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THREATENED SPECIES SURVEYS – TWEEFONTEIN OPTIMISATION PROJECT AMENDMENT (Ogies, Mpumalanga)

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1. INTRODUCTION

De Castro and Brits Ecological Consultants conducted baseline vegetation and faunal surveys of the entire 12 019ha Tweefontein Optimization Project Amendment (TOPA) study area between 2006 and 2010 (De Castro & Brits, 2006, 2009b, 2010a). This information was used to compile an ecological impact assessment for the proposed project (De Castro, 2010b).

The study area is situated in the Mpumalanga Province, a few kilometres east of Ogies and south of Witbank. Clean Stream Environmental Consultants approached De Castro and Brits Ecological Consultants in 2012 to conduct a screening of the potential conflicts that the proposed infrastructure create in areas identified as being of high ecological sensitivity, and to conduct field surveys of key species of conservation concern that could be impacted in these areas of conflict. This report presents the findings of the desktop screening and subsequent fieldwork.

2. TERMS OF REFERENCE

- Desktop screening of the proposed infrastructure layout, including open cast pits and underground mining areas, in relation to Biodiversity Management Units (BMUs) that have been identified as being of high or very high sensitivity. This involved overlaying the most recent proposed infrastructure shapefiles on the sensitivity map produced in De Castro (2010a) and determining where key areas of conflict are.
- Lists of potentially occurring threatened and / or sensitive flora species as given in De Castro (2010a) were used to produce a schedule for further fieldwork needed to confirm the presence / absence of these species in the areas of conflict. Fieldwork was to be conducted during optimal times for locating these species.
- Produce a report summarising the desktop screening and fieldwork results, including an assessment of the impacts of the project on terrestrial ecology in these areas of conflict.

3. APPROACH

The TOPA study area for this current report includes the original Tweefontein mineral rights area, which covers approximately 9 102ha, as well as the mineral rights area to the north-east, here termed the 'North-eastern portion' of the TOP area, which covers approximately 2 917ha. Both these areas have already been subjected to various vegetation and fauna surveys, which included intensive floristic surveys conducted during every month of the year from September to April (De Castro, 2006, 2009b, 2010a). These reports are included as Appendix 3 to this report. The Terms of reference for the current study was for a screening of the sensitive species and an impact assessment only. For an understanding of the context of the baseline biodiversity the reader should refer to the reports by De Castro (2006, 2009a, 2009b, 2010a).

4. METHODOLOGY

Mapping

The shapefiles for the sensitivity map produced in De Castro (2010a) and shapefiles of proposed infrastructure layout were used to produce a map showing potential conflict between areas of high sensitivity and proposed infrastructure (Figure 2).

Fieldwork

According to the recommendations of De Castro (2010a), areas of untransformed habitat that were classified as having High or Very High sensitivity were targeted for surveys for species of conservation concern. The list of potentially occurring plant species of conservation concern that was produced in De Castro (2010a) was used to draw up a matrix of optimal survey times for each species (Appendix 1). This was used as a basis for a proposed schedule of fieldwork needed in areas of potential conflict. The first survey was conducted in November 2012 and the second survey in February 2013. The key areas of conflict identified during screening were located and walked through, investigating all microhabitats where the potentially occurring species of conservation importance were most likely to occur. Localities of all individuals located were recorded on a hand-held GPS unit.

Impact Assessment

The impact assessment methodology described below was provided by Clean Stream Environmental Consultants. Once the major potential impacts were identified, a further investigation was conducted in order to predict the nature of the impact. The criteria used to describe the nature of the impacts are shown below.

Table 1: Impact prediction criteria

Status of impact		
Positive	+	Impact will be beneficial to the environment (a benefit).
Negative	-	Impact will not be beneficial to the environment (a cost).
Neutral	0	Positive and negative impact (neutral).
Magnitude		
Minor	2	Negligible effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been altered significantly, and have little to no conservation importance (negligible sensitivity*).
Low	4	Minimal effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been largely modified, and / or have a low conservation importance (low sensitivity*).
Moderate	6	Notable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been moderately modified, and have a medium conservation importance (medium sensitivity*).
High	8	Considerable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been slightly modified and have a high conservation importance (high sensitivity*).

Very high	10	Severe effects on biophysical or social functions / processes. Includes areas / environmental aspects which have not previously been impacted upon and are pristine, thus of very high conservation importance (very high sensitivity*).
Extent of impact		
Site only	1	Effect limited to the site and its immediate surroundings.
Local	2	Effect limited to within 3-5 km of the site.
Regional	3	Activity will have an impact on a regional scale.
National	4	Activity will have an impact on a national scale.
International	5	Activity will have an impact on an international scale.
Duration of impact		
Immediate	1	Effect occurs periodically throughout the life of the activity.
Short term	2	Effect lasts for a period 0 to 5 years.
Medium term	3	Effect continues for a period between 5 and 15 years.
Long term	4	Effect will cease after the operational life of the activity either because of natural process or by human intervention.
Permanent	5	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
Probability of occurrence		
Improbable	1	Less than 30% chance of occurrence.
Low	2	Between 30 and 50% chance of occurrence.
Medium	3	Between 50 and 70% chance of occurrence.
High	4	Greater than 70% chance of occurrence.
Definite	5	Will occur, or where applicable has occurred, regardless or in spite of any mitigation measures.

Once the prediction components have been ranked for each impact, the significance of the potential impacts are evaluated (or calculated) using the following formula:

Significance = (Magnitude + Duration + Extent) x Probability

For each impact the extent (spatial scale), magnitude, duration (time scale) and the probability of occurrence were predicted and was used to determine the significance of each impact, with and without the implementation of the proposed mitigation measure.

A Significance Rating is calculated by multiplying the Severity Rating with the Probability Rating. Significance is therefore a product of the probability and the severity of the impact. Probability describes the likelihood of the impact occurring and severity is calculated from the sum of the factors given to magnitude, duration and extent.

The maximum value is 100 SP[1]. The unmitigated and mitigated scenarios for each environmental impact were rated as High (SP≥60), Moderate (SP 31-60) and Low (SP<30) significance as shown in **Table 2**.

[1] SP: Significant Points.

Table 2: Definition of significance rating (positive and negative)

Significance of predicted NEGATIVE impact		
Low	0-30	Where the impact will have a relatively small effect on the environment and will require minimum or no mitigation.
Medium	31-60	Where the impact can have an influence on the environment and should be mitigated.
High	61-100	Where the impact will definitely influence the environment and must be mitigated, where possible.
Significance of predicted POSITIVE impact		
Low	0-30	Where the impact will have a relatively small positive effect on the environment.
Medium	31-60	Where the positive impact will counteract an existing negative impact and result in an overall neutral effect on the environment.
High	61-100	Where the positive impact will improve the environment relative to baseline conditions.

Once the significance rating of an impact before mitigation has been determined, the reversibility of the impact, replaceability of the affected resources and the mitigatory potential of the impact can also be determined. These factors have been included in the EIAMAPs (Environmental Impact Assessment and Management Action Plan) below. These factors play an important role in the determination of the level and type of mitigation to be performed. **Table 3** provides the criteria used to assess the above mentioned factors.

Table 3: Mitigation prediction criteria

Reversibility of impact		
Reversible	1	The impact on natural, cultural and / or social structures, functions and processes is totally reversible.
Partially	2	The impact on natural, cultural and / or social structures, functions and processes is partially reversible.
Irreversible	3	Where natural, cultural and / or social structures, functions or processes are altered to the extent that it will permanently cease, i.e. impact is irreversible.
Irreplaceable loss of resources		
Replaceable	1	The impact will not result in the irreplaceable loss of resources.
Partially	2	The Impact will result in a partially irreplaceable loss of resources.
Irreplaceable	3	The impact will result in the irreplaceable loss of resources.
Potential of impacts to be mitigated		
High	1	High potential to mitigate negative impacts to the level of insignificant effects, or to improve management to enhance positive impacts.
Medium	2	Potential to mitigate negative impacts. However, the implementation of mitigation measures may still not prevent some negative effects.
Low	3	Little or no mechanism exists to mitigate negative impacts.

