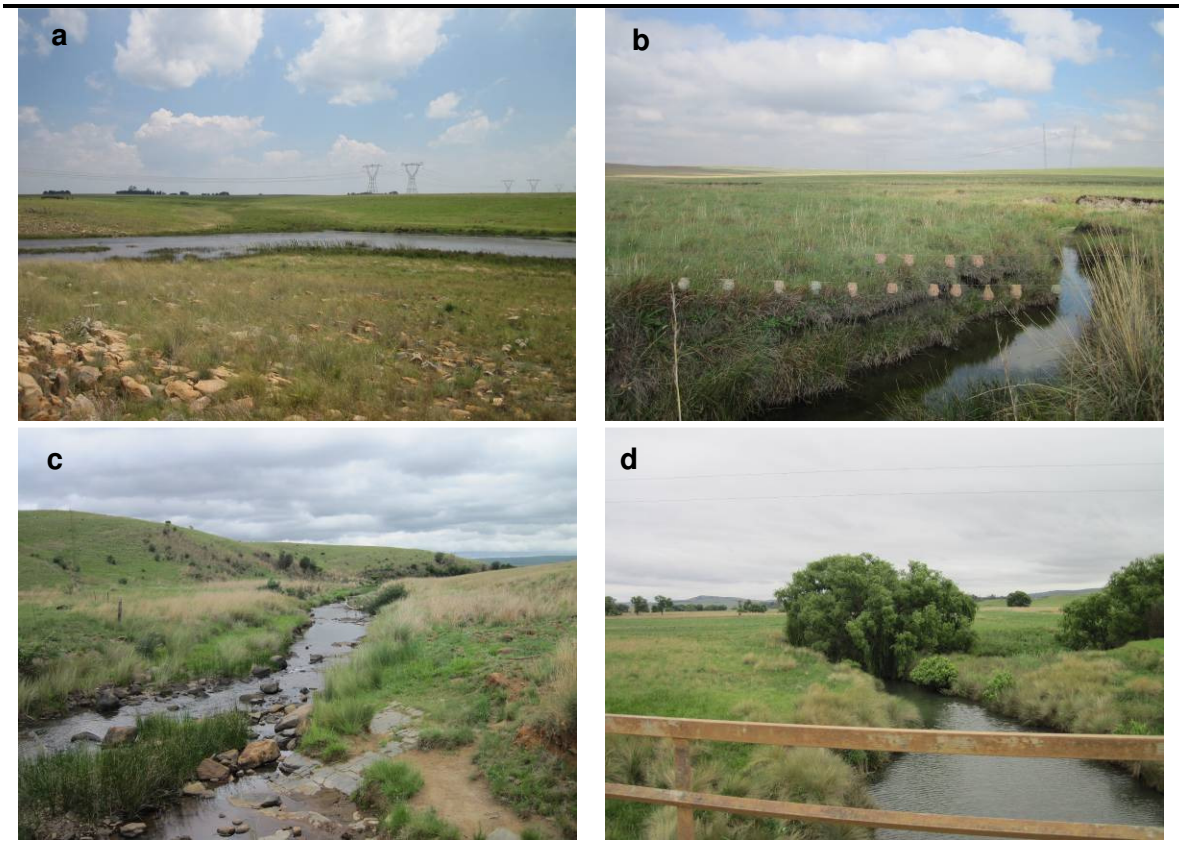

Figure 7: A view of the (a-b) unnamed tributaries of the Elands River systems and the (c-d) Klein-Komati River.

3.2.5 Wetlands (upland seeps and artificial impoundments)

These are scattered on the study area, and are subjectively classified into three categories. However, they are important in providing refuge and foraging habitat for a large diversity of waterfowl species (mainly ducks and geese of the Anatidae family), waders (mainly members of the Charadriiform Order) and wading birds (such as herons, storks and ibises).

- Upland and Hillslope Seeps

The former represent large extensive swamps and marshlands, and are often important breeding habitat for the globally threatened Wattled Crane (*Bugeranus carunculatus*) and Grey Crowned Crane (*Balearica regulorum*) (Figure 8). This habitat type was mostly encountered near Machadodorp (corresponding to Lydenburg Montane Grassland) and was prevalent on the upper plateau (montane) grasslands (Figure 8).

