional nationally protected tree species likely to occur	None
Confirmed alien plant species	<i>Pennisetum clandestinum</i> <i>Cortaderia jubata</i> <i>Datura ferox</i> <i>Verbena bonariensis</i> <i>Cirsium vulgare</i>



Photo Plate 3: Moist grassland in the study area

The moist grassland in the study area was modified by anthropogenic activities to certain degrees. On the east side of the road, the construction of the water treatments works and activities associated with the Sublime works restricted the wetland to few remaining areas. On the west side of the road, the wet areas had been manipulated by trenches and berms to allow more dry areas for cattle grazing. Species present such as *Sporobolus africanus* and *Homeria pallida* indicate overgrazing.



Photo Plate 4: Modified areas of moist grassland

3.1.3 Disturbed Dry grassland

The remaining natural vegetation in the study area comprised disturbed, natural dry grassland with ecotonal habitats between moist and dry areas. Grassland areas had been disturbed mainly by cattle grazing and previous construction activities associated with the installation of powerline pylons and the construction of the existing road. Common grass species included *Eragrostis curvula*, *Eragrostis chloromelas*, *Pennisetum clandestinum*, *Cynodon dactylon*, *Sporobolus africanus*, and *Harpochloa falx*. Common herbaceous species included *Albuca* sp., *Barleria obtusa*, *Berkheya* sp., *Gomphocarpus physocarpus*, *Helichrysum* sp., and *Homeria pallida*. Species present such as *Sporobolus africanus* and *Homeria pallida* indicate overgrazing. Table 4 summarises the common species found in the vegetation unit.

While wetland and agricultural fields made up the majority of the road alignment, the grassland found within a 20m corridor on either side of the road was considered highly disturbed.



Photo Plate 5: Disturbed dry grassland in the study area

Table 4: Summary of the vegetation recorded in the disturbed dry grassland

Category	Taxonomic Name
Common indigenous plant species at the time of the survey	<i>Eragrostis curvula</i> <i>Themeda triandra</i> <i>Eragrostis chloromelas</i> <i>Cynodon dactylon</i> <i>Sporobolus africanus</i> <i>Imperata cylindrica</i> <i>Aristida congesta</i> <i>Harpochloa falx</i> <i>Nidorella podocephala</i> <i>Ajuga ophrydis</i> <i>Centella asiatica</i> <i>Hermannia depressa</i> <i>Albuca sp.</i> <i>Barleria obtusa</i> <i>Berkheya sp.</i> <i>Bulbine sp.</i> <i>Gomphocarpus physocarpus</i> <i>Haplocarpha scaposa</i> <i>Helichrysum sp.</i> <i>Homeria pallida</i> <i>Pseudognaphalium luteoalbum</i> <i>Arctotis arctotooides</i>
Confirmed plant species of conservation concern	<i>Hypoxis hemerocallidea</i> (Declining)
Additional plant species of conservation concern likely to occur	None
Confirmed provincially protected plant species	None
Additional provincially protected plant species likely to occur	None
Confirmed nationally protected tree species	None
Additional nationally protected tree species likely to occur	None
Confirmed alien plant species	<i>Eucalyptus sp.</i> <i>Pennisetum clandestinum</i> <i>Verbena bonariensis</i> <i>Datura ferox</i> <i>Trifolium repens</i> <i>Gleditsia triacanthos</i> <i>Cirsium vulgare</i>

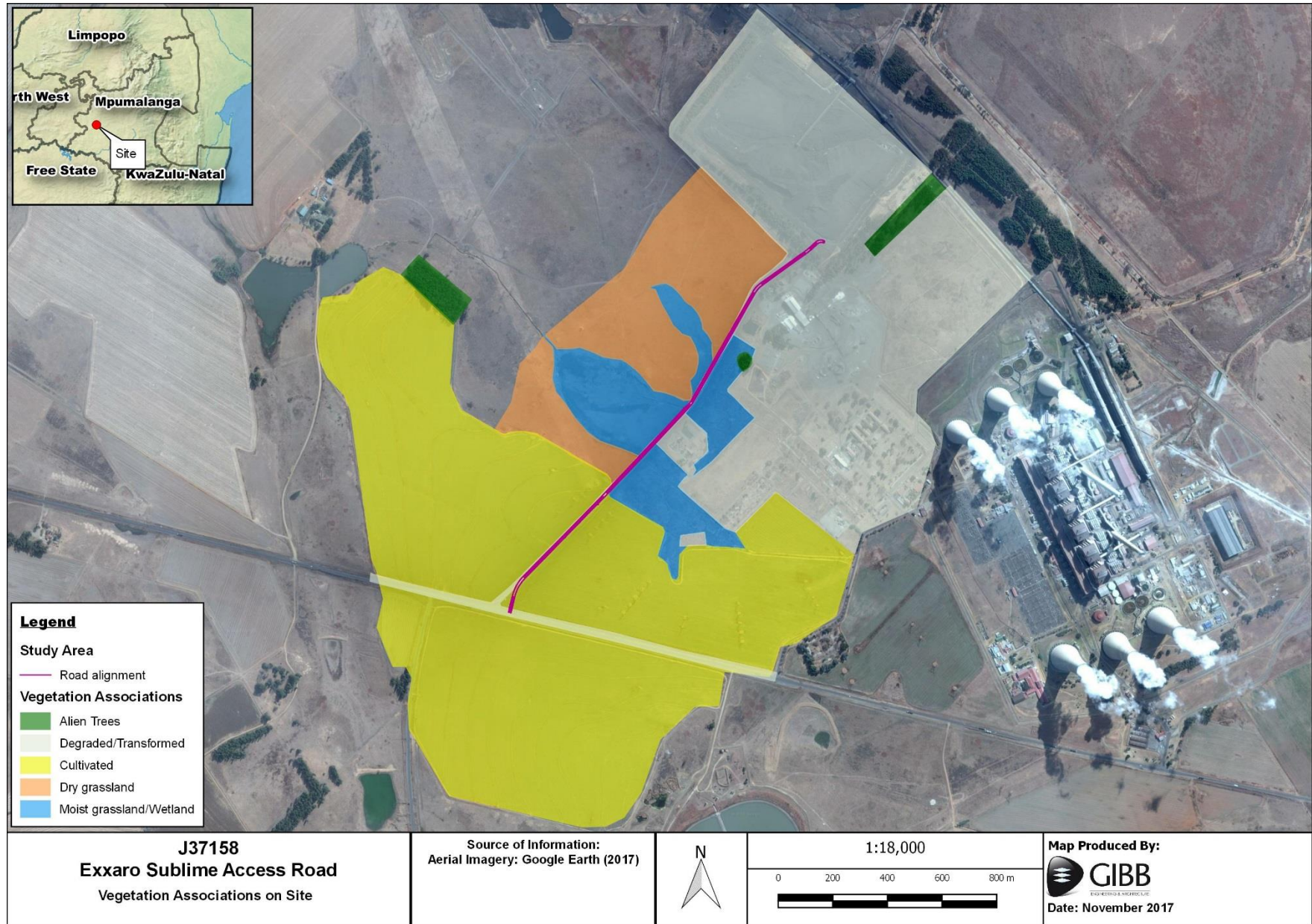


Figure 5: Vegetation associations described within the study area

3.2 Plants of Conservation Concern

Plants of conservation concern are those plants that are important for South Africa’s conservation decision-making processes. A plant taxon is of conservation concern when it is considered to be threatened, or close to becoming threatened with extinction and therefore classified as Critically Endangered, Endangered, Vulnerable, or Near Threatened. These plants are nationally protected by NEMBA. Within the context of this report, plants that are Declining, Rare, and Data Deficient (Taxonomic and Distribution) are also referenced under this heading. Removal or trimming of individuals of these species will require a permit that should be accompanied by a rehabilitation plan specifying either re-establishment or rescue and relocation to a suitable site.

Rare and Endangered species are mostly small, very localised and visible for only a few weeks in the year when they flower (Ferrar and Lötter, 2007). As these plants might not have been visible at the time of the field survey, the probabilities of occurrence for these plants were based on distribution data and information gathered concerning the area. These species as well as their habitat requirements and likelihood of occurrence in the study area are listed in Table 5.

Table 5: Species of conservation concern and likelihood of occurring in the study area

Species	Conservation Status	Likelihood of occurring on the site
<i>Boophone disticha</i>	Declining	Unlikely
<i>Callilepis leptophylla</i>	Declining	Unlikely
<i>Callilepis leptophylla</i>	Declining	Unlikely
<i>Gladiolus robertsoniae</i>	Near Threatened	Unlikely
<i>Hypoxis hemerocallidea</i>	Declining	Confirmed
<i>Khadia beswickii</i>	Vulnerable	Unlikely
<i>Kniphofia typhoides</i>	Near Threatened	Possible
<i>Nerine gracilis</i>	Vulnerable	Unlikely
<i>Stenostelma umbelluliferum</i>	Near Threatened	Unlikely

A small population of *Hypoxis hemerocallidea* was recorded on the east side of the road; however it is not likely to be affected by the road construction.



Photo Plate 6: *Hypoxis hemerocallidea* recorded in the study area

3.3 Alien and Invasive Plants

Declared weeds and invaders have the tendency to dominate or replace the herbaceous layer of natural ecosystems, thereby transforming the structure, composition and process of natural ecosystems. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species (Henderson, 2001). Therefore, it is important that all these habitat transformers be removed and controlled by means of an eradication and monitoring programme, provided there is a proactive strategy to rehabilitate the land to prevent re-colonisation.

The amended Regulations (Regulation 15) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) identifies three categories of problem plants:

- **Category 1** plants may not occur on any land other than a biological control reserves and must be controlled or eradicated. Therefore, no person shall establish, plant, maintain, propagate or sell / import any category 1 plant species;
- **Category 2** plants are plants with commercial application and may only be cultivated in demarcated areas (such as biological control reserves) otherwise they must be controlled; and
- **Category 3** plants are ornamentally used plants and may no longer be planted, except those species already in existence at the time of the commencement of the regulations (30 March 2001), unless they occur within 30m of a 1:50 year flood line and must be prevented from spreading.

The following categories are applicable in the revised Conservation of Agriculture Resource Act (CARA) and NEMBA:

- **Category 1a** plants are high-priority emerging species requiring compulsory control. All breeding, growing, moving and selling are banned.
- **Category 1b** plants are widespread invasive species that must be controlled by a management programme.
- **Category 2** plants are invasive species controlled by area. They can be grown under permit conditions in demarcated areas. All breeding, growing, moving, and selling activities are banned without a permit.
- **Category 3** plants are ornamental and other species that are permitted on a property but may no longer be planted or sold.

Table 6: Invasive alien plant species recorded in the study area and immediate surroundings

Scientific name	Common name	NEMBA Category
<i>Cirsium vulgare</i>	Scotch Thistle	1b
<i>Datura ferox</i>	Large thorn apple	1b
<i>Eucalyptus sp.</i>	Gum	3; in wetlands 1b
<i>Verbena bonariensis</i>	Tall Verbena	1b
<i>Cortaderia jubata</i>	Pampas grass	1b
<i>Pennisetum clandestinum</i>	Kikuyu	1b
<i>Gleditsia triacanthos</i>	Honey locust	1b

4 Results: Fauna

4.1 Faunal Habitat

Important habitat for fauna observed within the study area included moist grassland and wetland areas, as well as certain areas of dry grassland. High faunal activity was detected in the wetland areas on the east side of the road where the habitat was less subject to intense cattle grazing. Faunal activity was also detected on the west side of the road with bird activity centred on moist areas and mammals burrows observed in the dry grassland.

Watercourses and wetlands are usually areas of high faunal diversity as the riparian environment and dense, emergent vegetation provides abundant cover, feeding and breeding habitat for many species of invertebrates, birds, mammals, reptiles and amphibians. When it is available, surface water provides drinking water, while the soft substrate provides perfect burrowing environments for fossorial animals such as Bullfrog and Mongoose. The increase in prey and vegetation attracts a high diversity of birds as well as terrestrial mammals and reptiles, including predators.