Once the mitigation prediction has been conducted the management and mitigation measures can be developed. The criteria used for prescribing and designing management measures for mitigation has been adopted from the Council on Environmental Quality Regulations (1998) and includes the following:

Table 4: Management Measures criteria

Management Measures	
Avoidance	Mitigation by not carrying out the proposed aspect or the unacceptable parts of the proposed aspect*.
Minimisation	Mitigation by scaling down the magnitude of a project, reorienting the layout of the project or employing technology that reduces the factors generating the undesirable environmental impact.
Rectification	Mitigation through the restoration of environments affected by the aspect.
Reduction	Mitigation by taking maintenance steps during the course of the aspect.
Compensation	Mitigation through the creation, enhancement or acquisition of environments similar to those affected by an aspect. This step should only be considered after all steps above have been completed. As a last resort, donation of land or money for a regional programme of habitat creation or enhancement could be considered.

* Note: For the purpose of this document aspect refers to actions and processes on site that may potentially have an environmental impact.

5. OVERVIEW OF UNTRANSFORMED VEGETATION UNITS WITHIN THE STUDY AREA

Although the original vegetation of the study area was Eastern Highveld Grassland, the terrestrial vegetation of most the study area has been transformed through cultivation and opencast mining, and the only remaining untransformed vegetation that is not degraded occurs along drainage lines and around sandstone outcrops or scarps. These few areas still contain intact vegetation that is representative of this threatened vegetation type. Other untransformed vegetation has been degraded by anthropogenic impacts such as heavy grazing by cattle and sheep (or in some cases exclusion of grazing by ungulates), altered fire regimes (in the form of reduced or increased frequency of burning and unseasonal burns), alterations to hydrological patterns and water quality, and various edge effects emanating from surrounding transformed areas.

The broad-scale vegetation units and land-cover type units described in De Castro (2010a) were selected so as to form practical vegetation/habitat units which could be used to produce an ecological sensitivity map which formed the basis for an ecological impact assessment for the TOP study area (de Castro, 2010b). Despite the high levels of transformation within the study area, the remaining fragments of untransformed habitat and vegetation remain highly diverse and species rich (α-diversity), as is reflected by the fact that 546 plant species were recorded during previous surveys (see references above). The Beta diversity (β-diversity), which is the 'rate of change in species composition across habitats or among communities' is also very high.

A total of four units comprising untransformed vegetation/habitat and six units comprising transformed vegetation/habitat were identified. It is the four untransformed vegetation units that are relevant to this report and these are summarised in Table 5 below.

Table 5: Untransformed Broad-scale vegetation units identified within the study area.

Vegetation and land-cover type units	**Typical vegetation and variations**
1a. Pan Wetlands	Includes ten endorheic pans, varying in size from the approximately 13ha Makoupan which holds permanent surface water to the small ephemeral pan of less than 0.25ha on the Farm Boschmansfontein 12 I.S. Unit includes the more or less permanently inundated area of the pan, the seasonally inundated area and the hillslope seeps grassland surrounding the pan. The upper parts of all the catchments of these pans have been transformed by ploughing.
1b. Valley-bottom wetlands – seasonal marsh wetlands of drainage lines	Includes the marsh vegetation and reedbeds of channelled and un-channelled valley-bottom wetlands occurring in the study area, most of which are part of the Zaaiwaterspruit and Tweefonteinspruit systems. Also includes the lower reaches of hillslope seep wetlands situated immediately adjacent to the valley-bottom wetlands.
2. Rocky scarp vegetation – shrubland, thicket, herbland and grassland mosaic of sandstone scarps	Closed Shrubland, Closed *Pteridium* Herbland , rocky grassland on scree slopes and cliff top seeps on low (1-6m) sandstone scarps comprising cliffs, linear boulder outcrops, scree slopes and steep grassland below cliffs.
3. Untransformed grassland	Grassland on deeper soils on flat to gently undulating terrain, but also includes sheet rock habitats with skeletal soils on crests, and grassland on hillslope seeps with temporary hydromorphic soils.

6. OVERVIEW OF SENSITIVITY OF UNTRANSFORMED VEGETATION UNITS WITHIN THE STUDY AREA

1a Pan Wetlands

These wetlands do not provide important habitat for any of the seven plant species of conservation concern recorded within the study area (see Table 7), but do provide habitat for two of the 21 protected (in terms of the Mpumalanga Nature Conservation Act) plant species recorded within the study area (see Table 8). However, this vegetation unit is likely to be of considerable importance as foraging habitat for a number of threatened and near-threatened bird species, such as Greater Flamingo (*Phoenicopterus ruber*), Chestnut-banded Plover (*Charadrius pallidus*) and Black-winged Pratincole (*Glareola nordmanni*), as well breeding and feeding habitat for the near-threatened Giant Bullfrog (*Pyxicephalus adspersus*) and the threatened Marsh Sylph Butterfly (*Metisella meninx)*. The vegetation of this unit is therefore considered to have a **High** sensitivity and value in terms of biodiversity conservation.

1b. Valley-bottom Wetlands – seasonal marsh wetlands of drainage lines

Valley-bottom Wetlands provide habitat for two (*Crinum bulbispermum* and *Gunnera perpensa*) of the seven plant species of conservation concern recorded within the study area (see Table 7), and for nine of the 21 protected (in terms of the Mpumalanga Nature Conservation Act) plant species recorded within the study area (see Table 8). These wetlands also provide breeding and / or feeding habitat for at least two near-threatened mammals, namely Serval (*Leptailurus serval*) and Water Rat (*Dasymys incomtus*), several threatened and near-threatened bird species, particularly African Marsh Harrier (*Circus ranivorus*) and African Grass Owl (*Tyto capensis*), and the threatened Marsh Sylph Butterfly. In addition, this vegetation unit is considered to be of elevated conservation importance for a number of reasons, such as important ecological functioning (maintaining water purity, reducing soil erosion), overall threatened status of the vegetation types in which they are embedded, etc. The vegetation of this unit is therefore considered to have a **High** sensitivity and value in terms of biodiversity conservation.

2. Rocky Scarp Vegetation – shrubland, thicket, herbland and grassland mosaic of sandstone scarps

The Scarp Vegetation unit provides habitat for three (*Boophone disticha, Callilepis leptophylla* and *Frithia humilis*) of the seven plant species of conservation concern recorded within the study area (see Table 7), and for eight of the 21 protected (in terms of the Mpumalanga Nature Conservation Act) plant species recorded within the study area (see Table 8). However, the Rocky Scarp Vegetation Unit is unlikely to provide habitat for most of the potentially occurring conservation-important fauna. The only species likely to utilise this unit for shelter or foraging habitat are Honey Badger (*Mellivora capensis*) and two small birds of prey, namely Peregrine Falcon (*Falco peregrinus*) and Lanner Falcon (*Falco biarmicus*). This vegetation unit does however constitute an important botanical refuge, which may contain unique ecotypes of various plant species. Rocky Scarp Vegetation is therefore considered to have a **High** sensitivity and value in terms of botanical biodiversity conservation.

3. Untransformed Grassland

The Untransformed Grassland vegetation unit provides habitat for five (*Boophone disticha, Callilepis leptophylla, Eucomis autumnalis* subsp. *clavata, Frithia humilis* and *Hypoxis hemerocallidea*) of the seven plant species of conservation concern recorded within the study area (see Table 7), and for ten of the 21 protected (in terms of the Mpumalanga Nature Conservation Act) plant species recorded within the study area (see Table 8). One of these species is the Endangered succulent *Frithia humilis*, which was recorded from prime sheetrock habitat within this unit, but also occurs in the transition zone between this unit and the Scarp Vegetation unit, which provides marginal habitat for this species.

Furthermore, the vegetation of this unit is representative of the Eastern Highveld Grassland vegetation type (Mucina & Rutherford, 2007), which is considered to be endangered at a national level. The fragments of untransformed grassland provide important breeding and / or foraging habitat for several near-threatened mammals, particularly Southern African Hedgehog (*Atelerix frontalis*), Serval and Honey Badger, and a number of threatened and near-threatened bird species, such as Southern Bald Ibis (*Geronticus calvus*), Lesser Kestrel (*Falco naumanni*) and Blue Korhaan (*Eupodotis caerulescens*). This vegetation unit is therefore considered to have a **High** sensitivity and value in terms of biodiversity conservation.

