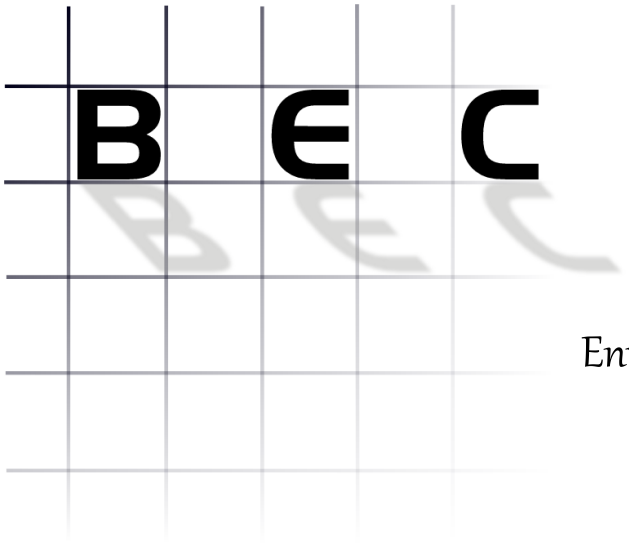
BEC Report Code:	LDW – HAD – 2012/10
Version:	2.2012 12 06
DEA Reference Number:	12/12/20/2175

Terrestrial Biodiversity Impact Assessment for the proposed extension of the Ash Dam Facilities at Hendrina Power Station, Mpumalanga Province

compiled by



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November 2011

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I PROJECT DETAILS

Client:	Lidwala Consulting Engineers
Report name:	Strategic Biodiversity Impact Assessment for the proposed extension of the Ash Dam Facility at Hendrina Power Station, Mpumalanga Province.
Report type:	Biodiversity/ Ecological Impact Assessment Report
BEC Project number:	LDW - HAD – 2012/10
DEA Reference:	**12/12/20/2175**
Compiled by:	Riaan A. J. Robbeson (Pr.Sci.Nat.), Bathusi Environmental Consulting

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III SPECIALIST INVESTIGATORS

The Natural Scientific Professions Act of 2003 aims to '*provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP), and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith'.*

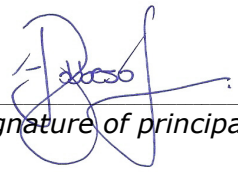
Quoting the Natural Scientific Professions Act of 2003: '*Only a registered person may practice in a consulting capacity*' (20(1) – pg 14).

Table 1: Biodiversity Specialists for this project	
Botanical Investigator:	**Riaan Robbeson (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Botany), UP
Affiliation:	**South African Council for Natural Scientific Professions**
Fields of Expertise:	**Botanical Scientist & Ecological Scientist (400005/03)**
Affiliation:	Botanical Society of South Africa
Affiliation:	Grassland Society of Southern Africa (667.08/08)
Affiliation:	Succulent Society of Southern Africa
Faunal Investigator:	**Dewald Kamffer (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Conservation Biology), UP
Affiliation:	**South African Council for Natural Scientific Professions**
Fields of expertise:	**Ecological Scientist & Zoological Scientist (400204/05)**

IV DECLARATION OF INDEPENDENCE

All specialist investigators, project investigators and members of companies employed for conducting this biodiversity investigation declare that:

- We act as independent ecologists compiling this report
- We consider ourselves bound to the rules and ethics of the South African council for natural scientific professions;
- At the time of completing this report, we did not have any interest, hidden or otherwise, in the proposed development or activity as outlined in this document, other than financial compensation for work performed in a professional capacity in terms of the environmental impacts assessment regulations, 2005;
- We will not be affected in any manner by the outcome of the environmental process of which this report forms part of, other than being part of the general public;
- We do not have any influence over decisions made by the governing authorities;
- Undertake to disclose, to the competent authority, any material information that have 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 environmental impact assessment regulations, 2005;
- 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;
- We do not necessarily object to or endorse the proposed development, but aim to present facts and recommendations based on scientific data and relevant professional experience; and
- Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and register as an Interested and Affected Party.



Signature of principal ecologist:

Bathusi Environmental Consulting cc (CK1999/052182/23)

Name of company:

14th November 2011

Date:

V SURVEY DETAILS

Field surveys were conducted from the 17th to 19th October 2011.

VI LEGISLATION

This report has been prepared in terms of the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 – Specialist reports and reports on specialised processes under the Act. Relevant clauses of the above regulation include:

Regulation 33.(1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.

Regulation 33.(2): A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

(a) Details of (i) The person who prepared the report, and
(ii) The expertise of that person to carry our the specialist study or specialised process;
(b) A declaration that the person is independent in a form as may be specified by the competent authority;
(c) An indication of the scope of, and the purpose for which, the report was prepared;
(d) A description of the methodology adopted in preparing the report of carrying out the specialised process;
(e) A description of any assumptions made and any uncertainties or gaps in knowledge;
(f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
(h) A summary and copies of any comments that were received during any consultation process;
(i) Any other information requested by the competent authority.

Compliance with provincial, national and international legislative aspects is strongly advised during the planning, assessment, authorisation and execution of this particular project. Legislative aspects of which cognisance were taken during the compilation of this report are summarised in, but not necessarily limited to, Table 2.

Table 2: Legislative guidance for this project

Biodiversity Act (No. 10 of 2004)	To provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.
Conservation of Agricultural Resources Act 43 of 1983	The conservation of soil, water resources and vegetation is promoted. Management plans to eradicate weeds and invader plants must be

Table 2: Legislative guidance for this project	
	established to benefit the integrity of indigenous life.
Constitution of the Republic of South Africa (Act 108 of 1996)	The Bill of Rights, in the Constitution of South Africa (No. 108 of 1996), states that everyone has a right to a non-threatening environment and requires that reasonable measures are applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development. These principles are embraced in NEMA and given further expression.
Convention on Biological Diversity, 1995	International legally binding treaty with three main goals; conserve biological diversity (or biodiversity); ensure sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources.
Convention on International Trade in Endangered Species of Wild Life and Fauna	International agreement between governments, drafted because of a resolution adopted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33,000 species of animals and plants.
Environmental Conservation Act (No. 73 of 1989)	To provide for the effective protection and controlled utilization of the environment and for matters incidental thereto.
National Environmental Management Act (No. 107 of 1998)	Requires adherence to the principles of Integrated Environmental Management (IEA) in order to ensure sustainable development, which, in turn, aims to ensure that environmental consequences of development proposals be understood and adequately considered during all stages of the project cycle and that negative aspects be resolved or mitigated and positive aspects enhanced.
National Environmental Management Act (No 10 of 2004)	Restriction of activities involving alien species, restricted activities involving certain alien species totally prohibited and duty care relating to listed invasive species.
National Forest Act, 1998 (No 84 of 1998)	Cutting, disturbing, damaging or destroying any indigenous, living tree in a natural forest, except in terms of a licence issued under section 7(4) or section 23; or an exemption from the provisions of the subsection published by the Minister in the Gazette. The sections include protected tree species, a particular tree, a group of trees or particular woodland to be a protected tree, group of trees, woodland or species. In terms of section 15, no person may cut, disturb, damage, destroy or remove any protected tree; or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire of dispose of any protected tree, except under a licence granted by the Minister.
Northern Cape Nature Conservation Act, No. 9 of 2009	Provides for the sustainable utilisation of wild animals, aquatic biota and plants, provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Amongst other regulations, the following may apply to the current project: • Boundary fences may not be altered in such a way as to prevent wild animals from freely moving into or off of a property; • Aquatic habitats may not be destroyed or damaged; and • The Act provides lists of protected species for the Province.
Protected Areas Act (No. 57 of 2003)	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

VII LIMITATIONS OF THIS INVESTIGATION

- Although care was taken to ensure the proper investigation of the study area, it is only reasonable to expect that not all species could be located or identified during a single survey that was conducted during the beginning of the austral summer.
- active faunal communities (i.e. species readily found and identified) differ significantly between seasons; for example, butterfly species are only on the wing for a couple of weeks each year, the list of species found in the study area therefore gives only a partial glimpse into the ecological status of the faunal habitats found in the study area. Likewise, some animals (especially medium and large mammals and birds) might not be resident in the study area but could migrate through the area (on a migration route or otherwise) – a snap shot of the faunal communities of the study area is unlikely to include such species.
- Because rare and endemic species normally do not occur in great densities and because of customary limitations in the search and identification of Red Listed species, the detailed investigation of these species was not possible and results are ultimately based on estimations and specialist interpretation of limited data.
- Results presented in this report are based on a snapshot investigation of the study area and not on detailed and long-term investigations of all environmental attributes and the varying degrees of biological diversity that may be present in the study area. No concrete conclusions may therefore be drawn concerning biological diversity or conservation strategies as far as this study area is concerned.
- It is emphasised that information, as presented in this document, only have bearing on the site as indicated on accompanying maps. This information cannot be applied to any other area, however similar in appearance or any other aspect, without proper investigation.
- Furthermore, additional information may become known during a later stage of the process or development. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.
- This report should always be considered as a whole. Reading and representing portions of the report in isolation could lead to incorrect conclusions and assumptions. In case of any uncertainty, the author should be contacted to clarify viewpoints, recommendations and/ or results.

IX LIST OF TABLES

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1 EXECUTIVE SUMMARY

Hendrina Power Station in the Mpumalanga Province currently have five ash dams, of which two are currently in operation, the other three are not in use due to either having reached their full capacity or due to stability issues. It has been determined that the existing ashing facilities are not capable to provide sufficient ash disposal capacity for the volume of ash for the full life of the station and the need for extending the existing facilities has become evident. This particular project comprehends the expansion of the Ash Dam facilities at the Hendrina Power Station in the Mpumalanga Province. In addition to the expansion of the ash dams, the project also need to consider expansion of the relevant infrastructure associated with the ashing system, such as Ash water dams, pipelines, stormwater trenches, seepage water collection systems, pump stations, seepage dams etc.

As part of the environmental process, separate biodiversity screening and scoping reports have been compiled to identify and assess the potential suitability of alternative sites. A total of 5 (five) sites were originally investigated and, based on a holistic assessment of all relevant environmental information, a suitable site (Site E) has been identified. The detailed assessment of potential impacts on the biological environment will form the topic of this report.

1.1 BIOPHYSICAL ATTRIBUTES

The study area is situated approximately 300m south of the Hendrina Power Station, near Pullenshope, Mpumalanga Province. It is also situated approximately 33km southeast from Middelburg and 17km northwest from Hendrina Town. The N11 is situated approximately 6.5km to the east.

The study area falls within the upper reaches of the Orange Primary Catchment area. No significant rivers or drainage lines are present within the study area, but endorheic pans and unnatural dams (manmade impoundments) are present in the site as well as in the immediate surrounds. These areas are likely to be affected by the proposed development and significant mitigation measures will be required. The status of these areas do vary significantly, from moderately to severely degraded.

The region of the study area comprises extensive transformed habitat with small portions areas of natural grassland habitat. Major developments include agriculture, mining and residential areas. Consequently, local and regional habitat fragmentation and isolation is extremely high. The topography of the study area is described as Moderately Undulating Plains and Pans, situated approximately between 1,600m above sea level. No area of obvious physical variability is present within the study area and the immediate surrounds. No declared area of conservation is present within the general surrounds of the study area.

The study area is situated within the Bb4 land type unit. The geology of the study area conforms mostly to the Vryheid Arenite Formation.
The study area comprises three of categories of the Mpumalanga Biodiversity Conservation Plan (MBCP), namely:

- No Natural Habitat Remaining; and
- Least Concern.

The proposed development relates to 'Mining Activities' (Land Use 15 - Surface mining, dumping, dredging) and is included in the category 'Urban Industrial Land Uses' with the other development types such as Urban & Business Development, Major Development Projects, Linear Engineering Structures and Water Projects & Transfers. These land uses not only produce the highest local impacts but also dominate the dispersed and cumulative impacts. No specific limitations in terms of surface mining are indicated for the study area. However, it is evident that the database does not consider smaller, localised habitat variations.

1.2 FLORA

The study area is located in the Mesic Highveld Grassland Bioregion, more specifically the Eastern Highveld Grassland vegetation type. This vegetation type is regarded Endangered and only very small fractions are conserved in statutory reserves. The SANBI database indicates the known presence of only 38 plant species within this particular ¼-degree grid (2629BA). This low diversity is the result of the poor floristic knowledge of the area and is not a reflection of a poor habitat and floristic diversity. The SANBI database also indicates no floristic species of conservation importance occurring in this region.

The site investigation revealed the presence of approximately 71 plant species in the study area. The recorded phytodiversity is regarded relative diverse, not only reflecting the species richness of the regional vegetation types, but also the effect of transformation and the influx of weeds and alien invasive species that are not normally associated with pristine vegetation of the region. The grassland physiognomy of the region is indicated by the absence of woody species in areas of natural vegetation and the dominance of grasses and forbs that constitute the majority of the diversity. A total of 24 plant families are represented by the floristic diversity of the site, typically dominated by Asteraceae and Poaceae.

No Threatened plant species were recorded during the site investigation. Considering the habitat variability and status, it is unlikely that species of conservation importance will occur within these parts. However, parts of the study area, endorheic pans in particular are regarded moderately suitable for the presence of *Crinum bulbispermum* (Declining), *Nerine gracilis* (Near Threatened) and *Kniphofia typhoides* (Near Threatened).

Due to relative high transformation levels and effects of frequent burning noted across most of the site, vegetation within the study area was found to be relatively degraded. Because of intensive human activities, remaining natural vegetation within the study area is not regarded

representative of the regional vegetation type, i.e. pristine. Results of the photo analysis and site investigations revealed the presence of the following habitat types:

- Agricultural Fields (low floristic sensitivity);
- Excavations (low floristic sensitivity);
- Exotic Trees (low floristic sensitivity);
- Grassland (medium/ medium-high floristic sensitivity);
- Moist Grassland (medium-low/ medium-high floristic sensitivity);
- Rehabilitated Land (medium-low floristic sensitivity);
- Roads & Railways (low floristic sensitivity);
- Transformed Habitat (low floristic sensitivity);
- Unrehabilitated Land (low floristic sensitivity) and;
- Wetland Habitat (medium/ medium-high/ high floristic sensitivity).

Vegetation of the study area exhibits the expected signs of continued and long-term impacts resulting from agriculture, severe grazing pressure in the remaining parts of natural grassland and effects of indirect and direct mining and agricultural impacts on wetland habitats. On a regional scale, these impacts are the main causes resulting in the Endangered status that is ascribed to the Eastern Highveld Grassland. On a local scale, the level of impacts on the natural vegetation is regarded severe and irreversible and therefore any remaining parts of natural/ pristine vegetation should be regarded as highly sensitive and conserved at all costs.

Extremely little untransformed grassland remains in the study area. Wetland habitat types are highly impacted because of trampling and severe grazing pressure from cattle, as well as from species changes that result from infestation from nearby agricultural fields, seeds that are imported by cattle droppings as well as poor quality water entering from nearby agricultural fields and mining areas. Remaining portions of the study area mostly exhibit low floristic sensitivity levels and the loss of these areas is not expected to result in significant impacts on a local or regional scale.

In the event of unavoidable impacts on wetland related habitat, it is recommended that a biodiversity offset programme be initiated that should target a nearby wetland/ endorheic pan. The details of such an offset programme (offset ratios, area identification and management options) should be addressed by the wetland ecologist.

1.3 FAUNA

A total of 30 animal species was recorded during the site investigation by means of visual sightings, tracts, faecal droppings, burrows and characteristic behaviour patterns. This diversity includes four insects, one frog, twenty birds and five mammals. None of the species found is considered to be under threat (IUCN Red Data, CITES or TOPS). This diversity of animals confirmed to occur in the study area are regarded typical of an area the size of the study site in this part of the Grassland Biome, given the mixture of habitat types present in the study area. In

addition to species that were identified to species level, nine invertebrate families were also recorded during the field investigation.

Eighty-two Red Data animals are known to occur in the Mpumalanga Province (mammals, reptiles, amphibians and invertebrates). It is estimated that 79 of the 82 species have a low probability of occurring in the study area; two have a moderate-low probability and one species a high probability, namely the Marsh Sylph (*Metisella meninx*). This species is restricted to the wet vleis of highveld grassland in KZN, Mpumalanga, FS, Gauteng and the North West Province. The species is known to feed on *Leersia hexandra* (Poaceae – larval host) and is well represented in the wetlands of the general region in which the study area is located.

The faunal sensitivity assessment confirmed the visual assessment of degradation of remaining natural habitat with only selected portions of the wetland related habitat that exhibits characteristics of medium-high and high faunal sensitivities. None of the potential impacts associated with the proposed project for the Ash Dam at Site E, pipeline alternatives routes 1 and 2 and transmission line corridors 1 and 2 are considered high for any of the project phases – construction, operational or decommissioning (including cumulative impacts).

It is however strongly recommended that a biodiversity offset be considered for the unavoidable loss of the wetland habitat in the study area. The ecological management of a similarly sized wetland nearby could easily mitigate the loss of the wetland in the study area. Such an offset need not be extensive or costly; the proper ecological management of such a wetland can be effectively achieved by employing ecological and biodiversity conservation principles.

1.4 IMPACT ASSESSMENT

Estimated ecological sensitivities reflect the separate floristic and faunal sensitivities and furthermore provide evidence of a highly degraded and transformed habitat that is characterised by the presence of mosaical remnants of natural habitat that are largely isolated. While selected portions of habitat exhibit characteristics of medium-high and high ecological sensitivity, the remainder of the proposed site is regarded low in ecological sensitivity. The loss of these areas is not regarded significant on a local or regional scale. Remaining portions of higher sensitivity categories could effectively be protected by the implementation of generic mitigation measures. Whilst complete protection of these areas is not regarded possible, the implementation of a biodiversity offset programme, which should target surrounding areas of high biodiversity value, is regarded a suitable mitigation measure.

The following impacts are relevant to this particular development:

- (Direct) Loss or degradation of natural/ pristine habitat;
- (Direct) Impacts on common fauna & interactions with structures & personnel;
- (Indirect) Loss, or disruption of ecological connectivity;
- (Direct) Faunal interactions with structures, servitudes and personnel;
- (Indirect) Loss/ degradation of surrounding habitat, species;

- (Cumulative) Impacts on SA's conservation obligations & targets; and
- (Cumulative) Increase in local and regional fragmentation/ isolation of habitat.

It is emphasised that not all of the impacts are likely to occur during the entire lifespan of the development, impacts were therefore assessed in a case-by-case scenario.