The smaller hillslope seeps were earmarked by a rich diversity of cyperoid-dominated plant taxa (e.g. *Cyperus, Schoenoplectus, Carex* and *Pycreus*) as well as dense stands of *Arundinella nepalensis*, *Agrostis lachnantha* and *Imperata cylindrica* which are the favoured foraging and roosting habitat for the 'Vulnerable" African Marsh

Harrier (*Circus ranivorus*), African Grass-owl (*Tyto capensis*) and the “near-threatened” Broad-tailed Warbler (*Schoenicola brevirostris*). It is also the preferred habitat for a number of wetland-dependant faunal taxa such as the *Crocidura* and *Myosorex* shrews and the "Vulnerable" butterfly *Metisella meninx*.

These habitat types are important dispersal routes for fauna taxa and flyway networks for wading birds and waterfowl (mainly herons, cranes, cormorants, ibises, ducks and geese) – any development within these areas will have a definite and significant impact on the avifaunal diversity and movement patterns of bird species. In addition, these systems span incredible distances, thereby preserving inherent “links” between important foraging and roosting sites.

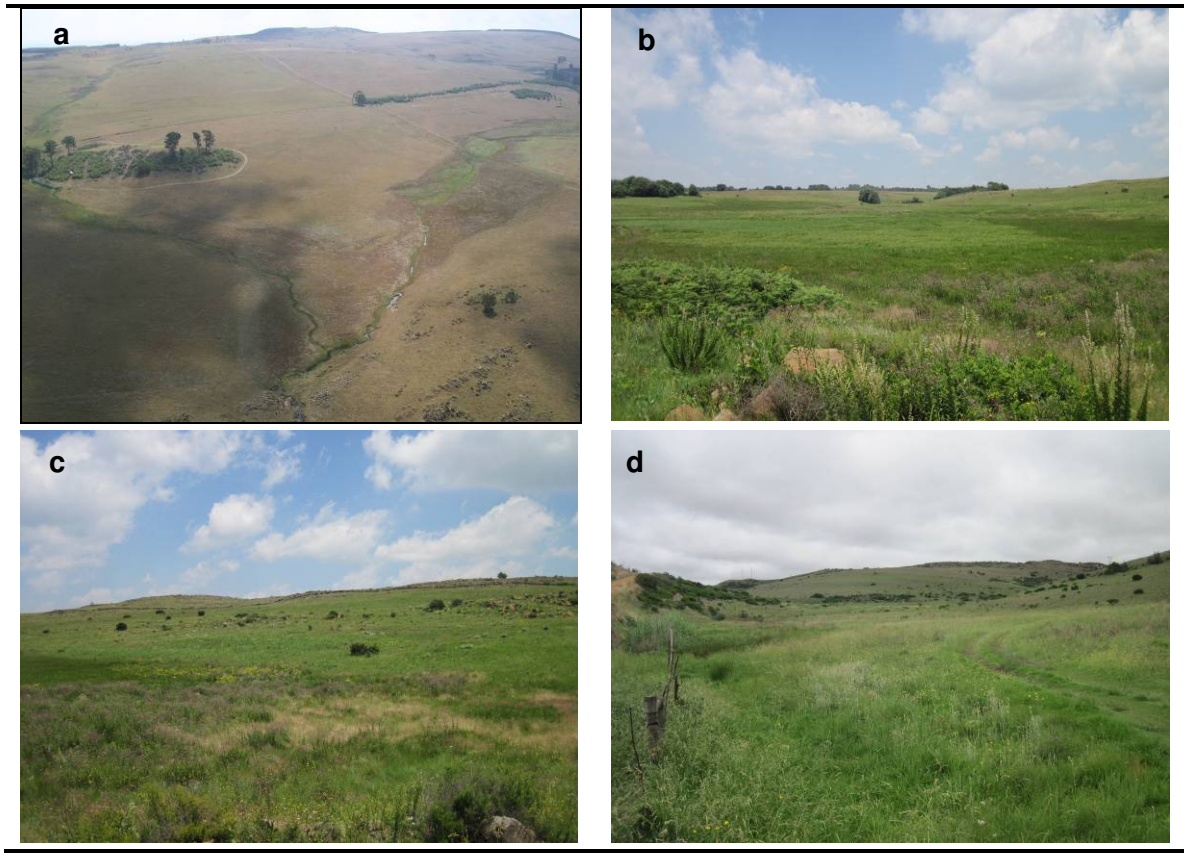

Figure 8: An example of extensive upland marshland (a-b) and seep zones (c-d) confined to high altitude grassland – the preferred habitat for cranes.

- Artificial Impoundments

Although many of these were artificial, a variety of waterbird species benefited from their presence and utilised these bodies of water for breeding and foraging purposes (Figure 9). The impoundments are also important moulting sites for waterfowl and provide refuge during prolonged periods of drought. Typical bird species include herons, ducks, cormorants, coots and darters.

Figure 9: An example of artificial impoundments on the study area.

- Endorheic Pans

These habitat types were mainly centred near the western section of the study area and were represented by many depressions ranging from very large pans to quite small pans (Figure 10). One particular area were represented by a number of pans situated in close proximity to each other, and provide foraging habitat for both Greater and Lesser Flamingos (both nationally “near-threatened”). Large flocks of both species were observed from these pans that were located on the farms Klippan 452 JS, Leeuwpan 494 JS and Grootpan 456 JS.