Please note that in the context of the faunal section in this report, wetland habitat refers to the physical habitat features associated with moist areas that are utilised by fauna for shelter, foraging or breeding, and does not denote the exact extent of any wetland. Please refer to the wetland delineation report for details pertaining to the extent of wetlands within the area of study.



Photo Plate 7: Important faunal habitat in the study area

4.2 Faunal Species Occurrence

Following is an account of the faunal species associated with the study area and those confirmed or likely to occur on the site. Refer to the appendices for detailed lists of the species discussed below. Species of conservation concern are those with a Red List status (national and global) higher than Least Concern and includes Protected species (national). Any conservation status reported in the text refers to the current national listing.

4.2.1 Avifauna

Approximately 303 bird species have been confirmed to occur within QDGC 2629AC. Of this total, approximately 264 species (87%) are associated with a grassland / farmland mosaic, including inland freshwater ecosystems. This implies that the habitat types found in the region of the study area are generally representative of the species found in the QDGCs, and therefore the area has the potential to support the majority of the species. During the field survey, 40 bird species were recorded on and around the site, which are listed in Table 7 along with their provincial (MTPA), national (Taylor *et al.*, 2015) and global (IUCN [World Conservation Union] Red List of Threatened Species, 2017) conservation status. Overall the bird species observed on site were mostly adapted to grassland and riparian / wetland habitats.

A relatively high level of endemism exists in the area with 42 bird species endemic to southern Africa occurring in the QDGC. A smaller proportion of species are of conservation concern, with a total of 32 bird species occurring in the QDGC listed either nationally or globally as being of conservation concern (Appendix C). While no bird species of conservation concern was recorded in the study area during the field visit, it must be noted that *Tyto capensis* (African Grass-Owl) has been recorded historically on the farm portion adjacent to the study area, GROOTPAN 86 IS. No suitable breeding habitat was observed during the field survey, although the species may use the study area for feeding purposes.

Six species endemic to southern Africa were recorded in the study area during the field survey, and included *Pternistis swainsonii* (Swainson's Spurfowl), *Afrotis afroaides* (Northern Black Korhaan), *Prinia flavicans* (Black-chested Prinia), *Passer melanurus* (Cape Sparrow), *Passer diffusus* (Southern grey-headed Sparrow), and *Macronyx capensis* (Cape Longclaw).

Table 7: Faunal species recorded in the study area during the field surveys

Scientific Name	Common Name	Conservation Status		
		Provincial	National	Global
Birds				
<i>Pternistis swainsonii</i>	Swainson's Spurfowl	LC	LC; En	LC
<i>Numida meleagris</i>	Helmeted Guineafowl	LC	LC	LC
<i>Alopochen aegyptiaca</i>	Egyptian Goose	LC	LC	LC
<i>Plectropterus gambensis</i>	Spur-winged Goose	LC	LC	LC
<i>Apus caffer</i>	White-rumped Swift	LC	LC	LC
<i>Asio capensis</i>	Marsh Owl	LC	LC	LC
<i>Columba livia</i>	Rock Dove	LC	LC; Intro	LC
<i>Spilopelia senegalensis</i>	Laughing Dove	LC	LC	LC

Scientific Name	Common Name	Conservation Status		
		Provincial	National	Global
<i>Streptopelia capicola</i>	Cape Turtle-Dove	LC	LC	LC
<i>Afrotis afraoides</i>	Northern Black Korhaan	LC	LC; En	LC
<i>Burhinus capensis</i>	Spotted Thick-knee	LC	LC	LC
<i>Charadrius tricollaris</i>	Three-banded Plover	LC	LC	LC
<i>Vanellus armatus</i>	Blacksmith Lapwing	LC	LC	LC
<i>Elanus caeruleus</i>	Black-shouldered Kite	LC	LC	LC
<i>Ardea melanocephala</i>	Black-headed Heron	LC	LC	LC
<i>Ardea alba</i>	Great Egret	LC	LC	LC
<i>Bubulcus ibis</i>	Cattle Egret	LC	LC	LC
<i>Bostrychia hagedash</i>	Hadedea Ibis	LC	LC	LC
<i>Corvus albus</i>	Pied Crow	LC	LC	LC
<i>Saxicola torquatus</i>	African Stonechat	LC	LC	LC
<i>Acridotheres tristis</i>	Common Myna	LC	LC; Intro	LC
<i>Hirundo rustica</i>	Barn Swallow	LC	LC	LC
<i>Hirundo albigularis</i>	White-throated Swallow	LC	LC	LC
<i>Cecropis abyssinica</i>	Lesser Striped Swallow	LC	LC	LC
<i>Cisticola tinniens</i>	Levaillant's Cisticola	LC	LC	LC
<i>Cisticola ayresii</i>	Wing-snapping Cisticola	LC	LC	LC
<i>Prinia subflava</i>	Tawny-flanked Prinia	LC	LC	LC
<i>Prinia flavicans</i>	Black-chested Prinia	LC	LC; En	LC
<i>Acrocephalus arundinaceus</i>	Great Reed-Warbler	LC	LC	LC
<i>Acrocephalus gracilirostris</i>	Lesser Swamp-Warbler	LC	LC	LC
<i>Mirafra africana</i>	Rufous-naped Lark	LC	LC	LC
<i>Passer melanurus</i>	Cape Sparrow	LC	LC; En	LC
<i>Passer diffusus</i>	Southern grey-headed Sparrow	LC	LC	LC
<i>Macronyx capensis</i>	Cape Longclaw	LC	LC; En	LC
<i>Anthus cinnamomeus</i>	African Pipit	LC	LC	LC
<i>Ploceus velatus</i>	Southern Masked-Weaver	LC	LC	LC
<i>Euplectes orix</i>	Southern Red Bishop	LC	LC	LC
<i>Euplectes progne</i>	Long-tailed Widowbird	LC	LC	LC
<i>Ortygospiza fuscocrissa</i>	African Quailfinch	LC	LC	LC
<i>Crithagra atrogularis</i>	Black-throated Canary	LC	LC	LC
<i>Crithagra mozambica</i>	Yellow-fronted Canary	LC	LC	LC
Mammals				
<i>Canis mesomelas</i>	Black-backed Jackal	LC	LC	LC
<i>Cynictis penicillata</i>	Yellow Mongoose	LC	LC	LC
<i>Raphicerus campestris</i>	Steenbok	LC	LC	LC
<i>Lepus saxatilis</i>	Scrub Hare	LC	LC	LC
<i>Cryptomys hottentotus</i>	Common Mole-rat	LC	LC	LC
<i>Hystrix africaeaustralis</i>	Cape Porcupine	LC	LC	LC
<i>Gerbilliscus brantsii</i>	Highveld Gerbil	LC	LC	LC

Scientific Name	Common Name	Conservation Status		
		Provincial	National	Global
<i>Otomys irroratus</i>	Vlei Rat	LC	LC	LC
<i>Suricata suricatta</i>	Suricate	LC	LC	LC
Amphibians				
<i>Amietia delalandii</i>	Common River Frog		LC	LC
<i>Cacosternum boettgeri</i>	Boettger's Caco		LC	LC

LC = Least Concern; En = Endemic; Intro = Introduced (alien)

4.2.2 Mammals

The region includes a relatively high diversity of mammals with approximately 90 species expected to occur within QDGC 2629AC under natural conditions, according to the IUCN distribution ranges and the electronic database contained within MammalMap (ADU, 2017). These species are listed in Appendix D along with the likelihood of each species occurring in the study area as well as their provincial (MTPA), national (Child *et al.*, 2016; DEA, 2015) and global (IUCN, 2017) conservation status. During the field survey, 10 mammal species were identified in the study area, all of which are currently listed as Least concern (LC) and are listed in Table 7.

Although not recorded during the field survey, four mammal species of conservation concern were given a high likelihood of occurring in the study area due to the presence of suitable breeding and/or foraging habitat. Such species included *Leptailurus serval* (Serval; Near Threatened and Protected), *Crocidura maquassiensis* (Maquassie Musk Shrew; Vulnerable), *Rhinolophus clivosus* (Geoffroy's Horseshoe Bat; Near Threatened), and *Felis silvestris* (African Wild Cat; Near Threatened).

4.2.3 Herpetofauna

Amphibians

According to FrogMAP (Minter *et al.*, 2004; ADU, 2017), the continuation of the Southern African Frog Atlas Project (SAFAP), 12 amphibian species have been confirmed to occur within the QDGC, while a further seven possibly occur in the area according to IUCN species distribution ranges. These are listed in Appendix B along with their national (Measey, 2011) and global (IUCN, 2017) conservation status. All of these species are currently listed as Least Concern both nationally and globally except for *Pyxicephalus adspersus* (Giant Bullfrog) currently listed as Vulnerable in Mpumalanga.

Two amphibian species were encountered during the field survey (Table 7), with an additional nine species given a high likelihood of occurring in the study area due to the presence of suitable habitat (Appendix E).

Reptiles

According to ReptileMAP (Bates *et al.*, 2014; ADU, 2017), the continuation of the Southern African Reptile Conservation Assessment (SARCA), only seven reptile species have been confirmed to occur within the QDGC. The search was therefore extended to the surrounding

QDGCs, which produced a total of 43 species. These are listed in Appendix B along with their national (Bates *et al.*, 2014) and global (IUCN, 2017; CITES, 2017) conservation status. While no reptiles were encountered during the field survey, seven species were given a high likelihood of occurring in the study area due to the presence of suitable habitat (Appendix F). None of these species is currently considered to be of conservation concern.

4.2.4 Lepidoptera

The Lepidoptera is one of the most diverse groups of insects and often perform unique roles in ecosystem functioning such as pollination. Because of the intimate relationship between some butterflies and plant species both in the adult and larval forms, and since butterflies are generally easy to identify, butterflies are frequently used as indicators of ecosystem and habitat quality in monitoring programmes (Mecenero *et al.*, 2013). South Africa is home to about 666 species of butterflies (Woodhall, 2005). The most significant causes of habitat loss for butterflies include invasive alien vegetation, changing fire regimes, agricultural activities, urbanisation, mining, plantation forestry, increased grazing and road construction (Henning *et al.*, 2009).

According to LepiMAP (Mecenero *et al.*, 2013; ADU, 2017), the Atlas of African Lepidoptera, 17 butterfly species have been confirmed to occur within the QDGC, none of which are conservation concern. While its presence was not confirmed, suitable habitat for *Metisella meninx* (Marsh Sylph) was observed around moist grassland in the study area. *Metisella meninx* inhabits marshes in wetlands located in open grasslands and they lay their eggs exclusively on *Leersia hexandra* (Wild Rice Grass), a species of grass that was confirmed to be present. *Metisella meninx* is currently listed as Rare Habitat Specialist (Mecenero *et al.*, 2013), and the presence of the host plant is essential for its survival. *Metisella meninx* is regarded as an indicator species for healthy water resources.

5 *Habitat Assessment and Sensitivity Analysis*

5.1 Sensitivity Analysis and Criteria

The study area was assessed in terms of its ecological importance. To do this we considered the site in terms of ecological function and conservation value. Importance, and therefore sensitivity to development, was classified as follows:

High – Areas that contain predominantly natural habitat and are important in maintaining biodiversity in the region. These areas have both high ecological function and conservation importance. Destruction of this habitat may result in a regional loss of biodiversity.

Medium – Habitat recorded on site that has medium ecological importance. These areas contain secondary vegetation / semi-natural habitat or modified habitat utilised by fauna (may include alien vegetation). These areas either have the potential for conservation (if rehabilitated for example) and moderate ecosystem function, or may have high ecological function and low conservation importance. Destruction of this habitat will not result in significant loss of biodiversity from a regional perspective.

Low – Habitat recorded within the study area that has low ecological importance. These areas have little or no ecological function and conservation importance due to the high level of transformation and/or degradation.

