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ASSESSMENT OF THE VEGETATION OF THE PROPOSED HEKPOORT-CASHAN SUBSTATION AND POWERLINE SERVITUDE

GJ Bredenkamp DSc PrSciNat

Commissioned by

SRK CONSULTING

October 2013, Revised April 2014

Final October 2014

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by

GJ Bredenkamp DSc PrSciNat

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SRK CONSULTING

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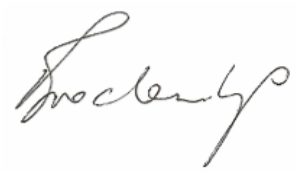
Contents

DECLARATION OF INDEPENDENCE

I, George Johannes Bredenkamp, Id 4602105019086, declare that I:

- Hold a DSc in biological sciences, am registered with SACNASP as a professional ecological scientist which sanctions me to function independently as a specialist consultant
- Declare that, as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003, this vegetation survey project was my work since appointed by SRK, reflects exclusively my observations and unbiased scientific interpretations, and was executed to the best of my ability
- abide by the Code of Ethics of the SACNASP
- Am the owner of Eco-Agent CC, CK 95/37116/23
- Act as an independent specialist consultant in the field of ecology, vegetation science and botany
- Am committed to biodiversity conservation but concomitantly recognize the need for economic development
- Am assigned as specialist consultant by SRK Consulting for the proposed project “Assessment of the vegetation of the proposed Hekpoort-Cashan substation and powerline servitude” described in this report
- Do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work performed
- Have or will not have any vested interest in the proposed activity proceeding
- Have no and will not engage in conflicting interests in the undertaking of the activity
- Undertake to disclose to the client and the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2010
- Will provide the client and competent authority with access to all information at my disposal, regarding this project, whether favourable or not.
- Reserve the right to only transfer my intellectual property contained in this report to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, I recognise that written consent from the client(s) will be required for me to release any part of this report to third parties.



GJ Bredenkamp

ASSIGNMENT

Eco-Agent CC Ecological Consultants were appointed by SRK Consulting to assess the vegetation for the proposed new Hekpoort-Cashan Eskom power line and the associated substations. This assignment is in accordance with the EIA Regulations (No. R. 545, Department of Environmental Affairs and Tourism, 18 June 2010) emanating from Part 5 of the National Environmental Management Act 1998 (Act No. 107 of 1998).

The assignment is interpreted as follows: Compile a study on the vegetation of the area proposed for the Hekpoort Eskom power line, and the associated substations, with emphasis on red data plant species that occur or may occur along the site. This report was submitted to SRK Consulting during October 2013.

On 25 August 2014 the scope of work on the Cashan project has changed and an alternative line has now been included in the project. A further quote to include the second alignment and change in substation position had to be submitted. This revised report includes the first and second alignments.

ABSTRACT

The vegetation and flora along the proposed alternative Hekpoort-Cashan power lines and the alternative proposed substations were investigated. Most of the area is covered with secondary vegetation that developed on old fields, or some highly disturbed areas. All these areas have low ecological sensitivity. Limited natural dense bush is present along both alternative routes. The proposed first power line as well as the alternative power will cross several small seasonal spruits. All spruit systems are regarded as ecologically sensitive, however, at all these localities the lines will easily span across the small spruits and will not affect the vegetation of the banks negatively. Locally both alternatives will have to transect the dense bush and here vegetation will have to be cleared. Care should be taken to avoid damage to the streams and stream banks. The pylons should be located far enough from the banks to avoid damage. Any damage caused to the spruits and spruit banks by the construction, should immediately be rehabilitated.

From the vegetation and flora assessment, any of the two proposed power lines and the substation can be supported, though little preference is given to the alternative power (southern) line alignment, as the vegetation along this route is more disturbed.

RATIONALE

It is widely recognised that it is of utmost importance to conserve natural resources in order to maintain ecological processes and life support systems for plants, animals and humans. To ensure that sustainable development takes place, it is therefore important that the environment is considered before relevant authorities approve any development. This led to legislation protecting the natural environment. The Environmental Conservation Act (Act 73 of 1989), the National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998) and the National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004) ensure the protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment. It also ensures the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes or products or human activities.

All components of the ecosystems (physical environment, vegetation, animals) of a site are interrelated and interdependent. A holistic approach is therefore imperative to effectively include the development, utilisation and where necessary conservation of the given natural resources in an integrated development plan, which will address all the needs of the modern human population (Bredenkamp & Brown 2001).

It is therefore necessary to make a thorough inventory of the plant communities and biodiversity along the alternative transects of the proposed Eskom line, their biota and their associated habitats (i.e. ecosystems), in order to evaluate the biodiversity and possible rare species. This inventory should then serve as a scientific and ecological basis for the planning exercises.

Authoritative legislation that lists impacts and activities on natural areas, including wetlands and riparian areas that requires authorisation includes (Armstrong, 2009):

- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983);
- Environment Conservation Act, 1989 (Act 73 of 1989);
- National Water Act, 1998 (Act 36 of 1998);
- National Forests Act, 1998 (Act 84 of 1998);
- National Environmental Management Act, 1998 (Act No. 107 of 1998);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).

THE AREA

The route the Alternative 1 power line runs from the proposed new Cashan substation eastwards along a small farm road, pass south of a small farm dam, runs along a furrow that feeds the dam, crosses the furrow and a spruit and runs through or along dense bush and eventually turns north along the R563, mainly along cultivated fields, then turns north-eastwards along the R560 and finally turns southwards to the existing Hekpoort substation, where it also crosses a small spruit before entering the substation.

The route of the Alternative 2 power line runs from the proposed new Cashan power (similar to Alternative 1) line eastwards along a small farm road, pass south of a small farm dam, runs along a furrow that feeds the dam, crosses the furrow and a spruit and runs through or along dense bush. It does however not turn northwards along the R563, but crosses the R563, remains along the small road until it reaches the Hekpoort substation.

Most of both the Alternative power lines run through Gauteng Province, within the City of Tshwane Metropolitan Municipality, while the eastern end of the line and Hekpoort substation apparently fall within North West Province and the Bojanala Platinum District Municipality (Fig. 1).

The R560 road in this area runs more or less parallel to the Magaliesberg range to the north and the Witwatersberg (linking eastwards to the Daspoortrand) to the south, and passes just south of the Magaliesrivier that drains the valley between the ranges as it runs northeast into the Hartebeestpoort Dam (Fig. 2). The power line will pass through a series of properties that are engaged in various forms of agriculture, based mainly in the sandy and loamy soils that have accumulated from the northern slopes of the Witwatersberg, and these sands are also quarried closer to the range. Water runs north off the Witwatersberg in small northwest-draining tributaries to the Magaliesrivier, besides forming seepages in the deep sands along the base of the Witwatersberg. The power line is apparently intended to conduct additional power to Hekpoort village, including the informal settlements evident on its eastern side and around the proposed new western substation.