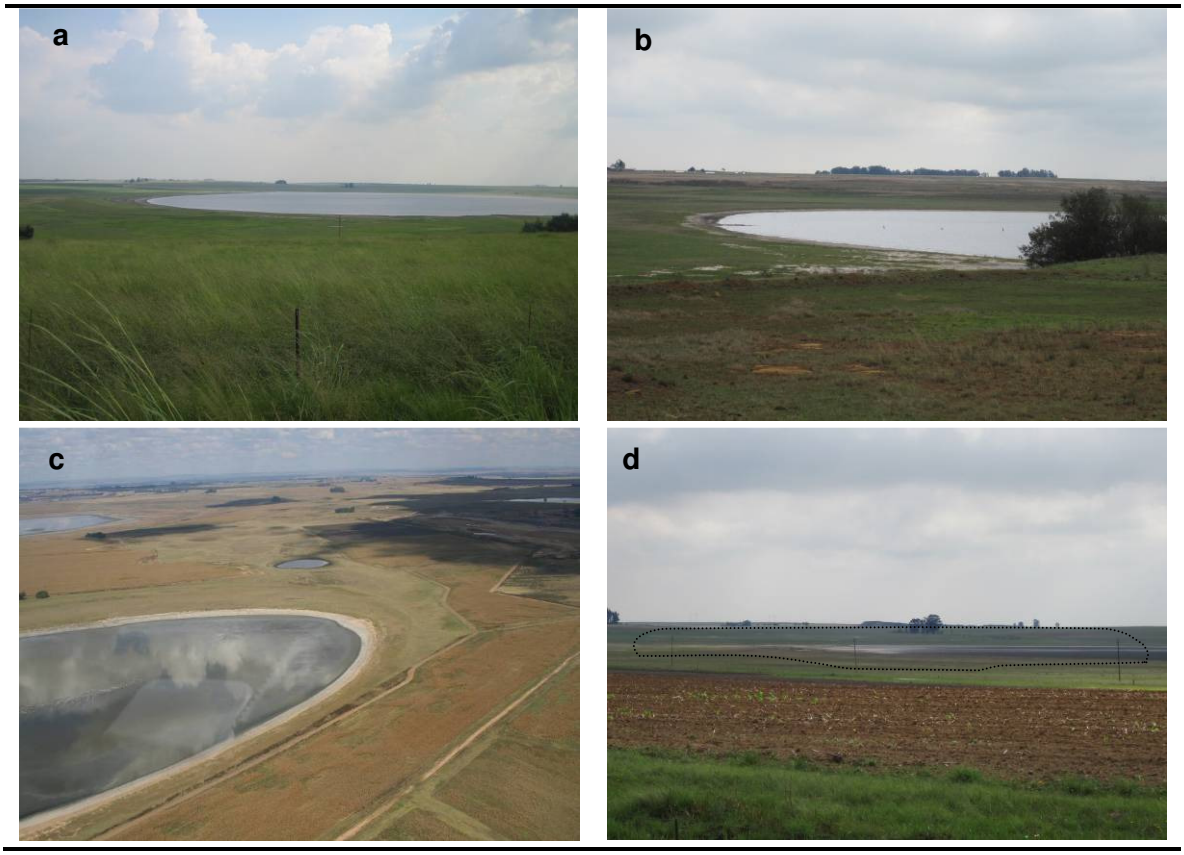

Figure 10: An example of a cluster of large endorheic pan systems near the central part of the study site.

3.3 Avifauna

3.3.1 Impacts associated with transmission lines

Birds are impacted in three ways by means of transmission lines. It is however a common rule that large and heavy-bodied terrestrial bird species are more at risk of being affected in a negative way when interacting with transmission lines. These include the following:

- *Electrocution*

Electrocution happens when a bird bridges the gap between the live components or a combination of a live and earth component of a power line, thereby creating a short circuit. This happens when a bird, mainly a species with a fairly large wingspan attempts to perch on a tower, or attempts to fly-off a tower. Many of these species include large birds of prey (e.g. vultures and the Martial Eagle *Polemaetus bellicosus*) (Ledger & Annegarn, 1981; Kruger, 1999; Van Rooyen, 2000). These species will attempt to roost and even breed on the tower structures if available nesting platforms are a scarce commodity, e.g. in the treeless Karoo. Other types of electrocutions happen by means of so-called “bird-streamers”. This happens when a bird, especially when taking off, excretes and thereby causing a short-circuit through the fluidity excreta (Van Rooyen & Taylor, 1999). This method of electrocution is however a rare phenomena. Other species also likely to be affected are those roosting on towers such as the Black Stork (*Ciconia nigra*), Grey Crowned Crane (*Balearica regulorum*), large species of geese, vultures and the Black-headed Heron (*Ardea melanocephala*).

Large transmission lines (from 220 kV to 765 kV) are seldom a risk of electrocution. This statement is supported by data obtained from the central incident register of EWT. It demonstrated that the smaller distribution lines (88 – 132kV) pose a higher risk of electrocution, with 24 documented cases reported for the study site (during 1996 to 2010). Additional threats are provided by network breakers and pole transformers.

It is recommended that the “Cross-rope Suspension” tower, a bird-friendly design, be used if the proposed alignment is approved. This design does not provide a suitable roosting or nesting substrate for birds, and discourages them from breeding or roosting on the tower (Vosloo, 2003; Figure 11). However, the use of other towers that do offer perching or nesting habitat, for example the “Self-supporting” (which is commonly used at bend points) and “Guyed-Suspension” towers should be limited and fitted with metal bird guards (Figure 12) to insulate certain phases of the lines (Vosloo, 2003).