Note that areas may be classified by a combination of the above categories, e.g. **medium-high**, if for example an area is disturbed and has moderate ecosystem function but if rehabilitated may provide habitat for species of conservation concern and/or biodiversity features identified by the KZN BSP for CBA: Irreplaceable, and the site could contribute to reaching conservation targets for these features. Alternatively an area may have high ecological function but is fragmented and too small to offer high conservation value.

Definitions:

Ecological Function: Ecological function describes the intactness of the structure and function of the vegetation communities which in turn support faunal communities. It also refers to the degree of ecological connectivity between the identified vegetation associations and/or habitats and other systems within the landscape. Therefore, systems with a high degree of landscape connectivity among each other are perceived to be more valuable.

High – Natural areas with no or low evidence of human impact are considered to have intact ecosystem function and are considered important for the maintenance of ecosystem integrity. Most of these habitats are represented by vegetation communities in late succession and ecosystems with connectivity to other important ecological systems, or are specialised habitats for fauna. These areas also offer valuable ecosystem services.

Medium – Habitat that occurs at disturbances of medium intensity and are representative of vegetation communities in secondary succession stages with some degree of connectivity with other ecological systems. These areas, although often disturbed, are usually utilised by fauna.

Low – Degraded and highly disturbed habitat or modified vegetation with little or no ecological function.

Conservation Importance: The conservation importance of the site gives an indication of the necessity to conserve areas based on factors such as the importance of the site on a regional, provincial or national scale and on the ecological state of the area (level of degradation/disturbance). This is determined by the number of species, presence of rare, threatened, protected or endemic species, threatened ecosystems and areas that are protected by legislation.

High – Ecosystems or habitats with high species richness and usually provide suitable habitat for species of conservation concern, or habitats representative of a threatened ecosystem. These areas should be maintained for the persistence of biodiversity.

Medium – Habitats with intermediate levels of species richness without any species of conservation concern.

Low – Areas with little or no conservation potential and are usually species poor or contain transformed and/or degraded habitat (majority of species are usually alien).

5.2 Ecological Sensitivity within the Study Area

Based on the findings of the ecological assessment and the above criteria, importance of habitats pertaining to flora and fauna, and thus sensitivity to the proposed development, was mapped (Figure 6).

5.2.1 Highly Sensitive Habitats

All wetlands and moist grassland were deemed highly sensitive. These areas supported the highest diversity from a faunal and floral perspective.

5.2.2 Medium-high Sensitivity

The disturbed dry grassland was considered medium-high sensitivity due to the habitat it provided for fauna.

5.2.3 Medium-low Sensitivity

Large stands of exotic trees were considered low-medium sensitivity due to the fact that they may support nesting birds and roosting bats, although these areas are not likely to be affected by the road construction.

5.2.4 Low Sensitivity

All transformed areas were considered to be of low ecological importance.

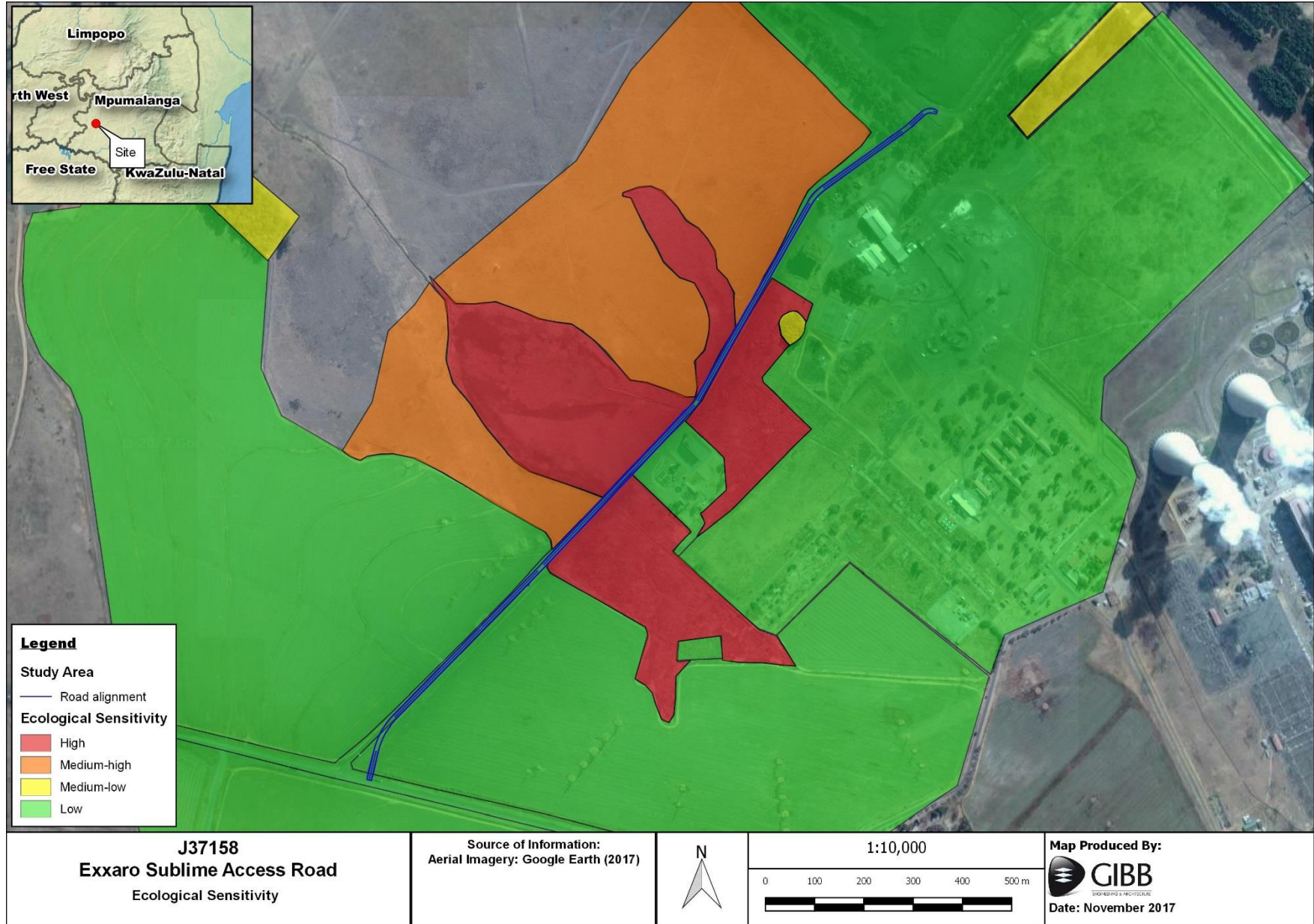


Figure 6: Areas of ecological importance in the study area

6 Impact Assessment and Mitigation

6.1 Impacts of Developments on Biodiversity

Any developmental activities in a natural system will impact on the surrounding environment, usually in a negative way. The purpose of this phase of the study was to identify and assess the significance of the impacts caused by the proposed development and to provide a description of the mitigation required so as to limit the perceived impacts on the natural environment.

There are various impacts resulting from any development within natural areas and these can be divided into the following four categories:

- **Direct Impacts:** These impacts are directly as a result of the development and include clearing of land, contamination of natural habitats, ground clearing activities, sedimentation and changes in water tables;
- **Indirect Impacts:** These impacts occur beyond the boundaries of the project site and could include pollution of water sources;
- **Induced Impacts:** The impacts are not directly attributed to the project, but occur because of the presence of the project in the area such as the increase of residential settlements leading to pressure on biodiversity; and
- **Cumulative Impacts:** These are impacts from the past, existing and foreseeable future projects which are all affecting the same biodiversity.

There is an international demand towards greater transparency and accountability from companies to develop a more comprehensive understanding of the impacts of the project or activity with regards to issues such as biodiversity, climate change and water use, and to focus on mitigating impacts more effectively.

Mitigation

The term mitigation covers all the components of the “mitigation hierarchy” (described below) and involves selecting and implementing measures to conserve biodiversity and to protect users of biodiversity as well as other affected stakeholders from potentially detrimental impacts as a result of the development (Guideline for mainstreaming biodiversity into mining, 2012).

Mitigation measures should aim to achieve “no net loss” of biodiversity which is defined by the International Finance Corporation (IFC) as:

“the point at which project-related impacts on biodiversity are balanced by measures taken to avoid and minimise the project’s impacts, to undertake on-site restoration and finally to offset significant residual impacts, if any, on an appropriate geographic scale”.

Mitigation is a broad term and involves the following steps of the mitigation hierarchy:

1. Avoid or prevent loss to biodiversity and ecosystem services: This is the first option and refers to project location and layout of the project, as well as phasing to avoid impacts on

biodiversity. These areas need to be identified early in the development's lifecycle so that impacts can be avoided;

2. Minimise impacts on biodiversity and ecosystem services: The location, layout, technology and phasing of the project should minimise the impacts on biodiversity. This should be considered even in areas where the environmental constraints are not particularly high and every effort should be made to minimise these impacts;
3. Rehabilitate concurrently or progressively with the activity and on cessation of the activity: This refers to the rehabilitation of areas where impacts were unavoidable and impacted areas should be returned to a condition ecologically similar to their pre-development natural state. Unfortunately, rehabilitation is a limited process that usually falls short of replicating the diversity of natural systems. Rehabilitation should occur progressively; and
4. Offset significant residual negative impacts on biodiversity or ecosystem services: This refers to the compensation for the remaining and unavoidable negative residual impacts on biodiversity.

6.2 Assessment Criteria

For the current assessment, environmental impacts were assessed with mitigation measures (WMM) and without mitigation measures (WOMM) and the results are presented in the impact tables which summarise the assessment. Mitigation and management actions are also recommended with the aim of enhancing positive impacts and minimising negative impacts.

A ranking or scoring system was used to evaluate the significance of each impact where the potential significance is based on both occurrence and severity of each impact. Occurrence includes both the probability of occurrence (how likely is it that the impact will occur?) and the duration of the occurrence; while severity is based on the magnitude (how destructive?) as well as the scale or extent (limited to the site only or farther reaching?) of the impact. Each impact was assessed in light of these factors using the ranking scales listed in Table 8.

Once the impacts were ranked based on the above factors, the significance of each impact was determined using the following formula:

$$\text{Significance Points} = (\text{Magnitude} + \text{Duration} + \text{Scale}) \times \text{Probability}$$

The maximum potential value for the significance of an impact is 100 points. Environmental impacts were therefore ranked as high, medium or low significance on the following basis:

- High environmental significance 60 – 100 points
- Medium environmental significance 30 – 59 points
- Low environmental significance 0 – 29 points

Significance

This describes the degree of significance for the predicted impact based on the available information and level of knowledge and expertise. It is based on both occurrence and severity of each impact has been divided into high, medium or low.

Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as definite, high, medium, low and improbable.

Duration of the Impact

This provides an indication of whether the lifespan of the impact would be permanent, long term (ceases at end of operational phase), medium term (6-15 years), short term (0-5 years) or immediate.

Magnitude of the Impact

This is an appraisal of the severity of effect the project would have on the environment. This description includes what would be affected and how severe or destructive the impact would be, ranging from complete destruction (high) to minor disturbance (low).

Scale of the Impact

A description of whether the impact will be local, limited to the study area and its immediate surroundings, regional, national or on an international scale.

Table 8: Scales used to determine significance ranking

Occurrence of Impact		Severity of Impact	
Probability (P)		Magnitude (M)	
Description	Numerical Value	Description	Numerical Value
Definite (or unknown)	5	Very high	10
High	4	High	8
Medium	3	Moderate	6
Low	2	Low	4
Improbable	1	Minor	2
Duration (D)		Scale (S)	
Description	Numerical Value	Description	Numerical Value
Permanent	5	International	5
Long-term (ceases at end of operation)	4	National	4
Medium-term	3	Regional	3
Short-term	2	Local	2
Immediate	1	Site	1

6.3 Impact Assessment

Possible impacts on terrestrial flora and fauna and their sources associated with the proposed development are provided in Table 9 (construction and operational phase). Most of the proposed project occurs within disturbed areas, therefore the construction phase is deemed to have a relatively low impact on the surrounding vegetation. However, the more sensitive wetland habitats will experience higher impacts and indirect impacts are possible. Mitigation measures will need to be applied in these instances. There is also a potential positive impact if road design allows for correct storm water drainage.