It is evident that direct impacts associated with the various phases of the project are mostly restricted to the physical activities associated with construction activities and, to some extent, activities associates with the decommissioning phase (rehabilitation). Indirect as well as direct impacts are mostly restricted to the site and immediate surrounds.

The implementation of generic mitigation measures are expected to ameliorate impacts to an acceptable significance. In selected areas, mostly associated with wetland related habitat, will the success of mitigation measures be of a moderate nature.

The major objective of this Biodiversity Impact Assessment is to establish the presence/absence of ecologically sensitive areas or species within the proposed project area. In order to achieve this it is necessary to assess potential impacts of the development on the natural environment (terrestrial biodiversity), provide pertinent comments on the suitability of the area for the proposed project and to provide development guidance to limit impacts as far as possible.

The Terms of Reference for the floristic assessment are as follows:

- Obtain all relevant Précis and Red Data flora information;
- Conduct a photo analysis of the proposed area;
- Identify preliminary floristic variations;
- Survey preliminary habitat types to obtain a broad understanding of the floristic diversity;
- Assess the potential presence of Red List flora species according to information obtained from SANBI;
- Incorporate existing knowledge of the region into the assessment;
- Describe broad habitat variations present in the study area in terms of biophysical attributes and phytosociological characteristics;
- Compile a floristic sensitivity analysis;
- Incorporate results into the Biodiversity Impact Evaluation;
- Map all relevant aspects;
- Provide pertinent recommendations; and
- Present all results in a suitable format.

The Terms of Reference for the faunal assessment are as follows:

- Obtain available faunal distribution records and Red Data faunal information
- Survey the site to obtain a broad overview of available faunal habitat types;
- Assess the potential presence of Red Data fauna species;
- Incorporate existing knowledge of the region;
- Describe the status of available habitat in terms of faunal attributes, preferences and conservation potential;
- Compile a faunal sensitivity analysis;
- Incorporate results into the Biodiversity Impact Evaluation;
- Map all relevant aspects; and
- Present all results in a suitable format.

Destructive activities in a natural environment require vigilance to ensure that the biological and cultural heritage of future generations is not adversely affected by activities of today. Concern is growing about the consequences of biodiversity losses, for ecosystem functioning, for the provision of ecosystem services and for human well being.

Why is Biodiversity Conservation Important? Biodiversity sustains life on earth. An estimated 40 percent of the global economy is based on biological products and processes. Biodiversity has allowed massive increases in the production of food and other natural materials, which in turn have fed the (uncontrolled) growth and development of human societies. Biodiversity is also the basis of innumerable environmental services that keep humans and the natural environment alive, from the provision of clean water and watershed services to the recycling of nutrients and pollination.

Current pressures on and losses of biodiversity are unfortunately threatening to undermine the functionality of natural ecological processes and adaptive responses of the environment. The last few centuries have witnessed brutal increases in the rate at which biodiversity is being altered by humanity. With uncontrolled growth of human population, consumption needs have increased exponentially as well as the drive to extract more economically valuable resources at ever-faster rates. Natural habitats that harbour some of the world's most valuable biodiversity are being lost at increasingly faster and over progressively wider areas, while managed lands are undergoing increasing simplification. Adopting 'biodiversity friendly' practices remains challenging within the entire developmental sphere, especially for smaller companies and peripheral players. This is partly because governments, while perhaps committed on paper to biodiversity, have found it difficult to create the right incentives and apply the necessary regulations in a way that could encourage all players to conserve biodiversity.

Humanity faces the challenge of supporting the needs of growing populations from a rapidly shrinking natural resource base. Achieving a balance while doing this will require a better understanding and recognition of conservation and development imperatives and this is only a step towards more strategic and integrated approach to land use planning and management that helps societies make better-informed decisions. Evidence illustrate how management tools, rehabilitation and restoration processes, together with improved scientific knowledge, can help conserve biodiversity; also highlighting that mutual benefits can result from stronger collaboration between the mining and conservation sectors. Good practice, collaboration and innovative thinking can advance biodiversity conservation worldwide while ensuring that the minerals and products that society needs are produced responsibly.

In 1992, the Convention of Biological Diversity, a landmark convention, was signed by more than 90 % of all members of the United Nations. The enactment of the National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004), together with the abovementioned treaty, focuses on the preservation of all biological diversity in its totality, including genetic

variability, natural populations, communities, ecosystems up to the scale of landscapes. Hence, the local and global focus changed to the sustainable utilisation of biological diversity.

Lidwala Consulting Engineer has appointed by Eskom as an independent Environmental Assessment Practitioner (EAP), to undertake the necessary environmental studies to identify and assess all potential environmental impacts associated with the proposed project. Bathusi Environmental Consultants (BEC) has been appointed as independent ecological specialists to conduct a strategic biodiversity impact evaluation of the biological environment that will be affected by this proposed development. Dewald Kamffer (FSI) conducted the faunal assessment; Riaan Robbeson (BEC) conducted the floristic assessment, provided the ecological interpretation and compiled the ecological sensitivity analysis.

4 PROJECT BACKGROUND

The reliable provision of electricity by Eskom is critical to industrial development and other poverty alleviation initiatives in the country. If Eskom is to meet its mandate and commitments, one requirement will be to extend the life of existing infrastructure. Expansion therefore not only includes building of new power stations but also expanding and upgrading existing power stations and infrastructure to ensure that the operating life of the power stations can be extended.

The Hendrina Power Station, in the Mpumalanga Province currently uses a wet ashing system for the disposal of ash. Hendrina Power Station currently have five ash dams, of which two (Ash dam 3 and 5) are currently in operation, the other three (Ash dam 1, 2 & 4) are not in use due to either having reached their full capacity (Dams 1 and 4) or due to stability issues (Dam 2). At the current rate of disposal Dams 3 and 5 will reach full capacity within five years (from the end of 2010). The Hendrina Power Station is anticipated to ash approximately 64.2 million m³ until the end of its life span, which is currently estimated to be 2035.

It has been determined that the existing ashing facilities are not capable to provide sufficient ash disposal capacity for the full life of the station. Extension of the current facilities will allow the Hendrina Power Station to continue ashing in an environmentally responsible way for the duration of the operating life of the Power Station, which is related to the high ash content in the coal, and an urgent need to extend station life.

This particular project comprehends the expansion of the Ash Dam facilities at the Hendrina Power Station in the Mpumalanga Province. The ash dam expansion will need to accommodate 43.3 million m^3 of ash. The footprint of the proposed expansion is estimated to be in the order of 200 ha however, the final shape and design of the footprint is still to be determined through conceptual engineering and design. In addition to the expansion of the ash dams, the project also need to consider expansion of the relevant infrastructure associated with the ashing system, such as Ash water dams, pipelines, stormwater trenches, seepage water collection systems, pump stations, seepage dams etc.

As part of the environmental process, separate biodiversity screening and scoping reports have been compiled to identify and assess the potential suitability of alternative sites. A total of 5 (five) sites were originally investigated and, based on a holistic assessment of all relevant environmental information, a suitable site (Site E) has been identified. The detailed assessment of potential impacts on the biological environment will form the topic of this report.

5 METHOD STATEMENT

5.1 ASSESSMENT PHILOSOPHY

Inherent characteristics of a project of this nature implies that no method will be foolproof, mainly as a result of shortcomings in available databases and lack of site specific detail that could be obtained from limited detailed site investigations conducted over a short period of time. It is an unfortunate limitation of every scientific study; it simply is not possible to know everything or to consider aspects to a level of molecular detail. However, to present an objective opinion of the biodiversity sensitivity of the study area and how this relates to the suitability/ unsuitability of the study area in terms of the proposed development, all opinions and statements presented in this document are based on the following aspects, namely:

- A desk-top assessment of all available biological and biophysical data;
- Augmentation of existing knowledge by means of site specific and detailed field surveys;
- Specialist interpretation of available data, or known sensitivities of certain regional attributes; and
- An objective impact assessment, estimating potential impacts on biological and biophysical attributes.

The Ecosystem Approach, that is employed in this assessment, is advocated by the Convention on Biological Diversity. It recognizes that people and biodiversity are part of the broader ecosystems on which they depend, and that it should thus be assessed in an integrated way. Principles of the Ecosystem Approach include the following:

- The objectives of ecosystem management are a matter of societal choice;
- Ecosystem managers should consider the effects of their activities on adjacent and other systems;
- Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target;
- Ecosystems must be managed within the limits of their functioning;
- The approach must be undertaken at appropriate spatial and temporal scales;
- Objectives for ecosystem management should be set for the long-term;
- Management must recognise that change is inevitable;
- The approach should seek an appropriate balance between, and integration of, conservation and use of biodiversity;
- All forms of relevant information should be considered; and
- All relevant sectors of society and scientific disciplines should be involved.

For the purpose of this particular study, a local scale was selected as suitable in terms of the size of the study area. The approach of Landscape Ecology includes the assessment of biophysical and societal causes, consequences of landscape heterogeneity and factors that causes disturbance to these attributes. Species conservation is therefore largely replaced by the concept of habitat conservation. This investigation therefore aims to:

- Determine the biological sensitivity of the receiving natural environment as it relates to the construction and operation of the plant and associated infrastructure in a natural environment;
- Highlight the known level of biodiversity;
- Highlight flora and fauna species of conservation importance that are likely to occur within the study area;
- Estimate the level of potential impacts of the construction and operation of proposed power lines on the biological resources of the study area;
- Apply the Precautionary Principal throughout the assessment[1].

Available databases of biophysical attributes are implemented to identify regional areas of importance as it relates to biodiversity. Biophysical attributes that are known to be associated with biodiversity aspects of importance, conservation potential or natural status of the environment were implemented to compile the ecological sensitivity analysis of the study area. These attributes include the following:

- Areas of known biological importance (ENPAT);
- Geology and soil types;
- Areas of surface water (ENPAT);
- Degradation classes (ENPAT Land Cover Classes);
- Regional vegetation types (VEGMAP);
- Land cover categories (ENPAT); and
- Regional conservation plans (where available).

5.2 FLORISTIC ASSESSMENT

The floristic assessment was conducted by R. A. J. Robbeson (Pr.Sci.Nat.).

5.2.1 General Floristic Attributes

The botanical assessment is based on a variation of the Braun-Blanquet method whereby vegetation is stratified on aerial images with physiognomic[2] characteristics as a first approximation. These initial stratifications are then surveyed for floristic and environmental diversity during a site investigation and ultimately subjected to a desktop analysis to establish differences/ similarities between observed units. In preparation for the site survey, physiognomic homogenous units are identified and delineated on digital aerial photos, using standard aerial photo techniques (downloaded from www.googleearth.com and georectified on Arcview 3.2). A

[1] (www.pprinciple.net/the_precautionary_principle.html).

[2] Physiognomy refers to the visual appearance of vegetation in terms of different growth classes, biomass, height, etc.

site visit was conducted to examine the general floristic attributes and -diversity of the study area.
A desktop analysis of sample data was conducted to establish differences/ similarities between delineated vegetation units, which were subsequently described in terms of species composition and dominance as well as driving (developmental) environmental parameters. Preliminary results and species lists that are provided should be interpreted with normal liabilities in mind.

It is not the intention to provide exhaustive and comprehensive lists of all species that occur on this site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation worthy species and habitat associated with these species are considered the highest priority, the presence of which is most likely to result in significant negative effects on the ecological environment.

5.2.2 Red Data Flora

The purpose of listing Red Data plant species is firstly to provide information on the potential occurrence of species of special concern in the study area that may be affected by the proposed infrastructure. Secondly, the potential occurrence of these species can then be assessed in terms of their habitat requirements in order to determine whether they have a likelihood of occurring in habitats that may be affected by the proposed infrastructure. Red Listed flora information, as presented by SANBI was used as a point of departure for this assessment. A snapshot investigation of an area, such as this particular investigation, represents a severe limitation in terms of locating and identification potential Red Listed flora species. Particular emphasis was therefore placed on the identification and assessment of habitat deemed suitable for the potential presence of Red Listed.

It should be noted that Red List species are, by nature, usually rare and difficult to locate. Compiling a list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. Notwithstanding the application of the Precautionary Principle, there is always the likelihood that a species that is not included in a list might be unexpectedly present in an area.

5.2.3 Floristic Sensitivity

The aim of this exercise is to determine the inherent sensitivity of vegetation communities or habitat types by means of the comparison of weighted floristic attributes. Results of this exercise are not 'stand-alone' and will eventually be presented in conjunction with results obtained from the faunal investigation.

Each vegetation unit is subjectively rated on a scale of 1 to 10 (**Sensitivity Values**) in terms of the influence that the particular Sensitivity Criterion has on the floristic status of the plant community. Separate Values are multiplied with the specific Criteria Weighting, which emphasises the importance/ triviality that the individual Sensitivity Criteria have on the status of

each community. **Ranked Values** are then added and expressed as a percentage of the maximum possible value (**Floristic Sensitivity Value**) and placed in a particular class, namely:

High	80%	–	100%
Medium – high	60%	–	80%
Medium	40%	–	60%
Medium – low	20%	–	40%
Low	0%	–	20%

This method is considered effective in highlighting sensitive areas, based on recorded floristic attributes rated across the spectrum of communities. Phytosociological attributes (species diversity, presence of exotic species, etc.) and physical characteristics, e.g. human impacts, size, fragmentation are important in assessing the status of the various communities.

High Sensitivity Index Values indicate areas that are considered pristine, unaffected by human influences or generally managed in an ecological effective manner. These areas are comparable to nature reserves and even well managed farm areas. Low Sensitivity Index Values indicate areas of lower ecological status or importance in terms of vegetation attributes, or areas that have been negatively affected by human impacts or poor management. Sensitivity Criteria employed in assessing the floristic sensitivity of separate units may vary between different areas, depending on location, type of habitat, size, etc.

5.3 FAUNAL ASSESSMENT

The faunal assessment was conducted by D. Kamffer (Pr.Sci.Nat.). This faunal assessment is based on holistic ecological principles and included qualitative surveys across the major habitat types observed in the study area. This approach prefers biodiversity conservation to single species conservation; the focus is on sensitive faunal habitats rather than single red data species; these two approaches often coincide, but not always. The study area was therefore not considered in isolation and without linkage to surrounding natural faunal habitats. Within an ecological consideration, there is no difference in importance between species found in a system and the interactions between these species. Therefore, this assessment focused on assessing available faunal habitats; the sensitivities of these habitats are based on the status of each habitat as well as the level of isolation because of habitat transformation and fragmentation.

5.3.1 General Faunal Observations

Animals found within the study area's boundaries were identified using ecological indicators (tracks, dung, diggings, etc.), morphological characteristics (colour, size, shape etc.) and species-specific calls (especially for birds and frogs).

5.3.2 Data analysis

- All GPS acquired data is converted from text to shapefiles to allow GIS analyses.
- Shapefiles of environmental attributes such as geology, soil, hydrology and vegetation are incorporated in the analyses of available faunal habitats.
- Sensitivity maps are compiled, where relevant, subsequent to data analyses.
- Species lists are compiled for relevant taxa using fieldwork data, literature and data supplied by various other institutions and specialists.

5.3.3 *Red Listed fauna Probabilities*

Three parameters are used to assess the Probability of Occurrence for Red Listed species:

- Habitat requirements (HR) - Red Listed animals have specific habitat requirements and the presence of these habitat characteristics in the study area is evaluated.
- Habitat status (HS) - The status or ecological condition of available habitat in the study area is assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Listed species (especially wetland-related habitats where water quality plays a major role); and
- Habitat linkage (HL) - Movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to surrounding habitats and adequacy of these linkages are evaluated for the ecological functioning of Red Listed species within the study area.

The estimated Probability of Occurrence for Red Data fauna species is presented in five categories, namely:

- Very low;
- Low;
- Moderate;
- High; and
- Very high.

5.3.4 *Faunal Habitat Sensitivities*

Faunal habitat sensitivities are subjectively estimated based on the following criteria:

- Habitat status;
- Connectivity;
- Recorded species composition & RD Probabilities; and
- Functionality.

and is place in one of the following classes:

- High;
- Medium-high
- Medium;
- Medium-low; or
- Low.

5.4.1 *Extent of the Impact*

The spatial scale of the impact was assessed according to the following criteria:

(1) None - no impact;
(2) Low - site specific, within the boundaries of the site;
(3) Medium – local, extending beyond the boundaries of the site, (i.e. up to 5km);
(4) High – Regional, extends far beyond the site boundaries (i.e. >5km); or
(5) Very high – National and/ or international.

5.4.2 *Duration of Impacts*

The lifespan of the impact was assessed to be either:

(0) None – no impact
(1) Low – short term, quickly reversible (0 – 5 years);
(2) Medium - medium term, reversible over time (5 – 15 years);
(3) High - long term, approximate life span of project (16 - 30 years); or
(4) Very high – permanent, over 30 years, resulting in permanent and lasting changes.

5.4.3 *Magnitude of Impacts*

The magnitude or severity of the impacts is indicated as either:

(0) None;
(2) Small (where the aspect will have no impact on the environment);
(4) Negligible/ minor – Systems are marginally affected by proposed development;
(6) Average - Medium or short-term impacts on the affected system. Mitigation is easy, cheap, less time consuming or not necessary. For example, a temporary fluctuation in the water table due to water abstraction;
(8) Severe - Medium to long term impacts on the affected system that could be mitigated. For example constructing a narrow road through vegetation with a low conservation value; or
(10) Irreversible - A permanent change to the affected system that cannot be mitigated. For example, the permanent change to topography resulting from a quarry.

5.4.4 *Probability of Impact*

The likelihood of the impact actually occurring was indicated as either:

(1) No impact;
(2) Improbable - possibility of the impact materializing is negligible (<10%);
(3) Probable – possibility that impact will materialise is likely, (10 – 49%);

(4) Highly probable - expected that impact will occur, (50 – 90%); or
(5) Definite - the impact will occur regardless of any prevention measures (>90%).

5.4.5 Significance of the Impact

Based on a synthesis of the information contained in the points above, the significance of a specific impact is expressed as follows:

Significance = (Extent + Duration + Magnitude) x Probability

Based on the above criteria the significance of issues will be determined. This is the importance of the impact in terms of physical extent and time scale, and is rated as:

- **Low (</= 30)**: the impacts are less important, but may require some mitigation action.
- **Medium (</= 60)**: the impacts are important and require attention; mitigation is required to reduce the negative impacts
- **High(>= 60)**: the impacts are of great importance. Mitigation is therefore crucial.

5.4.6 Status of the Impact

The impacts are assessed as either having a:

- Negative effect (i.e. at a cost to the environment);
- Positive effect (i.e. at a benefit to the environment); or
- Neutral effect on the environment.