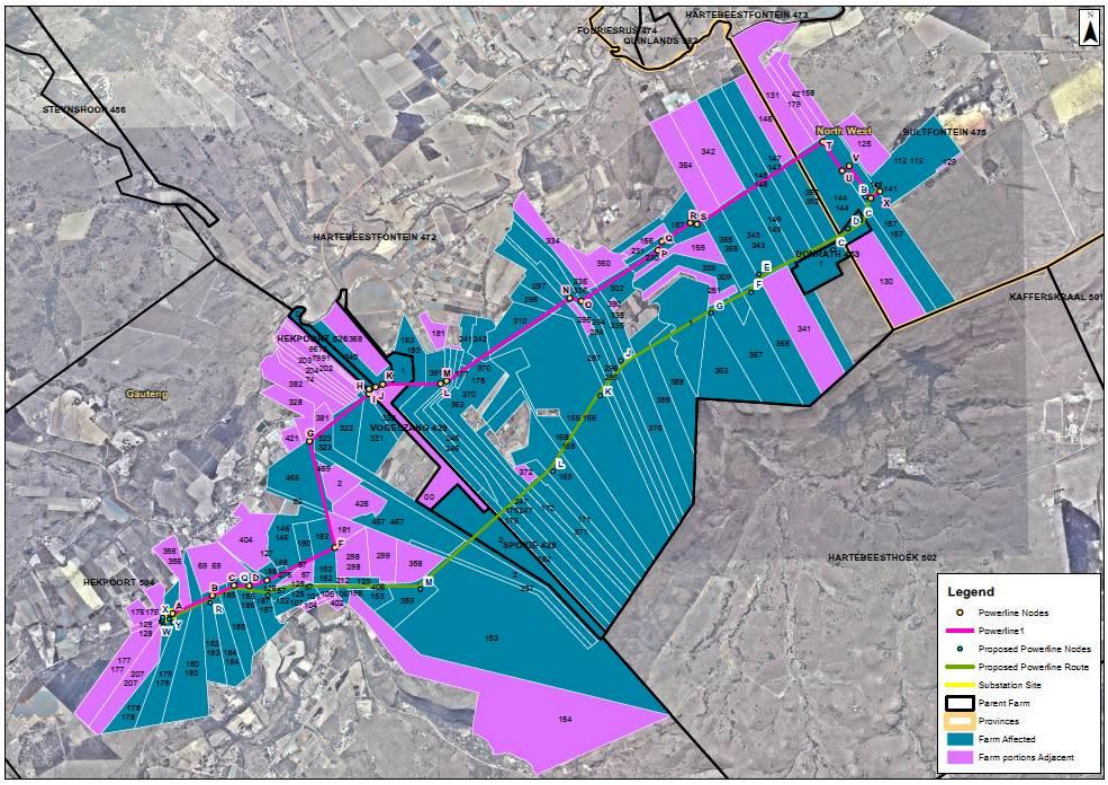


Figure 1: Image showing the alignment of the initially proposed power line 1 (purple line), extended to the south-west; and the newly proposed power line (green line)

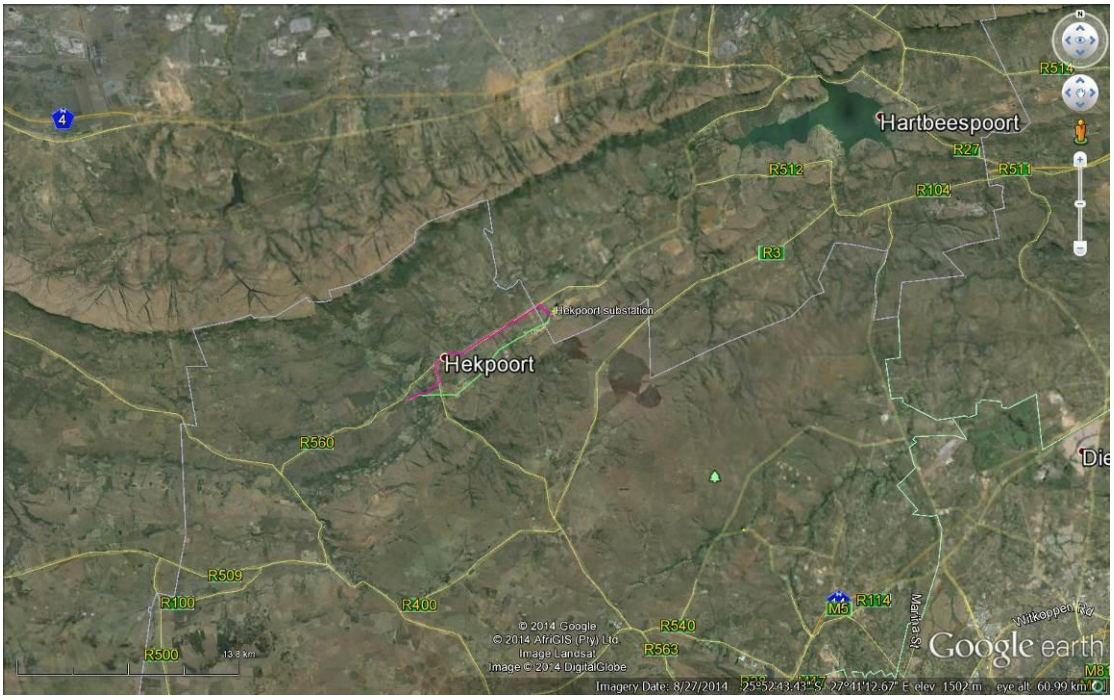
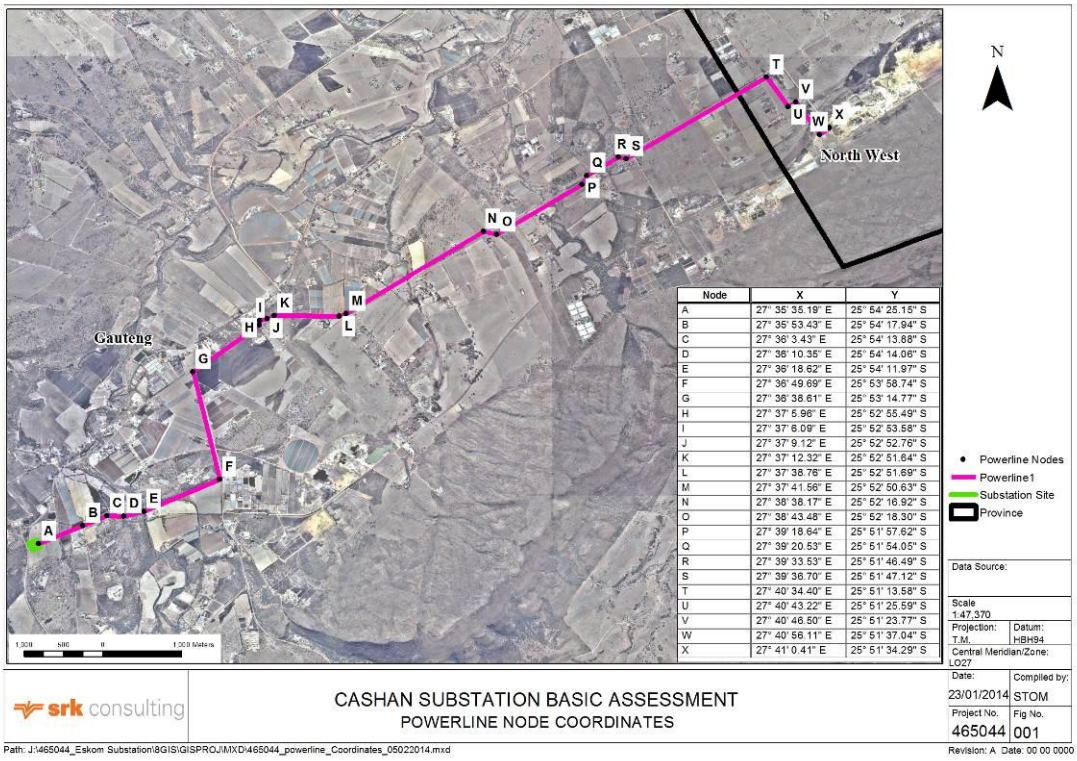


Figure 2: Satellite image showing the approximate position of the general study site area relative to the Magaliesberg and Witwatersrand ranges, Hartebeestpoort Dam and major road network