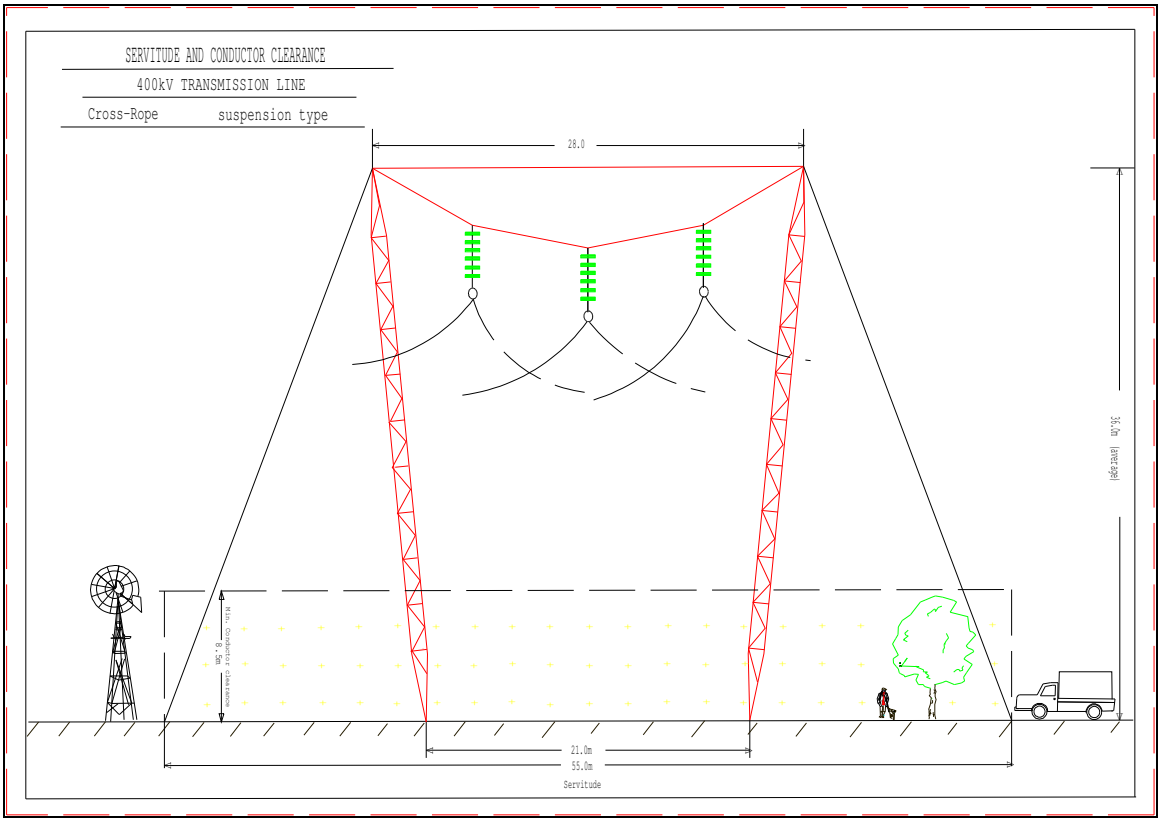

Figure 11: The “cross-rope suspension” tower design - a bird-friendly design.

Figure 12: Bird guards (‘spikes’) fitted to a self-supporting tower.

- *Collision*

Collisions with earth wires have probably accounted for most bird-transmission line interactions in South Africa. In general, the earth wires are much thinner in diameter when compared to the live components, and therefore less visible to approaching birds. Many of the species affected include heavy, large-bodied terrestrial species such as cranes, storks, flamingos, bustards, korhaans and a variety of waterbirds that are not very agile or manoeuvrable once airborne. These species, especially those with the habit of flying with outstretched necks (e.g. cranes, most species of storks and flamingos) find it difficult to make a sudden change of direction while flying – resulting in the bird flying into the earth wires. Some species are able to perceive the live bundles with the immediate effect to gain altitude, which result in the collision with the earth wires. Poor weather conditions such as mist and fog impairs the visibility of approaching bird species, thereby contributing towards collision rates.

Areas where bird collisions are likely to be high could be ameliorated by marking the lines with bird devices such as “bird diverters” and “flappers” to increase the visibility of the lines (APLIC, 1994). Many studies have proved that “bird diverters” can reduce mortalities by up to 60 % (Alonso & Alonso, 1999) and if applied correctly (e.g. utilising large devices spaced at least 5 m apart), they appear to be very effective. For the current project it is proposed that intact patches of upland and rocky grassland and river, wetland and dam crossings be fitted with the Double Loop Bird Diverter (e.g. BFD; Figure 13) since they are more durable (pers. comm., Van Rooyen) and less prone to extensive wear and tear. However, the Inotec BFD88 (a reflective stainless steel sphere) is also recommended due the increased visibility of this device during low light conditions (e.g. dawn and dusk, overcast conditions) when many bird species commute between foraging and roosting sites (Figure 14).