5.4.7 Confidence

This is the level knowledge/information that the environmental impact practitioner or a specialist has in his/her judgement, and is rated as:

- **Low**: the judgement is based on intuition and not on knowledge or information.
- **Medium**: common sense and general knowledge informs the decision.
- **High**: Scientific and or proven information has been used to give such a judgement.

6 THE BIOPHYSICAL ENVIRONMENT

6.1 LOCATION

The regional setting of the proposed site is illustrated in Figure 1, with a georeferenced Google Earth image presented in Figure 2 (images courtesy of Google Earth website and georeferenced using Arcview 3.2). The study area is situated approximately 300m south of the Hendrina Power Station, near Pullenshope, Mpumalanga Province. It is also situated approximately 33km southeast from Middelburg and 17km northwest from Hendrina Town. The N11 is situated approximately 6.5km to the east.

6.2 SURFACE WATER

A separate, detailed report on the hydrology, wetlands and aquatic ecology of the study area is compiled by Ecotone, general comments on this aspect are however included in this report as it relates to terrestrial biodiversity on a local and regional scale. For a detailed account of this component, the reader is referred to the relevant specialist report.

Areas of surface water contribute significantly towards the local and regional biodiversity of an area due to the atypical habitat that is available within the ecotonal areas. These ecotones (areas or zones of transition between different habitat types) are frequently occupied by species that occur in both of the bordering habitats, and is therefore generally rich in species due to the confluence of habitats. In addition to daily visitors that utilise water sources on a frequent basis, some flora and fauna species are specifically adapted to exploit the temporal or seasonal fluctuation in moisture levels in these areas, exhibiting extremely little tolerance levels towards habitat variation. Ecotonal interface areas form narrow bands around areas of surface water and they constitute extremely small portions when calculated on a purely mathematical basis. However, considering the high species richness, these areas are extremely important on a local and regional scale. Rivers also represent important linear migration routes for a number of fauna species as well as a distribution method for plant seeds.

The study area falls within the upper reaches of the Orange Primary Catchment area. No significant rivers or drainage lines are present within the study area, but endorheic pans and unnatural dams (manmade impoundments) are present in the site as well as in the immediate surrounds. These areas are likely to be affected by the proposed development and significant mitigation measures will be required. The status of these areas do vary significantly, from moderately to severely degraded.

Figure 1: Regional setting of the study area

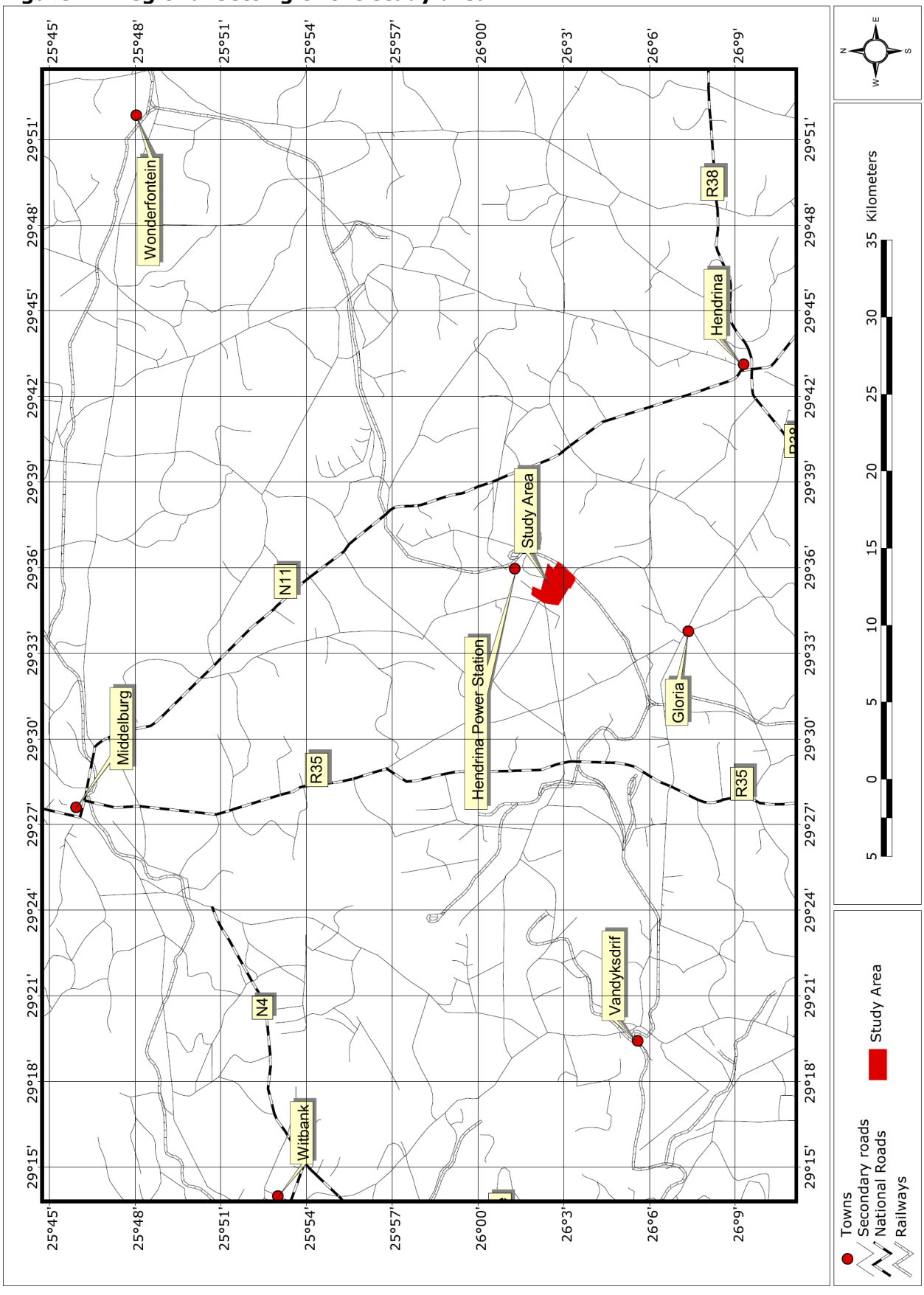
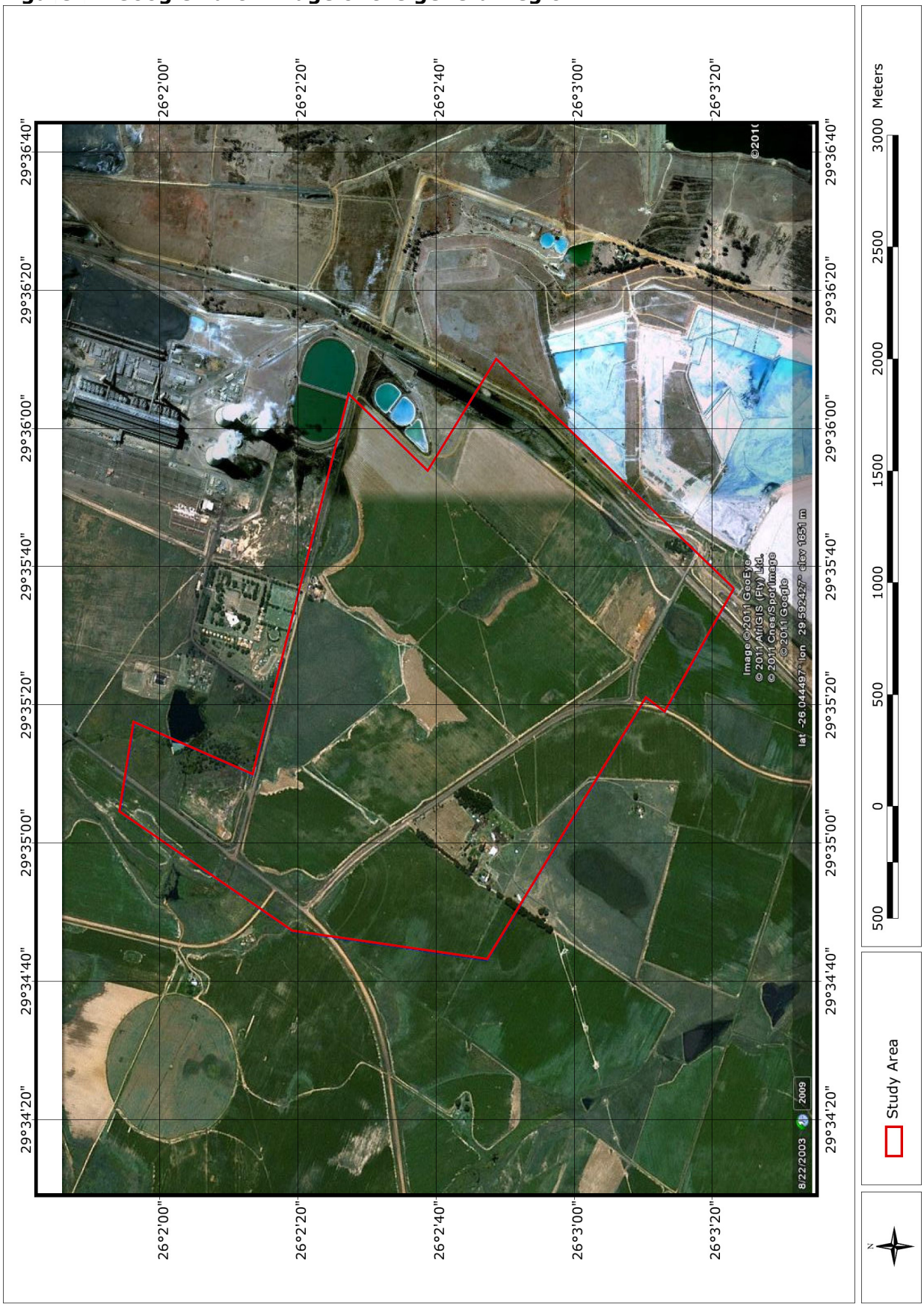


Figure 2: Google Earth image of the general region



6.3 Land Cover & Land Use of the Region

Land use often determines land cover; it is an important factor contributing to the condition of the land. Different uses have varying effects on the integrity of the land.

Land cover categories of the general region are presented in Figure 3. For the purpose of this assessment, land cover are loosely categorised into classes that represent natural habitat and land cover categories that resulted from habitat degradation and transformation on a local or regional scale. Areas that are characterised by high levels of transformation and habitat degradation is generally more suitable for development purposes as it is unlikely that biodiversity attributes of importance will be present or affected by development. Conversely, areas that are characterised by extensive untransformed and pristine habitat are generally not regarded suitable options for development purposes.

The region of the study area comprises extensive transformed habitat with small portions areas of natural grassland habitat. Major developments include agriculture, mining and residential areas. Consequently, local and regional habitat fragmentation and isolation is extremely high.

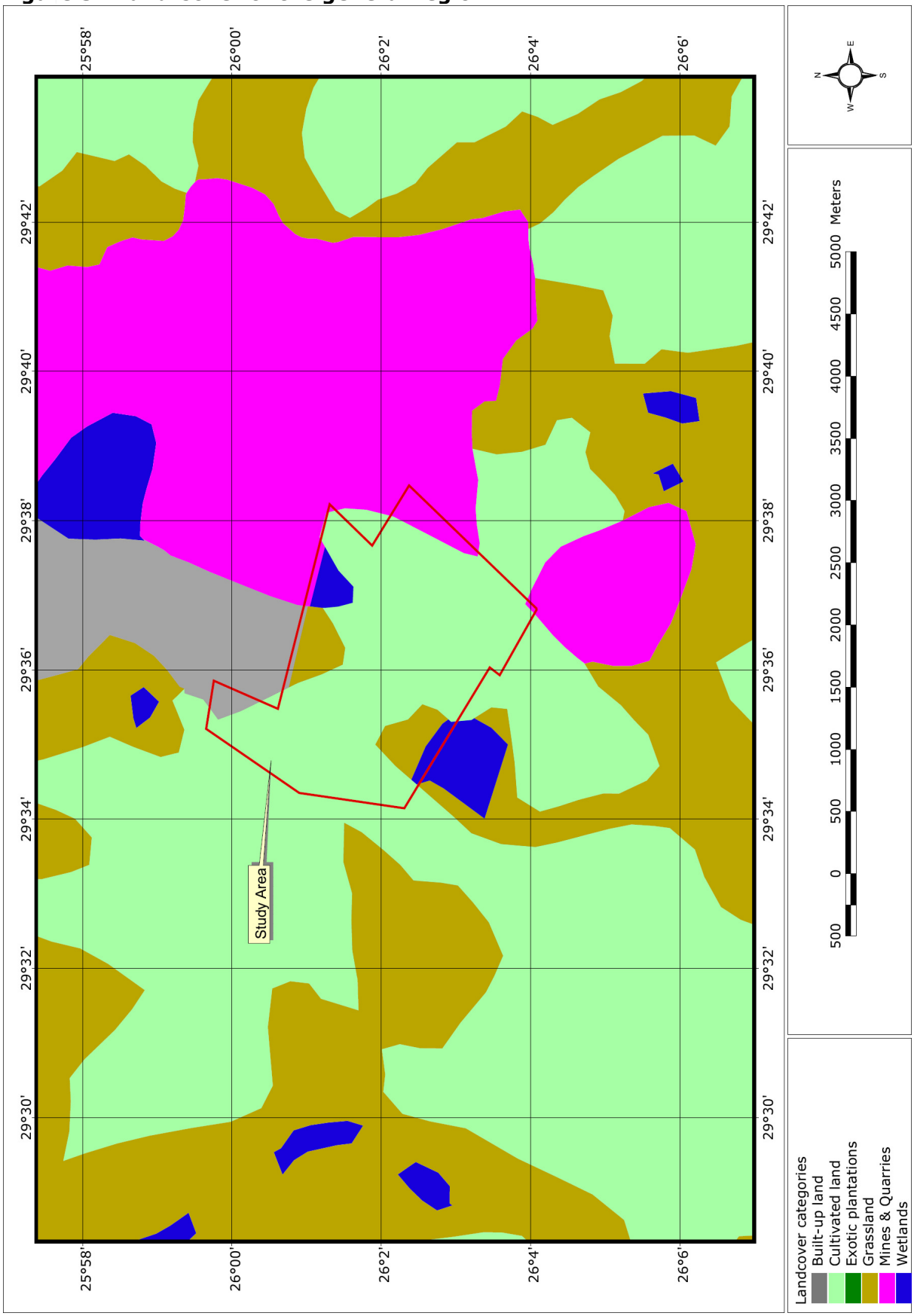
6.4 Topography, Relief and Slopes

The topography of the study area is described as Moderately Undulating Plains and Pans, situated approximately between 1,600m above sea level. No area of obvious physical variability is present within the study area and the immediate surrounds.

6.5 Declared Areas of Conservation

No declared area of conservation is present within the general surrounds of the study area.

Figure 3: Land Cover of the general region



Although it is not in the scope of this report to present a detailed account of the soil types and geology of the area, a basic description will suffice for this assessment as a strong association between habitat types and land types are typically known to exist.

The study area is situated within the Bb4 land type unit. A large part of the South African interior is occupied by a catena which in its perfect form is represented by (in order from highest to lowest in the upland landscape) Hutton, Bainsvlei, Avalon and Longlands forms. The valley bottoms are occupied by one or other gley soil (e.g. Rensburg, Willowbrook, Katspruit, Champagne forms). In addition to these, Glencoe, Wasbank, Westleigh, Kroonstad, Pinedene and Tambankulu (rare) forms, and Klipfontein and (occasional) Hillside soil series are found. Soils with hard plinthite are particularly common over sandstones in the moist climate zones in the eastern parts of the country. Depending on the extent to which tater tables have been operative over a landscape, Longlands and Avalon and related grey and yellow soils may predominate, even to the exclusion of red soils. Where water tables have not extended far beyond the valley bottoms, red soils may predominate with plinthic soils restricted to narrow strips of land around valley bottoms or pans. However, plinthic soils must cover more than 10% of the area for to qualify for inclusion in units Ba to Bd. Upland margalitic soils are absent or occupy less than 10% in units Ba to Bd.

Unit Ba indicates land in which red and/or yellow apedal soils (Hutton, Bainsvlei, Avalon, Glencoe and Pinedene forms) that are dystrophic and/ or mesotrophic predominate over red and/ or yellow apedal soils that are eutrophic, and in which red soils (mainly Hutton and Bainsvlei) occupy more than a third of the area. The same rule, with appropriate adaptations, applies to units Bb (dystrophic and/ or mesotrophic, red soils not widespread.

The geology of the study area conforms to the Vryheid Arenite Formation. Arenite is a sedimentary rock composed of sand-sized fragments irrespective of composition. The Vryheid Formation follows conformably, and in most localities by way of a transition, on the Pietermaritzburg Shale Formation, from the southern part of Natal northwards. The formation is characterized by thick beds of yellowish to white cross-bedded sandstone and grit, which alternate with beds of soft, dark-grey, sandy shale and a few seams of coal.

7 MPUMALANGA BIODIVERSITY CONSERVATION PLAN

7.1 TERRESTRIAL BIODIVERSITY SENSITIVITIES ON A LOCAL SCALE

The local and regional designation of Mpumalanga Terrestrial Biodiversity Conservation Categories (MBCP) is illustrated in Figure 4.

The mandate for conserving biodiversity lies with state agencies at national, provincial and local levels of government, forming part of a wider responsibility for the environment and the sustainable use of natural resources. Constitutional and national laws require these environmental issues to be dealt with in cooperative, participatory, transparent and integrated ways. The MBCP is the first spatial biodiversity plan for Mpumalanga that is based on scientifically determined and quantified biodiversity objectives. The purpose of the MBCP is to contribute to sustainable development in Mpumalanga.

The MBCP maps the distribution of Mpumalanga Province's known biodiversity into six categories. These are ranked according to ecological and biodiversity importance and their contribution to meeting the quantitative targets set for each biodiversity feature. The categories are:

1 Protected areas - already protected and managed for conservation;
2 Irreplaceable areas - no other options available to meet targets––protection crucial;
3 Highly Significant areas - protection needed, very limited choice for meeting targets;
4 Important and Necessary areas - protection needed, greater choice in meeting targets;
5 Ecological Corridors – mixed natural and transformed areas, identified for long term connectivity and biological movement;
6 Areas of Least Concern – natural areas with most choices, including for development;
7 Areas with No Natural Habitat Remaining – transformed areas that do not contribute to meeting targets.

The study area comprises two of these categories, namely:

- No Natural Habitat Remaining; and
- Least Concern.