The percentage of the study area occupied by each of the untransformed broad-scale vegetation units, number of surveyed sites in each unit, mean species richness per $100m^2$, and perceived biodiversity conservation value / sensitivity of each unit is provided in Table 6. A vegetation / botanical biodiversity sensitivity map is provided in Figure 1.

Table 6: Percentage of the study area occupied by each of the identified broad-scale vegetation and land-cover type units, number of surveyed sites where sampling within $100m^2$ quadrats was undertaken within each unit, mean species richness per $100m^2$, and perceived biodiversity/conservation value of each unit.

Vegetation and land-cover type units	**Surface area (ha) covered by unit within study area**	***Number of $100m^2$ plots surveyed within unit**	**Mean species richness per $100m^2$ for plots surveyed**	**#Mean species richness per $100m^2$ for plots surveyed**	**Biodiversity Conservation Value or Ecological Sensitivity**
1a. Pan Wetlands	192.09	0 [species lists compiled and vegetation described at all 10 pans within study area]	-	-	High
1b. Valley-bottom wetlands – seasonal marsh wetlands of drainage lines	1 138.18	16 (11 and 5)	16.1	22.0 (16 and 28)	High
2. Rocky scarp vegetation – shrubland, thicket, herbland and grassland mosaic of sandstone scarps	40.96	6 (2 and 4)	35.0	37.1 (29 and 45)	High
3. Untransformed grassland	2 248.95	17 (8 and 9)	33.8	28.0 (22 and 37)	High

*Number of sites where quantitative sampling was undertaken within $100m^2$ sampling plots/quadrats. Numbers in brackets are the number of plots surveyed within the 9102ha 'original Tweefontein mineral rights area' and the number of plots surveyed within the 2917ha 'north-eastern portion' of Tweefontein, respectively.
#Numbers in brackets represent the measured sample minimum and sample maximum.

7. FLORA OF CONSERVATION IMPORTANCE

Threatened, Near Threatened and Declining species

Lists of historical occurrences of threatened species and other species of conservation concern (*sensu* Raimondo *et al*., 2009) were obtained from the PRECIS Database (South African National Biodiversity Institute) and PlantDat database (Mpumalanga Tourism & Parks Agency) for the quarter degree grids within which the study area is situated, namely 2629AA and 2529CC, as well as for five adjacent grids which contain similar grassland habitat, namely 2629AB, 2628BD, 2628BD, 2529CC and 2529CD). Threatened species are those that are currently facing a high risk of extinction, and are placed in the categories Critically Endangered, Endangered or Vulnerable. Species that are important for South Africa's decision-making processes are classified as Species of Conservation Concern. While this does include threatened species, it also includes other categories that are not considered threatened, namely Near Threatened, Critically Rare, Rare and Declining (Raimondo *et al*., 2009).

The obtained lists of historically recorded species of conservation concern included one threatened species, namely *Frithia humilis* (Endangered), two Near Threatened species, namely *Nerine gracilis* and *Gladiolus robertsoniae*, and three Declining species, namely *Callilepis leptophylla*, *Eucomis autumnalis* subsp. *clavata* and *Hypoxis hemerocallidea*. Four of these six species were confirmed during fieldwork and are listed in Table 7. Also included in Table 7, are three additional Declining species which have been recorded within the study area during 2013 surveys, namely *Crinum bulbispermum, Boophone disticha* and *Gunnera perpensa.*

The two species recorded historically in the general vicinity of the study area that were not confirmed during fieldwork are *Nerine gracilis* and *Gladiolus robertsoniae*, both of which are classified as Near Threatened. Fieldwork for the baseline vegetation survey was conducted during optimal flowering times and in optimal habitats for both species. It can therefore be stated that both species are most likely absent from the study area.

Table 7: List of Threatened Species and other Species of Conservation Concern occurring within the TOP study area.

Species	Family	Latest Conservation Status Category*	Vegetation or unit where recorded
Boophone disticha	Amaryllidaceae	Declining	2 & 3 (widespread but scarce within the study area)
Callilepis leptophylla	Asteraceae	Declining	2 & 3 (widespread but scarce within the study area)
Crinum bulbispermum	Amaryllidaceae	Declining	1b (Widespread and common within the study area along the Tweefonteinspruit, the Saaiwater and there tributaries.)
Eucomis autumnalis subsp. *clavata*	Hyacinthaceae	Declining	3 (Widespread but generally scarce within the study area in hygrophilous grassland on hillslope seeps.)
Frithia humilis	Mesembryanthemaceae	Endangered	3 & 2 (recorded only at Sites 11 and 7, on the farm

			Kliplaate)
Gunnera perpensa	Gunneraceae	Declining	1b (Recorded only from an unchannelled valley-bottom wetland directly below sandstone scarp at Site 38, which arises some 50m above sandstone cliffs.)
Hypoxis hemerocallidea	Hypoxidaceae	Declining	3 (widespread but scarce within the study area)

With the exception of *Frithia humilis*, which is categorised as Endangered and is discussed separately, all the species listed in Table 7 are categorised as Declining. This category is reserved for species which are not threatened or Near Threatened, but are declining as a result of over-utilisation, and therefore merit some conservation effort. All six of the aforementioned species have widespread distributions, which extend over the eastern half of South Africa, and all are common to abundant over much of their ranges. These species are not under any immediate threat of extinction, and all have been classified as species of conservation concern as a result of the fact that they are popular and heavily utilised medicinal plants, and there are concerns that long-term over utilisation of wild plants will lead to a decline in many of the populations of these species. Three of these six species (*Boophone disticha, Crinum bulbispermum* and *Eucomis autumnalis*) are protected plants for which, under Schedule 11 of the Mpumalanga Nature Conservation Act (Act no. 10 of 1998), a permit has to be obtained prior to their removal (see 'Protected plant species' section of this report). The threat from utilisation, and the conservation of these species within the study area, has been dealt with in detail in the medicinal plant report compiled for the study area (De Castro, 2009). *Callilepis leptophylla* is not known to be harvested within the study area and is therefore not dealt with in the medicinal plant report, and neither is *Gunnera perpensa* which was only recorded during the current field survey conducted in the north-eastern portion of the TOP study area. Of the remaining four species only *Crinum bulbispermum* is currently considered to be under threat from harvesting within the study area, and the medicinal plant report (De Castro, 2009) provides recommendations for limited monitoring of this species. An additional recommendation is that the recently discovered population of *Gunnera perpensa* at Site 38, should also be included in any periodic medicinal plant monitoring programme. All six of the above-mentioned medicinal plant species will furthermore benefit from increased access control to the study area as recommended in the medicinal plant report.

Frithia humilis, which is endemic to Mpumalanga and Gauteng, has been recorded from a total of 11, severely fragmented subpopulations (Raimondo *et al.,* 2009). These subpopulations continue to decline because of expanding informal settlements, overgrazing, invasion by alien plants and harvesting for horticultural purposes (Raimondo *et al.,* 2009). In the author's experience mining poses a significant threatened to this species, and of the two sub-populations previously recorded by the author, one has been almost entirely destroyed by mining, and the other is situated within a proposed opencast mining area. Of the 11 known sub-populations, three have been lost subsequent to their discovery as a result of habitat destruction (personal communication with Ms P. Burgoyne of SANBI). *Frithia humilis* is an extremely habitat specific species, and based on the published habitat descriptions and the authors own observations, the habitat of the colonies recorded within the study area is typical and very similar to that of other known populations. The three recorded colonies are all within 220m of each other on the upper slopes of gently undulating terrain. As a result of the fact that this highly threatened (Endangered) species is almost entirely restricted to the Mpumalanga Province and was until this survey known from only 11 sub-populations, most of which are under threat from a variety of impacts of which open-cast mining is possibly the most significant, *Frithia humilis* is regarded as the most important conservation priority within the study area.

Sensitive species

Though not species of conservation concern, three species confirmed to occur in the study area are considered to be sensitive. These three species are *Dierama mossii* (Iridaceae), *Kniphofia porphyrantha* (Asphodelaceae) and *Ornithogalum flexuosum* (Hyacinthaceae). All three species are confined to threatened wetland habitats, which are considered sensitive to development pressures such as mining.