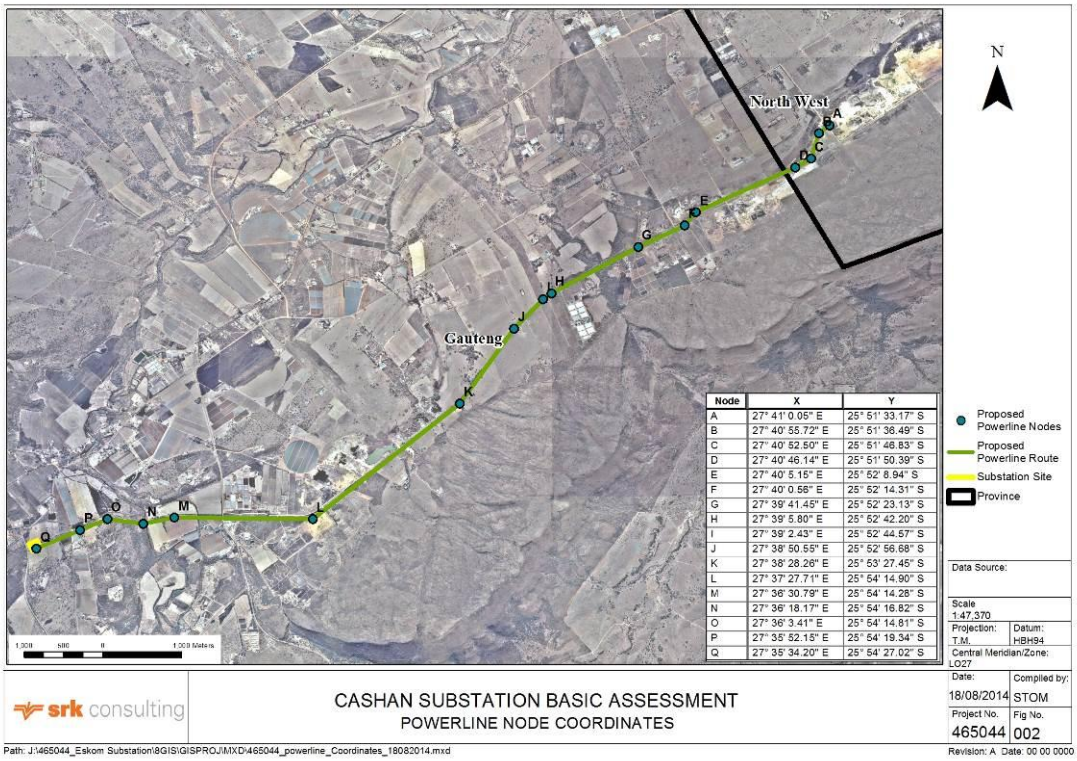


Figure 3: The co-ordinates of the proposed alternative power lines

The line passes through a series of properties engaged in various forms of agriculture (Fig. 1), based in the loamy and sandy soils that have accumulated from

the northern slopes of the Witwatersberg, and these sands are also quarried closer to the range. These sands also drain off water in small northwest-running tributaries to the Magaliesrivier, besides forming seepages along the southern base of the Witwatersberg.

The co-ordinates of the two Alternative power lines are given in Figure 3.

The following applies:

- The sites and transect do not fall in a protected area or conservancy.
- The lines will cross spruits.
- No natural hills or ridges occur on the transect areas, though the line runs parallel to the Magaliesberg in the north and the Witwatersberg in the south.

RECEIVING ENVIRONMENT

Regional Climate

The study area experiences austral summer rainfall and very dry winters, the mean annual precipitation being 650-700 mm. Extreme temperatures (at Pretoria) are from 33.6^{o}C in January to -3.1^{o}C in June, and frost is frequent in winter.

Geology and soils

Soils in the Magaliesrivier valley derive from the ranges on either side, stony with patches of clay and loam on the higher slopes, but sandier lower down before the more apedal and clayey soils on the valley floor and closer to the river. The deep yellow and red sands are exposed along the northern base of the Witwatersberg where the ground cover has been removed for commercial sand extraction (Fig. 4).

Topography and drainage

The Magaliesrivier valley is at an altitude of about 1300-1250 m a.s.l. It slopes and drains to the northeast, where it enters the Hartebeestpoort Dam. The main runoff into the river comes from the shallow and wider northern slopes of the Witwatersberg to the south, with less from the steep and narrower southern slopes of the Magaliesberg to the north. Runoff across the study site is predominately to the north, beginning as seeps within the sandy soils accumulated at the base of the Witwatersberg and then forming a few deeper drainage lines as southern tributaries to the Magaliesrivier.

Land Use

The predominant land use on and around the study site is agriculture, with few small patches of relatively natural vegetation remaining. The habitat has been transformed by everything from heavy grazing and mowing to ploughed croplands, many of them now fallow for different periods. Much of the remaining grassland is secondary, interspersed with the altered habitats around farmyards and the various hospitality and chicken-rearing operations.

Vegetation Types

The site is situated within the Mixed Bushveld veld type as described by Acocks (1988). Low & Rebelo (1996) also described the vegetation of the area as Mixed Bushveld. The floor of the valley supports Moot Plains Bushveld (vegetation type SVcb8 of Mucina & Rutherford 2006); with the mountain ranges on either side supporting Gold Reef Mountain Bushveld (SVcb9). The sour, mixed bushveld on the valley floor of the Magaliesrivier is dominated by various *Acacia* species, generally denser on the more clayey soils along the drainage slopes and lines, and more open with a well-developed grass layer in the higher, flatter and sandier areas. This grades into and becomes more wooded towards the adjoining mountain bushveld habitat that does not occur on the site and is best developed along the steeper southern aspects of the ranges.

Conservation status of habitats

The valley floor habitat is classified as 'vulnerable', mainly due to development resulting from its higher agricultural potential, as exhibited by the extensive transformation along the study site, but also due to the invasion of a range of alien plant species evident on site. Signs of erosion were generally few, except in the southern areas where sand extraction had removed the ground cover. The mountain habitats on either side are much better conserved and only 'least threatened', especially within the extensive Magaliesberg Nature Area to the north, but with other smaller conservancies of importance to the south such as the Cradle of Humankind World Heritage Site and the Rhino and Lion Nature Reserve.

METHODS

The field survey was done by Prof GJ Bredenkamp, accompanied by Dr AC Kemp (ornithologist) on 4 October 2013, when the vegetation of the route was assessed. The survey was done before the rainy season commenced, with the herbaceous layer of the vegetation still in a dormant condition. Additional fieldwork for the changes to the alignment of the Alternative 1 power line and the newly added Alternative 2 power line, was done during October 2014.

The vegetation communities found along the transect and the relevant substation was identified on recent aerial photographs of the area. At the substation site and along the proposed power lines a description of the dominant and characteristic species was made. These descriptions were based on total floristic composition, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). Data recorded included a list of the plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents was therefore derived for each plant community / ecosystem present on the site. These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Mucina *et al*. 2000) and are considered to be an efficient method of describing vegetation and capturing species information. Notes were additionally made of any other features that might have an ecological influence.

The identified systems are described in terms of their plant species composition, and evaluated in terms of the potential habitat for red data plant species.

Some species could not be identified, due to dormancy during the dry survey period, before the summer rains.

Red data plant species for the area were obtained from the SANBI data bases, with updated threatened status, (Raimondo *et al.* 2009). These lists were then evaluated in terms of habitat available on the site, and also in terms of the present development and presence of man in the area.

Alien invasive species, according to the Conservation of Agricultural Resources Act (Act No.43 of 1983) as listed in Henderson (2001), are indicated.

Medicinal plants are indicated according to Van Wyk, Van Oudthoorn & Gericke (1997),

The following **conservation priority** / **sensitivity** categories were used for each site:

High: Ecologically sensitive and valuable land with high species richness and/or sensitive ecosystems that should be conserved and no developed allowed.

Medium-high: Land where smaller sections are disturbed but which is in general ecologically sensitive to development/disturbances.

Medium: Land that should be conserved but on which low impact development could be considered under exceptional circumstances.

Medium-low: Land of which small sections could be considered to conserve but where the area in general has little conservation value.

Low: Land that has little conservation value and that could be considered for developed with little to no impact on the vegetation.

Plant species recorded in each plant community with an indication of the status of the species by using the following symbols:

A = Alien woody species
D = Dominant
d = subdominant
G = Planted in Garden (Garden Escape)
M = Medicinal plant species
P = Protected trees species
p = Provincial protected species
RD = Red data listed plant
W = weed

This report should **not** be considered as a wetland specialist report, however, the wetlands, spruits and rivers were investigated as part of the vegetation and flora survey.