Recent research conducted by Eskom in collaboration with EWT (Martin *et al.*, 2010) has found that certain bird species (especially bustards and cranes) are virtually blind in the direction they travel when engaged in voluntary head movements (e.g. when birds are scanning areas below). Their research has shown that the visual capacity and visual depth of field varies tremendously between different birds species (with certain bustards and crane species being unable to detect obstacles ahead). Therefore, bird deterrent devices could be effective for certain species (e.g. storks) but not necessarily for others (e.g. cranes). There is a need for additional avoidance measures to distract birds away from power lines and forcing them to settle on the ground. Such avoidance behaviour could enhance their perception of nearby power lines when they take off again. This opens up new research possibilities in the field of ground-marking devices.

In addition, by placing the transmission line along an existing transmission line will also greatly increase the visibility of the overhead cables.

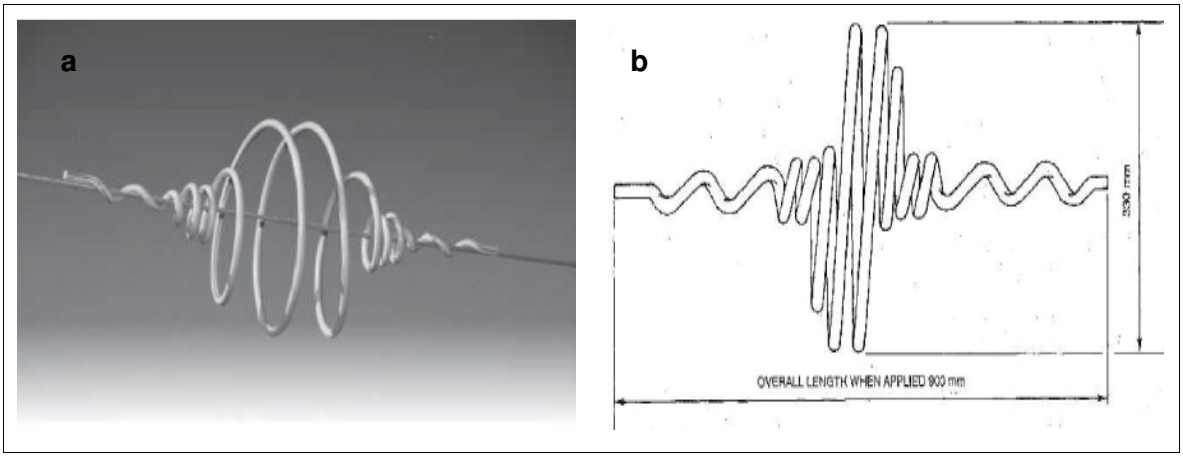

Figure 13: The recommended bird diverter to be used: the Double Loop Bird Flight Diverter (copyright Preformed Line Products, www. preformedsa.co.za).

Figure 14: An example of the Inotec BFD88 diverter used alongside conventional dynamic devices (photographs courtesy of Chris van Rooyen).

- *Physical disturbances and habitat destruction*

The construction of access roads and the clearing of vegetation underneath the power line servitude could result in physical disturbances to breeding, feeding and roosting bird species. However, the clearing of vegetation is regarded to be minimal where the transmission line traverses short grassland, although clearing and pruning of trees is likely to take place at river crossings where a well-established riparian community is confined to the riverbank.

Birds in general are highly mobile and therefore able to vacate areas should such adverse environmental conditions prevail. Therefore, direct impacts associated with construction activities on adult mortality are less likely to occur, although indirect impacts will have severe consequences on their "fitness" (e.g. the ability of a species to reproduce). Likely examples include habitat loss and disturbances preventing individuals from breeding successfully, especially when in close proximity to crane

nesting areas. However, persistent disturbances across extended temporal scales will eventually affect any population's ability to sustain itself, and will more than likely result in total abandoning of a particular area.

3.3.2 Bird species likely to be impacted

In general, the study area supports a fairly high diversity of bird species (mean of 229.3 spp, n=4 QDGC; Harrison *et al*., 1997) as explained by the high spatial heterogeneity provided by the different habitat and vegetation types. The number of bird species recorded for each quarter degree square ranges from 219 species at Moedig to as many as 243 species at Languitsig.