Table 9: Possible impacts arising from the proposed development

Possible Impact	Source of Impact	Area to be Affected	Nature of Impact
Destruction of sensitive vegetation and disturbance to fauna and faunal habitat	Construction of new road and necessary culverts and drains	Moist grassland and wetland habitat	Direct negative
Increased potential of invasion by alien vegetation	Construction of new road and necessary culverts and drains	Whole site	Direct negative
Increase of erosion potential	Construction of new road and necessary culverts and drains	Whole site especially wetland channels	Direct negative
Pollution of downstream watercourses	Construction of new road and necessary culverts and drains	Downstream watercourses	Indirect negative
Correctly managed stormwater runoff	Installation of formal storm water drains	Moist grassland, wetland habitat and downstream watercourses	Positive

6.3.1 Destruction of indigenous vegetation and disturbance to faunal habitat

During construction, especially in areas where culverts will be installed, vegetation and faunal habitat will be destroyed and/or disturbed.

Impact Table

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
WOMM	Regional (3)	Long-term (4)	High (8)	High (4)	High (60)	High
WMM	Localised (2)	Short-term (2)	Low (4)	Low (2)	Low (16)	Medium

Mitigation

- An independent Ecological Control Officer (ECO) should be appointed to oversee construction.
- The removal of indigenous vegetation must be limited.
- Construction activities must remain within the footprint of the road reserve.
- Following construction, all remaining areas that have been cleared of indigenous vegetation must be rehabilitated with appropriate indigenous plant species found in the

area. A site specific rehabilitation plan must be compiled by a suitable qualified ecologist and implemented by a suitably qualified rehabilitation specialist.

- If possible, construction should commence in the dry winter months to avoid disturbance to breeding fauna.
- No wild animal (including birds) may under any circumstance be handled, removed or be interfered with by construction workers.
- No wild animal may under any circumstance be hunted, snared, captured, injured or killed. Regular checks of the surrounding natural areas, especially the rocky koppies, for snares and traps must be undertaken by the ECO.
- No wild animal may be fed on site and all food stuffs must be contained and not left unattended so that fauna are not attracted to the site during construction.
- Refuse must be disposed of in an appropriate manner so that vermin is not attracted to the site.

6.3.2 Increased potential of invasion by alien vegetation

During construction, disturbance to the soil and indigenous vegetation will increase the likelihood of invasion by alien plant species. Alien species establish easily and quickly on bare soil by colonisation or from seeds existing in the seed bank of the soil. Infestation by alien and invasive species will lead to degradation of the surrounding natural habitat and will increase the potential of spread into the greater landscape due to propagules being released into downstream watercourses.

Impact Table

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
WOMM	Regional (3)	Long-term (4)	High (8)	High (4)	High (60)	High
WMM	Localised (2)	Short-term (2)	Low (4)	Low (2)	Low (16)	Medium

Mitigation

- An independent Ecological Control Officer (ECO) should be appointed to oversee construction.
- The removal of indigenous vegetation must be limited.
- Construction activities must remain within the footprint of the road reserve. Camps must remain outside of wetland areas.
- Following construction, all remaining areas that have been cleared of indigenous vegetation must be rehabilitated with appropriate indigenous plant species found in the area.
- A site specific rehabilitation plan must be compiled by a suitable qualified ecologist and implemented by a suitably qualified rehabilitation specialist.

- An alien invasive species removal and management plan must be compiled by a suitably qualified ecologist.
- All alien seedlings and saplings must be removed as they become evident for the duration of construction.
- Unless chemical control is necessary, manual or mechanical removal is preferred to chemical control.
- All construction vehicles and equipment, as well as construction material must be free of plant material. Equipment and vehicles must be thoroughly cleaned prior to access on to the construction site.

6.3.3 Increase of erosion potential

During construction, exposed soil will be susceptible to erosion especially if indigenous vegetation is cleared. During operation the hardened surfaces will increase surface run-off and erosion potential will increase significantly leading to siltation of the surrounding wetland areas.

Impact Table

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
WOMM	Localised (2)	Long-term (4)	Medium (6)	Medium (3)	Medium (36)	High
WMM	Localised (2)	Long-term (4)	Low (4)	Low (2)	Low (20)	Medium

Mitigation

- A Water Use License (or General Authorisation) will be required from the Department of Water and Sanitation (DWS) for construction within 500m of a watercourse.
- The amount of vegetation removed must be limited to the least amount possible.
- Following construction, all remaining areas that have been cleared of indigenous vegetation must be rehabilitated with appropriate indigenous plant species found in the area. Grass species are recommended to limit erosion potential.
- Steep slopes must be stabilised using the most appropriate approved method and technology.
- The impact may be reduced if construction takes place in the winter months or outside of the rainy season.
- Formalised stormwater channels and drains fitted with silt traps must be included in the road design.

6.3.4 Pollution of downstream watercourses

During construction and operation, stormwater runoff will carry pollution from the road to the surrounding natural areas. This will result in the contamination of the wetland areas as well as watercourses further downstream.

Impact Table

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
WOMM	Regional (3)	Permanent (5)	High (8)	High (4)	High (64)	High
WMM	Localised (2)	Short-term (2)	Low (4)	Medium (3)	Low (24)	Medium

Mitigation

- The construction crews must be educated in the importance of natural resources and must not litter or pollute such areas, especially wetlands.
- Adequate disposal and toilet facilities must be provided on site.
- Stormwater channels must be fitted with litter and silt traps, which must be inspected and cleared on a regular basis.
- Oil or fuel spills must be avoided with regular vehicle checks. Any spills must be attended to immediately.

6.3.5 Positive Impacts

A positive impact of the proposed road upgrade project is the formalisation of the stormwater channels, drains and culverts associated with the road. The existing road does not have a drainage system for stormwater except informal trenches dug on the side of the road. These trenches do not allow the water to drain away and they become filled with stagnant water polluted by runoff from the road. For the impact to be positive however, pollution from the road must be prevented from entering the surrounding wetlands and other natural areas. Stormwater channels must be designed carefully and all drains must be fitted with silt and any other appropriate pollution traps.



Photo Plate 8: Informal trench alongside the existing road

6.3.6 Cumulative Impacts

The road is an existing impact in the landscape and the footprint of the new road will be on top of the existing one, therefore cumulative impacts are not deemed to be significant. Disturbance caused by the construction phase may add to the existing impact of alien and invasive plant species prevalent in the landscape. This may be mitigated easily by following all recommendations and suggested mitigation measures.

7 *Summary and Impact Statement*

The study site is located within the Grassland Biome, and more specifically within Eastern Highveld Grassland, which is considered an Endangered vegetation type. According to the Schedule of Threatened Terrestrial Ecosystems, remaining primary grassveld areas of Eastern Highveld Grassland as well as the Eastern Temperate Freshwater Wetlands are considered as Vulnerable Ecosystems in terms of Section 52 of NEMBA under criterion A1: Irreversible loss of natural habitat.

The study area contained a large wetland area supporting moist grassland and providing important habitat for fauna. This habitat was considered highly sensitive. The surrounding dry grassland was highly disturbed and was considered less sensitive although did support faunal species.

The existing road implies that impacts are already present in the landscape. Most of the proposed activity will occur within transformed or disturbed areas, therefore the construction phase is deemed to have a relatively low impact on the surrounding vegetation. However, the more sensitive wetland habitats will experience higher impacts and indirect impacts are possible. Mitigation measures will need to be applied in these instances.

A positive impact will be that with the road upgrade, a formal storm water drainage system will be installed. This will help alleviate the current impacts experienced by the surrounding environment by the informal trench dug as drainage for the road.

References

- Alexander, G. and Marais, J. (2010): *A guide to the Reptiles of Southern Africa*, Cape Town: Struik Nature.
- Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. and de Villiers, M.S. (eds.) (2014): Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland, *Suricata 1*, Pretoria: SANBI.
- Berliner, D. (2005): *Systematic Conservation Planning for the forest biome of South Africa*, Department of Water Affairs and Forestry, South Africa.
- Bromilow, C. (2010): *Problem plants and alien weeds of South Africa*, Pretoria: Briza Publications.
- Child, M.F., Raimondo, D., Do Linh San, E., Roxburgh, L., Davies-Mostert, H. (2016): *The Red List of Mammals of South Africa, Swaziland and Lesotho*, South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.
- Chittenden, H. (2007): *Roberts Bird Guide. A comprehensive field guide to over 950 bird species in southern Africa*, Cape Town: John Voelcker Bird Book Fund.
- Department of Environmental Affairs (2011): National Environmental Management: Biodiversity Act, 2004: National list of ecosystems that are threatened and in need of protection, *Government Gazette Number 34809*, Notice 1002, 9 December 2011, Pretoria: DEA.
- Department of Environmental Affairs (2015): NEMBA 2004 (Act 10 of 2004): Threatened or Protected Species Regulations, *Government Gazette No. 38600*, 31 March 2015, Pretoria: DEA.
- Du Preez, L. and Carruthers, V. (2009): *A Complete Guide to the Frogs of Southern Africa*, Cape Town: Struik Nature.
- Germishuizen, G. and Meyer, N.L. (eds.) (2003): Plants of southern Africa: an annotated checklist, *Strelitzia 14*, Pretoria: South African National Biodiversity Institute.
- Harrison, J.A., Allan D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. and Brown, C.J. (1997): *The Atlas of Southern African Birds*, Johannesburg: BirdLife South Africa.
- Henderson, L. (2001): *Alien weeds and invasive plants: A complete guide to declared weeds and invaders in South Africa*, Agricultural Research Council, Cape Town: Paarl Printer.
- Henning, G.A., Terblanche, R.F. and Ball, J.B. (2009): *South African Butterfly Conservation Assessment*, Sanbi Biodiversity Series 13, Pretoria.
- Hockey, P.A.R., Dean, W.R.J. and Ryan P.G. (2005): *Roberts Birds of Southern Africa, 7th Edition*, Cape Town: John Voelcker Bird Book Fund.
- Measey, G.J. (ed.) (2011): Ensuring a future for South Africa's frogs: a strategy for conservation research, *SANBI Biodiversity Series 19*, Pretoria: South African National Biodiversity Institute.
- Mecenero, A., Ball, J.B., Hamer, M.L., Henning, G.A., Kruger, M., Pringle, E.L., Terblanche, R.F. and Williams, M.C. (2013): *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland. Red List and Atlas*, Johannesburg: Saftonics (Pty) Ltd., Cape Town: Animal Demography Unit.
- Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. and Kloepfer, D. (eds.) (2004): Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland, *SI/MAB Series no. 9*, Washington, D.C.: Smithsonian Institution.

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- Monadjem, A., Taylor, P.J., Cotterill, F.P.D., and Schoeman, M.C. (2010): *Bats of Southern and Central Africa. A Biogeographic and Taxonomic Synthesis*, Johannesburg: Wits University Press.
- Mucina, L. and Rutherford, M. C. (2006): The vegetation of South Africa, Lesotho and Swaziland, *Strelitzia 19*, Pretoria: South African National Biodiversity Institute.
- Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. and Manyama, P.A. (eds.) (2009): Red list of South African plants 2009, *Strelitzia 25*:1-668.
- Rutherford, M.C. and Westfall, R.H. (1994): *Biomes of Southern Africa: an objective categorisation*, Pretoria: National Botanical Institute.
- Skinner, J.D. and Chimimba, C.T. (2005): *The Mammals of the Southern African Subregion*, London: Cambridge.
- Stuart, C. and Stuart, T. (2000): *A Field Guide to the Tracks & Signs of Southern and East African Wildlife*, Cape Town: Struik.
- Stuart, C. and Stuart, T. (2015): *Stuarts' Field Guide to Mammals of Southern Africa Including Angola, Zambia and Malawi*, Cape Town: Struik Nature.
- Taylor, M.R., Peacock, F. and Wanless, R.M. (eds.) (2015): *Eskom Red Data Book of Birds of South Africa Lesotho and Swaziland*, Johannesburg: BirdLife South Africa.
- Von Maltitz, G., Mucina, L., Geldenhuys, C., Lawes, M., Eeley, H., Adie, H., Vink, D., Flemming, G. and Bailey, C. (2003): Classification system for South African Indigenous Forests. An objective classification for the Department of Water Affairs and Forestry, *Environmentek Report ENV-P-C 2003-017*, Pretoria: CSIR.
- Woodhall, S. (2005): *Field Guide to the Butterflies of South Africa*, Cape Town: Struik.