Areas of '**No Natural Habitat Remaining**' comprise approximately 35.8% of the Province. This category has already lost most of its biodiversity and ecological functioning. In the remnants of natural habitat that occur between cultivated lands and along river lines and ridges, residual biodiversity features and ecological processes do survive, but these disconnected remnants are biologically impoverished, highly vulnerable to damage and have limited likelihood of being able to persist. The more transformed a landscape becomes; the more value is placed on these remnants of natural habitat. Areas with no natural habitat remaining are preferred sites for developments, taking the potential presence of lands with high agricultural potential into consideration.

Biodiversity assets in landscapes categorized as '**Least Concern**' contributes to natural ecosystem functioning, ensuring the maintenance of viable species populations and providing essential ecological and environmental goods and services across the landscape. This category comprises approximately 25.5% of the Mpumalanga Province and although these areas contribute the least to the achievement of biodiversity targets they have significant environmental, aesthetic and social values and should not be viewed as wastelands or carte-blanche development zones. Development options are widest in these areas. At the broad scale, these areas and those where natural habitat has been lost serve as preferred sites for all forms of development. It is still required to consider other environmental factors such as socioeconomic efficiency, aesthetics and the sense-of-place in making decisions about development. Prime agricultural land should also be avoided for all non-agricultural land uses.

Land-use and administrative options for positive biodiversity outcomes include:

- Where this category of land occurs close to areas of high biodiversity value, it may provide useful ecological connectivity or ecosystem services functions, e.g. ecological buffer zones and corridors or water production. Encouragement needs to be given to biodiversity-friendly forms of management and even restoration options where appropriate;
- Develop incentives to reverse lost biodiversity for selected parcels of land where buffer zones and connectivity are potentially important;
- Standard application of EIA and other planning procedures are required; and
- These areas might serve as preferred sites for all forms of urban and industrial development (Land-Use Types 10 – 15).

7.2 DEVELOPMENT RESTRICTIONS IN TERMS OF THE MBCP

The MBCP suggests that the categories of 'Irreplaceable' and 'Highly Significant' should remain unaltered and rather be managed for biodiversity conservation purposes. Other categories incorporate increasing options for different types of land use that should be decided by the application of EIA procedures and negotiation between stakeholders. The MBCP also recognised that 35.8% of the Province is included in the category of 'No natural habitat remaining', which has very little biodiversity value.

The proposed development relates to 'Mining Activities' (Land Use 15 - Surface mining, dumping, dredging) and is included in the category 'Urban Industrial Land Uses' with the other development types such as Urban & Business Development, Major Development Projects, Linear Engineering Structures and Water Projects & Transfers. These six land uses cause the greatest environmental impact and are almost completely destructive of natural vegetation and natural biodiversity. Where biodiversity persists, it is artificially maintained, generally supporting only opportunistic assemblages of plants and animals. Ecosystem processes are completely disrupted, heavily impacted or artificially maintained at high cost. These land uses not only produce the highest local impacts but also dominate the dispersed and cumulative impacts. They are the most destructive and wide-ranging, often spreading hundreds of kilometres from their source,

especially along river systems. These land-use types also require special provision in land-use planning, impact assessment and mitigation.

Restrictions in terms of major developments according to the Mpumalanga Biodiversity Conservation Plan (MBCP) are illustrated in Figure 5. The proposed activity is regarded a 'Restricted' activity, but it is evident that the database does not consider smaller, localised biodiversity variations. These aspects will be addressed in the subsequent chapters.

Figure 4: MBCP Conservation categories of the study area

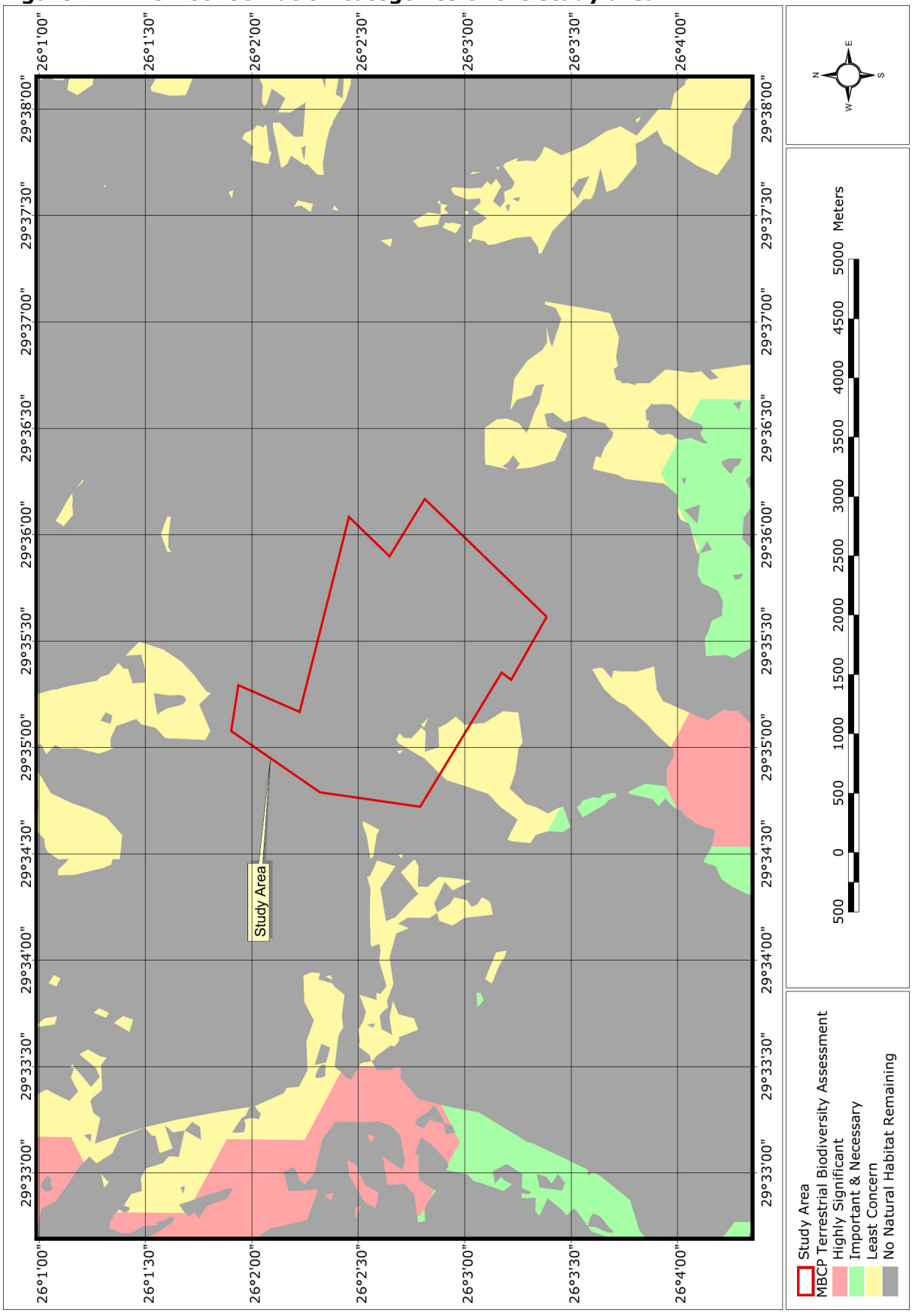
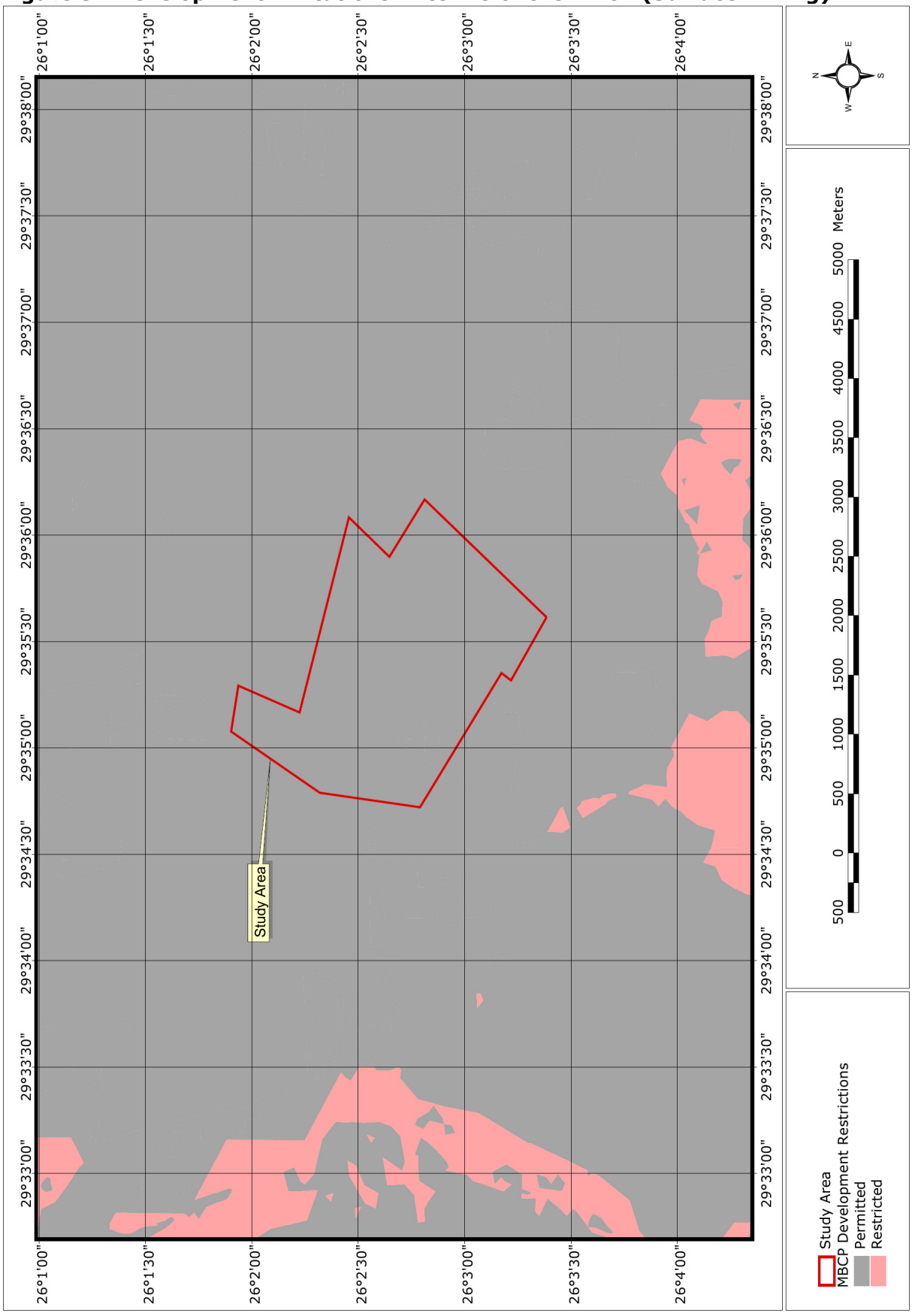


Figure 5: Development limitations in terms of the MBCP (Surface Mining)



8 FLORISTIC ASSESSMENT

8.1 REGIONAL FLORISTIC TRAITS

The study area is located in the Mesic Highveld Grassland Bioregion (Mucina & Rutherford, 2006), more specifically the Eastern Highveld Grassland vegetation type. This vegetation type is regarded Endangered and only very small fractions are conserved in statutory reserves. Some 44% is transformed by cultivation, plantations, mines, urbanisation and by building of dams. Cultivation may have had a more extensive impact, indicated by land cover data. The Endangered status of this vegetation type warrants a medium-high environmental sensitivity.

The vegetation is short, dense grassland dominated by the usual highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya*, etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (Acac*ia caffra, Celtis africana, Diospyros lycioides, Parinari capensis, Protea caffra, P. welwitchii* and *Searsia magalismontana*). The following species are regarded representative of the Eastern Highveld Grassland vegetation type:

- **Graminoids**

Aristida aequiglumis, A. congesta, A. junciformis subsp*. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. curvula, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata* subsp*. eckloniana, Andropogon appendiculatus, A. schirensis, Bewsia biflora, Ctenium concinnum, Diheteropogon amplectens, Eragrostis capensis, E. gummiflua, E. patentissima, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyrium sanguineum, Setaria nigrirostris* and *Urelytrum agropyroides.*

- **Herbs**

Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp*. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides* subsp*. latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala Wahlenbergia undulata, Gladiolus crassifolius, Haemanthus humilis* subsp*. hirsutus, Hypoxis rigidula* var*. pilosissima, Ledebouria ovatifolia* and *Aloe ecklonis*

- **Low Shrubs**

Anthospermum rigidum subsp*. pumilum* and *Stoebe plumosa.*

The SANBI database indicates the known presence of only 38 plant species within this particular ¼-degree grid (2629BA). This low diversity is the result of the poor floristic knowledge of the area and is not a reflection of a poor habitat and floristic diversity (refer Table 3).

The following plant species are known to occur in the region of the study area (POSA, 2010):

Table 3: PRECIS data for 2629BA (POSA, 2010)

Species	***Family***	***Threat status***	***Growth form***
Ceratiosicyos laevis	Achariaceae	LC	Climber
Alepidea peduncularis	Apiaceae	DDT	Herb
Asclepias gibba	Apocynaceae	LC	Herb
Aponogeton junceus	Aponogetonaceae	LC	Geophyte
Schkuhria pinnata	Asteraceae		Herb
Bryum dichotomum	Bryaceae		Bryophyte
Cyperus difformis	Cyperaceae	LC	Cyperoid
Cyperus laevigatus	Cyperaceae	LC	Cyperoid
Cyperus marginatus	Cyperaceae	LC	Cyperoid
Fimbristylis complanata	Cyperaceae	LC	Cyperoid
Isolepis costata	Cyperaceae	LC	Cyperoid
Isolepis setacea	Cyperaceae	LC	Cyperoid
Kyllinga pulchella	Cyperaceae	LC	Cyperoid
Pycreus macranthus	Cyperaceae	LC	Cyperoid
Pycreus nitidus	Cyperaceae	LC	Cyperoid
Pycreus rehmannianus	Cyperaceae	LC	Cyperoid
Eriocaulon abyssinicum	Eriocaulaceae	LC	Herb
Acalypha angustata	Euphorbiaceae	LC	Dwarf shrub
Lespedeza cuneata	Fabaceae		Dwarf shrub
Trifolium africanum var. *africanum*	Fabaceae	LC	Herb
Pelargonium pseudofumarioides	Geraniaceae	LC	Herb
Eucomis autumnalis subsp. *clavata*	Hyacinthaceae		Geophyte
Juncus dregeanus subsp. *dregeanus*	Juncaceae	LC	Helophyte
Linum thunbergii	Linaceae	LC	Herb
Mossia intervallaris	Mesembryanthemaceae	LC	Succulent
Alloteropsis semialata subsp. *eckloniana*	Poaceae	LC	Graminoid
Andropogon eucomus	Poaceae	LC	Graminoid
Digitaria ternata	Poaceae	LC	Graminoid
Eragrostis curvula	Poaceae	LC	Graminoid
Eragrostis mexicana subsp. *virescens*	Poaceae		Graminoid
Eragrostis patentissima	Poaceae	LC	Graminoid
Hyparrhenia hirta	Poaceae	LC	Graminoid
Panicum schinzii	Poaceae	LC	Graminoid
Sporobolus albicans	Poaceae	LC	Graminoid
Riccia cavernosa	Ricciaceae		Bryophyte
Riccia natalensis	Ricciaceae		Bryophyte
Riccia rosea	Ricciaceae		Bryophyte
Riccia stricta	Ricciaceae		Bryophyte

8.3 PLANT SPECIES OF CONSERVATION IMPORTANCE

No floristic species of conservation importance is indicated to occur in this region, according to the POSA database. Areas of natural grassland habitat and wetland habitat exhibit moderate levels of suitability for the potential presence of flora species of conservation importance, considering the current status.

8.4 RECORDED PHYTODIVERSITY OF THE SITE

The site investigation revealed the presence of approximately 71 plant species in the study area (Appendix 1). The diversity of this portion of land, in spite of the degraded status of most of the site, is regarded relative diverse, reflecting not only on the species richness of the regional vegetation types, but also the effect of transformation and the influx of plant species not normally associated with the region, such as weeds and alien invasive species.

The grassland physiognomy of the region is indicated by the absence of woody species in areas of natural vegetation. Grasses and forbs constitute the majority of the composition (refer Table 4). Grasses (12 species, 17.1%) and forbs (40 species, 57.1%) dominate the species diversity (refer Table 4).

Table 4: Growth forms of the study area

Growth Form	*Number*	*Percentage*
Climbers	1	1.43%
Forbs	40	57.14%
Geophytes	4	5.71%
Grasses	12	17.14%
Hydrophilics	4	5.71%
Sedges	4	5.71%
Shrubs	3	4.29%
Trees	2	2.86%
Total	**70**	

A total of 24 plant families are represented by the floristic diversity of the site, dominated by Asteraceae (24 species, 34.3%) and Poaceae (13 species, 18.6%) (refer Table 5).

Table 5: Plant families of the study area

Family	*Number*	*Percentage*
Amaranthaceae	1	1.43%
Anacardiaceae	1	1.43%
Apiaceae	1	1.43%
Asclepiadaceae	2	1.43%
Asteraceae	24	1.43%
Caesalpiniaceae	1	1.43%
Cyperaceae	4	1.43%
Dipsacaceae	1	1.43%
Fabaceae	4	1.43%

Table 5: Plant families of the study area		
Family	***Number***	***Percentage***
Hypoxidaceae	2	1.43%
Iridaceae	1	1.43%
Lobeliaceae	1	1.43%
Myrsinaceae	1	1.43%
Orchideaceae	1	1.43%
Oxalidaceae	1	2.86%
Plantaginaceae	2	2.86%
Poaceae	13	2.86%
Polygonaceae	1	2.86%
Rubiaceae	2	4.29%
Scrophulariaceae	1	5.71%
Solanaceae	1	5.71%
Thymelaeaceae	1	18.57%
Typhaceae	1	34.29%
Verbenaceae	3	1.43%

8.5 FLORA SPECIES OF CONSERVATION IMPORTANCE

8.5.1 Red List Species

South Africa's Red List system is based on the IUCN Red List Categories and Criteria Version 3.1 (finalized in 2001), amended to include additional categories to indicate species that are of local conservation concern. The IUCN Red List system is designed to detect risk of extinction. Species that are at risk of extinction, also known as threatened or endangered species are those that are classified in the categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

The South African Red List contains three additional categories (Critically Rare, Rare and Declining) to highlight plant species that are not in danger of extinction, but are of local conservation concern because they are rare, or there are threatening processes affecting their populations. These categories have been developed to highlight those taxa classified as Least Concern according to the IUCN system, should be considered in conservation prioritization processes. It is important to emphasize that the South African categories Critically Rare, Rare and Declining are intended for use in local conservation prioritization processes only. In submission to the IUCN Red List of Threatened Species, these taxa have to be categorized according to the IUCN system and therefore their global status will be Least Concern.