RESULTS:

VEGETATION AND FLORA

Large areas within the study area are covered with either agriculture or old fields of previous agricultural practices. Consequently much of the vegetation is secondary. The areas along the spruits could not be ploughed and here riparian bush is found. Limited primary natural vegetation occur along the transects.

The vegetation (plant communities) of the entire area that will be crossed by the two alternative power lines and the new substation is described in the following section.

The vegetation and sensitivity maps are given in Figures 4 and 5 respectively.

The following plant communities occur on the study area:

No	Plant Community	Sensitivity
1	Agriculture / Old Fields on Cashan substation site	Low
2	Old Fields with *Vachellia karroo* shrubs	Low
3	Spruits	High
4	Current Agriculture	Low
5	Old fields / planted pasture	Low
6	Dense bush	Medium
7	Highly disturbed areas	Low

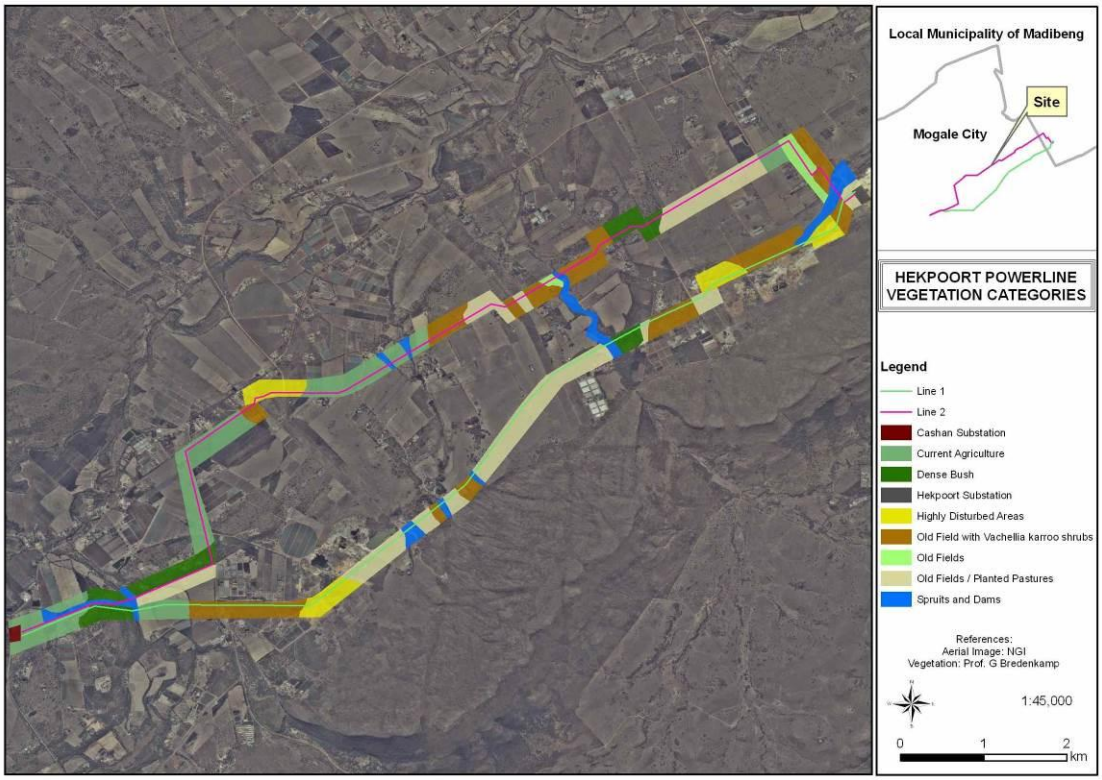


Figure 4: Vegetation map of the area

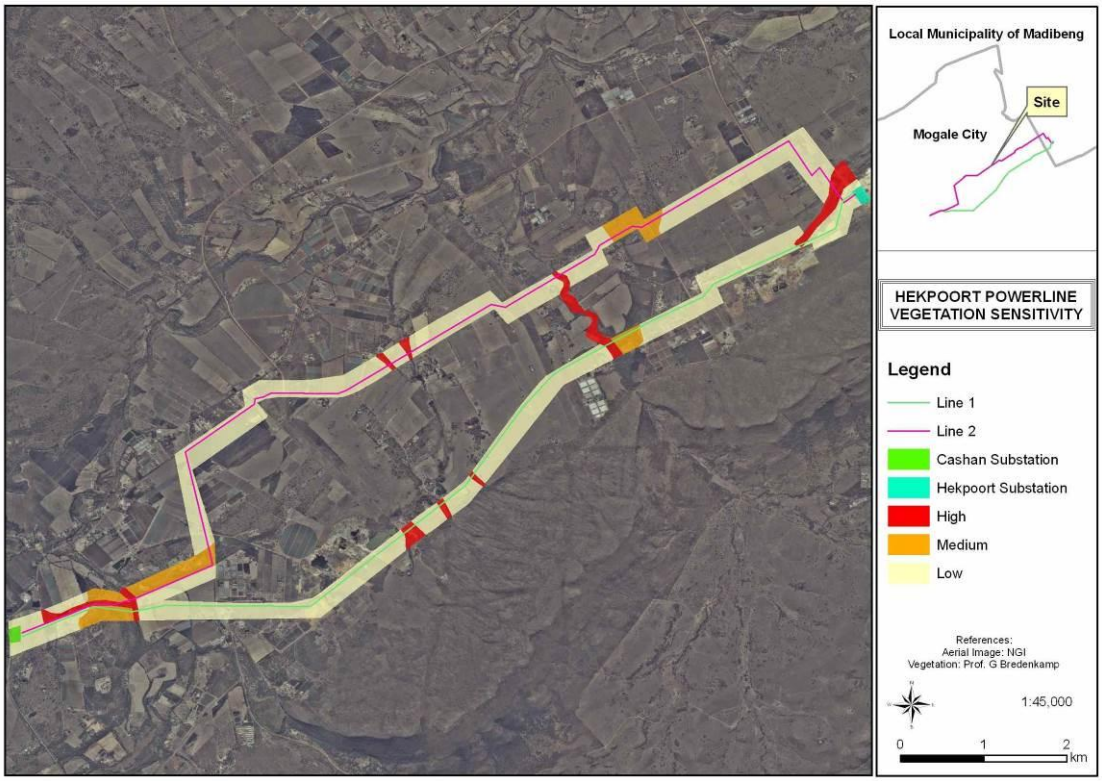


Figure 5: Sensitivity map of the area

DESCRIPTION OF THE VEGETATION AT THE NEW SUBSTATION SITE

1. Agriculture / old field on substation site

The vegetation at the substation site 25° 54' 26"S; 27° 35' 34"E is an old field / current agriculture. No plant species of concern grows on the site, but close-by the plant species are *Aristida congesta, Aristida adscensionis* and *Cynodon dactylon,* however tall-growing *Hyparrhenia hirta* is locally present. On the fringes some *Vachellia karroo* (new official name for *Acacia karroo*) shrubs may be present.

1. Old field on Cashan substation site			
Status	Current Agriculture / Degraded secondary vegetation		
Soil	brown clay loam	**Rockiness**	0%
Conservation value:	Low	**Ecological sensitivity**	Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Aristida congesta, Aristida adscensionis, Cynodon dactylon*		

The following plant species were recorded at or close to this site:

Trees and shrubs

Acacia karroo

Grasses

Aristida adscensionis	d	*Cynodon dactylon*	d
Aristida congesta	d		

Forbs

Conyza bonariensis	W	*Schkuhria pinnata*	W
Conyza podocephala		*Tagetes minuta*	W
Felicia muricata		*Verbena aristigera*	W
Pentarrhinum insipidum		*Verbena bonariensis*	W

Discussion

The conservation value and ecological sensitivity are both low. The vegetation of the site is highly disturbed due to agriculture and the construction of the proposed Cashan substation can be supported.