Digital References

- Animal Demography Unit: FrogMAP – South African Frog Atlas Project (SAFAP) (2017): <http://vmus.adu.org.za>
- Animal Demography Unit: LepiMAP – The Atlas of African Lepidoptera (2016): <http://vmus.adu.org.za>
- Animal Demography Unit: MammalMAP – The Mammal Atlas of Africa (2017): <http://vmus.adu.org.za>
- Animal Demography Unit: ReptileMAP – South African Reptile Conservation Assessment (SARCA) (2017): <http://sarca.adu.org.za>
- IUCN (2017): IUCN Red List of Threatened Species, Version 2017-2: <http://www.iucnredlist.org>
- SANBI (2012): Vegetation Map of South Africa, Lesotho and Swaziland [*vector geospatial dataset*], Pretoria: South African National Biodiversity Institute.
- SANBI Plants of Southern Africa (POSA) (2013): <http://posa.sanbi.org/searchspp.php>
- South African National Red List (2014): <http://redlist.sanbi.org>
- South African Bird Atlas Project 2 (SABAP2) (2017): <http://sabap2.adu.org.za/index.php/>
- Southern African Birding cc. (2011): Roberts VII Multimedia, Birds of Southern Africa, Computer Software.

Appendices

APPENDIX A: Methodology

Methodology involved a desktop analysis and a field visit. Field investigations were undertaken on the 25th and 26th of October 2017 when floral and faunal elements within the study area were surveyed. Daytime surveys were conducted by moving slowly through the site to observe changes in land cover and habitat, as well as record flora and fauna present on site. Landscape features that were considered of high ecological importance were mapped.

Flora

The desktop study entailed a literature survey of all plant species occurring in QDGC 2629AC according to the Plants of Southern Africa online checklist (SANBI, 2013). Additional data such as habitat distribution and species descriptions were gathered for all plants of conservation concern, which were included in the list. Background information on the regional vegetation was gathered using GIS data, and Mucina and Rutherford (2006).

The field surveys were focussed within areas where natural vegetation persisted, while alien and invasive plant species were recorded as they were encountered. The description of the regional vegetation relied on literature from Mucina and Rutherford (2006) and the SANBI species databases were queried for plant species of conservation concern previously recorded or potentially occurring within the study area. The South African National Red List status follows the latest update <http://redlist.sanbi.org> (2017.1), while plant names follow Germishuizen and Meyer (2003), Henderson (2001) and Bromilow (2010).

During the site visit, points where plants of conservation concern (red data or protected plants) occurred were recorded. The points were recorded using a hand-held Garmin GPSMAP 62s GPS receiver. Waypoint localities are accurate to within 4m. Due to the limited time in the field, the cover abundance of the species was not assessed; rather species presence was noted.

Avifauna

A comprehensive list of bird species occurring in the area was compiled using electronic databases within Roberts VII Multimedia Birds of Southern Africa (SA Birding, 2011) where distribution maps have been interpreted and updated from the Atlas of Southern African Birds (Harrison *et al.*, 1997), and supplemented with current Southern African Bird Atlas Project 2 (SABAP2, 2017) data. Species of conservation concern that could potentially occur on site were noted and their habitat requirements were determined by consulting the relevant literature. Bird names follow Hockey *et al.* (2005) while conservation status follows Taylor *et al.* (2015).

The likelihood of bird species occurrence was determined using geographical distribution and the presence of suitable habitat on site (Table 10). High likelihood of occurrence pertains to species whose known distribution overlaps the study site and suitable habitat occurs in the study area. Medium likelihood of occurrence refers to species that have a distribution that is marginal to the study site or its known habitat occurs within the surroundings of the study area. The Medium likelihood of occurrence definition was extended to include areas where the level of degradation or disturbance in the surrounding landscape renders the species unlikely to utilise the site. Low likelihood of occurrence

indicates that while the species may occur within the QDGC, its distribution range may or may not fall within the geographic locality of the study site and/or no suitable habitat for the species exists on site.

Table 10: Criteria used for determining likelihood of occurrence of species in the study area

Likelihood of Occurrence	Criteria
High	<ul style="list-style-type: none"> Species distribution overlaps the study area; and Study site supports suitable habitat for the species
Medium	<ul style="list-style-type: none"> Species distribution is marginal to the study area; or General area supports suitable habitat for the species; or Suitable habitat in the study area is degraded
Low	<ul style="list-style-type: none"> Species distribution overlaps or is marginal to the study area; and Study site supports no suitable habitat for the species

Bird species were detected by sight, call, and field evidence such as nests, feathers and droppings by moving slowly through all perceived habitats on the site. Species were verified using Chittenden (2007) as well as Roberts VII Multimedia Birds of Southern Africa (SA Birding, 2011). Habitats for bird species, especially those of conservation concern, were noted.

Mammals

A list of the mammal species occurring in the area was compiled using data provided by the International Union for Conservation of Nature (IUCN) and supplemented using the recently established electronic database MammalMap (2017) provided by the Animal Demography Unit's (ADU) Virtual Museum. Species of conservation concern that could potentially occur on site were noted and their habitat requirements were determined by consulting the relevant literature. Conservation status follows the recently revised 2016 Red List of Mammals of South Africa, Lesotho and Swaziland (Child *et al.*, 2016).

The likelihood of mammal species occurrence was also determined using geographical distribution and the presence of suitable habitat on site (Table 10). Information regarding species distribution and habitat was obtained from Skinner and Chimimba (2005), Stuart and Stuart (2015) and Monadjem *et al.* (2010).

Mammal species were identified by sightings as well as field evidence such as spoor, droppings, roosting sights and burrows. Species identification was verified using Stuart and Stuart (2000; 2007). Due to the limited time in the field, no mammal trapping was undertaken.

Herpetofauna

Amphibians

A list of the amphibian species occurring in the area was compiled using the electronic databases provided by the ADU's Virtual Museum including FrogMAP (2017), as well as the IUCN (2016). Species of conservation concern that could potentially occur on site were noted and their habitat requirements were determined by consulting the relevant literature. The likelihood of amphibian species occurrence was also determined using geographical distribution and the presence of suitable habitat on site (Table 10). Information regarding species' distribution and habitat was obtained from du Preez and Carruthers (2010) and Measey (2011).

Reptiles

A list of the reptile species occurring in the area was compiled using the electronic databases provided by the ADU's Virtual Museum including ReptileMAP (2017), as well as the IUCN (2016). Species of conservation concern that could potentially occur on site were noted and their habitat requirements were determined by consulting the relevant literature. Reptile names and conservation status follows Bates *et al.*, 2014).

The likelihood of reptile species occurrence was also determined using geographical distribution and the presence of suitable habitat on site (Table 10). Information regarding species' distribution and habitat was obtained from Bates *et al.* (2014) and Alexander and Marais (2010).

Reptiles were noted and identified as they were encountered. Possible burrows or suitable micro-habitats were noted. Identification of reptiles was confirmed using Alexander and Marais (2010).

Lepidoptera

Apart from the Lepidoptera, information on the distribution ranges and conservation status of most terrestrial invertebrate groups is limited and highly specialised knowledge is required to identify species. Comprehensive sampling and accurate identification of most macro-invertebrate fauna requires a considerable sampling effort and specialist expertise. This assessment therefore focussed on the Lepidoptera.

A list of the butterfly species occurring in the area was compiled using the electronic database LepiMap – Atlas of African Lepidoptera (Mecenero *et al.*, 2013; ADU, 2017) the continuation of the Southern African Butterfly Conservation Assessment (SABCA) provided by the ADU's Virtual Museum. Species of conservation concern that could potentially occur on site were noted and their habitat requirements were determined by consulting the relevant literature.

Butterfly and moth species as well as suitable habitat on site were noted as they were encountered. Identification was confirmed using Woodhall (2005; 2013). Other conspicuous macro-invertebrate species were noted as they were encountered.

APPENDIX B: Plant species recorded in QDGC 2629AC (POSA, 2013)

Family	Species	Threat status	Lifecycle	Growth forms
AMARYLLIDACEAE	Boophone disticha (L.f.) Herb.	Declining	Perennial	Geophyte, succulent
AMARYLLIDACEAE	Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.	Declining	Perennial	Geophyte, hydrophyte
AMARYLLIDACEAE	Nerine krigei W.F.Barker	LC	Perennial	Geophyte
ASPHODELACEAE	Aloe ecklonis Salm-Dyck	LC	Perennial	Herb, succulent
ASPHODELACEAE	Aloe greatheadii Schönland var. davyana (Schönland) Glen & D.S.Hardy	LC	Perennial	Herb, succulent
ASPHODELACEAE	Kniphofia typhoides Codd	NT	Perennial	Herb, succulent
ASTERACEAE	Euryops transvaalensis Klatt subsp. transvaalensis	LC	Perennial	Herb
ASTERACEAE	Helichrysum nudifolium (L.) Less. var. pilosellum (L.f.) Beentje	LC	Perennial	Herb
BRYACEAE	Bryum argenteum Hedw.		Perennial	Bryophyte
CAMPANULACEAE	Wahlenbergia undulata (L.f.) A.DC.	LC	Perennial	Herb
COLCHICACEAE	Colchicum striatum (Hochst. ex A.Rich.) J.C.Manning & Vinn.	LC		Geophyte
COMMELINACEAE	Commelina africana L. var. lancispatha C.B.Clarke	LC	Perennial	Herb
CONVOLVULACEAE	Ipomoea oblongata E.Mey. ex Choisy	LC	Perennial	Herb, succulent
CONVOLVULACEAE	Ipomoea pellita Hallier f.	LC	Perennial	Herb
CYPERACEAE	Carex glomerabilis V.I.Krecz.	LC	Perennial	Cyperoid, helophyte, herb
CYPERACEAE	Cyperus congestus Vahl	LC	Perennial	Cyperoid, helophyte, herb
CYPERACEAE	Cyperus esculentus L. var. esculentus	LC	Perennial	Cyperoid, geophyte, herb, mesophyte
CYPERACEAE	Eleocharis dregeana Steud.	LC	Perennial	Cyperoid, helophyte, herb
CYPERACEAE	Fuirena pachyrrhiza Ridl.	LC	Perennial	Cyperoid, helophyte, herb
CYPERACEAE	Fuirena pubescens (Poir.) Kunth var. pubescens	LC	Perennial	Cyperoid, helophyte, herb, mesophyte
CYPERACEAE	Kyllinga erecta Schumach. var. erecta	LC	Perennial	Cyperoid, helophyte, herb
CYPERACEAE	Schoenoplectus decipiens (Nees) J.Raynal	LC	Perennial	Cyperoid, helophyte, herb
CYPERACEAE	Schoenoplectus leucanthus (Boeckeler) J.Raynal	LC	Annual	Cyperoid, helophyte, herb
CYPERACEAE	Schoenoplectus muriculatus (Kük.) Browning	LC	Perennial	Cyperoid, emergent hydrophyte, helophyte, herb
CYPERACEAE	Schoenoplectus pulchellus (Kunth) J.Raynal	LC	Perennial	Cyperoid, emergent hydrophyte, helophyte, herb
EUPHORBIACEAE	Acalypha angustata Sond.	LC	Perennial	Dwarf shrub, herb
FABACEAE	Elephantorrhiza elephantina (Burch.) Skeels	LC	Annual (occ. perennial)	Dwarf shrub, shrub, suffrutex