No Threatened plant species were recorded during the site investigation. Taking the habitat variability and status into consideration, it is regarded unlikely that species of conservation importance will occur within these parts. However, parts of the study area, endorheic pans in particular are regarded moderately suitable for the presence of *Crinum bulbispermum* (Declining), *Nerine gracilis* (Near Threatened) and *Kniphofia typhoides* (Near Threatened).

According the Act (National Forests Act (Act no 84 of 1998)), the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions that 'no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

No tree species that are currently included in the National Forests Act is present within the study area.

8.6 Alien & Invasive Plant Species

The following invasive and weed species were noted on the study site (refer Table 6). Some of these species occur at densities that approximate a dominant status. The generally degraded nature of most of the site is indicated by the presence of these species, dominant species in particular.

Table 6: Invasive and weed plant species recorded in the study area

Species Name	***Growth Form***	***Family***	***Status/ Uses***
Amaranthus hybridus	Forb	Amaranthaceae	Edible parts
Bidens formosa	Forb	Asteraceae	Weed, exotic (S. America), aesthetic uses
Cirsium vulgare	Forb	Asteraceae	Declared Invader - Category 1, weed
Conyza bonariensis	Forb	Asteraceae	Weed, indicator of disturbed areas
Crepis hypochoeridea	Forb	Asteraceae	Weed, indicator of disturbed areas
Cynodon dactylon	Grass	Poaceae	Indicator of disturbed areas, grazing potential
Datura stramonium	Forb	Solanaceae	Declared Invader - Category 1, weed
Eucalyptus species	Tree	Myrsinaceae	Declared Invader - Category 2, essential oils
Galinsoga parviflora	Forb	Asteraceae	Weed
Gomphocarpus fruticosus	Shrub	Asclepiadaceae	Medicinal uses
Hypochaeris radicata	Forb	Asteraceae	Weed
Lactuca capensis	Forb	Asteraceae	Weed
Pennisetum clandestinum	Grass	Poaceae	Invader (E. Africa), palatable grazing
Pentarrhinum insipidum	Climber	Asclepiadaceae	Edible parts
Pseudognaphalium luteo-	Forb	Asteraceae	Weed (Europe)
Richardia brasiliensis	Forb	Rubiaceae	Weed
Schkuhria pinnata	Forb	Asteraceae	Medicinal uses, weed (S. America)
Sonchus oleraceus	Forb	Asteraceae	Edible parts
Sonchus wilmsii	Forb	Asteraceae	Weed
Stoebe vulgaris	Shrub	Asteraceae	Invasive properties
Tagetes minuta	Forb	Asteraceae	Essential oils, colours & dyes
Verbena bonariensis	Forb	Verbenaceae	Weed (S. America)
Verbena brasiliensis	Forb	Verbenaceae	Weed (S. America)
Xanthium strumarium	Shrub	Asteraceae	Category 1, weed (S. America)

Due to the relative high levels of transformation as well as low utilisation levels and the effect of frequent burning noted across most of the site, vegetation within the study area was found to be relatively degraded. Because of intensive human activities, remaining natural vegetation within the study area is not regarded representative of the regional vegetation type, i.e. pristine. Results of the photo analysis and site investigations revealed the presence of the following habitat types (refer Figure 6):

- Agricultural Fields (171.6ha, 49.7%);
- Excavations (11.9ha, 3.4%);
- Exotic Trees (5.4ha, 1.6%);
- Grassland (33.6ha, 9.7%);
- Moist Grassland (13.0ha, 3.8%);
- Rehabilitated Land (31.1ha, 9.0%);
- Roads & Railways (36.1ha, 10.5%);
- Transformed Habitat (11.8ha, 3.4%);
- Unrehabilitated Land (4.9ha, 1.4%) and;
- Wetland Habitat (26.1ha, 7.6%).

8.7.1 Agricultural Fields

Cultivation represents the major land transformation activity in the region, resulting in a mosaical pattern of agricultural fields within a natural grassland environment. These areas comprise lands that are either currently actively cultivated for crops, or fallow fields where agricultural activities has ceased some time ago, but the vegetation still reflects the impact of transformation. Fallow fields are characterised by a composition of weeds and pioneer species, representing early successional stages of vegetation. These species will continuously be replaced by species that are better adapted to changing environmental conditions. Ultimately, a new climax status will be achieved, but the species composition and physiognomy will not be similar to the original status.

Species that indicate the poor habitat status of this habitat type include *Bidens formosa, Chloris virgata, Cirsium vulgare, Crepis hypochoeridea, Cynodon dactylon, Galinsoga parviflora, Pennisetum clandestinum, Plantago longissima* and *Tagetes minuta.* The absence of species that are normally associated with pristine regional grasslands is absent, or occurs at extremely low cover abundance levels. The original grassland vegetation in these parts is entirely compromised and is unlikely to recover to a status that approximates the original status. A low floristic status is consequently ascribed to these areas. No Red Data plant species were recorded within these areas. The likelihood of encountering Red Data plant species within these areas are regarded low because of habitat transformation.

8.7.2 Excavations

Excavations represent areas where significant surface disturbances resulted from the removal of all vegetation and part of the topsoil in the area. Since these areas are mostly devoid of any vegetation, a low floristic sensitivity was ascribed to all representative areas.

8.7.3 Exotic Trees

Small stands of exotic trees occur in the study area, the most significant being associated with the homestead that is situated in close vicinity to one of the proposed power line alignments. This habitat type comprises all areas where natural vegetation has been replaced by stands of exotic trees, mostly *Eucalyptus* species. A low floristic status is ascribed to these areas and it is regarded highly unlikely that these areas will be inhabited by any Red Data flora species.

8.7.4 Grassland

The natural grassland of the study areas are characterised by a short, low cover of herbaceous species, physiognomically dominated by grasses. The floristic status of these areas is largely determined by the intensity of grazing by cattle and sheep and by the intensity and frequency of burning. In areas where high grazing pressure predominate the vegetation is dominated by the grasses *Eragrostis plana, E. chloromelas, Cynodon dactylon* and the forbs *Cirsium vulgare* and *Crepis hypochoeridea.* The species diversity in these parts is frequently low. No area of particularly pristine status was observed within the study area. Other species that co-dominate the vegetation of this habitat type include *Chamaecrista comosa, Digitaria eriantha, Eragrostis, chloromelas, E. plana, Gazania krebsiana, Helichrysum rugulosum, Hyparrhenia hirta, Richardia brasiliensis, Scabiosa columbaria, Senecio erubescens, S. inaequidens* and *Verbena bonariensis.*

A medium floristic status is attributed to this variation, mainly because of the poor floristic status of remaining areas of natural grassland. It should be noted that the Endangered status of the regional vegetation type was also taken into consideration in this estimation. No Red Data plant species were recorded within these areas. The likelihood of encountering Red Data plant species within these areas are regarded low because of poor habitat status.

8.7.5 Moist Grassland

Small parts of the study area comprises grassland that occur in-between terrestrial and aquatic systems, usually situated on terrain type 4 (footslopes) in close vicinity to valley bottoms (drainage lines, streams, rivers, pans). This vegetation type is generally termed 'Hydromorphic Grasslands'. Soil conditions indicate temporary inundation during times of high rain, but are generally dry for the longest part of the year. Since this community occur in close vicinity to wetland habitat systems, they are generally regarded as sensitive, but a poor floristic status that is observed generally resulted in a medium-low sensitivity ascribed to these parts. Only in one

case was a relative pristine status noted and a medium high status and sensitivity was ascribed. Soils are frequently high in clay content and the vegetation is therefore highly palatable; a high grazing factor subsequently contributes to the moderately degraded status or some parts.

A relative low floristic diversity is noted in these parts. The physiognomy is grassland with a well-developed and dense herbaceous layer. Moist conditions are indicated by the presence of flora species that are well adapted to moist conditions, including *Cyperus* species, *Denekia capensis, Eragrostis gummiflua, Homeria pallida, Imperata cylindrica, Lobelia* species, *Scirpus burkei, Senecio erubescens* and *Verbena brasiliensis.*

The poor floristic status of portions of this unit is indicated by the (extensive) presence of the following weeds, *Amaranthus hybridus, Bidens formosa, Crepis hypochoeridea, Hyparrhenia tamba, Paspalum dilatatum* and in particular the grass *Pennisetum clandestinum.* [3]Depending on the level of degradation that is noted within portions of this habitat, the floristic sensitivity varies between medium-high and medium-low.

8.7.6 Rehabilitated Land

A portion of the property constitutes an area where previous surface disturbances were rehabilitated (presumed) and some flora species were sown in. The surface soil conditions indicate the presence of stone granules that are more commonly associated with lower soil horizons. In addition, some parts are present where surface restructuring is incomplete and remaining topsoil is present. In spite of the rehabilitated status, the vegetation was found to be relatively diverse, albeit not representative of the regional vegetation. It would appear as if these areas are not grazed and the vegetation is afforded chance to develop constantly. Further evidence of the rehabilitated status of the vegetation is the relative low basal cover of these parts.

Species that abound in this area include *Chamaecrista comosa, Bidens formosa, Cirsium vulgare, Conyza bonariensis, Crepis hypochoeridea, Cynodon dactylon, Digitaria eriantha, Eragrostis chloromelas, E. curvula, E. plana, Gazania krebsiana, Gnidia microcephala, Gomphocarpus fruticosus, Helichrysum argyrosphaerum, H. caespititium, H. rugulosum, Hyparrhenia hirta, H. tamba, Indigofera* species, *Nemesia fruticans, Oldenlandia herbacea, Richardia brasiliensis, Schkuhria pinnata, Tagetes minuta, Tephrosia species* and *Zornia linearis.*

A medium-low floristic status is ascribed to this habitat type because of previous degradation. It is unlikely that this habitat is suitable for any flora species of conservation importance.

8.7.7 Roads & Railways

[3] Due to the variance in status of this habitat type, the sensitivity analysis will reflect 2 separate calculations for the Moist Grassland habitat type (MG Units 1 & 2)

No natural vegetation is associated with these features and a low floristic status is ascribed to these parts of the study area.

8.7.8 Transformed Habitat

This habitat type represents areas where historical or recent human activities led to transformation of the natural vegetation. No natural vegetation remains in these areas and the floristic status of these areas is therefore regarded low because of the secondary vegetation that characterises this community. The likelihood of encountering Red Data species within these areas are regarded low.

8.7.9 Unrehabilitated Land

This portion of land is situated within close proximity to the Rehabilitated portion of land. Evidence of surface disturbances is still evident and the bare nature to the soil indicates that no revegetation activities have been undertaken. No natural vegetation remains in this area and the floristic status is regarded low because of the secondary vegetation that characterises this community. The likelihood of encountering Red Data species within these areas are therefore regarded low.

8.7.10 Wetland Habitat

This habitat type correspond to the endorheic pans that are present within the study area where soils are inundated or standing water are present for extensive parts of the year. In spite of rain that occurred prior to the site investigation, no water was present within these parts at the time, but soils were moist. Vegetation of these parts has not had chance to develop and the poor floristic diversity that was noted during the survey is likely an indication of the seasonality and not a true reflection of the status of these areas.

The floristic status of these areas is generally regarded medium-high and few impacts other than grazing and trampling, which are significant impacts on their own, were noted. Impacts on this habitat type include trampling of the topsoil by cattle, peripheral infestation by terrestrial species that abound in agricultural fields, cultivation and roads and other linear developments.

In a pristine status, these areas would be dominated by a dense grass layer and diverse herbaceous composition. The vegetation composition is likely to be dominated by hydrophilic species or grass and forb species that are adapted to permanent or temporary inundation with water. Soils in these areas are frequently high in clay content and a significant humic layer is present. The vegetation that characterise these parts are therefore highly palatable and normally targeted by cattle, resulting in frequent degradation.

In a pristine condition, the grass *Leersia hexandra* is likely to dominate, with *Helictotrichon turgidulum, Paspalum* species*, Juncus oxycarpus* and *Kyllinga pulchella*. Forbs, herbs and bulbs

are normally not abundant, but those that frequently do occur in this type of habitat include *Persicaria attenuata, Verbena bonariensis, Cycnium tubulosum, Lobelia erinus, Helichrysum rugulosum* and *H. coriaceum.* Species that were recorded during this assessment include *Berula erecta, Cyperus* species, *Denekia capensis, Homeria pallida, Imperata cylindrica, Leersia hexandra, Lobelia* species, *Oxalis* species, *Paspalum dilatatum, Rumex* species, *Senecio achilleifolius, S. erubescens, Typha capensis, Phragmites australis* and *Persicaria* species.

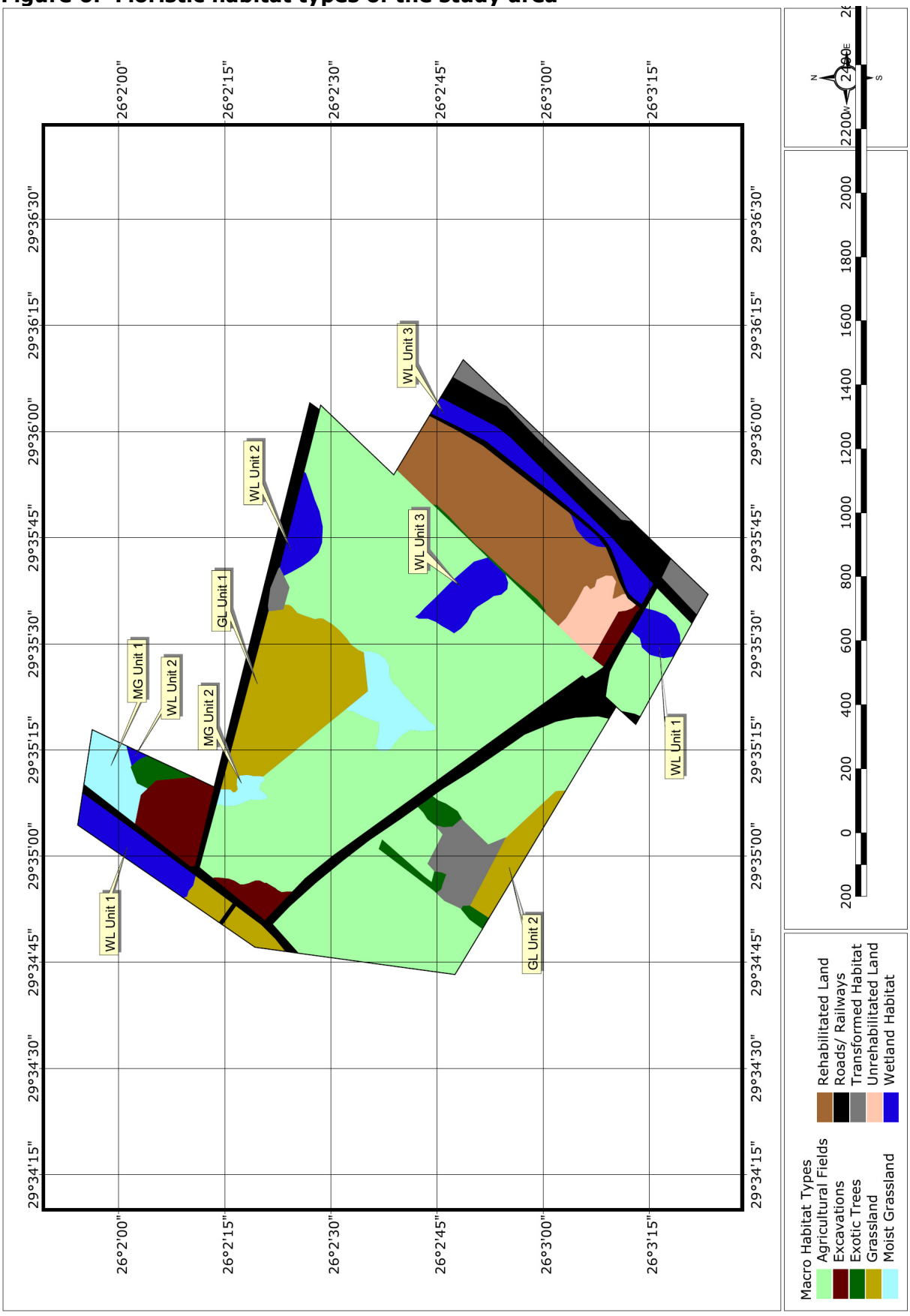
Many of the pans in the region are in relatively good condition, despite existing impacts of agriculture. This habitat type is therefore ascribed a medium-high floristic status and, because several flora species of conservation importance are likely to occur within these areas, a high floristic sensitivity resulted for the following reasons:

- they perform an important ecological function, e.g. maintaining water purity and supply and reducing soil erosion;
- they provide habitats for various wild animal and bird populations and contain many plant species that are restricted to this habitat;
- they have been transformed or are under threat by various factors in many parts of the country; and
- Red or Orange List plant species that could potentially occur within this vegetation unit include *Crinum bulbispermum* (Declining), *Nerine gracilis* (Near Threatened) and *Kniphofia typhoides* (Near Threatened).

[4]Parts of the study area also comprises wetland habitat that developed from the accumulation of runoff water from infrastructure, impounded alongside the road in the southern part of the study area. The vegetation of this part comprises mostly flora species that indicate poor habitat conditions. A medium-low status is ascribed to these parts and it is regarded unlikely that flora species of conservation importance will occur within these areas.

[4] Due to the variance in status of this habitat type, the sensitivity analysis will reflect separate calculations for the Wetland habitat type (WL Units 1 – 3)

Figure 6: Floristic habitat types of the study area



Floristic sensitivity calculations are presented in Table 7 and illustrated in Figure 7.