THE DESCRIPTION OF THE VEGETATION ALONG THE ROUTE OF THE PROPOSED POWER LINE

2. Old fields with *Acacia karroo* shrubs

Several patches of this type of vegetation occur at various localities along the routes of both alternative power lines (Fig. 4). The vegetation is old field with recovered, secondary vegetation. The vegetation is sparse grassland dominated by *Hyparrhenia hirta, Cynodon dactylon* and *Aristida congesta.* Short *Vachellia karroo* shrubs (1-2 m high) occur scattered over the area (Figure 8). The vegetation is grazed by cattle.

2. Old fields with *Vachellia karroo* shrubs			
Status	Mostly secondary grassland that recovered on old fields		
Soil	brown clay loam	**Rockiness**	0-1%
Conservation value:	Low	**Ecological sensitivity**	Low
Agricultural potential:	High	**Need for rehabilitation**	Low
Dominant spp.	*Aristida congesta, Cynodon dactylon, Hyparrhenia hirta, Vachellia karroo*		

The following plant species were recorded in this plant community:

Trees and shrubs, dwarf shrubs

Vachellia karroo	M	*Stoebe vulgaris*	
Clematis brachiata			

Grasses

Aristida congesta	d	*Heteropogon contortus*	
Cynodon dactylon	d	*Hyparrhenia hirta*	d
Eragrostis curvula			

Forbs

Commelina africana	*Felicia muricata*
Conyza podocephala	*Gazania krebsiana*

Geigeria burkei		*Polygala hottentotta*	
Gnidia capitata		*Plantago lanceolata*	
Gomphocarpus fruticosus	W	*Rhynchosia totta*	
Helichrysum rugulosum		*Schkuhria pinnata*	MW
Lactuca inermis	W	*Tagetes minuta*	W

These patches of secondary grassland are quite widespread over both the transect routes. The conservation value and sensitivity in general are regarded as Low. The power lines can be supported in these habitats.

Figure 6: The Old fields with recovered secondary vegetation. Note the small *Vachellia karroo* shrubs

3. Spruits

Both alternative power lines will have to cross spruits.

Alternative 1 will cross five small spruits

- **1.1** Small spruit close to the proposed Cashan substation, at approximately 25^{o} 54' 12.0" S; 27^{o} 36' 18.8" E. This is a narrow spruit that originates on the south-facing slopes of the Witwatersberg and flows in a northerly direction. The riparian vegetation is quite dense, merging into dense bush on both sides of the spruit. On the southern side some of the dense bush has been cleared for (former) agriculture. Generally the woody species on the spruit banks include the indigenous *Combretum erythrophyllum, Searsia lancea, Acacia karroo, Ziziphus mucronata* and the alien *Melia azedarach* and *Morus alba.* Locally in the spruit the alien invader *Sesbania punicea* was present, while the sedges *Cyperus textilis,* and the grasses *Hyparrhenia dregeana* and *Hyparrhenia tamba* are locally present.

  Note that between the substation and this spruit crossing the power line runs along a small dam and a furrow feeding into the dam.

- **1.2** Much further east, on the northern side of the R560 road, are two small spruits crossings close to each other. The first is very small, hardly noticeable, at approximately 25^{o} 52' 40.1" S; 27^{o} 37' 59.3" E, situated between agricultural lands. Just a few shrubs mainly *Vachellia karroo* occur in this drainage line.

  The second spruit crossing just east of the first is at approximately 25^{o} 52' 35.9"S; 27^{o} 38' 06.2" E. Here the power line will cross the spruit close to a dam, the vegetation being mainly *Typha capensis.* On the banks of the river the alien *Pyracantha angustifolia* and *Morus alba* were found. These alien trees should be removed as they infest the rivers. On the sides of the river the grass was mowed, containing mainly *Eragrostis curvula* and *Cynodon dactylon.* Other herbaceous species present are *Plantago lanceolata* and *Oenothera rosea.* Just north-east of the spruit crossing is an alley (remains) of indigenous trees of *Searsia lancea* and *Combretum erythrophyllum.*

- **1.3** The power line crosses the R560 road so that the next spruit crossing is south of the R560 road at approximately 25^{o} 52' 05.3" S; 27^{o} 39' 05.0" E. At this

spruit dense trees are present on the river banks. The woody species include the indigenous *Combretum erythrophyllum, Searsia lancea, Acacia karroo, Ziziphus mucronata* and the alien *Melia azedarach* and *Morus alba.* In the spruit the alien invader *Sesbania punicea* was present, while the sedges *Cyperus textilis, Typha capensis* and the grasses *Hyparrhenia dregeana* and *Hyparrhenia tamba* are locally present.

- **1.4** At the spruit crossing close to the Hekpoort substation at approximately 25^{o} 51' 33.6" S; 27 40 53.3 E. The power line will cross the spruit just above a small dam. This spruit is highly disturbed; it is close to the Hekpoort substation and had been highly affected by the sand mining activities in this area. The river banks are covered with *Stoebe vulgaris.* Locally in wetter areas *Typha capensis, Phragmites australis, Paspalum dilatatum,* and *Imperata cylindrica* are found. Woody species on the banks include the indigenous *Searsia lancea, Searsia pyroides* and the alien *Melia azedarach.*

Alternative 2 will cross seven small spruits

- **2.1** The first spruit crossing of the Alternative 2 power line is very to the Cashan substation, just south of the crossing point of the Alternative 1 line, but south of the small farm road at approximately 25^{o} 54' 12.0" S; 27^{o} 36' 18.8" E. The stream is somewhat narrower, but the riparian vegetation is quite similar to that of the Alternative 1 crossing namely quite dense, merging into dense bush west of the spruit. East of the stream is agriculture. Generally the woody species on the spruit banks include the indigenous *Combretum erythrophyllum, Searsia lancea, Acacia karroo, Ziziphus mucronata* and the alien species *Morus alba.* Locally in the spruit the sedge *Cyperus textilis* and the grass *Hyparrhenia dregeana* are present.
- **2.2** A second group of four very small spruits occur close to each other, all originating on the Witwatersberg slopes south of the power line alignment. Only a few small shrubs occur in these small drainage lines. The general area is quite disturbed. The southern slopes of the Witwatersberg are located just south of the power line transect.

  The co-ordinates of the four streams are as follows:

  25^{o} 53' 45.0" S; 27^{o} 38' 04.1" E

  25^{o} 53' 43.7" S; 27^{o} 38' 07.4" E

  25^{o} 53' 34.4" S; 27^{o} 38' 19.5" E

25° 53’ 23.4” S; 27° 38’ 31.3” E

- **2.3** At the next spruit crossing at approximately 25° 52’ 31.3” S; 27° 39’ 26.4” E dense trees are present on the river banks. The woody species include the indigenous *Combretum erythrophyllum, Searsia lancea, Acacia karroo, Ziziphus mucronata* and the alien *Morus alba.* Some sedges e.g. *Cyperus textilis* and few grasses are locally present. On the eastern side of the spruit the riparian bush grades into dense bush(see below). The western side of the spruit is cleared for agriculture and other developments.