Threatened and Near-threatened Species

The presence of extensive, undulating grassland and the presence of large endorheic pan systems are responsible for a the observed diversity of threatened and near-threatened bird species. Approximately 22.5 % (29 spp) of all regional and globally threatened and near-threatened species are present on the study area.

Table 3 summarises the threatened and near-threatened species that could potentially occur on the study area based on the SABAP1 database. It is evident that the highest reporting rates (according to Harrison *et al*., 1997) were recorded from the western part of the study area (2529DD - Wonderfontein) which is represented by high numbers of flamingo species that occur on the large pan systems. Other parts of the study area with moderate-high reporting rates correspond to 2530CC (Moedig), an area sustaining patches of extensive primary grassland that support high numbers of large terrestrial bird species (e.g. Secretarybird, Blue Crane and White-bellied Korhaan).

Some of the threatened and near-threatened species observed on the study site during the site visits include the Greater Flamingo (*Phoenicopterus ruber*), Lesser Flamingo (*P. minor*), Southern Bald Ibis (*G. calvus*), Wattled Crane (*Bugeranus carunculatus*), Blue Crane (*Anthropoides paradiseus*), Blue Korhaan (*Eupodotis caerulescens*), White-bellied Korhaan (*E. senegalensis*), Denham's Bustard (*Neotis denhami*), Black-winged Lapwing (*Vanellus melanopterus*), Yellow-breasted Pipit (*Anthus chloris*) and Rudd's Lark (*Heteromirafra ruddi*). Appendix 1 provides an indication of the bird species observed from 19 site of high-altitude grassland and selected wetland features corresponding to the eastern section of the study area.

According to Figure 15, the southern parts of the study area are more sensitive due to high reporting rates of threatened and near-threatened species. There is little difference between the corridors when the reporting rates for Red listed species are superimposed, although the northern section of Alternative 3 appears to traverse an area with lower reporting rates.

Examination of the Mpumalanga conservation plan correlates positively with the reporting rates as shown in Figure 15 (Lötter & Ferrar, 2006) and Table 4. Figure 16 demonstrates that the southern and central parts of the study area are highly significant with scattered areas flagged as being irreplaceable. The irreplaceable areas are flagged based on the occurrence of large concentrations of flamingo species and the breeding occurrence of Wattled Cranes.

Non-threatened bird species

Non-threatened bird species with a high susceptibility towards power line interactions include the White Stork (*Ciconia ciconia*), Abdim's Stork (*Ciconia abdimii*), Jackal Buzzard (*Buteo rufofuscus*), African Fish Eagle (*Haliaeetus vocifer*) and a number of waterbird species pertaining to the Anatidae (ducks and geese), Ardeidae (herons and egrets), Threskiornithidae (ibises) and Cerylidae (large aquatic kingfishers).

Table 3: The reporting rates (%) for each threatened and near-threatened species (Barnes, 2000; IUCN, 2012) likely to occur on four quarter degree squares. CR – Critically Endangered, EN - Endangered, VU - Vulnerable and NT – Near-threatened.

QDGC Species	Global Status	Regional Status	2529DB Languitsig	2530CA Belfast	2530CC Moedig	2529DD Wonderfontein
African Finfoot	-	VU		1		2
African Grass Owl	-	VU	2	1		
African Marsh Harrier	-	VU	3	6	7	2
Black Stork	-	NT	2	1		2
Black-bellied Bustard	-	NT	2	2		2
Black-winged Lapwing	-	NT	2	3	3	2
Black-winged Pratincole	NT	NT				2
Blue Crane	**VU**	**VU**	**17**	**34**	**24**	**2**
Blue Korhaan	**NT**	**NT**	**5**	**2**	**11**	**11**
Broad-tailed Warbler	-	NT		2		
Caspian Tern	-	NT				2
Cape Vulture	VU	VU		4		
Denham's Bustard	**NT**	**VU**	**2**	**10**	**4**	**2**
Greater Flamingo	**-**	**NT**	**16**		**3**	**50**
Greater Painted Snipe	-	NT		1		
Grey Crowned Crane	**EN**	**VU**	**3**	**25**	**7**	**5**
Half-collared Kingfisher	-	NT	2	2	3	
Lanner Falcon	-	NT	2	3	1	
Lesser Flamingo	**NT**	**NT**	**3**		**4**	**29**
Lesser Kestrel	-	VU	6		1	7
Maccoa Duck	NT	-	5		1	29
Saddle-billed Stork	EN	EN		2		
Secretarybird	**VU**	**NT**	**2**	**12**	**21**	**2**
Southern Bald Ibis	VU	VU	23	11	29	23
Wattled Crane	**VU**	**CR**	**3**	**15**		**2**
White-bellied Korhaan	**-**	**V**	**2**	**2**	**17**	**2**
White-winged Flufftail	EN	CR		5		