Table 7: Floristic sensitivity estimations for the respective habitat types

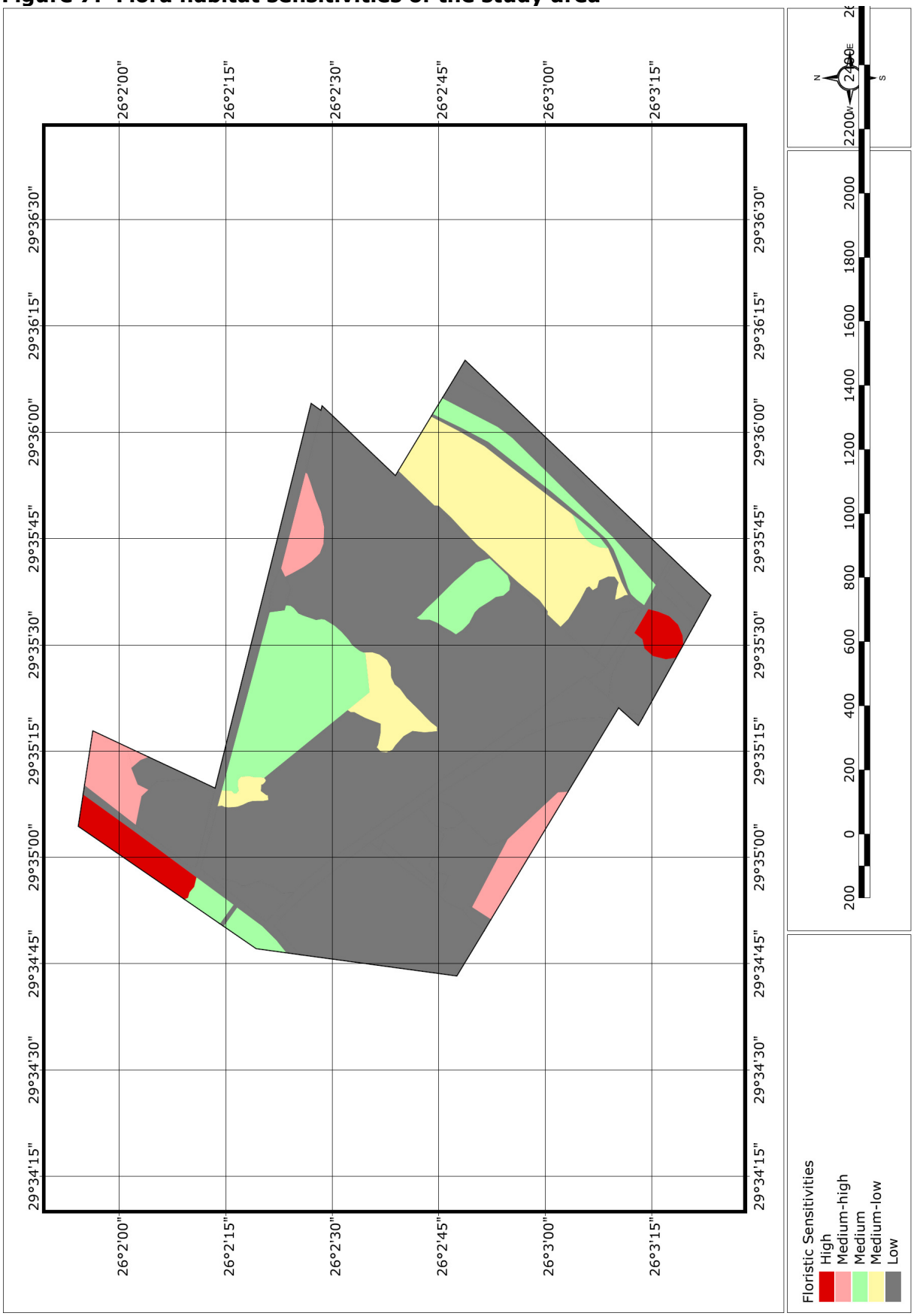
Criteria	*RD species*	*Landscape sensitivity*	*Status*	*Species diversity*	*Functionality/ fragmentation*	*TOTAL*	*SENSITIVITY INDEX*	*SENSITIVITY CLASS*
Community	**Criteria Ranking**							
Agricultural Fields	1	0	1	2	2	32	10%	low
Excavations	0	0	0	0	0	0	0%	low
Exotic Trees	1	1	1	1	2	35	11%	low
Grassland – Unit 1	4	8	6	7	8	199	62%	medium-high
Grassland – Unit 2	3	6	2	6	7	141	44%	medium
Moist Grassland - Unit 1	6	7	5	6	6	194	61%	medium-high
Moist Grassland - Unit 2	1	6	1	2	2	80	25%	medium-low
Rehabilitated Land	1	2	2	3	4	65	20%	medium-low
Roads/ Railways	0	0	0	0	0	0	0%	low
Transformed Habitat	0	0	0	0	0	0	0%	low
Unrehabilitated Land	1	1	1	1	2	35	11%	low
Wetland Habitat - Unit 1	6	10	8	8	9	255	80%	high
Wetland Habitat - Unit 2	6	10	6	6	6	224	70%	medium-high
Wetland Habitat - Unit 3	3	5	4	4	6	132	41%	medium

The extent of habitat sensitivities within the respective alternatives is presented in Table 8.

Table 8: Extent of floristic habitat sensitivities within the study area

Habitat Sensitivity	*Extent*	*Percentage*
High	8.9ha	2.6%
Medium-high	14.8ha	4.3%
Medium	41.4ha	12.0%
Medium-low	38.7ha	11.2%
Low	241.7ha	70.0%

Figure 7: Flora habitat sensitivities of the study area



The vegetation of the study area exhibits the expected signs of continued and long-term impacts resulting from agriculture, severe grazing pressure in the remaining parts of natural grassland and effects of indirect and direct mining and agricultural impacts on the wetland habitat. On a regional scale, these impacts are the main causes resulting in the Endangered status that is ascribed to the Eastern Highveld Grassland, of which only 55% remains of the original 1.27 million hectares. On a local scale, the level of impacts on the natural vegetation is regarded severe and irreversible and therefore any remaining parts of natural/ pristine vegetation should be regarded as highly sensitive and conserved at all costs.

Extremely little untransformed grassland remains in the study area, these portions are furthermore degraded due to severe and prolonged grazing pressure; to the extent that much of the flora species generally associated with this vegetation type, no longer occur, particularly forb and herb species. Wetland habitat types are similarly severely impacted due to, in particular, trampling and severe grazing pressure from cattle, but also from species changes that result from infestation from nearby agricultural fields, seeds that are imported by cattle droppings as well as poor quality water entering from nearby agricultural fields and mining areas.

The result of these long-term direct and indirect impacts is that only selected portions of the study area exhibit floristic characteristics of medium-high and high sensitivity. The location of areas of higher sensitivity categories are such that generic mitigation measures (exclusion) will likely result in preservation of these areas, although significant mitigation measures should be implemented in order to conserve/ improve the current status of these areas. For this purpose, the reader should refer to the wetland report. In the case of unavoidable impacts, it is recommended that a biodiversity offset programme be initiated that will target a nearby wetland/ endorheic pan. The details of such an offset programme (offset ratios, area identification and management options) should be addressed by the wetland ecologist.

Remaining portions of the study area are mostly low in floristic sensitivity and the loss of these areas is not expected to result in significant impacts on a local or regional scale. No species of conservation importance are likely to occur within these areas and no relocation is recommended for any plant species that might occur in the site.

9 FAUNA OF THE STUDY AREA

Please note that although the avifaunal component is addressed in a separate investigation, general comments to the presence of birds are made as it relates to biodiversity of the site and surroundings as well as to ascribed faunal sensitivities of parts of the study area.

9.1 REGIONAL FAUNAL DIVERSITY

Only specific faunal groups are used during the species-specific element of this faunal assessment because of restrictions concerning database availability. Data on the Q-degree level is available for the following faunal groups:

- Invertebrates: Butterflies (South African Butterfly Conservation Assessment – http://sabca.adu.org.za)
- Amphibians: Frogs (Atlas and Red Data Book of the South Africa, Lesotho and Swaziland)
- Reptiles: Snakes and other Reptiles (South African Reptile Conservation Assessment - http://sarca.adu.org.za)
- Mammals: Terrestrial Mammals (Red Data Book of the Mammals of South Africa: A Conservation Assessment.)

Animals known to be present in the Q-grid of the study area are considered potential inhabitants of the study area (all species known from the Mpumalanga Province were included to minimize the effect of sampling bias). The likelihood of each species' presence in the study areas was estimated based on known ecological requirements of species; these requirements were compared to the ecological conditions found in the study area and surrounding faunal habitat.

9.2 FAUNAL DIVERSITY OF THE SITE

A total of 30 animal species was recorded during the site investigation (refer Table 9) by means of visual sightings, tracts, faecal droppings, burrows and characteristic behaviour patterns. Signs of, or individuals of, four insects, one frog, twenty birds and five mammals were confirmed for the study area. None of the recorded species is currently considered to be under threat (IUCN Red Data, CITES or TOPS). This diversity of animals recorded in the study area are regarded typical of an area the size of the study site in this part of the Grassland Biome, given the mixture of habitat types present in the study area.

Table 9: Faunal species recorded in the study area

Class	***Order***	***Family***	***Biological Name***	***Colloquial Name***
Insecta	Coleoptera	Coccinellidae	*Cheilomenes lunata*	Lunate Ladybird
	Lepidoptera	Nymphalidae	*Danaus chrysippus orientis*	African Monarch
			Vanessa cardui	Painted Lady
	Hymenoptera	Apidae	*Apis mellifera*	Honey Bee

Table 9: Faunal species recorded in the study area				
Class	***Order***	***Family***	***Biological Name***	***Colloquial Name***
Amphibia	Anura	Pyxicephalidae	*Strongylopus grayii*	Clicking Stream Frog
Aves	Galliformes	Numididae	*Numida meleagris*	Helmeted Guineafowl
		Phasianidae	*Pternistis swainsonii*	Swainson's Spurfowl
	Ciconiiformes	Threskiornithidae	*Bostrychia hagedash*	Hadeda Ibis
		Ardeidae	*Ardea cinerea*	Grey Heron
	Falconiformes	Accipitridae	*Elanus caeruleus*	Black-winged Kite
	Charadriiformes	Charadriidae	*Vanellus coronatus*	Crowned Lapwing
	Columbiformes	Columbidae	*Streptopelia capicola*	Ring-necked Dove
			Spilopelia senegalensis	Laughing Dove
	Strigiformes	Strigidae	*Asio capensis*	Marsh Owl
	Passeriformes	Laniidae	*Lanius collaris*	Common Fiscal
		Hirundinidae	*Cecropis cucullata*	Greater Striped Swallow
		Cisticolidae	*Cisticola tinniens*	Levaillant's Cisticola
			Cisticola cinnamomeus	Pale-crowned Cisticola
		Passeridae	*Passer melanurus*	Cape Sparrow
			Passer diffusus	Southern Grey-headed Sparrow
		Ploceidae	*Ploceus velatus*	Southern Masked Weaver
			Quelea quelea	Red-billed Quelea
		Estrildidae	*Estrilda astrild*	Common Waxbill
		Viduidae	*Vidua macroura*	Pin-tailed Whydah
		Motacillidae	*Macronyx capensis*	Cape Longclaw
Mammalia	Lagomorpha	Leporidae	*Lepus saxatilis*	Scrub Hare
	Rodentia	Muridae	*Tatera brantsii*	Highveld Gerbil
	Carnivora	Herpestidae	*Cynictis penicillata*	Yellow Mongoose
		Canidae	*Canis mesomelas*	Black-backed Jackal
	Artiodactyla	Bovidae	*Sylvicapra grimmia*	Common Duiker

In addition to species that were identified to species level, nine invertebrate families were recorded during the field investigation (refer Table 10).

Table 10: Invertebrate Families of the study area			
Class	***Order***	***Family***	***Colloquial Name***
Insecta	Odonata	Coenagrionidae	Pond Damsels
		Libellulidae	Skimmers
	Dermaptera	Labiduridae	Long-horned Earwigs
	Orthoptera	Acrididae	Short-horned Grasshoppers
	Phasmatodea	Phasmatidae	Walking Sticks
	Coleoptera	Coccinellidae	Ladybirds
	Diptera	Tipulidae	Craneflies
		Muscidae	House Flies
		Calliphoridae	Bluebottles

Eighty-two Red Data animals are known to occur in the Mpumalanga Province (mammals, reptiles, amphibians and invertebrates) (refer Table 11). Of these 25 are listed as Data Deficient (DD), 28 as Near Threatened (NT), 20 as Vulnerable (VU), 7 as Endangered (EN) and 2 as Critically Endangered (CR). It is estimated that 79 of the 82 species have a low probability of occurring in the study area; two have a moderate-low probability and one species a high probability.

This Red Data Probability Assessment is based on:

- the size of the study area;
- the location of the study area within a largely untransformed environment; and
- the presence of relatively pristine habitat such as those associated with grassland, woodland, wetlands and outcrops.

Table 11: Red Data fauna assessment of the study area

Biological Name	***English Name***	***Status***	***Probability***
Butterflies			
Aloeides barbarae	Barbara's Copper	Vulnerable	low
Aloeides nubilus	Cloud Copper	Vulnerable	low
Aloeides rossouwi	Rossouw's Copper	Endangered	low
Chrysoritis aureus	Golden Opal	Near Threatened	low
Chrysoritis phosphor	Scarce Scarlet	Vulnerable	low
Lepidochrysops jefferyi	Jeffery's Blue	Vulnerable	low
Lepidochrysops swanepoeli	Swanepoel's Blue	Vulnerable	low
Metisella meninx	Marsh Sylph	Vulnerable	high
Pseudonympha swanepoeli	Swanepoel's Brown	Vulnerable	low
Amphibians			
Breviceps sopranus	Whistling Rain Frog	Data Deficient	low
Hemisus guttatus	Spotted Shovel-nosed Frog	Vulnerable	low
Strongylopus wageri	Plain Stream Frog	Near Threatened	low
Reptiles			
Cordylus giganteus	Giant Girdled Lizard	Vulnerable	low
Homoroselaps dorsalis	Striped Harlequin Snake	Near Threatened	low
Kinixys natalensis	Natal Hinge-back Tortoise	Near Threatened	low
Lamprophis fuscus	Yellow-bellied House Snake	Near Threatened	low
Lamprophis swazicus	Swazi Rock Snake	Near Threatened	low
Tetradactylus breyeri	Breyer's Long-tailed Seps	Vulnerable	low
Mammals			
Acinonyx jubatus	Cheetah	Vulnerable	low
Amblysomus hottentotus	Hottentot's Golden Mole	Data Deficient	low
Amblysomus robustus	Robust Golden Mole	Endangered	low
Amblysomus septentrionalis	Higveld Golden Mole	Near Threatened	low
Atelerix frontalis	South African Hedgehog	Near Threatened	low
Canis adustus	Side-striped Jackal	Near Threatened	low
Cercopithecus mitis	Samango Monkey	Vulnerable	low
Cercopithecus mitis labiatus	Samango Monkey	Endangered	low
Chrysospalax villosus	Rough-haired Golden Mole	Critically Rare	low
Cloeotis percivali	Short-eared Trident Bat	Critically Rare	low
Crocidura cyanea	Reddish-grey Musk Shrew	Data Deficient	mod-low

Table 11: Red Data fauna assessment of the study area			
Biological Name	***English Name***	***Status***	***Probability***
Crocidura flavescens	Greater Musk Shrew	Data Deficient	low
Crocidura fuscomurina	Tiny Musk Shrew	Data Deficient	low
Crocidura hirta	Lesser Red Musk Shrew	Data Deficient	low
Crocidura maquassiensis	Maquassie Musk Shrew	Vulnerable	low
Crocidura mariquensis	Swamp Musk Shrew	Data Deficient	low
Crocidura silacea	Lesser Grey-brown Musk Shrew	Data Deficient	low
Crocuta crocuta	Spotted Hyaena	Near Threatened	low
Damaliscus lunatus lunatus	Tsessebe	Endangered	low
Dasymys incomtus	Water Rat	Near Threatened	low
Diceros bicornis minor	Black Rhinoceros	Vulnerable	low
Elephantulus brachyrhynchus	Short-snouted Elephant-shrew	Data Deficient	low
Epomophorus gambianus	Gambian Epauletted Fruit Bat	Data Deficient	low
Grammomys dolichurus	Woodland Mouse	Data Deficient	low
Graphiurus platyops	Rock Dormouse	Data Deficient	low
Hipposideros caffer	Sundevall's Leaf-nosed Bat	Data Deficient	low
Hippotragus equinus	Roan Antelope	Vulnerable	low
Hippotragus niger niger	Sable Antelope	Vulnerable	low
Hyaena brunnea	Brown Hyaena	Near Threatened	low
Kerivoula lanosa	Lesser Woolly Bat	Near Threatened	low
Lemniscomys rosalia	Single-striped Mouse	Data Deficient	low
Leptailurus serval	Serval	Near Threatened	low
Lutra maculicollis	Spotted-necked Otter	Near Threatened	low
Lycaon pictus	African Wild Dog	Endangered	low
Manis temminckii	Pangolin	Vulnerable	low
Mellivora capensis	Honey Badger	Near Threatened	low
Miniopterus fraterculus	Lesser Long-fingered Bat	Near Threatened	low
Miniopterus schreibersii	Schreiber's Long-fingered Bat	Near Threatened	low
Myosorex cafer	Dark-footed Forest Shrew	Data Deficient	low
Myosorex varius	Forest Shrew	Data Deficient	mod-low
Myotis bocagei	Rufous Hairy Bat	Data Deficient	low
Myotis tricolor	Temminck's Hairy Bat	Near Threatened	low
Myotis welwitschii	Welwitsch's Hairy Bat	Near Threatened	low
Mystromys albicaudatus	White-tailed Rat	Endangered	low
Neamblysomus juliane	Juliana's Golden Mole	Vulnerable	low
Otomys slogetti	Sloggett's Rat	Data Deficient	low
Ourebia ourebi	Oribi	Endangered	low
Panthera leo	Lion	Vulnerable	low
Paracynictis selousi	Selous' Mongoose	Data Deficient	low
Pipistrellus anchietae	Anchieta's Pipistrelle	Near Threatened	low
Pipistrellus rusticus	Rusty Bat	Near Threatened	low
Poecilogale albinucha	African Weasel	Data Deficient	low
Raphicerus sharpei	Sharp's Grysbok	Near Threatened	low
Rhinolophus blasii	Peak-saddle Horseshoe Bat	Vulnerable	low
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	Near Threatened	low
Rhinolophus darlingi	Darling's Horseshoe Bat	Near Threatened	low
Rhinolophus fumigatus	Ruppel's Horseshoe Bat	Near Threatened	low
Rhinolophus hildebrantii	Hildebrant's Horseshoe Bat	Near Threatened	low
Rhinolophus landeri	Lander's Horseshoe Bat	Near Threatened	low
Rhynchogale melleri	Meller's Mongoose	Data Deficient	low
Suncus infinitesimus	Least Dwarf Shrew	Data Deficient	low
Suncus lixus	Greater Dwarf Shrew	Data Deficient	low
Suncus varilla	Lesser Dwarf Shrew	Data Deficient	low

Table 11: Red Data fauna assessment of the study area			
Biological Name	***English Name***	***Status***	***Probability***
Tatera leucogaster	Bushveld Gerbil	Data Deficient	low

All of the animals recorded in the study area during the survey period (Tables 9 & 10) are commonly observed in the grasslands and wetlands of central Mpumalanga (pers. obs.). None of these animals indicates the presence of scarce or threatened faunal habitats of habitat characteristics within the study area, as they are generally associated with abundant habitat, such as that found in the study area. The faunal assemblages of the study area support the observation that the natural faunal habitats of the study area are degraded, fragmented and isolated. These observations are reflected in Table 11. Only three of the 82 Red Data species listed for Mpumalanga are not considered to have a low probability of occurring in the study area. This is a direct result of the poor status of the remaining habitat found in the study area (that is, for the species that are known from the general area in which the study area is located within Mpumalanga – within the Q-degree or Q-catchment).