3. Spruits			
Status	Spruit wetland		
Soil	Clay loam	**Rockiness**	0%
Conservation value:	High	**Ecological sensitivity**	High
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Vachellia karroo, Combretum erythrophyllum, Searsia lancea, Ziziphus mucronata, Cyperus* sp, hygrophilous grasses, *Typha capensis*		

The following plant species were recorded in this plant community:

Trees and shrubs, dwarf shrubs

Vachellia karroo	dM	*Searsia lancea*	d
Combretum erythrophyllum	d	*Searsia pyroides*	
Eucalyptus sp	A	*Sesbania punicea*	A
Melia azedarach	A	*Stoebe vulgaris*	
Morus alba	A	*Ziziphus mucronata*	d

Grasses and sedges

Cynodon dactylon		*Hyparrhenia hirta*	d
Cyperus spp (various)		*Hyparrhenia tamba*	
Cyperus textilis		*Imperata cylindrica*	
Eragrostis chloromelas		*Paspalum dilatatum*	
Eragrostis curvula	d	*Phragmites australis*	
Heteropogon contortus		*Sporobolus africanus*	
Hyparrhenia dregeana		*Typha capensis*	d

Forbs

Bidens bipinnata	W	*Plantago lanceolata*	
Gomphocarpus fruticosus	W	*Tagetes minuta*	W
Oenothera rosea		*Verbena bonariensis*	W

As they form part of the drainage system, all rivers and spruits are regarded as ecologically sensitive. The lines will, however, easily span across the spruits, and will not affect the vegetation of the banks negatively. At some crossings dense bush occur on the river banks – the bush will have to be cleared here. Care should be taken to avoid damage to the streams and stream banks. The pylons should be located far enough from the banks to avoid damage. Any damage caused to the spruits and spruit banks by the construction, should immediately be rehabilitated.

Figure 7: A collage of spruits close to spruit crossings: Top left:- the dam at spruit 1.2; top right:- dense bush at spruit crossing 1.3 and 2.3; bottom left:- the degraded spruit at 1.4 with *Stoebe vulgaris* on the banks.

4. Current Agriculture

Current agricultural lands occur along the route of both alternative power lines (Fig. 4). These areas have, from, a vegetation and flora point of view, no conservation value and low sensitivity. The natural occurring vegetation has been destroyed and replaced by crops. Current agriculture is more prominent along Alternative power line 1.

4: Current Agriculture			
Status	Agriculture		
Soil	Brown loam	**Rockiness**	0%
Conservation value:	Low	**Ecological sensitivity**	Low
Agricultural potential:	High	**Need for rehabilitation**	Low
Dominant spp.	crops		

No indigenous plant species were recorded in the agriculture areas. From a vegetation perspective the proposed power line can be supported in these areas.

5. Old fields / planted pasture

These areas seem to represent old fields some of which have been transformed to planted pasture where the grass is regularly mowed. The chicken farm is also in this area. Plant species richness is very low, with *Eragrostis curvula* prominent.

5. Old fields / planted pasture			
Status	Transformed		
Soil	Brown to red loam	**Rockiness**	0%
Conservation value:	Low	**Ecological sensitivity**	Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Eragrostis curvula*		

This is transformed area with low species richness and low sensitivity. The power lines can be supported.

Figure 8: Old field with mowed grass

6. Dense Bush

Dense woody vegetation occurs in the vicinity of spruit crossings 1.1, 1.2, 2.1 and 2.2 (Fig. 4). However, the herbaceous vegetation is in a disturbed and degraded condition. The most prominent woody species are *Vachellia karroo, Euclea natalensis, Searsia lancea* and *Vachellia robusta* (Fig. 9).

6. Dense Bush			
Status	Natural wooded vegetation, though quite disturbed		
Soil	brown loam	**Rockiness**	0%
Conservation value:	Medium	**Ecological sensitivity**	Medium
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Vachellia karroo, Euclea natalensis, Searsia lancea, Vachellia robusta.*		

The following plant species were recorded in this plant community:

Trees and shrubs, dwarf shrubs

Vachellia karroo	dM	*Melia azedarach*	A
Vachellia robusta		*Searsia lancea*	
Combretum erythrophyllum		*Searsia pyroides*	
Euclea natalensis	d	*Ziziphus mucronata*	

Grasses and sedges

Cynodon dactylon		*Schizachyrium sanguineum*	
Eragrostis chloromelas		*Setaria sphacelata*	
Eragrostis curvula	d	*Sporobolus africanus*	
Heteropogon contortus		*Themeda triandra*	
Hyparrhenia hirta			

Forbs

Aloe davyana		*Lippia javanica*	
Bidens bipinnata	W	*Tagetes minuta*	W
Lantana rugosa		*Teucrium capense*	

This dense bush is disturbed with low species richness and Medium sensitivity. Although some of the bush will have to be removed for the construction, the power lines can be supported.

Figure 9: The dense bush

7. Highly disturbed areas

Along the routes of both Alternatives 1 and 2 are highly disturbed areas (Fig. 4). The disturbances are mainly linked to the sand mining operations, but also to other developments. These areas are basically devoid of natural vegetation, and no species of concern occur here. There are more highly disturbed areas along Alternative power line 2. The most conspicuous plant species are weedy annuals, e.g. *Tagetes minuta* and *Conyza bonariensis*, but grasses such as *Cynodon dactylon, Eragrostis curvula* and *Hyparrhenia hirta.*

7. Highly disturbed areas			
Status	Transformed		
Soil	Brown to red loam	**Rockiness**	0%
Conservation value:	Low	**Ecological sensitivity**	Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Eragrostis curvula*		

The following plant species were observed in these disturbed areas:

Trees and shrubs, dwarf shrubs

Vachellia karroo	M	*Stoebe vulgaris*	

Grasses

Aristida congesta	d	*Heteropogon contortus*	
Cynodon dactylon	d	*Hyparrhenia hirta*	d
Eragrostis curvula			

Forbs

Conyza podocephala		*Lactuca inermis*	W
Felicia muricata		*Plantago lanceolata*	
Geigeria burkei		*Schkuhria pinnata*	MW
Gomphocarpus fruticosus	W	*Tagetes minuta*	W
Helichrysum rugulosum			

This is transformed area with low species richness and low sensitivity. The power lines can be supported.

PLANT SPECIES OF CONSERVATION CONCERN

Red data species

A Threatened species and Species of Conservation Concern list for the Grid 2527DC and CA was obtained from the POSA database on the SANBI website. Threatened species are those that are facing high risk of extinction, indicated by the categories Critically Endangered, Endangered and Vulnerable. Species of Conservation Concern include the Threatened Species, but additionally have the categories Near Threatened, Data Deficient, Critically Rare, Rare and Declining. This is in accordance with the new Red List for South African Plants (Raimondo *et al*. 2009).

Species of conservation concern from Grid 2527DC and CA (From the SANBI Database) include the following:

Species	Status	Suitable habitat	Possibility to occur
Aloe peglerae Schönland	EN	No	Low
Bowiea volubilis Harv. ex Hook.f.	VU	Marginal	Low
Callilepis leptophylla Harv.	Declining	No	Low
Gunnera perpensa L.	Declining	Marginal	Low
Ilex mitis (L.) Radlk. var. *mitis*	Declining	No	Low
Prunus africana (Hook.f.) Kalkman	VU	No	Low

There is limited suitable habitat for *Bowiea volubilis* in the Dense Bush (Plant Community 6), and maybe in the riparian zones of the Spruits. This species is used for medicinal purposes. No individuals were found during the field survey and it is doubtful that it is present along the route of the proposed power line.

Gunnera perpensa occurs in water and there is little or no water in the streams that are crossed by the proposed power line.

No protected tree species occur in this area.

Medicinal plants

According to the description provided in Van Wyk, Van Oudthoorn & Gericke (1997), and medicinal plants found on the site are the following:

Vachellia karroo *Schkuhria pinnata*

DISCUSSION

The vegetation and flora along both alternatives of the proposed Hekpoort-Cashan power line and the newly proposed Cashan substation were investigated. Most of the area is covered with secondary vegetation that developed on old fields. All these areas have low ecological sensitivity. Limited natural dense bush is present, close to riparian zones at some of the spruits that are crossed along the two alternative routes. In some cases the bush will have to be cleared here. The proposed power lines will cross several small seasonal spruits. All spruit systems are regarded as ecologically sensitive (Figure 5). The lines will easily span across the spruits and will not affect the vegetation of the banks negatively. Care should be taken to avoid damage to the streams and stream banks. The pylons should be located far enough from the banks to avoid damage. Any damage caused to the spruits and spruit banks by the construction, should immediately be rehabilitated.