Protected plant species

A number of plant species occurring in Mpumalanga Province are not considered to be threatened but are protected under Schedule 11 of the Mpumalanga Nature Conservation Act (No.10 of 1998). Twenty-one species recorded within the TOP study area are protected plants for which, under Schedule 11 of the Mpumalanga Nature Conservation Act (Act no. 10 of 1998), a permit has to be obtained prior to their removal. These twenty-one protected species are listed in Table 8 together with BMU's in which they have been recorded and those in which they are considered likely to occur.

Table 8: Plants occurring in the study area that are protected under Schedule 12 of the Mpumalanga Nature Conservation Act (No.10 of 1998).

Species	**Family**	**Vegetation / land-cover type unit**
Boophone disticha	Amaryllidaceae	3 & 2
Crinum bulbispermum	Amaryllidaceae	1b
Crinum cf. *graminicola*	Amaryllidaceae	3
Cyrtanthus breviflorus var. *breviflorus*	Amaryllidaceae	1b
Cyrtanthus contractus	Amaryllidaceae	1b, 2 & 3
Cyrtanthus tuckii	Amaryllidaceae	2
Disa woodii	Orchidaceae	1a & 1b
Eucomius autumnalis	Hyacinthaceae	1b & 3
Eulophia hians var. *hians*	Orchidaceae	3
Gladiolus cf. *antholyzoides*	Iridaceae	3
Gladiolus crassifolius	Iridaceae	3
Gladiolus dalenii	Iridaceae	2
Gladiolus elliotii	Iridaceae	3 & 1b
Gladiolus papilio	Iridaceae	1b
Habenaria epipactidea	Orchidaceae	3
Habenaria filicornis	Orchidaceae	1b
Habenaria nyikana	Orchidaceae	1a & 1b
Haemanthus humilis	Amaryllidaceae	2
Kniphofia porphyrantha	Asphodelaceae	2
Schizocarpus nervosus	Hyacinthaceae	2 & 3
Watsonia bella	Iridaceae	2

8. FAUNA OF CONSERVATION IMPORTANCE

A baseline assessment of the vertebrate fauna of Tweefontein Colliery study area was conducted by Engelbrecht (2010a) and incorporated into De Castro (2011). Although the environment at Tweefontein has been considerably modified through a combination of mining activities, agriculture and infrastructure development, it still hosts a surprisingly rich faunal diversity. The level of disturbance varies from moderate (e.g. grazing) to severe (e.g. open-cast mining). Nevertheless, there are small patches of untransformed grassland, particularly along the major drainage lines. These patches of grassland, valley-bottom wetlands (Tweefontein Spruit and Saaiwater Spruit) and pans make the largest contributions to the faunal diversity at the Tweefontein Complex. While secondary habitats and artificial wetlands do also attract significant numbers of birds, these are mostly generalist species, while habitat specialists are mostly absent from these habitats. Habitat loss and fragmentation is continuing in the general vicinity of the study area, resulting in a constant decrease in faunal diversity and reducing the capacity for species of conservation concern to move between fragments of untransformed vegetation.

Mammals

Much of the study area and surrounding areas have been transformed and extensively disturbed through mining, agriculture and urban spread. This habitat transformation, together with elevated human presence and impacts such as disturbance, hunting and persecution, has negatively impacted on large mammal occurrence, particularly ungulates and predators. As a result, mammals remaining in the study area are mostly small, cryptic and often nocturnal species that are adapted to live in close proximity to transformed ecosystems such as cultivated fields or urban developments. Larger mammals that are still present include Springbok (*Antidorcas marsupialis*), Common Duiker (*Sylvicapra grimmia*) and Bushpig (*Potamochoerus larvatus*). As noted by Engelbrecht (2010a), Bushpigs have spread into the Highveld grasslands through the provision of cover in the form of stands of invasive alien trees. They then enter croplands and wetlands in the evening to forage. Their foraging activities cause extensive damage to vegetation in wetlands, which is likely to have a negative impact on species of conservation concern that depend on wetland habitat.

One species of conservation concern was confirmed to occur in the study area during fieldwork, namely Serval (*Leptailurus serval*). Scats were found in untransformed grassland and hillslope seeps along a tributary of the Saaiwaterspruit in the central part of the study area. Serval is regularly reported during specialist surveys of Highveld grassland and wetland habitat (*pers.obs*.), with most evidence being in the form of scats. The preferred habitat on the Highveld is valley-bottom wetlands, but Serval have even been seen utilising narrows strips of grassland between large maize fields (D.McKenzie, *pers.comm*.). It is likely that natural habitat in the study area supports at least a few individuals which are possibly resident and thus likely to be affected by expanding mining activities.

An additional six mammal species of conservation concern potentially occur in untransformed vegetation fragments remaining in the study area and are dealt with in more detail below.

The Spotted-necked Otter (*Lutra maculicollis*) has been classified as Near Threatened by Friedman & Daly (2004). While this species is known as primarily an aquatic species which prefers large expanses of clear, relatively deep, open water such as large rivers, lakes and swamp areas, with plenty of cover along the edges (Skinner and Smithers, 1990), it has been noted as adapting to small Highveld streams and rivers, with regular sightings recorded by aquatic specialists working on the Highveld (Michiel Jonker, pers.comm.). Considering the disturbed nature of many of the wetlands in the study area, Spotted-necked otter is unlikely to be resident, although it may move into the area to forage.

Brown Hyaena (*Hyaena brunnea*) has been reported from the farm Elandsfontein 309 JS, about 5 km to the north of the TOPA study area (Engelbrecht 2010b). Brown Hyaena is a solitary forager which may travel between 30-50km in search of food and have home ranges ranging in size from approximately 19km^2 to 310 km^2 (Skinner & Smithers 1990). This species is primarily a nocturnal

scavenger, particularly in areas where it is persecuted. Recent records of Brown Hyaenas in the vicinity of Johannesburg and Pretoria indicate that this species can survive in close proximity to high numbers of people. However, given the size of their home ranges, it is unlikely that the study area will support a significant or viable sub-population and the proposed mining activities should have no significant impact on the individuals present, or on the overall conservation status of the species.

Southern African Hedgehog (*Atelerix frontalis*) has a wide habitat tolerance, from semi-arid to subtemperate habitats, often tolerating proximity of high human density. It is thus possible in any area of untransformed habitat within the study area. Honey Badger (*Mellivora capensis*) does occur on the Highveld, but it does so at very low densities, occurring in untransformed vegetation or even alien tree plantations, particularly where bee-keeping is practiced. If this species does occur within the study area, it is unlikely to be resident because of the fragmented nature of untransformed vegetation in the general vicinity and the relatively small size of grassland fragments. The Highveld Golden Mole (*Amblysomus septentrionalis*) is confined to Highveld grasslands of Mpumalanga, with an isolated population in the mountains between Bethlehem and Harrismith. It appears to be restricted to friable soils in valleys and on mountainsides, often occurring in meadows and edges of marshes in high-altitude grasslands. It has also been reported as being common in farmyards, gardens, golf courses, and present also in exotic plantations, though seemingly at lower densities (Bronner, 2008). Thus, any untransformed grassland and short-grass wetland habitat in the study area could support small numbers of this species and it is considered to have a moderate likelihood of being present.
Water Rat (*Dasymys incomtus*) is a widespread species in Africa, although in South Africa it is confined to the eastern and northern parts. Within its range it prefers channelled or unchannelled valley-bottom wetlands, rarely found far from water. It is absent over much of the Highveld, although there are specimen records from the Middelburg-Witbank area (Friedman & Daly, 2004). Water Rat has a moderate likelihood of occurring in valley-bottom wetlands along the Brugspruit.

Birds

The level of transformation of Highveld Grassland has had significant impacts on bird assemblages. It is probable that populations of seed-eating species such as Red-billed Quelea and Southern Red Bishop are much higher and less nomadic than in the past because of the planting of crops, resulting in a more predictable food supply. More sensitive grassland specialists such as Botha's Lark, Denham's Bustard, White-bellied Korhaan and Blue Crane have declined dramatically in numbers as their habitat has been reduced. Thus, any sizeable fragment of untransformed grassland should be considered very valuable to populations of conservation-important birds.