Only one species is considered to have a high probability of occurring in the study area, namely the Marsh Sylph (*Metisella meninx,* Hesperiidae: Heteropterinae). This species is restricted to the wet vleis of highveld grassland in KZN, Mpumalanga, FS, Gauteng and the North West Province. The species is known to feed on *Leersia hexandra* (Poaceae – larval host) and is well represented in the wetlands of the general region in which the study area is located (pers. obs.).

9.4 FAUNAL HABITAT SENSITIVITY ASSESSMENT

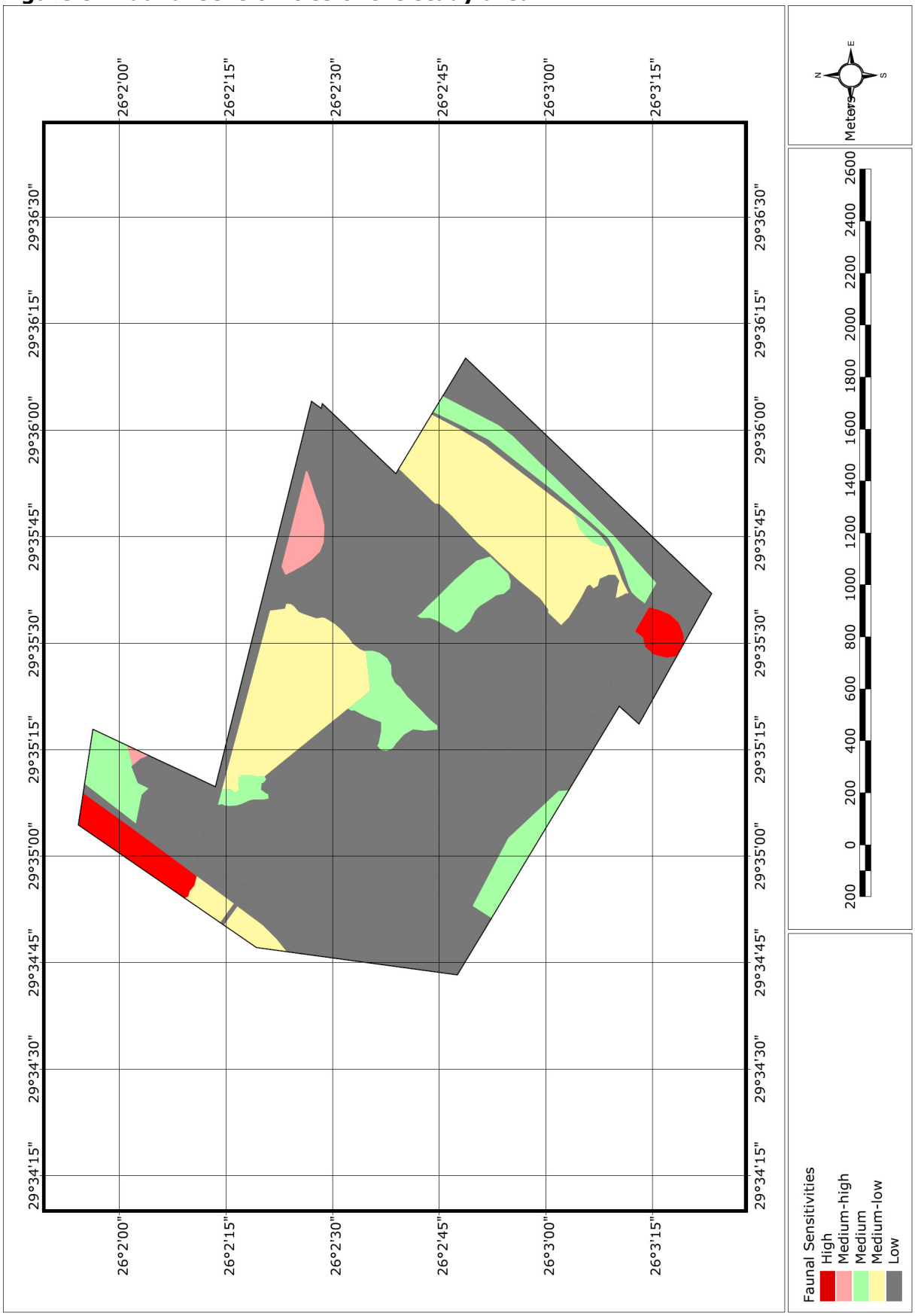
During the field assessment, the study area was investigated and assessed in terms of the following biodiversity attributes (refer Table 12):

- Habitat status: level of habitat transformation and degradation vs. pristine faunal habitat;
- Habitat diversity: the number of different faunal habitat types (both on micro- and macro-scale) found within the proposed site and bordering areas;
- Habitat linkage: the degree to which the faunal habitat of the proposed site is linked to other natural areas enabling movement of animals to and from the habitat found on site;
- Red Data species: the degree to which suitable habitat for the red data species likely to be found in the study area (larger study area) is located on each site; and
- Sensitive faunal habitat: the relative presence of faunal sensitive habitat type elements such as surface rock associated with outcrops and hills as well as wetland elements.

In order to allow for a parallel comparison between floristic and faunal sensitivities, the floristic units are used as an indication of the faunal communities. Faunal sensitivities are illustrated in Figure 8.

Table 12: Faunal Habitat Sensitivities for the study area							
Community	**Status**	**Diversity**	**Linkage**	**RD Likelihood**	**Habitat Sensitivity**	**Average**	**Sensitivity Class**
Agricultural Fields	2	2	3	1	1	18%	low
Excavations	0	2	1	0	0	6%	low
Exotic Trees	2	3	1	2	1	18%	low
Grassland – Unit 1	3	3	4	3	4	34%	medium-low
Grassland – Unit 2	6	6	5	8	10	70%	medium-high
Moist Grassland - Unit 1	4	5	4	7	5	50%	medium
Moist Grassland - Unit 2	3	3	3	6	5	40%	medium
Rehabilitated Land	3	4	3	1	2	26%	medium-low
Roads/ Railways	0	0	0	0	0	0%	low
Transformed Habitat	1	2	2	1	0	12%	low
Unrehabilitated Land	0	1	1	0	0	4%	low
Wetland Habitat - Unit 1	8	7	8	8	10	82%	high
Wetland Habitat - Unit 2	4	6	5	8	10	66%	medium-high
Wetland Habitat - Unit 3	4	4	4	4	5	42%	medium

Figure 8: Faunal sensitivities of the study area



The study area is situated in an environment that comprehends extensive transformed faunal habitats because of crop agriculture and opencast coal mining. Similarly, the study area exhibits characteristics of severe transformation and degradation, comprising only small fragments of natural faunal habitat; most of these areas are wetland related with very little terrestrial faunal habitat remaining.

The faunal diversity of the study area that comprises 30 animal species and 9 invertebrate families are common to the region and none of these taxa is considered to be under any threat.

The only Red Data species listed for Mpumalanga that are considered to have a high probability of occurring in the study area is the Marsh Sylph (*Metisella meninx*). This species is commonly found in wetlands where the larval host plant, *Leersia hexandra*, abounds; as is the case within the wetlands of the study area.

None of the potential impacts associated with the proposed project for the Ash Dam at Site E, pipeline alternatives routes 1 and 2 and transmission line corridors 1 and 2 are considered high for any of the project phases – construction, operational or decommissioning (including cumulative impacts).

It is however strongly recommended that a biodiversity offset be considered for the unavoidable loss of the wetland habitat in the study area. The ecological management of a similarly sized wetland nearby could easily mitigate the loss of the wetland in the study area. Such an offset need not be extensive or costly; the proper ecological management of such a wetland can easily be done by employing ecological and biodiversity conservation principles.

Results of the respective floristic- and faunal habitat sensitivity assessments are interpreted to present an estimation (refer Table 13) that would reflect the expected impact of the construction and operation of the required infrastructure on the biological environment. While the estimations of habitat sensitivity, as presented in preceding chapters do provide an indication in terms of the extent and locality of important habitat, an interpretation of the surrounding habitat sensitivity is also implemented in these estimations.

Table 13: Ecological Sensitivity of the study area

Community	Floristic Sensitivity	Faunal Sensitivity	Ecological Sensitivity
Agricultural Fields	low	low	**Low**
Excavations	low	low	**Low**
Exotic Trees	low	low	**Low**
Grassland – Unit 1	medium-high	medium-low	**Medium-high**
Grassland – Unit 2	medium	medium-high	**Medium-high**
Moist Grassland - Unit 1	medium-high	medium	**Medium-high**
Moist Grassland - Unit 2	medium-low	medium	**Medium-low**
Rehabilitated Land	medium-low	medium-low	**Medium-low**
Roads/ Railways	low	low	**Low**
Transformed Habitat	low	low	**Low**
Unrehabilitated Land	low	low	**Low**
Wetland Habitat - Unit 1	high	high	**High**
Wetland Habitat - Unit 2	medium-high	medium-high	**Medium-high**
Wetland Habitat - Unit 3	medium	medium	**Medium**

The extent of ecological sensitivities is illustrated in Figure 9. Estimated sensitivities reflect the separate floristic and faunal sensitivities and furthermore provide evidence of a highly degraded and transformed habitat that is characterised by the presence of mosaical remnants of natural habitat that are largely isolated.

The status of these portions generally also reflects the severity of current impacts resulting from the dominant land uses, including mining and agriculture (grazing and cultivation). While selected portions of habitat exhibit characteristics of medium-high and high ecological sensitivity, the remainder of the proposed site is regarded low in ecological sensitivity. The loss of these areas is not regarded significant on a local or regional scale. Remaining portions of higher sensitivity categories could effectively be protected by the implementation of generic mitigation measures. Whilst complete protection of these areas is not regarded possible, the implementation of a biodiversity offset programme, which should target surrounding areas of high biodiversity value, is regarded a suitable mitigation measure.

Results of the floristic and faunal investigations were interpreted holistically in order to assess the potential impact on the ecological environment. The impact assessment is aimed at presenting a description of the nature, extent significance and potential mitigation of identified impacts on the biological environment. These tabular assessments are presented in Section 12.3 in the form of an Impact Rating Matrix for relevant impacts within the development option or alternative.

11.1 IDENTIFICATION OF IMPACTS

No impacts were identified that could lead to a beneficial impact on the ecological environment of the study area since the proposed development is largely destructive as it involves the alteration of natural habitat or further degradation of habitat that is currently in a sub-climax status.

Impacts resulting from the proposed development on ecological attributes of the study area are largely restricted to the physical impacts on biota or the habitat in which they occur. Direct impacts include any impacts on populations of individual species of concern, including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern. In addition, impacts on sensitive or protected habitat are included in this category, but only on a local scale. These impacts are mostly measurable and easy to assess, as the effects thereof is immediately visible and can be determined to an acceptable level of certainty.

In contrast, indirect impacts are not immediately evident and can consequently not be measured immediately. In addition, the extent of the effect is frequently large scale, mostly regional. A measure of estimation is therefore necessary in order to evaluate the importance of these impacts. Lastly, impacts of a cumulative nature places direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities.

The following impacts are relevant to any type of development in a natural environment:

- Direct impacts on threatened flora species;
- Direct impacts on threatened fauna species;
- Loss or degradation of natural/ pristine habitat;
- Direct impacts on common fauna & interactions with structures & personnel;
- Loss, or disruption of ecological connectivity;
- Faunal interactions with structures, servitudes and personnel;
- Loss/ degradation of surrounding habitat, species;
- Impacts on SA's conservation obligations & targets; and
- Increase in local and regional fragmentation/ isolation of habitat.

The following development alternatives are considered in the assessment:

- Proposed Ash Dam:
  - Alternative 1 – Site E;
  - Alternative 2 – No-Go Option;
- Proposed Transmission Lines:
  - Alternative Corridor 1;
  - Alternative Corridor 2;
  - Alternative 3 – No Go Option;
- Proposed Pipelines:
  - Alternative Route 1;
  - Alternative Route 2; and
  - Alternative 3 – No-Go Option.

Not all of the impacts are likely to occur; an assessment of the likelihood that respective impacts would occur is addressed in the following section. Based on this likelihood, the relevant impact is therefore omitted or included in the assessment section. Furthermore, not all impacts are likely to occur in all aspects of the proposed development. Impacts will therefore be included in a case-by-case scenario.

11.2 NATURE OF IMPACTS

11.2.1 Direct Impacts on Threatened Flora Species

This is a direct impact since it results in the physical damage or destruction of Red Data species or areas that are suitable for these species, representing a significant impact on the biodiversity of a region. Threatened plant species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers, as there are generally few of them, but a high ecological value is placed on the presence of such species in an area as they represent an indication of pristine habitat conditions. Conversely, the presence of pristine habitat conditions can frequently be accepted as an indication of the potential presence of species of conservation importance, particularly in moist habitat conditions.

Red Data species are particularly sensitive to changes in their environment, having adapted to a narrow range of specific habitat requirements. Changes in habitat conditions resulting from human activities is one of the greatest reasons for these species having a threatened status. Surface transformation/ degradation activities within habitat types that are occupied by flora species of conservation importance will ultimately result in significant impacts on these species and their population dynamics. Effects of this type of impact are usually permanent and recovery or mitigation is generally not perceived as possible.

One of the greatest limitations in terms of mitigating or preventing this particular impact, is that extremely little information is generally available in terms of the presence, distribution patterns, population dynamics and habitat requirements of Red Data flora species. To allow for

an accurate assessment, it is usually necessary to assess the presence/ distribution, habitats requirements, etc. associated with these species in detail and over prolonged periods; something that is generally not possible during EIA investigation such as this. However, by applying ecosystem conservation principles to this impact assessment and subsequent planning and development phases, potential impacts will be limited to some extent.

The likelihood of Red Data flora species occurring within the study area is regarded low and available data did not indicate the known presence of Red Data plants in the region. Furthermore, habitat types present in the study area is in a sub-optimum condition. The extremely low likelihood that this impact might occur therefore results in this impact being omitted from the assessment.

11.2.2 Direct Impacts on Threatened Fauna Species

Threatened animals also contribute significantly to the ecological diversity of a region since their presence usually provides an indication of a relatively pristine environment. Also regarded as a direct and significant impact on the biodiversity of a region, impacts resulting from developments such as this are less likely to affect these animals directly since they are generally mobile and will ultimately be able to migrate from impacts that result from the proposed development. Significantly, however, decreasing suitable habitat that is available to them represents an indirect, but significant impact on the status of these animals. Aspects of these animals that will also be affected include migration patterns and suitable habitat for breeding and foraging purposes. Since these requirements are frequently stricter than most generalist species, impacts on their habitat are likely to be more significant than for most other fauna species.

The presence of Red Data fauna species on this property is regarded unlikely for several reasons, mostly including the absence of habitat that would be suitable for the requirements of Red Data fauna species, as well as the lack of knowledge of any Red Data species occurring in the region.

The likelihood of Red Data fauna species occurring within the study area is regarded low. Furthermore, habitat types present in the study area is in a sub-optimum condition. The extremely low likelihood that this impact might occur therefore results in this impact being omitted from the assessment.

11.2.3 Loss or Degradation of Sensitive/ Natural Habitat

The loss or degradation of natural habitat or habitat that are regarded sensitive as a result of restricted presence in the larger region (atypical habitat) represents a potential loss of habitat and biodiversity on a local and regional scale. Sensitive habitat types might include mountains, ridges, koppies, wetlands, rivers, streams and localised habitat types of significant physiognomic variation and unique species composition. These areas represent centres of

atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is generally ascribed to floristic communities and faunal assemblages that occupy these areas as they contribute significantly to the biodiversity of a region.

While wetland habitat are regarded as sensitive, the assessment thereof is omitted from this report as it will be addressed in more detail in the wetland ecology report.

No terrestrial habitat of a highly sensitive (pristine) nature is present on the study area. However, moderately natural grassland habitat does occur and is utilised by some animal species. Although this impact is regarded of relative low significance, it is still included in the assessment.

11.2.4 Direct Impacts on Common Fauna & Interactions with Structures & Personnel

Although a relative low diversity of animals has been established on this property, this impact is still likely to occur. Additionally, activities that are known to transpire from human–animal conflicts are likely to affect animals that do utilise the surrounding areas. These activities might include poaching, snaring, killing by accidental contact, capturing, effects of domesticated cats and dogs, roadkills, etc. While the tolerance levels of common animal species is generally of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from areas of impact, some species are not able to relocate, such as ground living and small species.

It should be noted that animals generally avoid contact with human structures, but do grow accustomed to structures after a period. An aspect that is of concern is the presence of vehicles on access and infrastructure roads, leading to road kills, particularly amongst nocturnal animals that might occur in the study area.

The presence of personnel within the development area during construction and operational phases will inevitably result in some contact with animals. While most of the larger animal species are likely to move away from humans, encounters with snakes remain likely. Similarly, the presence of humans within areas of natural habitat could potentially result in killing of animals by means of snaring, poaching, poisoning, trapping, etc. In addition, the presence of domestic dogs and cats is generally associated with humans. These animals are frequently accountable for killing natural fauna. It is also regarded moderately likely that animals might be attracted to the artificial water sources.

The proposed development will ultimately result in some human-animal interactions. It is unlikely that their conservation status will be affected, but any impact on animals is considered significant. This assessment is therefore included in the assessment.

11.2.5 Loss or Disruption of Ecological Connectivity

The region is characterised by highly transformed and fragmented grassland habitat types that are unlikely to be occupied by a high diversity of animal species. Evidence of this investigation has confirmed this and it can therefore be assumed that the animals that utilises these habitat types migrate extensively across the region for various reasons. Foraging, available water, food sources, breeding patterns and seasonal climate changes include some of the more obvious explanations for migration of animals.