Although the vegetation route along Alternative 2 is more disturbed and degraded, mainly due to sand mining, this route is closer to the south-facing slopes of the Witwatersberg, with relatively undisturbed mountain grassland. The route is, however, mostly along a small road. Alternative 1 is further from the Witwatersberg, and is also mostly along a road, in this case the larger R560 and R563. From the vegetation and flora assessment, any of the two proposed power lines and the substation can be supported, though little preference is given to the alternative power (southern) line alignment, as the vegetation along this route is more disturbed.

IMPACT ASSESSMENT: IMPACTS ON VEGETATION

Methods

The anticipated impacts associated with the proposed project have been assessed according to SRK's standardised impact assessment methodology which is presented below. This methodology has been utilised for the assessment of environmental impacts where the consequence (severity of impact, spatial scope of impact and duration of impact) and likelihood (frequency of activity and frequency of impact) have been considered in parallel to provide an impact rating and hence an interpretation in terms of the level of environmental management required for each impact.

The first stage of any impact assessment is the identification of potential environmental activities' aspects and impacts which may occur during the commencement and implementation of a project. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. Environmental impacts (social and biophysical) are then identified based on the potential interaction between the aspects and the receptors/resources.

The significance (degree to which the impact may cause irreplaceable loss of resources) of the impact is then assessed by rating each variable numerically according to defined criteria as outlined in

Table 1. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed

can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix table as shown in Table 2.

This matrix thus provides a rating on a scale of 1 to 150 (low, medium low, medium high or high) based on the consequence and likelihood of an environmental impact occurring.

Natural and existing mitigation measures, including built-in engineering designs, are included in the pre-mitigation assessment of significance. Measures such as demolishing of infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

[Definitions

An ***activity*** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or pieces of infrastructure that are possessed by an organisation.
An ***environmental aspect*** is an 'element of an organisations activities, products and services which can interact with the environment'. The interaction of an aspect with the environment may result in an impact.
Receptors comprise, but are not limited to people or man-made structures.
Resources include components of the biophysical environment.
Environmental impacts are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. Receptors can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as aquifers, flora and palaeontology. In the case where the impact is on human health or well-being, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
Severity refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
Spatial scope refers to the geographical scale of the impact.
Duration refers to the length of time over which the stressor will cause a change in the resource or receptor.
Frequency of activity refers to how often the proposed activity will take place.
Frequency of impact refers to the frequency with which a stressor (aspect) will impact on the receptor.]

Table 1: Criteria for Assessing Significance of Impacts

SEVERITY OF IMPACT	RATING
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful	5

SPATIAL SCOPE (EXTEND) OF IMPACT	RATING
Activity specific	1
Development specific (within the development boundary)	2
Local area (within 5 km of the mine boundary)	3
Regional	4
National	5

DURATION OF IMPACT	RATING
One day to one month	1
One month to one year	2
One year to ten years	3
Life of operation	4
Post closure / permanent	5

CONSEQUENCE

FREQUENCY OF ACTIVITY / DURATION OF ASPECT	RATING
Annually or less / low	1
6 monthly / temporary	2
Monthly / infrequent	3
Weekly / life of operation / regularly / likely	4
Daily / permanent / high	5

FREQUENCY OF IMPACT	RATING
Almost never / almost impossible	1
Very seldom / highly unlikely	2
Infrequent / unlikely / seldom	3
Often / regularly / likely / possible	4
Daily / highly likely / definitely	5

LIKELIHOOD/ PROBABILITY

Table 2: Interpretation of Impact Rating

Consequence

Likelihood															
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
3	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
4	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
6	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
7	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
8	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
9	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
10	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

	High	76 to 150	Improve current management
	Medium High	40 to 75	Maintain current management
	Medium Low	26 to 39	
	Low	1 to 25	No management required

SIGNIFICANCE = CONSEQUENCE x LIKELIHOOD

Results

Alternative 1 and 2

The impacts on the vegetation along the two alternatives are exactly the same

Pre-construction: No pre-construction impacts are envisaged on vegetation or fauna.

Construction phase: During construction the vegetation will be cleared, especially at the position of the pylons, but often also along the route of the line. Access roads will not be applicable as the planned route is always along or very close to current roads. The impacts of the construction are removal of vegetation and plant species or habitat loss.

1. Clearing of vegetation

POTENTIAL ENVIRONMENTAL IMPACT (NATURE OF THE IMPACT)	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION						
	Consequence			Likelyhood (Probability)		Significance (Degree to which impact may cause irreplaceable loss of resources)	SRK Methodology		Consequence			Likelyhood (Probability)		Significance (Degree to which impact may cause irreplaceable loss of resources)	SRK Methodology
	Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact				Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
Removal of vegetation on new substation site (Agriculture/Old fields)	1	1	1	2		6	L No Management Required	Do not allow activities outside construction site	1	1	1	2		6	L No Management Required
Removal of vegetation along the power line routes in the areas of plant communities 2, 4, 5 and 7 (Old fields with *Vachellia*, current agriculture, planted pasture, disturbed areas)	1	1	1	2		6	L No Management Required	Do not allow any activities outside the Eskom servitude	1	1	1	2		6	L No Management Required
Removal of vegetation along the power line route in the areas of plant community 6 (Dense Bush)	3	3	1	2		14	L No Management Required	Do not allow any activities outside the Eskom servitude	3	2	1	3		18	L No Management Required
Removal of vegetation along river banks	4	3	1	2		16	L No Management Required	River banks are ecologically sensitive Pylons must be at such a distance from the river bank that it will not cause erosion Avoid causing erosion at all times Rehabilitate if river banks were damaged during construction Let power lines span over riverine bush if at all possible	3	3	1	2		14	L No Management Required

Although the SRK prescribed impact table does not recognise removal of vegetation on the river banks as being a significant impact, this is considered to be a significant impact. Therefore, should river banks be damaged during the construction, this should be considered as a serious impact and the mitigation measures given in the above table become applicable.

2. Species or habitat loss

POTENTIAL ENVIRONMENTAL IMPACT (NATURE OF THE IMPACT)	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION						
	Consequence			Likelyhood (Probability)		Significance (Degree to which impact may cause irreplaceable loss of resources)	SRK Methodology		Consequence			Likelyhood (Probability)		Significance (Degree to which impact may cause irreplaceable loss of resources)	SRK Methodology
	Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact				Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
Species or habitat loss on new substation site	1	1	1	2		6	L No Management Required	Do not allow activities outside construction site	1	1	1	2		6	L No Management Required
Removal of vegetation along the power line routes in the areas of plant communities 2, 4, 5 and 7 (Old fields with Vachellia, current agriculture, planted pasture, disturbed areas)	1	1	1	2		6	L No Management Required	Do not allow any activities outside the Eskom servitude	1	1	1	2		6	L No Management Required
Species or habitat loss along the power line route in the areas of plant community 6 (Dense Bush)	3	2	1	2		12	L No Management Required	Do not allow any activities outside the Eskom servitude	3	2	1	3		18	L No Management Required
Species or habitat loss along river banks	4	3	1	2		16	L No Management Required	River banks are ecologically sensitive Pylons must be at such a distance from the river bank that it will not cause erosion Avoid causing erosion at all times Rehabilitate if river banks were damaged during construction Let power lines span over riverine bush if at all possible	3	3	1	2		14	L No Management Required

No important plant species of conservation concern or protected species were found along the proposed power line transect. The impact on species loss is therefore not considered as significant. However, should river banks be damaged during the construction, this should be considered as a serious impact and the mitigation measures given in the above table become applicable.

Neither the Operational, closure or post-closure phases are considered to be important in the case of this proposed power line, as any impacts on vegetation and flora during these phases are considered to be insignificant.