The quarter-degree grid in which the study area is situated (2629AA) has had a total of 171 bird species recorded thus far in the ongoing second South African Bird Atlas (SABAP2). Each quarter-degree grid is divided into nine mapping units (pentads) for the purposes of this atlas. The pentads 2600_2905 and 2600_2910, in which the study area is situated, have had a total of 130 species, or 76% of the species total for the entire grid 2629AA[2].

Six species of conservation concern were confirmed in the TOP study area by Engelbrecht (2010b) and a seventh species was recorded during this study. These are dealt with in more detail below.

African Marsh Harrier (*Circus ranivorus*) was recorded over a valley-bottom wetland in the TOP study area in 2006 (Engelbrecht 2010a) and has been recorded in both of the pentads in which the study area lies in recent years[3]. It is most likely to be a non-breeding visitor to valley-bottom wetlands anywhere in the study area, but because of the highly transformed nature of much of the habitat surrounding the wetlands it is unlikely to be resident. It has a conservation status of Vulnerable (Barnes, 2000).

[2] http://sabap2.adu.org.za/

[3] http://sabap2.adu.org.za/

Southern Bald Ibis (*Geronticus calvus*) is another Vulnerable species confirmed to occur in the TOP complex and reported in Engelbrecht (2010a). The species breeds on cliffs, often close to waterfalls, and is thus likely to be a non-breeding visitor to areas of Untransformed Grassland, especially soon after these have been burnt.

Lesser Kestrel (*Falco naumanni*) has been recorded as a non-breeding visitor to the TOP area on a number of occasions and reported in Engelbrecht (2006) and Engelbrecht (2010a). While its preferred foraging habitat is untransformed grassland, it will also hunt over secondary grassland, wetlands and cultivated lands. The birds usually roost colonially in large numbers, most often in stands of Eucalyptus trees. It is declining globally and has been assessed as Vulnerable (Barnes, 2000).

African Grass Owl (*Tyto capensis*) is the fourth Vulnerable species confirmed to occur in the TOP study area. It was recorded in a valley-bottom wetland and reported in Engelbrecht (2010a). A number of the valley-bottom wetlands in the study area are suitable breeding habitat for this species and it is likely to be a breeding resident in small numbers. However, since this species is cryptic and difficult to survey, it is not possible to get an accurate idea of numbers present without intensive fieldwork.

Several Greater Flamingo (*Phoenicopterus roseus*) were seen in the pans to the east of the study area and this area is likely to constitute regular foraging habitat for this species. Juveniles are occasionally seen at artificial waterbodies and could be irregular visitors to some of the dams in the study area. The species has been classified as Near Threatened (Barnes, 2000).

Two Lanner Falcons (*Falco biarmicus*), a Near Threatened species, were seen foraging over a pan in the eastern part of the study area and a single bird was seen hunting over untransformed grassland near the Zaaiwaterspruit during the current survey. These falcons are fairly widespread over the Highveld and potentially breed on the rocky scarp habitat on the eastern boundary of the study area.

The final species of conservation that has been confirmed in the TOP study area is Blue Korhaan (*Eupodotis caerulescens*), which is classified as Near Threatened (Barnes, 2000). Two birds were heard calling in a patch of untransformed grassland to the north of the Zaaiwaterspruit in the current survey. This species has adapted moderately well on the Highveld and is able to survive in small and highly fragmented grassland patches between maize fields (pers.obs.). It is likely to be resident in the study area in small numbers.

An additional seven bird species of conservation concern potentially occur because of the presence of suitable habitat. Two of these are threatened, both having a status of Vulnerable. Both Blue Crane (*Anthropoides paradiseus*) and White-bellied Korhaan (*Eupodotis senegalensis*) have a low likelihood of occurring in the remaining fragments of untransformed grassland in the study area, since both prefer significantly larger patches of less disturbed grassland. Of the remaining five Near Threatened species, Secretarybird (*Sagittarius serpentarius*) has a High likelihood of occurring as an infrequent visitor, since this species has been recorded in grassland fragments on the nearby farm Schoongezicht 308 JS in McCleland (2013). The large pans to the east of the TOPA area provide suitable habitat for two more Near Threatened species, namely Lesser Flamingo (*Phoenicopterus minor*) and Chestnut-banded Plover (*Charadrius pallidus*), both of which are likely to be irregular non-breeding visitors. A Near Threatened migrant from the Palearctic region, Black-winged Pratincole (*Glareola nordmanni*), is likely to be a non-breeding visitor to the patches of untransformed grassland, valley-bottom wetlands and pans in the study area. Peregrine Falcon (*Falco peregrinus*) occurs in small numbers on the Highveld, particularly where they are concentrations of seed-eating birds. It has also adapted to the lack of typical nesting habitat by breeding on maize silos. These falcons are likely to be irregular non-breeding visitors to the TOPA study area.

Reptiles & Frogs

While the Highveld does not have high numbers of threatened or near threatened reptiles, two species potentially occur and have been recorded on nearby properties (MTPA threatened species database, 2010). These are Transvaal Grass Lizard (*Chamaesaura aenea*) and Striped Harlequin Snake (*Homoroselaps dorsalis*). While the grass lizard does not have national threat status, it has been assessed by the MTPA and given a provincial status of Vulnerable. It occurs in scattered sub-populations in Escarpment and Highveld grasslands, usually in small numbers. It potentially occurs in the larger fragments of untransformed grassland in the study area. Striped Harlequin Snake has a national status of Near Threatened. It favours sandy areas with termitaria, so is only likely in the untransformed grassland fragments in the study area. However, it spends much of its time underground and is rarely seen and it is impossible to assess the likelihood of it occurring in the study area.

The only frog species of conservation concern that was confirmed in the study area by Engelbrecht (2010a) is Giant Bullfrog (*Pyxicephalus adspersus*), which has been assessed as Near Threatened (Minter *et al*., 2004). Ideal habitat for this species present, particularly in association with the pans along the eastern boundary and it is likely to be a breeding resident.

9. AREAS OF POTENTIAL CONFLICT

For the purposes of this report, areas of conflict are defined as areas that have been allocated High or Very High sensitivity over which potential mining infrastructure and pit layout have been proposed. Areas of potential conflict have been illustrated spatially in Figure 2 below. These areas have the potential to experience significant loss of biodiversity and loss of populations of species of conservation concern if developed. Planned mining activity that has resulted in these areas being identified are:

- Open-cast Pits;
- Underground Mining;
- Waste rock stockpiles;
- Tailings storage facilities;
- Associated mining infrastructure (haul roads, pipelines, fences, etc.).

These activities are likely to result in direct loss of habitat and / or populations of species of conservation concern, or indirect degradation of habitat quality through subsidence and / or groundwater loss through dewatering.

Key areas of potential conflict are the main wetland systems running through the centre of the TOP area, the patches of primary grassland scattered through the study area, particularly in the southern half of the study area, and the rocky scarp on the eastern boundary (Figure 2).