While most of the larger mammal species (ungulates) are restricted in their movement by fences, small and medium sized animals, that include predators, burrowing species, small mammals, invertebrate species, reptiles, amphibians, etc. utilises all available natural habitat as either corridors or habitat. The loss of an area as large, as this property, will affect the migration pattern of some species that are present in the immediate region. While larger animals are able to avoid unsuitable habitat, smaller animals might not be able to cross or avoid these areas. Of note is also the effect of disruption of migration patterns of particularly flightless animals.

The size of the proposed development implies that much of the natural habitat that is present on the study area will become unsuitable for a number of species that might utilise this area on a frequent or infrequent nature. This assessment is therefore included in the assessment.

11.2.6 Impacts on Surrounding Habitat/ Species & Ecosystem Functioning

Surrounding areas and species present in the direct vicinity of the study area could potentially be affected by indirect impacts resulting from construction and operational activities. This indirect impact also includes adverse effects on any processes or factors that maintain ecosystem health and character, including the following:

- Disruption of nutrient-flow dynamics;
- Introduction of chemicals into the ground- and surface water through leaching;
- Impedance of movement of material or water;
- Habitat fragmentation;
- Changes to abiotic environmental conditions;
- Changes to disturbance regimes, e.g. increased or decreased incidence of fire;
- Changes to successional processes;
- Effects on pollinators; and
- Increased invasion by plants and animals not endemic to the area.

Changes to factors such as these may lead to a reduction in the resilience of ecological communities and ecosystems or loss or changes in ecosystem function. Furthermore, regional ecological processes, particularly aquatic processes that is dependent on the status and proper functioning of the drainage line, is regarded important. It is well known that the status of a

catchment is largely determined by the status of the upper reaches of the rivers. Small drainage lines, such as the one on this property, might be insignificant on a regional scale, but the combined status of numerous such small drainage lines will determine the quality of larger rivers further downstream.

The nature of this impact dictates that potential impacts are likely to spread from the development area into bordering areas; it is therefore included in the assessment.

11.2.7 Impacts on SA's Conservation Obligations & Targets

This impact is regarded a cumulative impact since it affects the status of conservation strategies and targets on a local as well as national level and is viewed in conjunction with other types of local and regional impacts that affects conservation areas. The importance of vegetation types is based on the conservation status ascribed to regional vegetation types and while any impact that results in irreversible transformation of natural habitat is regarded significant, no significant disruption of ecosystem functioning is assumed in least threatened vegetation types, which still have more than 80% of their original extent untransformed.

Although the loss of natural vegetation is expected to result in an insignificant impact on the conservation status of the regional vegetation types, it is still included in the assessment of cumulative impacts based on the Endangered status thereof.

11.2.8 Increase in Local & Regional Fragmentation/ Isolation of Habitat

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources in the immediate surrounds. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size.

The danger in this type of cumulative impact is that effects are not known or is not visible with immediate effect and normally when these effects become visible, they are beyond repair. Impacts on linear areas of natural habitat affect the migratory success of animals in particular.

The general region is characterised by extremely high levels of transformation and habitat fragmentation. Although impacts from the proposed development are unlikely to increase regional or local levels of fragmentation and habitat isolation significantly, this impact is still included in the assessment of cumulative impacts.

In estimating the significance and likelihood of impacts of the proposed development on the biological environment, cognisance is taken of all biophysical, floristic and faunal attributes that characterise the study area as well as the immediate region. It represents a subjective interpretation of biophysical attributes, estimated sensitivities of the study area and the region, and how the proposed project will affect biodiversity attributes on a larger scale. Impacts are assessed prior to as well as subsequent to the implementation of all recommended mitigation measures.

A summary of the assessment tables are presented in the following section due to the extensive and detailed nature of the assessment tables, which makes use of relevant calculations in Excel spreadsheets. The detailed tables have been included in Chapter 9 of the main EIA Report.

11.3.1 Construction Phase

Impacts relevant to this phase of the development include the following:

- Loss or degradation of natural/ pristine habitat;
- Direct impacts on common fauna & interactions with structures & personnel;
- Loss, or disruption of ecological connectivity;
- Loss/ degradation of surrounding habitat, species;

Table 14: Impact Assessment of the Construction Phase

Alternative	Significance Before Mitigation	Significance After Mitigation
Ash Dam - Site E	45.0 (Medium)	36.3 (Medium)
Ash Dam - No-Go Alternative	No additional impacts if No-Go is selected	
Pipeline Route 1	36.3 (Medium)	17.3 (Low)
Pipeline Route 2	44.8 (Medium)	21.8 (Low)
Pipeline - No-Go Alternative	No additional impacts if No-Go is selected	
Transmission Line - Corridor 1	31.8 (Medium)	16.5 (Low)
Transmission Line - Corridor 2	46.0 (Medium)	26.3 (Low)
Transmission Line - No-Go Alternative	No additional impacts if No-Go is selected	

11.3.2 Operational Phase

Impacts relevant to this phase of the development include the following:

- Direct impacts on common fauna & interactions with structures & personnel;
- Loss/ degradation of surrounding habitat, species;

Table 15: Impact Assessment of the Operational Phase		
Alternative	**Significance Before Mitigation**	**Significance After Mitigation**
Ash Dam - Site E	40.0 (Medium)	15.0 (Low)
Ash Dam - No-Go Alternative	No additional impacts if No-Go is selected	
Pipeline Route 1	39.0 (Medium)	10.7 (Low)
Pipeline Route 2	47.7 (Medium)	22.0 (Low)
Pipeline - No-Go Alternative	No additional impacts if No-Go is selected	
Transmission Line - Corridor 1	28.0 (Low)	10.0 (Low)
Transmission Line - Corridor 2	34.0 (Medium)	22.0 (Low)
Transmission Line - No-Go Alternative	No additional impacts if No-Go is selected	

11.3.3 Decommissioning Phase

Impacts relevant to this phase of the development include the following:

- Direct impacts on common fauna & interactions with structures & personnel;
- Loss, or disruption of ecological connectivity;
- Loss/ degradation of surrounding habitat, species;

Table 16: Impact Assessment of the Decommissioning Phase		
Alternative	**Significance Before Mitigation**	**Significance After Mitigation**
Ash Dam - Site E	23.0 (Low)	11.3 (Low)
Ash Dam - No-Go Alternative	No additional impacts if No-Go is selected	
Pipeline Route 1	27.7 (Low)	11.3 (Low)
Pipeline Route 2	28.0 (Low)	12.0 (Low)
Pipeline - No-Go Alternative	No additional impacts if No-Go is selected	
Transmission Line - Corridor 1	21.0 (Low)	10.0 (Low)
Transmission Line - Corridor 2	31.0 (Medium)	14.0 (Low)
Transmission Line - No-Go Alternative	No additional impacts if No-Go is selected	

Impacts relevant to this phase of the development include the following:

- Impacts on SA's conservation obligations & targets; and
- Increase in local and regional fragmentation/ isolation of habitat.

Table 17: Cumulative Impact Assessment

Alternative	Significance Before Mitigation	Significance After Mitigation
Ash Dam - Site E	65.0 (High)	40.0 (Medium)
Ash Dam - No-Go Alternative	No additional impacts if No-Go is selected	
Pipeline Route 1	36.0 (Medium)	24.0 (Low)
Pipeline Route 2	44.0 (Medium)	27.0 (Low)
Pipeline - No-Go Alternative	No additional impacts if No-Go is selected	
Transmission Line - Corridor 1	36.0 (Medium)	21.0 (Low)
Transmission Line - Corridor 2	52.0 (Medium)	27.0 (Low)
Transmission Line - No-Go Alternative	No additional impacts if No-Go is selected	

11.4 DISCUSSION

It is evident that direct impacts associated with the various phases of the project are mostly restricted to the physical activities associated with construction activities and, to some extent, activities associates with the decommissioning phase (rehabilitation). Indirect as well as direct impacts are mostly restricted to the site and immediate surrounds.

The implementation of generic mitigation measures are expected to ameliorate impacts to an acceptable significance. In selected areas, mostly associated with wetland related habitat, will the success of mitigation measures be of a moderate nature.

12 RECOMMENDED MITIGATION MEASURES

12.1.1 General Aspects

Mitigation Measure 1 - Exclude all areas of high ecological sensitivity from development activities that would result in irreversible transformation of the habitat. This should be done during the planning phase of the project;

Mitigation Measure 2 - Allow for a suitable buffer in order to provide some protection of sensitive areas against peripheral impacts. Al areas that were ascribed a High Ecological Sensitivity should be buffered against potential impacts;

Mitigation Measure 3 - Appoint an Environmental Control Officer (ECO) prior to start of construction. Responsibilities should include, but not be limited to, ensuring adherence to EMP guidelines, guidance of activities, planning, reporting;

Mitigation Measure 4 - Compile and implement environmental monitoring programme, the aim of which should be ensuring long-term success of rehabilitation and prevention of environmental degradation. Environmental monitoring should be conducted at least twice per year (Summer, Winter);

Mitigation Measure 5 - Limit construction, maintenance and inspection activities to dry periods in order to curb occurrence/ augmentation of erosion in areas of existing erosion, destabilizing of substrate in areas of high slopes, drainage lines, etc;

Mitigation Measure 6 - Ensure off site storage of hazardous materials, chemicals, fuels, oils, etc. in order to prevent accidental spillage, contamination or pollution;

Mitigation Measure 7 - Develop emergency maintenance operational plan to deal with any event of contamination, pollution or spillages, particularly in sensitive areas;

Mitigation Measure 8 - Included in the monitoring programme should be a periodic assessment of possible leaching or spillage of any chemical into any natural water system (groundwater of surface water) occurs.

12.1.2 Fences & Demarcation

Mitigation Measure 9 - Demarcate all construction areas by semi-permanent means in order to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit spread of impacts;

Mitigation Measure 10 - No painting or marking of rocks or vegetation to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required;

Mitigation Measure 11 - Marking of plants should be done by means of semi-permanent (removable) marker tape.

12.1.3 Fire

Mitigation Measure 12 - Prevent all open fires;

Mitigation Measure 13 - Provide demarcated fire-safe zones, facilities and suitable fire control measures;

12.1.4 Roads & Access

Mitigation Measure 14 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 15 - Vehicular traffic shall not be allowed in permanently wet areas, no damage shall be caused to wet areas. Where necessary, alternative methods of construction shall be used to avoid damage to wet areas;

Mitigation Measure 16 - The Contractor shall select a suitable level area free of rock and large bushes as lay down area;

Mitigation Measure 17 - The Contractor shall select an area a suitable distance from any sensitive environmental feature as a construction camp.

12.1.5 Workers & Personnel

Mitigation Measure 18 - Provide temporary on-site ablution, sanitation, litter and waste management and hazardous materials management facilities;

Mitigation Measure 19 - Abluting anywhere other than in provided toilets shall not be permitted. Under no circumstances shall use of the veld be permitted.

12.1.6 Vegetation Clearance & Operations

Mitigation Measure 20 - Removal of vegetation/ plants shall be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible;

Mitigation Measure 21 - Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the area;

Mitigation Measure 22 - Disturbance of vegetation must be limited to areas of construction;

Mitigation Measure 23 - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed to by the ECO;

Mitigation Measure 24 - Cut vegetation (grass and shrubs) only if required. No clearing of vegetation or soil by grading machinery shall be undertaken;

Mitigation Measure 25 - The establishment and regrowth of alien vegetation must be controlled after the removal of grass;

Mitigation Measure 26 - All declared aliens must be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);

Mitigation Measure 27 - Ensure proper surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;

Mitigation Measure 28 - Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;

Mitigation Measure 29 - The grass mix should consist of indigenous grasses adapted to the local environmental conditions;

Mitigation Measure 30 - The revegetated areas should be temporarily fenced to prevent damage by grazing animals;

Mitigation Measure 31 - Re-vegetated areas showing inadequate surface coverage (less than 30 % within eight months after re-vegetation) should be prepared and re-vegetated from scratch;

Mitigation Measure 32 - Damage to re-vegetated areas should be repaired promptly;

Mitigation Measure 33 - Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish;

Mitigation Measure 34 - Monitoring the potential spread of declared weeds and invasive alien vegetation to neighbouring land and protecting the agricultural resources and soil conservation works are regulated by the Conservation of Agricultural Resources Act, No. 43 of 1983 and should be addressed on a continuous basis.

12.1.7 Animals

Mitigation Measure 35 - No animal may be hunted, trapped, snared or killed for any purpose whatsoever;

Mitigation Measure 36 - No pets whatsoever should be allowed in or near the project area. Any pets found anywhere related to the project must be confiscated and the guilty party fined accordingly;

Mitigation Measure 37 - Vehicular traffic should not be allowed after dark in order to limit accidental killing of nocturnal animals;

Mitigation Measure 38 - Dangerous animals should be handled by a competent person;

Mitigation Measure 39 - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction.

Mitigation Measure 40 - Ensure effective policing of fences and areas bordering the development area (at least weekly), advocate severe fines and resolute punishment of offenders (there must be strong focus on warnings at the site);

Mitigation Measure 41 - The construction of fences around all areas related to the project where personnel have daily access (construction, operation and decommission) is of the utmost importance. Regular inspection of these fences to ensure the fences' integrity and patrol of the borders and surrounding areas next to the site for the presence of snares etc. will limit the impact of poaching and snaring. Communication with farmers whose farms border the operational areas to create awareness of potential poaching problems in the area is important; and

Mitigation Measure 42 - Ensure that a snake handler and/ or anti venom serum is available at all times, together with a competent person to administer this serum.

Photo 1: Example of degraded grassland types of the study area

Photo 2: Example of moist grassland types in-between agricultural fields

Photo 3: Example of remaining natural grasslands indicating a high degree of impact due to fires

Photo 4: Rodent activity within the natural grasslands

Photo 5: Example of rehabilitated land

Photo 6: Example of a nearby endorheic pan

14 APPENDIX 1 – RECORDED PHTYODIVERSITY OF THE SITE

Species Name	Growth	Family	Status/ Uses
Amaranthus hybridus	Forb	Amaranthaceae	Edible parts
Berula erecta	Hydrophilic	Anacardiaceae	None
Bidens formosa	Forb	Asteraceae	Weed, exotic (S. America), aesthetic uses
Chamaecrista comosa	Forb	Caesalpiniaceae	None
Chloris virgata	Grass	Poaceae	None
Cirsium vulgare	Forb	Asteraceae	Declared Invader - Category 1, weed
Clerodendrum triphyllum	Forb	Verbenaceae	None
Conyza bonariensis	Forb	Asteraceae	Weed, indicator of disturbed areas
Crepis hypochoeridea	Forb	Asteraceae	Weed, indicator of disturbed areas
Cynodon dactylon	Grass	Poaceae	Indicator of disturbed areas, grazing
Cyperus esculentus	Sedge	Cyperaceae	Weed, edible parts
Cyperus rupestris	Sedge	Cyperaceae	None
Cyperus species	Sedge	Cyperaceae	None
Datura stramonium	Forb	Solanaceae	Declared Invader - Category 1, weed
Denekia capensis	Forb	Asteraceae	Indicator of moist conditions
Digitaria eriantha	Grass	Poaceae	Weaving, palatable
Eragrostis chloromelas	Grass	Poaceae	Edible parts
Eragrostis curvula	Grass	Poaceae	Edible parts, indicator of degraded areas
Eragrostis gummiflua	Grass	Poaceae	Unpalatable, low grazing potential
Eragrostis plana	Grass	Poaceae	Weaving, unpalatable, indicator of degraded
Eucalyptus species	Tree	Myrsinaceae	Declared Invader - Category 2, essential
Galinsoga parviflora	Forb	Asteraceae	None
Gazania krebsiana	Forb	Asteraceae	None
Gnidia microcephala	Forb	Thymelaeaceae	None
Gomphocarpus fruticosus	Shrub	Asclepiadaceae	Medicinal uses
Helichrysum argyrosphaerum	Forb	Asteraceae	None
Helichrysum caespititium	Forb	Asteraceae	None
Helichrysum nudifolium	Forb	Asteraceae	None
Helichrysum rugulosum	Forb	Asteraceae	None
Helichrysum species	Forb	Asteraceae	None
Homeria pallida	Geophyte	Iridaceae	None
Hyparrhenia hirta	Grass	Poaceae	Thatching & weaving

Hypochaeris radicata	Forb	Asteraceae	None
Hypoxis multiceps	Geophyte	Hypoxidaceae	None
Hypoxis rigidula	Geophyte	Hypoxidaceae	None
Imperata cylindrica	Grass	Poaceae	Thatching & weaving
Indigofera species	Forb	Fabaceae	None
Lactuca capensis	Forb	Asteraceae	None
Leersia hexandra	Grass	Poaceae	None
Lobelia species	Forb	Lobeliaceae	None
Nemesia fruticans	Forb	Scrophulariaceae	None
Oldenlandia herbacea	Forb	Rubiaceae	None
Oxalis species	Geophyte	Oxalidaceae	None
Paspalum dilatatum	Grass	Poaceae	Moist places, palatable
Pennisetum clandestinum	Grass	Poaceae	Invader (E. Africa), palatable grazing
Pentarrhinum insipidum	Climber	Asclepiadaceae	Edible parts
Peucedanum magalismontanum	Forb	Apiaceae	Edible parts
Phragmites australis	Hydrophilic	Poaceae	Thatching, traditional uses, medicinal
Plantago lanceolata	Forb	Plantaginaceae	Weed (Europe)
Plantago longissima	Forb	Plantaginaceae	None
Pseudognaphalium luteo-album	Forb	Asteraceae	Weed (Europe)
Richardia brasiliensis	Forb	Rubiaceae	None
Rumex species	Hydrophilic	Polygonaceae	None
Scabiosa columbaria	Forb	Dipsacaceae	Medicinal uses
Schkuhria pinnata	Forb	Asteraceae	Medicinal uses, weed (S. America)
Scirpus burkei	Sedge	Cyperaceae	None
Senecio achilleifolius	Forb	Asteraceae	Indicator of moist conditions
Senecio erubescens	Forb	Asteraceae	None
Senecio inaequidens	Forb	Asteraceae	None
Sonchus oleraceus	Forb	Asteraceae	Edible parts
Sonchus wilmsii	Forb	Asteraceae	None
Stoebe vulgaris	Shrub	Asteraceae	Invasive properties
Tagetes minuta	Forb	Asteraceae	Essential oils, colours & dyes
Tephrosia species	Forb	Fabaceae	None
Typha capensis	Hydrophilic	Typhaceae	Cosmopolitan weed, edible parts, medicinal
Verbena bonariensis	Forb	Verbenaceae	Weed (S. America)
Verbena brasiliensis	Forb	Verbenaceae	Weed (S. America)

Xanthium strumarium	Shrub	Asteraceae	Category 1, weed (S. America)
Zornia linearis	Forb	Fabaceae	None

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