Discussion

- The Old Fields on the proposed new substation site, as well as the Old Fields, Current Agriculture and Old Fields/ planted pastures along the routes of the proposed alternative power line are considered to be secondary vegetation with low species richness, no plant species of conservation concern and no protected plant species and therefore also low ecological sensitivity.
- The River banks on the contrary, are according to the relevant legislation, [National Water Act, 1998 (Act 36 of 1998), National Forests Act, 1998 (Act 84 of 1998), National Environmental Management Act, 1998 (Act No. 107 of 1998), National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) and

forthcoming regulations].regarded and ecologically sensitive ecosystems. Although the SRK prescribed impact table does not recognise removal of vegetation on the river banks as being a significant impact**, this is considered to be a significant impact.** Therefore, should river banks be damaged during the construction, this should be considered as a serious impact and the mitigation measures given in the above table become applicable.

- The Dense bush (Plat community 6) occurs in the vicinity of spruit crossings 1.1, 1.2, 2.1 and 2.2. However, the herbaceous vegetation is in a disturbed and degraded condition. This dense bush is disturbed with low species richness and Medium sensitivity. Although some of the bush will have to be removed for the construction, the power lines can be supported.

Mitigation measures

- Remain on existing service roads during construction
- Avoid going into adjacent natural vegetation during construction
- Avoid erosion at all times
- Avoid damage to the spruit ecosystems.

CONCLUSION

From an ecological and biodiversity point of view the Spruits along both alternative power lines are ecologically sensitive. However, most of these systems can be crossed by the power lines, without causing much degradation. The spruits are relatively narrow. The power line can therefore be constructed without harming the spruit or spruit banks, by placing the pylons away from the banks. Should any damage occur to the banks during construction, these should be rehabilitated immediately after construction. This is however not anticipated.

From a vegetation and flora point of view there will be only limited damage along both alternatives and any of the two alternative power line and substation can be supported.

REFERENCES

Acocks, J.P.H. 1988. Veld types of South Africa, 3rd ed. *Memoirs of the Botanical Survey of South Africa.* 57: 1–146.

Bredenkamp, G.J. & Brown, L.R. 2001. Vegetation – A reliable ecological basis for environmental planning. *Urban Greenfile* Nov-Dec 2001: 38-39.

Department of Environmental Affairs and Tourism. 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Notices.

Henderson, L. 2001. Alien weeds and invasive plants. ATC, Pretoria.

Low, A.B. & Rebelo, A.G. (eds) 1996 *Vegetation of South Africa, Lesotho and Swaziland*. Dept Environmental Affairs & Tourism, Pretoria.

Mucina, L, & Rutherford, M.C. (Eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
Mucina, L., Bredenkamp, G.J., Hoare, D.B. & Mcdonald, D.J. 2000. A National vegetation database for South Africa. *South Africa Journal of Science* 96:497-498.

Mueller-Dombois, D. & Ellenberg, H. 1974. Aims and methods of vegetation ecology. Wiley, New York.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. & Manyama, P.A. (Eds.). 2009. Red list of South African plants 2009. *Strelitzia* 25:1-668.

The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)

The Environmental Conservation Act, 1989 (Act No. 73 of 1989)

The National Environment Management Act, 1998 (Act No. 107 of 1998)

The National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004). Government Gazette RSA Vol. 467, 26436, Cape Town, June 2004.

The National Environmental Management: Biodiversity Act, 2004. (Act 10 0f 2004), Draft list of threatened ecosystems. Government Gazette RSA Vol. 1477, November 2009.

Van Wyk, B.E., Van Oudtshoorn, B. & Gericke, N. 1997. Medicinal plants of South Africa. Briza, Pretoria.

Westhoff, V. & Van der Maarel, E. 1978. The Braun-Blanquet approach. In: Whittaker, R.H. (ed.) Classification of plant communities. W. Junk, The Hague.

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1982 D.Sc. (Ph.D.) University of Pretoria, Plant Ecology.

Theses: (M.Sc. and D.Sc.) on plant community ecology and wildlife management in nature reserves in South African grassland and savanna.

Professional titles:

- MSAIE South African Institute of Ecologists and Environmental Scientists
  - 1989-1990 Council member
- MGSSA Grassland Society of Southern Africa
  - 1986 Elected as Sub-editor for the Journal
  - 1986-1989 Serve on the Editorial Board of the Journal
  - - 1990 Organising Committee: International Conference: Meeting Rangeland challenges in Southern Africa
  - 1993 Elected as professional member
- PrSciNat. South African Council for Natural Scientific Professions **Registration Number 400086/83**

- 1993-1997 **Chairman** of the Professional Advisory Committee: Botanical Sciences
- 1993-1997: **Council** Member
- 1992-1994: Publicity Committee
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Professional career:

- Teacher in Biology 1970-1973 in Transvaal Schools
- Lecturer and senior lecturer in Botany 1974-1983 at University of the North
- Associate professor in Plant Ecology 1984-1988 at Potchefstroom University for CHE
- Professor in Plant Ecology 1988-2008 at University of Pretoria.
- 2009 – current Professor Extra-ordinary in the Dept of Plant Science, University of Pretoria
- • Founder and owner of the Professional Ecological Consultancy firms Ecotrust Environmental Services CC and Eco-Agent CC, 1988-present.

Academic career:

• Students:

- Completed post graduate students: M.Sc. 53; Ph.D. 14.
- Presently enrolled post-graduate students: Ph.D. 2.

• Author of:

- 175 scientific papers in refereed journals
- >150 papers at national and international congresses
- >800 scientific (unpublished) reports on environment and natural resources
- 17 popular scientific papers.
- 39 contributions in books

• Editorial Committee of

- South African Journal of Botany,
- Journal Grassland Society of Southern Africa,
- Bulletin of the South African Institute of Ecologists.
- Journal of Applied Vegetation Science.(Sweden)
- Phytocoenologia (Germany)
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Membership:

• International Association of Vegetation Science.
• British Ecological Society
• International Society for Ecology (Intecol)
• Association for the Taxonomic study of the Flora of Tropical Africa (AETFAT).
• South African Association of Botanists (SAAB)

1988-1993 Elected to the **Council** of SAAB.
1989-1990 Elected as **Chairman** of the Northern Transvaal Branch
1990 Elected to the Executive Council as **Vice-President**
1990- Sub-editor Editorial Board of the Journal
1991-1992 Elected as **President** (2-year period)
1993 **Vice-President** and Outgoing President

• Wildlife Management Society of Southern Africa
• Suid-Afrikaanse Akademie vir Wetenskap en Kuns
(=South African Academy for Science and Art).
• Wildlife Society of Southern Africa

1975 - 1988: Member
1975 - 1983: Committee member, Pietersburg Centre
1981 - 1982: **Chairman**, Pietersburg Centre

• Dendrological Society of Southern Africa

1984 - present: Member
1984 - 1988: Committee member, Western Transvaal Branch
1986 - 1988: **Chairman**, Western Transvaal Branch
1987 - 1989: Member, Central Committee (National level)
1990 - 2000: Examination Committee

• Succulent Society of South Africa

1987 - 2000

• Botanical Society of South Africa

2000 – present: Member
2001- 2008: Chairman, Pretoria Branch
2002 – 2006: Chairman, Northern Region Conservation Committee
2002- 2007: Member of Council

Special committees:

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• Member of the International Code for Syntaxonomical Nomenclature 1993-present.

Merit awards and research grants:

1968 Post graduate merit bursary, CSIR, Pretoria.

1977-1979 Research Grant, Committee re Research Development, Dept. of Co-operation and Development, Pretoria.

1984-1989 Research Grant, Foundation for Research Development, CSIR, Pretoria.

1986-1987 Research Grant, Dept. of Agriculture and Water Supply, Potchefstroom.

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1986 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom

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1987 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom.

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Since 1988 **>800** reports as consultant on environmental matters, including:

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- Environmental Management Programme Reports,
- Vegetation Surveys,
- Wildlife Management,
- Veld Condition and Grazing Capacity Assessments,
- Red data analysis (plants and animals).

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