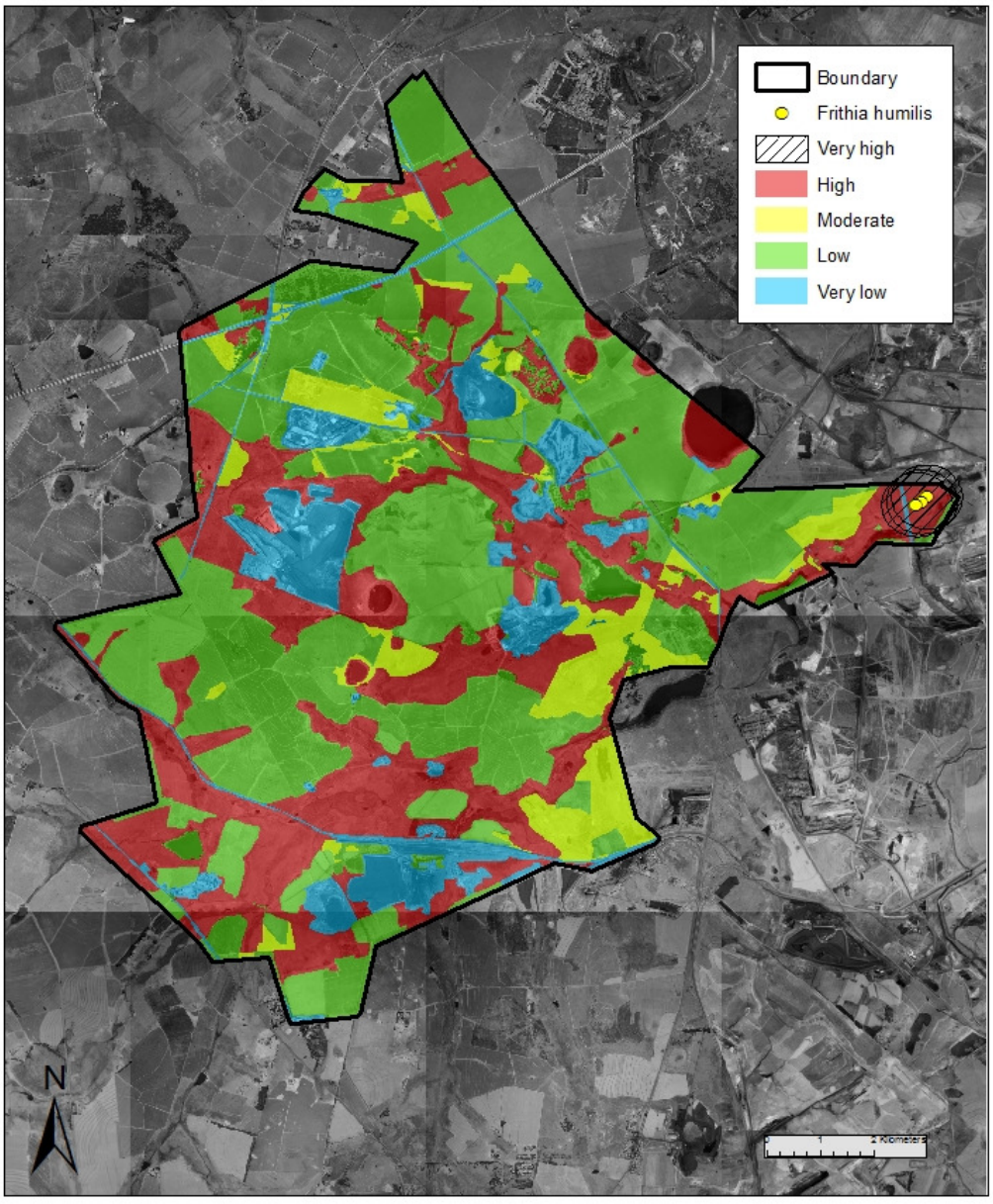

Figure 1: Vegetation sensitivity map for the TOP study area.

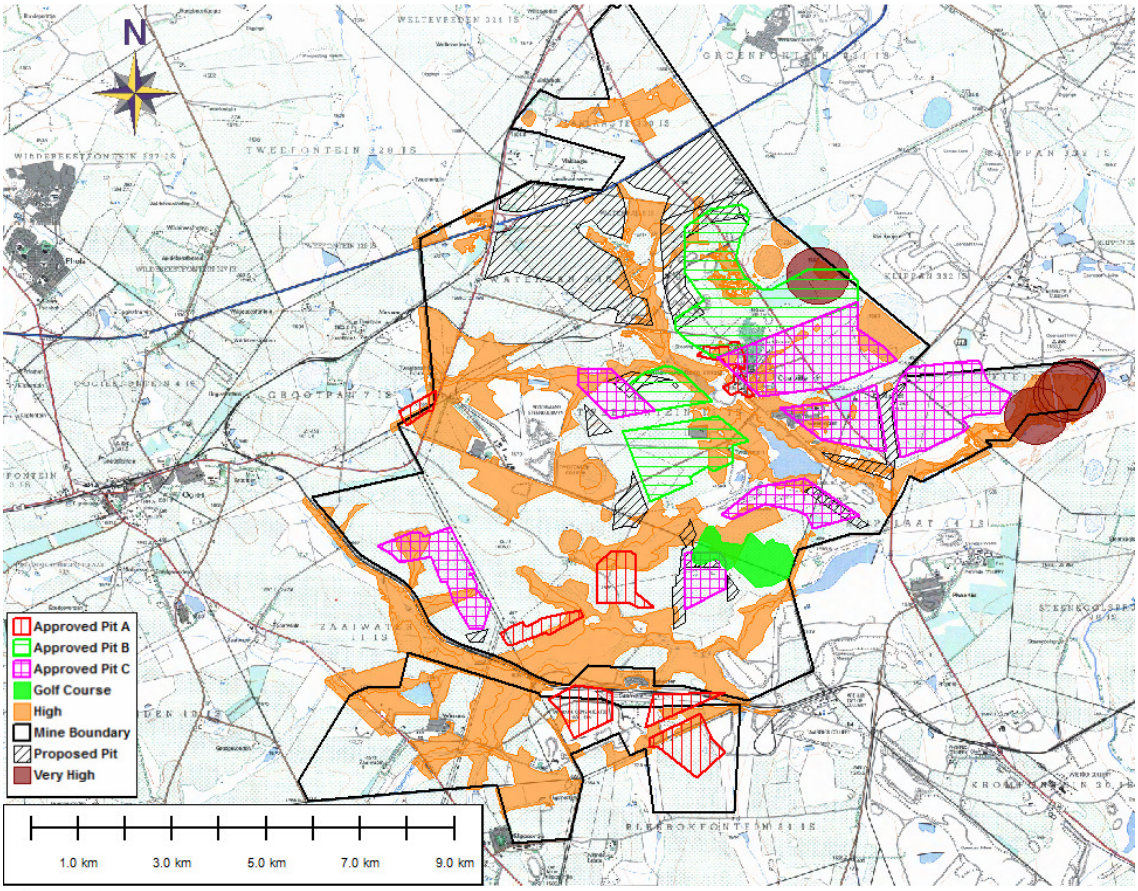

Figure 2. High and Very High Sensitivity Zones and areas of potential conflict with planned and approved pits.

10. ASSESSMENT OF IMPACTS

The potential impacts of mining in any given area can be broadly divided into two major categories, namely Direct Impacts in the form of destruction of plant communities and organisms within the footprint of proposed infrastructure, and Indirect Impacts or 'edge effects' to plant communities and organisms situated adjacent to the footprint of mining infrastructure. Such indirect impacts or edge effects include alien plant and animal invasion, alterations to hydrological regimes of ecosystems and various forms of air and water pollution. These impacts are described in more detail and the significance assessed in Appendix 2.

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Appendix 1. Flowering schedule of conservation-important plants in the study area.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Boophone disticha							■	■	■	■		
Callilepis leptophylla								■	■	■	■	
Crinum bulbispermum									■	■	■	■
Eucomis autumnalis subsp. *clavata*	■	■	■	■								■
Frithia humilis	■	■										■
Gunnera perpensa	■	■							■	■	■	■
Hypoxis hemerocallidea	■	■	■	■				■	■	■	■	■
Crinum cf. *graminicola*	■	■								■	■	■
Cyrtanthus breviflorus var. *breviflorus*	■	■	■	■	■	■	■	■	■	■	■	■
Cyrtanthus contractus								■	■	■		
Cyrtanthus tuckii								■	■	■	■	
Disa woodii									■	■	■	
Eulophia hians var. *hians*								■	■	■	■	
Gladiolus cf. *antholyzoides*	■	■	■	■					■	■	■	■
Gladiolus crassifolius		■	■	■								
Gladiolus dalenii	■	■	■	■					■	■	■	■
Gladiolus elliotii	■	■	■	■	■						■	■
Gladiolus papilio	■	■	■									■
Habenaria epipactidea	■	■	■									■
Habenaria filicornis	■	■	■									
Habenaria nyikana		■	■	■	■							
Haemanthus humilis											■	■
Kniphofia porphyrantha	■	■								■	■	■
Schizocarpus nervosus	■	■							■	■	■	■
Watsonia bella	■											■
	15	16	11	8	3	0	2	7	13	15	15	16

Appendix 2. Assessment of Impacts on Terrestrial Ecology in the TOPA Project.