Family	Species	Threat status	Lifecycle	Growth forms
FABACEAE	Indigofera evansiana Burt Davy	LC	Perennial	Herb
FABACEAE	Medicago laciniata (L.) Mill. var. laciniata	Not Evaluated	Annual	Herb
FABACEAE	Rhynchosia reptabunda N.E.Br.	LC	Perennial	Climber, herb
FABACEAE	Rhynchosia sordida (E.Mey.) Schinz	LC	Perennial	Dwarf shrub, herb, shrub
FABACEAE	Vigna vexillata (L.) A.Rich. var. vexillata	LC	Perennial	Climber, herb
GERANIACEAE	Geranium multisectum N.E.Br.	LC	Perennial	Herb
GERANIACEAE	Pelargonium minimum (Cav.) Willd.	LC	Annual	Herb
HYACINTHACEAE	Albuca setosa Jacq.	LC	Perennial	Geophyte
HYACINTHACEAE	Ornithogalum flexuosum (Thunb.) U. & D.Müll.-Doblies	LC	Perennial	Geophyte
JUNCACEAE	Juncus exsertus Buchenau	LC	Perennial	Helophyte, herb
MALVACEAE	Hibiscus aethiopicus L. var. ovatus Harv.	LC	Perennial	Herb
POACEAE	Aristida bipartita (Nees) Trin. & Rupr.	LC	Perennial	Graminoid
POACEAE	Digitaria sanguinalis (L.) Scop.	Not Evaluated	Annual	Graminoid
POACEAE	Eleusine coracana (L.) Gaertn. subsp. africana (Kenn.-O'Byrne) Hilu & de Wet	LC	Annual	Graminoid
POACEAE	Eleusine multiflora A.Rich.	Not Evaluated	Annual	Graminoid
POACEAE	Eragrostis curvula (Schrad.) Nees	LC	Perennial	Graminoid
POACEAE	Fingerhuthia sesleriiformis Nees	LC	Perennial	Graminoid
POACEAE	Paspalum distichum L.	LC	Perennial	Graminoid
POLYGALACEAE	Polygala hottentotta C.Presl	LC	Perennial	Dwarf shrub, herb
POTAMOGETONACEAE	Potamogeton richardii Solms	Not Evaluated		[No lifeform defined]
RANUNCULACEAE	Ranunculus multifidus Forssk.		Perennial	Herb
SCROPHULARIACEAE	Limosella longiflora Kuntze	LC	Annual	Herb, hydrophyte

APPENDIX C: Terrestrial bird species of conservation concern occurring within QDGC 2629AC, likelihood of occurring on site and habitat preference

CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; En = Endemic; Pr = Protected; NBM = Non-breeding Migrant.

Species are listed in order of likelihood of occurring on site and conservation status. Species with a high likelihood of occurrence and that have been recorded in the area in previous assessments are highlighted in red

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Bugeranus carunculatus</i>	Wattled Crane	CR	CR	VU	Medium	Fairly shallow wetlands with extensive short, emergent vegetation, especially sedges; farm dams, vleis, natural dryland habitats and cultivated fields
<i>Balearica regulorum</i>	Grey Crowned Crane	VU	EN	EN	Medium	Breeds in marshes, pans and dams with fairly tall emergent vegetation; forages in short to medium-height open grassland, sometimes lightly wooded areas; also extensively in cultivated fields and pastures
<i>Geronticus calvus</i>	Southern Bald Ibis	VU	VU; En	VU	Medium	High-altitude (1 200-1 850 m), high-rainfall (> 700 mm/yr), sour and alpine treeless grasslands, characterised by short, dense grass sward; favours recently burnt, ploughed, mowed or heavily grazed fields, also cultivated land with short grass or stubble
<i>Neotis denhami</i>	Denham's Bustard	VU	VU	NT	Medium	High-lying, open, sour grassland, often in rocky areas and on plateau grassland; occasionally uses cultivated fields, especially in winter and during droughts; attracted to burnt ground, especially in winter; avoids heavily grazed grassland
<i>Tyto capensis</i>	African Grass-Owl	VU	VU	LC	Medium	Treeless areas associated with damp substrata, mainly marshes and vleis. Favours patches of tall, rank grass, sedges or weeds. Also areas with dense ground cover in scattered thorn scrub, low fynbos and renosterveld, usually close to water and among thick stands of grass (<i>Stenotaphrum</i> sp.) and sedge (<i>Juncus</i> sp.)
<i>Falco biarmicus</i>	Lanner Falcon	NT	VU	LC	Medium	Most frequent in open grassland, open or cleared woodland, and agricultural areas. Breeding pairs favour habitats where cliffs available as nest and roost sites, but will use alternative sites (e.g. trees, electricity pylons, buildings) if cliffs absent
<i>Anthropoides paradiseus</i>	Blue Crane	VU	NT	VU	Medium	Open grassland and grassland/Karoo ecotone; wetlands, cultivated pastures and crop lands; tolerant of intensively grazed and burnt grassland
<i>Charadrius pallidus</i>	Chestnut-banded Plover	NT	NT	NT	Medium	Natural and man-made salt pans; less often in coastal lagoons, shallow bays and estuaries; rarely in freshwater habitats
<i>Coracias garrulus</i>	European Roller		NT; NBM	NT	Medium	Open, broadleaved and Acacia woodlands with grassy clearings

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Eupodotis caerulea</i>	Blue Korhaan	VU	LC; En	NT	Medium	Flat and undulating terrain in grassland and Nama Karoo, where rainfall 300-1 000 mm; often on damp ground; sometimes attracted to burnt areas; favours short vegetation
<i>Mirafra cheniana</i>	Melodious Lark	NT	LC; En	NT	Medium	Grassland dominated by <i>Themeda triandra</i> ; avoids wet lowlands, favouring fairly short grassland (< 0.5 m), with open spaces between tussocks, at 550-1 750 m altitude, with annual rainfall 400-800 mm
<i>Spizocorys fringillaris</i>	Botha's Lark	EN	EN; En	EN	Low	Heavily-grazed upland grassland in sour grassveld; avoids longer grass in valley bottoms, poorly drained areas, planted pastures, croplands and rocky areas
<i>Gyps coprotheres</i>	Cape Vulture	VU	EN; En	VU	Low	Wide habitat range; cliffs
<i>Circus maurus</i>	Black Harrier	NT	EN; En	VU	Low	Dry grassland, Karoo scrub, agricultural fields and high-altitude grasslands; intolerant of burnt areas
<i>Circus ranivorus</i>	African Marsh-Harrier	VU	EN	LC	Low	Almost exclusively inland and coastal wetlands
<i>Polemaetus bellicosus</i>	Martial Eagle	VU	EN	VU	Low	Open woodland, arid and mesic savanna, forest edges
<i>Mycteria ibis</i>	Yellow-billed Stork	NT	EN; NBM	LC	Low	Wetlands, including alkaline and freshwater lakes, rivers, dams, pans, flood plains, marshes, flooded grassland and small pools or streams
<i>Rostratula benghalensis</i>	Greater Painted-snipe		VU	LC	Low	Waterside habitats with substantial cover
<i>Hydroprogne caspia</i>	Caspian Tern	NT	VU	LC	Low	Along coast, mostly in sheltered bays and estuaries; inland, at large water bodies, both natural and man-made, with preference for saline pans and large impoundments
<i>Aquila verreauxii</i>	Verreaux's Eagle		VU	LC	Low	Mountains and rocky areas with cliffs
<i>Sagittarius serpentarius</i>	Secretarybird	NT	VU	VU	Low	Open grassland (< 0.5 m) with scattered trees, shrubland, open <i>Acacia</i> and bushwillow (<i>Combretum</i> spp) savanna; absent from dense woodland and rocky hills
<i>Ciconia nigra</i>	Black Stork	NT	VU	LC	Low	Dams, pans, floodplains, flooded grassland, associated with mountainous areas
<i>Glareola nordmanni</i>	Black-winged Pratincole	NT	NT; NBM	NT	Low	Open grassland, edges of pans and cultivated fields, but most common in seasonally wet grasslands and pan systems
<i>Circus macrourus</i>	Pallid Harrier	NT	NT; NBM	NT	Low	Grasslands associated with pans or floodplains; also croplands
<i>Falco vespertinus</i>	Red-footed Falcon		NT; NBM	NT	Low	Open, grassy, arid woodland; roosts in small stands of trees, often in alien <i>Eucalyptus</i> spp, in suburbs of small towns
<i>Oxyura maccoa</i>	Maccoa Duck		NT	NT	Low	Permanent wetlands in open grassland and semi-arid country

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Alcedo semitorquata</i>	Half-collared Kingfisher	NT	NT	LC	Low	Clear, fast-flowing perennial streams, rivers and estuaries, usually narrow and secluded, with dense marginal vegetation; often near rapids
<i>Phoenicopterus roseus</i>	Greater Flamingo	NT	NT	LC	Low	Large, shallow, eutrophic wetlands, salt pans, saline lakes, coastal mudflats
<i>Phoeniconaias minor</i>	Lesser Flamingo	NT	NT	NT	Low	Primarily open, eutrophic, shallow wetlands; breeds on saline lakes and salt pans
<i>Ciconia abdimii</i>	Abdim's Stork		NT	LC	Low	Grassland, savanna woodland, pan edges, pastures, cultivated land and suburban areas. On migration and after good rains, in semi-desert habitats, including Kalahari. Generally absent from wetlands, but uses rice paddies and marshes near Beira, Mozambique
<i>Leptoptilos crumeniferus</i>	Marabou Stork		NT	LC	Low	Both aquatic and terrestrial habitats, favouring open and semi-arid areas; largely absent from forest areas and true desert; common at wetlands, including dams, pans and rivers, and in wildlife reserves and ranching areas
<i>Limosa limosa</i>	Black-tailed Godwit		NA; Vagrant	NT	Low	A wide variety of habitats, even small Highveld pans; primarily inland, favouring lake margins, marshes, swamps and irrigated lands where substratum soft enough to allow probing; also at coastal wetlands, including estuaries, sheltered embayments and salt pans

APPENDIX D: Mammal species occurring within QDGC 2629AC, likelihood of occurring on site and habitat preference

CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; En = Endemic; Pr = Protected; Sp Pr = Specially Protected. Species are listed by likelihood of occurring on site and conservation status. Species of conservation concern are highlighted in red.