Environmental Component	Potential Impact	Issue of Concern with I&APs	Rating									Mitigation management objectives and principles	Mitigation by design	Proposed Mitigation measures	Rating after mitigation				
		Yes / No	Status	Magnitude	Extent	Duration	Probability	Significance	Reversibility	Irreplaceable loss of resources	Potential of impacts to be mitigated				Magnitude	Extent	Duration	Probability	Significance
1. CONSTRUCTION PHASE (approx. 6 months - 1 year)																			
1.1 Opening of initial boxcuts for coal mining																			
Vegetation	A portion of high sensitivity vegetation that is representative of an Endangered vegetation type will be lost through clearing of vegetation.		-	8	1	5	5	70	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	5	2	24
	Six Declining species occur in or within close proximity to planned boxcuts and could be lost due to vegetation clearing.		-	6	1	4	4	44	2	2	2	Limit extent of impact.		Areas to be cleared of vegetation should be walked by a botanist prior to clearing and individuals of these species should be removed and relocated to similar adjacent habitat.	4	1	5	2	20

	Increased risk of invasion of cleared surfaces by alien plants.		-	4	2	5	4	44	2	1	2	Limit extent of impact.		Areas of bare soil need to be regularly monitored by a team trained in the recognition of invasive alien plants and the use of appropriate herbicides. This team should be responsible for the control of populations of alien plants that attempt to establish disturbed areas.	4	2	5	2	22
	Pollination corridors between fragments of untransformed vegetation will be disrupted or broken, resulted in reduced probability of pollination of plants in remaining fragments.		-	4	2	5	4	44	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids fragments of high sensitivity vegetation.	4	2	5	3	33
Fauna	Reduction of wetland and untransformed grassland habitat for fauna, which includes a number of threatened and near threatened mammals and birds, as well as a threatened butterfly.		-	6	1	4	4	44	2	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	4	2	22
	Increased human presence in the area will cause disturbance to fauna that were recorded on site. Of specific concern is disturbance of Red Data bird species, particularly African Grass Owl, African Marsh Harrier, Secretarybird and Blue Korhaan.		-	6	2	4	3	36	2	2	2	Limit extent of impact.		Areas of high sensitivity vegetation should be fenced off with a five-strand cattle fence which would not restrict movement of mammals such as Common Duiker; access to these areas should be strictly controlled by security staff.	4	2	4	2	20
1.2 Opening of initial boxcuts for sand and gravel mining (Borrow pits) for construction purposes																			

Vegetation	A portion of high sensitivity vegetation that is representative of an Endangered vegetation type will be lost through this activity.		-	8	1	5	5	70	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	5	2	22
	Six Declining species occur in or within close proximity to planned boxcuts		-	6	1	4	4	44	2	2	2	Limit extent of impact.		Areas to be cleared of vegetation should be walked by a botanist prior to clearing and individuals of these species should be removed and relocated to similar adjacent habitat.	4	1	5	2	20
	Increased risk of invasion of cleared surfaces by alien plants.		-	4	2	5	4	44	2	1	2	Limit extent of impact.		Areas of bare soil need to be regularly monitored by a team trained in the recognition of invasive alien plants and the use of appropriate herbicides. This team should be responsible for the control of populations of alien plants that attempt to establish disturbed areas.	4	2	5	2	22
	Pollination corridors between fragments of untransformed vegetation will be disrupted or broken, resulted in reduced probability of pollination of plants in remaining fragments.		-	4	2	5	4	44	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids fragments of high sensitivity vegetation.	4	2	5	3	33
Fauna	Reduction of wetland and untransformed grassland habitat for fauna, which includes a number of threatened and near threatened mammals and birds, as well as a threatened butterfly.		-	6	1	4	4	44	2	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	4	2	22

	Increased human presence in the area will cause disturbance to fauna that were recorded on site. Of specific concern is disturbance of Red Data bird species, particularly African Grass Owl, African Marsh Harrier, Secretarybird and Blue Korhaan.		-	6	2	4	3	36	2	2	2	Limit extent of impact.		Areas of high sensitivity vegetation should be fenced off with a five-strand cattle fence which would not restrict movement of mammals such as Common Duiker; access to these areas should be strictly controlled by security staff.	4	2	4	2	20
1.3 Construction of water management infrastructure																				
Vegetation	A small portion of high sensitivity vegetation that is representative of an Endangered vegetation type will be lost through this activity.		-	4	1	5	5	50	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	4	1	5	2	20
	Two Declining species occur in or within close proximity to planned infrastructure		-	4	1	4	4	36	2	2	2	Limit extent of impact.		Areas to be cleared of vegetation should be walked by a botanist prior to clearing and individuals of these species should be removed and relocated to similar adjacent habitat.	4	1	4	2	18
Fauna	Reduction of wetland and untransformed grassland habitat for fauna, which includes a number of threatened and near threatened mammals and birds, as well as a threatened butterfly.		-	4	1	4	4	36	2	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	4	1	4	2	18
	Increased human presence in the area will cause disturbance to fauna that were recorded on site. Of specific concern is disturbance of Red Data bird species, particularly African Grass Owl, African Marsh Harrier,		-	6	2	4	3	36	2	2	2	Limit extent of impact.		Areas of high sensitivity vegetation should be fenced off with a five-strand cattle fence which would not restrict movement of mammals such as Common Duiker; access to these areas should be strictly controlled by security	4	2	4	2	20

	Secretarybird and Blue Korhaan.													staff.				
1.4 Construction of waste management infrastructure																		
Vegetation	A portion of high sensitivity vegetation that is representative of an Endangered vegetation type will be lost through this activity.		-	6	1	5	5	60	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	5	2	24
	Two Declining species occur in or within close proximity to planned infrastructure		-	4	1	4	4	36	2	2	2	Limit extent of impact.		Areas to be cleared of vegetation should be walked by a botanist prior to clearing and individuals of these species should be removed and relocated to similar adjacent habitat.	4	1	4	2	18
	Pollination corridors between fragments of untransformed vegetation will be disrupted or broken, resulted in reduced probability of pollination of plants in remaining fragments.		-	4	2	5	4	44	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids fragments of high sensitivity vegetation.	4	2	5	2	22
Fauna	Reduction of wetland habitat for fauna, which includes a number of threatened and near threatened mammals and birds, as well as a threatened butterfly.		-	4	1	4	4	36	2	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	4	1	4	2	18
	Increased human presence in the area will cause disturbance to fauna that were recorded on site. Of specific concern is disturbance of Red Data bird species, particularly African Grass Owl, African Marsh Harrier, Secretarybird and Blue Korhaan.		-	6	2	4	3	36	2	2	2	Limit extent of impact.		Areas of high sensitivity vegetation should be fenced off with a five-strand cattle fence which would not restrict movement of mammals such as Common Duiker; access to these areas should be strictly controlled by security staff.	4	2	4	2	20

1.5 Construction of roads																		
Vegetation	A portion of high sensitivity vegetation that is representative of an Endangered vegetation type will be lost through this activity.		-	6	1	5	5	60	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	5	2	24
	Six Declining species occur in or within close proximity to planned roads		-	6	1	4	3	33	2	2	2	Limit extent of impact.		Areas to be cleared of vegetation should be walked by a botanist prior to clearing and individuals of these species should be removed and relocated to similar adjacent habitat.	6	1	4	2	22
Fauna	Reduction of wetland and untransformed grassland habitat for fauna, which includes a number of threatened and near threatened mammals and birds, as well as a threatened butterfly.		-	6	1	4	4	44	2	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	4	2	22
	Increased human presence in the area will cause disturbance to fauna that were recorded on site. Increase in vehicle activity can also lead to elevated road mortalities of fauna. Of specific concern is disturbance of Red Data bird species, particularly African Grass Owl, African Marsh Harrier, Secretarybird and Blue Korhaan.		-	6	2	4	3	36	2	2	2	Limit extent of impact.		Areas of high sensitivity vegetation should be fenced off with a five-strand cattle fence which would not restrict movement of mammals such as Common Duiker; access to these areas should be strictly controlled by security staff. Speed bumps should be built in roads where these cross areas of untransformed habitat. Vehicle driving speeds should be strictly controlled and driving at night should be limited.	4	1	4	2	18
1.6 Construction of general fencing on site																		

Fauna	Restriction of movement for some larger mammal fauna such as Common Duiker and Bushpig		-	2	1	3	3	18	1	1	2	Limit extent of impact.		Ensure that no large mammals present in areas to be fenced off prior to fence construction.	2	1	3	2	12
2. Operational Phase (approx. years)																			
2.1 Open cast mining of coal																			
Vegetation	Further loss of a portion of high sensitivity vegetation that is representative of an Endangered vegetation type through this activity.		-	8	1	5	5	70	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	5	2	24
	Further loss of six Declining species occur in or within close proximity to planned boxcuts		-	6	1	4	4	44	2	2	2	Limit extent of impact.		Areas to be cleared of vegetation should be walked by a botanist prior to clearing and individuals of these species should be removed and relocated to similar adjacent habitat.	6	1	4	2	22
	Further disruption of pollination corridors between fragments of untransformed vegetation, resulted in reduced probability of pollination of plants in remaining fragments.		-	4	2	5	4	44	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids fragments of high sensitivity vegetation.	4	2	5	3	33
Fauna	Further reduction of wetland and untransformed grassland habitat for fauna, which includes a number of threatened and near threatened mammals and birds, as well as a threatened butterfly.		-	6	1	4	4	44	2	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	4	2	22
	Increased human presence in the area will cause disturbance to fauna that were recorded on site. Of		-	6	2	4	3	36	2	2	2	Limit extent of impact.		Areas of high sensitivity vegetation should be fenced off with a five-strand cattle fence which would not restrict	6	2	4	2	24

	specific concern is disturbance of Red Data bird species, particularly African Grass Owl, African Marsh Harrier, Secretarybird and Blue Korhaan.												movement of mammals such as Common Duiker; access to these areas should be strictly controlled by security staff.						
2.2 Underground mining of coal																			
Vegetation	Loss of a portion of high sensitivity vegetation that is representative of an Endangered vegetation type through subsidence of soil.		-	**8**	**1**	**4**	**3**	**39**	**3**	**2**	**2**	To ensure that surface subsidence does not impact negatively on sensitive landscapes or biodiversity.		Ensure that sufficient pillars remain in the underground mine that the upper soil strata do not subside.	**6**	**1**	**4**	**2**	**22**
	Loss of six Declining species occur in or within close proximity to underground mining areas through subsidence of soil.		-	**6**	**1**	**4**	**4**	**44**	**2**	**2**	**2**	Limit extent of impact.		Areas of untransformed habitat above underground mining zones should be regularly monitored to ensure that subsidence is not taking place. If this is detected, then individual plants of Declining species should be relocated to adjacent similar habitat.	**6**	**1**	**4**	**2**	**22**
Fauna	Reduction of wetland and untransformed grassland habitat for fauna, which includes a number of threatened and near threatened mammals and birds, as well as a threatened butterfly, through subsidence of soil.		-	**6**	**1**	**4**	**4**	**44**	**2**	**2**	**2**	Limit extent of impact.		Ensure that sufficient pillars remain in the underground mine that the upper soil strata do not subside.	**6**	**1**	**4**	**2**	**22**
2.3 Opencast mining of sand and gravel (Borrow pits) for construction purposes																			
Vegetation	Further loss of a portion of high sensitivity vegetation that is representative of an Endangered vegetation type through this activity.		-	**8**	**1**	**5**	**5**	**70**	**3**	**2**	**2**	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	**6**	**1**	**5**	**2**	**24**

	Further loss of six Declining species occur in or within close proximity to planned boxcuts		-	6	1	4	4	44	2	2	2	Limit extent of impact.		Areas to be cleared of vegetation should be walked by a botanist prior to clearing and individuals of these species should be removed and relocated to similar adjacent habitat.	6	1	4	2	22
	Further disruption of pollination corridors between fragments of untransformed vegetation, resulted in reduced probability of pollination of plants in remaining fragments.		-	4	2	5	4	44	3	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids fragments of high sensitivity vegetation.	4	2	5	3	33
Fauna	Further reduction of wetland and untransformed grassland habitat for fauna, which includes a number of threatened and near threatened mammals and birds, as well as a threatened butterfly.		-	6	1	4	4	44	2	2	2	Limit extent of impact.		Ensure that mine infrastructure plan avoids areas of high sensitivity.	6	1	4	2	22
	Increased human presence in the area will cause disturbance to fauna that were recorded on site. Of specific concern is disturbance of Red Data bird species, particularly African Grass Owl, African Marsh Harrier, Secretarybird and Blue Korhaan.		-	6	2	4	3	36	2	2	2	Limit extent of impact.		Areas of high sensitivity vegetation should be fenced off with a five-strand cattle fence which would not restrict movement of mammals such as Common Duiker; access to these areas should be strictly controlled by security staff.	6	2	4	2	24
2.4 Use of roads																			
Vegetation	Vegetation smothered by excess dust produced by heavy vehicle activity		-	4	1	5	4	40	1	2	1	Limit extent of impact.		Dirt roads should be regularly wet in order to limit dust generation	4	1	5	1	10

Fauna	Excess speeding on roads, especially at night, will result in fauna mortality through collisions with vehicles		-	8	1	4	4	52	1	2	1	Limit extent of impact.		Enforce speed restrictions on roads and limit road access at night.	6	1	4	2	22
	Noise and dust generated by heavy vehicle activity on roads will disturb fauna		-	6	1	4	4	44	1	2	1	Limit extent of impact.		Dirt roads should be regularly wet in order to limit dust generation	6	1	4	2	22
3. Decommissioning Phase (after operational phase until closure goals are reached)																			
3.1 Rehabilitation of areas impacted by the mining and related activities within the Tweefontein Complex																			
Vegetation	Increased risk of invasion of cleared surfaces by alien plants.		-	4	2	5	4	44	2	1	2	Limit extent of impact.		Areas of bare soil need to be regularly monitored by a team trained in the recognition of invasive alien plants and the use of appropriate herbicides. This team should be responsible for the control of populations of alien plants that attempt to establish disturbed areas.	4	2	5	2	22
	Establishment of natural vegetation in previously transformed areas.		+	2	1	5	5	40	2	2	2	Increase extent of impact		Rehabilitation plan needs to be written into EMP. Realistic restoration goals need to be set and actions implemented in order to achieve goals. Establishment of a nursery utilising seed bank from adjacent untransformed habitat and topsoil stockpiles.	n/a	n/a	n/a	n/a	n/a
	Vegetation smothered by excess dust produced by heavy vehicle activity		-	4	1	5	4	40	1	2	1	Limit extent of impact.		Dirt roads should be regularly wet in order to limit dust generation	4	1	4	2	18

Fauna	Establishment of natural vegetation in previously transformed areas.		**+**	**2**	**1**	**5**	**5**	**40**	**1**	**2**	**1**	Increase extent of impact		Rehabilitation plan needs to be written into EMP. Realistic restoration goals need to be set and actions implemented in order to achieve goals. Establishment of a nursery utilising seed bank from adjacent untransformed habitat and topsoil stockpiles.	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
	Reduced human presence in the area.		**+**	**2**	**1**	**5**	**5**	**40**	**1**	**2**	**1**	Increase extent of impact		Control access of people into area and only have minimal staff needed on site.	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
3.2 Construction of Golf Course																		
Vegetation	Increased risk of invasion of cleared surfaces by alien plants, particularly grasses used to establish playing surfaces.		**-**	**4**	**2**	**5**	**4**	**44**	**2**	**1**	**2**	Limit extent of impact.		Areas of bare soil need to be regularly monitored by a team trained in the recognition of invasive alien plants and the use of appropriate herbicides. This team should be responsible for the control of populations of alien plants that attempt to establish disturbed areas.	**4**	**2**	**5**	**3**	**33**
Fauna	Establishment of natural vegetation in previously transformed areas.		**+**	**2**	**1**	**5**	**5**	**40**	**1**	**2**	**1**	Increase extent of impact		Belts of natural vegetation need to be included into the landscaping of the golf course, to allow movement of fauna into the area. Plants should include indigenous fruit-bearing species that will attract birds.	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**