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Canis mesomelas</i>	Black-backed Jackal	LC	LC	LC	Confirmed	Savanna, shrubland, grassland, drier areas, omnivore, extreme generalist
<i>Cynictis penicillata</i>	Yellow Mongoose	LC	LC	LC	Confirmed	Savanna, shrubland, grassland, desert, insectivorous
<i>Raphicerus campestris</i>	Steenbok	LC	LC	LC	Confirmed	Savanna, shrubland, grassland, drier areas
<i>Lepus saxatilis</i>	Scrub Hare	LC	LC	LC	Confirmed	Arable land, savanna, grassland, desert, grazer
<i>Cryptomys hottentotus</i>	Common Mole-rat	LC	LC	LC	Confirmed	Subterranean, widespread
<i>Hystrix africaeaustralis</i>	Cape Porcupine	LC	LC	LC	Confirmed	Arable land, savanna, grassland, temperate, desert, throughout southern Africa
<i>Gerbilliscus brantsii</i>	Highveld Gerbil	LC	LC	LC	Confirmed	Temperate, grassland and scrub in sandy soils
<i>Otomys irroratus</i>	Vlei Rat	LC	LC	LC	Confirmed	Mesic grassland and mountain fynbos habitat
<i>Suricata suricatta</i>	Suricate	LC	LC	LC	Confirmed	Savanna, shrubland, grassland, desert, invertebrates, small vertebrates
<i>Leptailurus serval</i>	Serval	NT	NT; Pr	LC	High	Savanna, grassland, bogs, marshes, swamps, moist savanna, tall grass, small mammals, reptile, fruit, invertebrates, fish
<i>Crocodyra maquassiensis</i>	Maquassie Musk Shrew	VU	VU	LC	High	Montane grassland, rocky areas, coastal forest, garden, terrestrial
<i>Rhinolophus clivosus</i>	Geoffroy's Horseshoe Bat	NT	NT	LC	High	Grassland, caves and subterranean habitats, savanna, shrubland, fynbos, woodland, succulent and Nama karoo, aerial insectivore
<i>Felis silvestris</i>	African Wild Cat	NT	LC	LC	High	Savanna, shrubland, desert, broad habitat, small mammals, reptiles, birds and invertebrates
<i>Sylvicapra grimmia</i>	Common Duiker	LC	LC	LC	High	Widespread, thickets, savanna, widespread, karroid, forest and savanna
<i>Potamochoerus larvatus</i>	Bushpig	LC	LC	LC	High	Forests, shrub dominated wetlands, Afromontane and coastal forests, thickets, reedbeds and wetland associated grassland
<i>Atilax paludinosus</i>	Water Mongoose	LC	LC	LC	High	Coastline, rocky shores, intertidal, estuarine, brackish, bogs, marshes, swamps, freshwater and saltwater, eats invertebrates and small vertebrates

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Herpestes sanguineus</i>	Slender Mongoose	LC	LC	LC	High	Savanna, desert, urban areas, invertebrates and small vertebrates
<i>Mastomys coucha</i>	Southern Multimammate Mouse	LC	LC	LC	High	Widespread, nocturnal
<i>Mastomys natalensis</i>	Natal Multimammate Mouse	LC	LC	LC	High	Cosmopolitan, nocturnal
<i>Otomys angoniensis</i>	Angoni Vlei Rat	LC	LC	LC	High	Woody savanna, tall grasses and shrubs, shrub dominated wetlands, bogs, marshes swamps, fens, peatlands with good grass cover
<i>Saccostomus campestris</i>	Pouched Mouse	LC	LC	LC	High	Savanna, shrubland, grassland, temperate, nocturnal seed eater
<i>Steatomys pratensis</i>	Fat Mouse	LC	LC	LC	High	Grassland, temperate, savanna, sandy substrate, river fringes
<i>Crociodura cyanea</i>	Reddish-grey Musk Shrew		DD	LC	High	Broad habitat tolerance, terrestrial, nocturnal
<i>Gerbilliscus leucogaster</i>	Bushveld Gerbil		DD	LC	High	Sandy soils
<i>Ourebia ourebi</i>	Oribi	EN	EN	LC	Medium	Grassland, Lowlands and montane grasslands, open grasslands with gentle topography at lower altitudes, selective feeders
<i>Myodomys albicaudatus</i>	White-tailed Mouse		EN; En	EN	Medium	Temperate, sandy soils with good cover
<i>Rhinolophus blasii</i>	Blasius's Horseshoe Bat	VU	VU	LC	Medium	Grassland, caves and subterranean habitats, woodland, savanna, aerial insectivore
<i>Hyaena brunnea</i>	Brown Hyaena	NT	NT; Pr	NT	Medium	Savanna, grasslands, urban areas, scavenger
<i>Mellivora capensis</i>	Honey Badger	NT	NT	LC	Medium	Habitat varied, rain forests to arid deserts, solitary carnivores
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat	NT	NT	LC	Medium	Grassland, caves and subterranean habitats, savanna, woodland savanna, aerial insectivore
<i>Orycteropus afer</i>	Aardvark	LC	NT; Pr	LC	Medium	Savanna, shrubland, grassland, vital association between ants and termites
<i>Dasymys incommutus</i>	African Marsh Rat		NT	LC	Medium	Bogs, marshes, swamps, fens, peatlands, nocturnal, semi-aquatic
<i>Pelea capreolus</i>	Grey Rhebok	LC	LC; Pr; En	LC	Medium	Savanna, grassveld and renosterveld, hilly and mountainous terrain, ecotonal
<i>Poecilogale albinucha</i>	African Striped Weasel	VU	DD	LC	Medium	Grassland, savanna, shrubland, birds and eggs
<i>Aonyx capensis</i>	Cape Clawless Otter	LC	LC; Pr	LC	Medium	Permanent streams and rivers, coastline, rocky shores,, freshwater and marine, crustaceans and fish
<i>Ictonyx striatus</i>	Striped Polecat	LC	LC	LC	Medium	Savanna, grasslands, desert, forest, insects and mince, reptiles

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Caracal caracal</i>	Caracal	LC	LC	LC	Medium	Savanna, shrubland, eats small mammals and birds
<i>Proteles cristata</i>	Aardwolf	LC	LC	LC	Medium	Savanna, shrubland, grassland, eats termites
<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat	LC	LC	LC	Medium	Savanna, urban areas, all vegetation types,
<i>Nycteris thebaica</i>	Egyptian Slit-faced Bat	LC	LC	LC	Medium	Caves and subterranean habitats, savanna, fynbos, aerial, man-made structures, insectivore
<i>Neoromicia capensis</i>	Cape Serotine	LC	LC	LC	Medium	Urban areas, aerial insectivore, roosts in man-made structures, crevices of plants
<i>Papio ursinus</i>	Savanna Baboon	LC	LC	LC	Medium	Savanna and grassland, forest edges, omnivore
<i>Rhodomys pumilio</i>	Four-striped Grass Mouse	LC	LC	LC	Medium	Temperate, grassland with good cover, diurnal
<i>Thallomys paeuducus</i>	Acacia Rat	LC	LC	LC	Medium	Widespread
<i>Steatomys krebsii</i>	Kreb's Fat Mouse	LC	LC	LC	Medium	Temperate, sandy substrates, wide tolerance
<i>Pedetes capensis</i>	Springhare	LC	LC	LC	Medium	Sandy, hard soils, cultivated areas or open shrubland, deserts
<i>Thryonomys swinderianus</i>	Greater Canerat	LC	LC	LC	Medium	Savanna, Grassland, Seasonally wet or flooded wetlands, usually near water
<i>Cloeotis percivali</i>	Short-eared Trident Bat	CR	CR	VU	Low	Caves and subterranean habitats, mixed woodland savanna, aerial insectivore
<i>Felis nigripes</i>	Small Spotted Cat	NT	NT; Pr	VU	Low	Savanna, shrubland, desert, short-grass specialist feeding on small mammals, reptiles, birds and invertebrates
<i>Panthera pardus</i>	Leopard	NT	NT; Pr	NT	Low	Forest, savanna, desert, predated small to medium mammals
<i>Lutra maculicollis</i>	Spotted-necked Otter	NT	NT	LC	Low	Aquatic areas, natural and man-made, fish, crab, frogs, in low densities
<i>Kerivoula lanosa</i>	Lesser Woolly Bat	NT	NT	LC	Low	Savanna, riparian woodland, insectivore, roosts in old weaver nests
<i>Miniopterus natalensis</i>	Natal Long-fingered Bat	NT	NT	NT	Low	Caves
<i>Myotis tricolor</i>	Temminck's Myotis	NT	NT	LC	Low	Forest, shrubland, savanna, grassland, mountains, aerial insectivore, lives in caves
<i>Myotis welwitschii</i>	Welwitsch's Myotis	NT	NT	LC	Low	Savanna, insectivore, roosts in shrubs and trees
<i>Atelerix frontalis</i>	Southern African Hedgehog	NT	NT	LC	Low	Dry habitats with groundcover for nesting, nocturnal
<i>Vulpes chama</i>	Cape Fox	LC	NT; Pr	LC	Low	Savanna, shrubland, grassland, desert, omnivorous, small vertebrates and invertebrates

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Eidolon helvum</i>	African Straw-coloured Fruit Bat	LC	NBM	NT	Low	Wide distribution; dependent on intact fruit producing woodlands
<i>Damaliscus pygargus</i>	Blesbok	LC	LC; Pr; En	LC	Low	Grassland, grazers with a preference for short grass
<i>Alcelaphus buselaphus</i>	Red Hartebeest	LC	LC; Pr	LC	Low	Grassland, temperate areas, shrubland, karroid semi arid areas and coastal shrubland
<i>Connochaetes gnou</i>	Black Wildebeest	LC	LC; Pr	LC	Low	Temperate grasslands, selective grazer in open areas with short grass, open plains
<i>Connochaetes taurinus</i>	Blue Wildebeest	LC	LC; Pr	LC	Low	Savanna, short grass grazer, prefers open savanna woodlands/bushveld
<i>Taphozous mauritanus</i>	Mauritian Tomb Bat	LC	LC	LC	Low	Savanna, urban areas, rural gardens, roosts on outer bark of trees and under eaves of buildings
<i>Scotophilus dinganii</i>	Yellow-bellied House Bat	LC	LC	LC	Low	Urban areas, savanna, mixed bushland, aerial insectivore, roosts in roofs/crevices
<i>Ichneumia albicauda</i>	White-tailed Mongoose	LC	LC	LC	Low	Savanna, urban areas, grasslands, invertebrates and small vertebrates
<i>Mungos mungo</i>	Banded Mongoose	LC	LC	LC	Low	Savanna, social, termites and beetle larvae, other invertebrates
<i>Genetta genetta</i>	Small-spotted Genet	LC	LC	LC	Low	Forest, savanna, omnivorous
<i>Antidorcas marsupialis</i>	Springbok	LC	LC	LC	Low	Arid regions and dry open grassland, savanna, open plains, mixed feeder
<i>Redunca fulvorufula</i>	Mountain Reedbuck	LC	LC	LC	Low	Temperate grassland habitats, selective grazer
<i>Sauromys petrophilus</i>	Flat-headed Free-tailed Bat	LC	LC	LC	Low	Savanna, shrubland, aerial insectivore, roosts in rock fissures and exfoliated rock
<i>Epomophorus wahlbergi</i>	Wahlberg's Epauletted Fruit Bat	LC	LC	LC	Low	Forest and forest edge habitats; riparian forest in savanna; urban areas; wooded gardens; roosts in dense foliage of large trees
<i>Eptesicus hottentotus</i>	Long-tailed Serotine	LC	LC	LC	Low	Savanna, Nama karoo, riverine forest, aerial insectivore, roosts in rock crevices, caves and mine tunnels
<i>Neoromicia nana</i>	Banana Bat	LC	LC	LC	Low	Savanna, plantations, close to water, insectivore, roosting in banana and Strelitzia leaves
<i>Neoromicia zuluensis</i>	Zulu Serotine	LC	LC	LC	Low	Savanna, insectivore, found roosting amongst dead aloe leaves
<i>Procavia capensis</i>	Rock Hyrax	LC	LC	LC	Low	Krantzes and rocky outcrops throughout the fynbos, karroid habitats, generalist herbivore

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Pronolagus randensis</i>	Jameson's Red Rock Rabbit	LC	LC	LC	Low	Grassland, rocky highveld grassland, slopes of rocky outcrops
<i>Pronolagus saundersiae</i>	Hewitt's Red Rock Rabbit	LC	LC	LC	Low	Grassland, restricted to the top of rocky outcrops
<i>Elephantulus myurus</i>	Eastern Rock Sengi	LC	LC	LC	Low	Shrubland, grassland, crevices and crannies
<i>Graphiurus murinus</i>	Woodland Dormouse	LC	LC	LC	Low	Woodland, terrestrial arboreal
<i>Aethomys ineptus</i>	Tete Veld Rat	LC	LC	LC	Low	Rocky crevices and piles of boulders
<i>Micaelamys namaquensis</i>	Namaqua Rock Mouse	LC	LC	LC	Low	Rocky outcrops and koppies
<i>Desmodillus auricularis</i>	Cape Short-tailed Gerbil	LC	LC	LC	Low	Compact soil, nocturnal, in semi-arid karroid grassland
<i>Crociodura silacea</i>	Lesser Grey-brown Musk Shrew		DD	LC	Low	Coastal forest, grassland and rocky areas, woodland, terrestrial, nocturnal
<i>Suncus varilla</i>	Lesser Dwarf Shrew		DD	LC	Low	Terrestrial, nocturnal, broad tolerance but may be dependent on termite mounds
<i>Elephantulus brachyrhynchus</i>	Short-snouted Sengi		DD	LC	Low	Heavy cover in grass and scrubs
<i>Diceros bicornis</i>	Black Rhinoceros	VU	EN	CR	Zero	Savanna, bushveld habitats of Limpopo, Mpumalanga and KZN, prefers dense cover and permanent water, browser
<i>Ceratotherium simum</i>	White Rhinoceros	LC	NT; Pr	NT	Zero	Temperate grasslands, short grass areas in savanna and bushveld, prefers woody cover, water, bulk grazer
<i>Syncerus caffer</i>	African Buffalo	LC	LC; Pr	LC	Zero	Savanna, temperate shrubland, bulk feeder occurring throughout savannas lowveld and Eastern Cape thickets
<i>Tragelaphus oryx</i>	Eland	LC	LC	LC	Zero	Woodlands and woodland mosaics, grasslands and thickets
<i>Equus quagga</i>	Plains Zebra	LC	LC	LC	Zero	Savanna, temperate grasslands, grasslands or open woodlands near water Prefers short grasses and flat to gentle hills

APPENDIX E: Amphibian species occurring within QDGC 2629AC, likelihood of occurring on site and habitat preference

CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; En = Endemic

Species are listed by likelihood of occurring on site and conservation status. Species of conservation concern are highlighted in red. Endemic species are highlighted in green

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Amietia delalandii</i>	Common River Frog		LC	LC	Confirmed	Banks of slow-moving streams or other permanent bodies of water in a wide variety of wetland habitats in grassland, savanna and forest edge
<i>Cacosternum boettgeri</i>	Boettger's Caco		LC	LC	Confirmed	Variety of habitats in Nama Karoo, succulent Karoo, grassland and thicket favouring open areas and especially abundant in grassland areas; occasionally forest clearings
<i>Kassina senegalensis</i>	Bubbling Kassina		LC	LC	High	Grassland around vleis and pans; breeds in temporary and permanent water bodies including vleis, marshes, pans, ponds and dams
<i>Tomopterna tandyi</i>	Tandy's Sand Frog		LC	LC	High	Nama Karoo, grassland and savanna; breeds in small streams, pans and farm dams as well as temporary rain pools
<i>Tomopterna natalensis</i>	Natal Sand Frog		LC	LC	High	Variety of habitats in savanna and grassland; breeds in shallow permanent furrows, canals or streams in grassland and agricultural land
<i>Tomopterna cryptotis</i>	Tremelo Sand Frog		LC	LC	High	Variety of habitats in savanna and grassland
<i>Strongylopus fasciatus</i>	Striped Stream Frog		LC	LC	High	Open, grassy areas near dams, ponds or streams in forest, thicket, grassland and savanna, sometimes parks and gardens
<i>Sclerophrys gutturalis</i>	Guttural Toad		LC	LC	High	Around open pools, dams, vleis and other semi-permanent bodies of water in grassland, thicket and savanna; suburban gardens and farmland
<i>Xenopus laevis</i>	Common Platanna		LC	LC	High	Restricted to aquatic habitats but opportunistic and can be found in any form of wetland
<i>Ptychadena anchietae</i>	Plain Grass Frog		LC	LC	High	Widely distributed in savanna, open woodland and grassland; agricultural and suburban areas
<i>Sclerophrys capensis</i>	Raucous Toad		LC	LC	High	Rivers and streams in grassland and fynbos; frequently in gardens and farmland
<i>Pyxicephalus adspersus</i>	Giant Bullfrog	VU	LC; Pr	LC	Medium	Fossorial, breeding in seasonal, shallow, grassy pans, vleis and other rain-filled depressions in open, flat areas of grassland or savanna; Nama Karoo and thicket at the limits of its range

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Semnodactylus wealii</i>	Rattling Frog		LC	LC	Medium	Summer and winter rainfall areas in well-vegetated areas around pans and vleis in grassland or fynbos heath in south of range
<i>Phrynobatrachus natalensis</i>	Snoring Puddle Frog		LC	LC	Medium	Margins of permanent and temporary water bodies including shallow marshes, lakes, rivers, streams and pools; also semi-desert scrub, arid and humid savanna, agricultural land and forest clearings
<i>Amietia poyntoni</i>	Cape River Frog		LC	LC	Medium	Widespread around permanent rivers and streams in grassland, fynbos and Karoo scrub including farm dams and other artificial water bodies
<i>Breviceps adspersus</i>	Bushveld Rain Frog		LC	LC	Medium	Sandy to sandy-loam soils in semi-arid habitats in savanna and grassland, absent from forest
<i>Ptychadena porosissima</i>	Striped Grass Frog		LC	LC	Medium	Variety of vegetation types from sea level to 2300m including subtropical coastal areas, temperate and wooded grassland along escarpment and Highveld
<i>Sclerophrys garmani</i>	Eastern Olive Toad		LC	LC	Low	Vleis and pans in bushveld savanna with relatively high rainfall > 600mm pa; suburban gardens
<i>Schismaderma carens</i>	Red Toad		LC	LC	Low	Widespread in savanna and woodland, readily adapts to human habitation

APPENDIX F: Reptile species occurring within QDGC 2629AC, likelihood of occurring on site and habitat preference

CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; NE = Not Evaluated; En = Endemic

Species are listed by likelihood of occurring on site and conservation status. Species of conservation concern are highlighted in red. Endemic species are highlighted in green

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Hemachatus haemachatus</i>	Rinkhals		LC; En	LC	High	Grassland
<i>Hemidactylus mabouia</i>	Moreau's Tropical House Gecko		LC	NE	High	Varied, wet and dry savanna and coastal bush
<i>Boaedon capensis</i>	Brown House Snake		LC	NE	High	Highveld grassland, karroid regions and tolerant in urban areas
<i>Pseudaspis cana</i>	Mole Snake		LC	NE	High	Sandy scrubland in SW Cape, Highveld grassland, mountainous and desert areas
<i>Trachylepis capensis</i>	Cape Skink		LC	NE	High	Habitat generalist; widespread and common
<i>Trachylepis varia</i>	Variable Skink		LC	NE	High	Varied, grassland to arid mesic savanna
<i>Bitis arietans</i>	Puff Adder		LC	NE	High	Absent only from desert, dense forest and mountain tops
<i>Pelomedusa galeata</i>	Marsh Terrapin		NE	NE	Medium	Slow-moving and still water, temporary pans
<i>Nucras lalandii</i>	Delalande's Sandveld Lizard		LC; En	NE	Medium	Montane and temperate grassland
<i>Lycodonomorphus rufulus</i>	Common Water Snake		LC; En	NE	Medium	Small streams, pans and vleis
<i>Lamprophis aurora</i>	Aurora House Snake		LC; En	LC	Medium	Grassland, coastal bush and fynbos
<i>Aparallactus capensis</i>	Black-headed Centipede-eater		LC	LC	Medium	Varied, Highveld, montane grassland, savanna and coastal bush
<i>Trachylepis punctatissima</i>	Montane Speckled Skink		LC	LC	Medium	Variety of habitats, wet and dry, from grassland and savanna to shrubland, including rock outcrops
<i>Dasypeltis scabra</i>	Rhombic Egg-eater		LC	LC	Medium	Absent only from closed canopy and desert areas
<i>Varanus niloticus</i>	Water Monitor		LC	NE	Medium	Rivers, pans and major lakes
<i>Pachydactylus capensis</i>	Cape Gecko		LC	NE	Medium	Varied, karroid veld, grassland
<i>Lycophidion capense</i>	Common Wolf Snake		LC	NE	Medium	Variety of habitats including lowland forest, fynbos, moist savanna, grassland and karoo scrub
<i>Prosymna lineata</i>	Lined Shovel-snout		LC	NE	Medium	Dry areas, savanna woodlands, Highveld and karroid areas, entering mesic thicket in the cape
<i>Psammophis brevirostris</i>	Short-snouted Grass Snake		LC	NE	Medium	Varied including grassland and moist savanna
<i>Psammophis crucifer</i>	Crossed Whip Snake		LC	NE	Medium	Highveld and montane grassland, entering fynbos

Taxonomic Name	Common Name	Conservation Status			Likelihood of Occurrence	Preferred Habitat
		MP	RSA	IUCN		
<i>Psammophylax rhombeatus</i>	Spotted Skaapsteker		LC	NE	Medium	Highveld grassland, mesic thicket, fynbos, karroid areas
<i>Chamaesaura aenea</i>	Coppery Grass Lizard	VU	NT; En	NE	Low	Grass covered montane slopes and plateaus
<i>Agama aculeata</i>	Ground Agama		LC; En	NE	Low	Semi-desert and sanded savanna
<i>Pseudocordylus melanotus</i>	Drakensberg Crag Lizard		LC; En	NE	Low	Rock outcrops on mountain plateaus and rolling grassland
<i>Smaug vandami</i>	Van Dam's Girdled Lizard		LC; En	NE	Low	Rocky outcrops in mesic savanna
<i>Pachydactylus affinis</i>	Transvaal Gecko		LC; En	NE	Low	Rocky outcrops and dead termite nests
<i>Afrotrophlops bibronii</i>	Bibron's Blind Snake		LC; En	NE	Low	Highveld and coastal grassland
<i>Chamaeleo dilepis</i>	Flap-neck Chameleon		LC	LC	Low	Savanna woodland, coastal forest in KZN
<i>Cordylus vittifer</i>	Transvaal Girdled Lizard		LC	NE	Low	Rock outcrops in grassland
<i>Kinixys lobatsiana</i>	Lobatse Hinged Tortoise		LC	NE	Low	Bushveld, thornveld and Burkea savanna
<i>Stigmochelys pardalis</i>	Leopard Tortoise		LC	NE	Low	Varied, montane grassland, fynbos, mesic thicket, arid and mesic savanna
<i>Varanus albigularis</i>	Rock Monitor		LC	NE	Low	Savanna and moister karroid regions
<i>Agama atra</i>	Southern Rock Agama		LC	NE	Low	Semi-desert to fynbos
<i>Crotaphopeltis hotamboeia</i>	Herald Snake		LC	NE	Low	Savanna and open woodland
<i>Dispholidus typus</i>	Boomslang		LC	NE	Low	Open bush and savanna, sparsely wooded grassland in the Winterberg
<i>Philothamnus semivariegatus</i>	Spotted Bush Snake		LC	NE	Low	Open forest or savanna, arid regions
<i>Naja annulifera</i>	Snouted Cobra		LC	NE	Low	Savanna, bushveld and lowveld
<i>Lygodactylus capensis</i>	Cape Dwarf Gecko		LC	NE	Low	Well-wooded savanna and tropical thicket
<i>Gerrhosaurus flavigularis</i>	Yellow-throated Plated Lizard		LC	NE	Low	Varied, montane grassland, savanna, bushveld
<i>Ichnotropis capensis</i>	Cape Rough-scaled Lizard		LC	NE	Low	Arid and mesic savanna
<i>Afroablepharus walbergii</i>	Wahlberg's Snake-eyed Skink		LC	NE	Low	Arid and mesic savanna
<i>Causus rhombeatus</i>	Rhombic Night Adder		LC	NE	Low	Mesic savanna
<i>Crocodylus niloticus</i>	Nile Crocodile		VU; Pr	NT	Zero	Large, rivers, lakes and swamps, river mouths, estuaries and mangrove swamps

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FORM IP180_B

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PROJECT NAME : Exxaro Sublime Access Road **PROJECT No.** : J37158
TITLE OF DOCUMENT : Ecological Assessment
ELECTRONIC LOCATION :

	Approved By	Reviewed By	Prepared By
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DATE 2017/11/17	SIGNATURE	SIGNATURE	SIGNATURE

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