QDGC Species	Global Status	Regional Status	2529DB Languitsig	2530CA Belfast	2530CC Moedig	2529DD Wonderfontein
Yellowbilled Stork	-	NT			3	
Yellowbreasted Pipit	VU	VU	2	1		
Average Totals			**5.20**	**6.59**	**8.69**	**9.37**

Species highlighted in **red** are critically endangered or endangered, and very susceptible to habitat transformation and disturbance.
Species highlighted in **black bold** are especially vulnerable to power line collision.
Total values in red refer to QDGS with a high presence of threatened and near-threatened species.

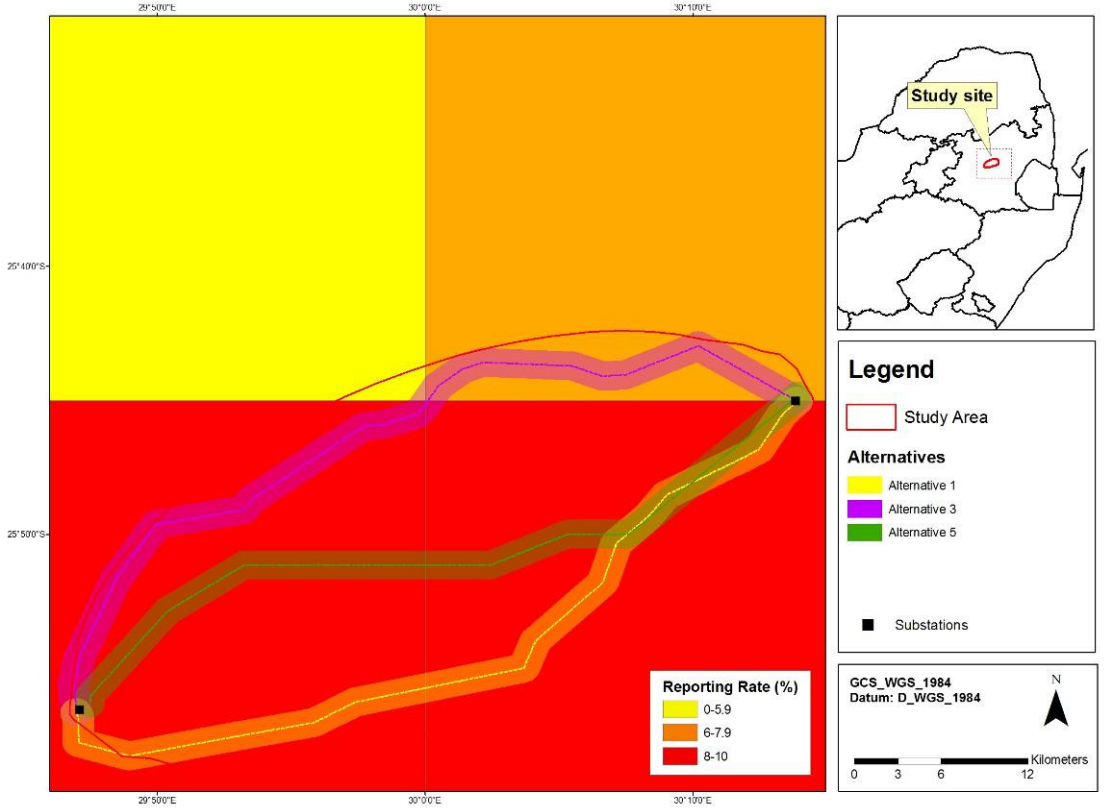

Figure 15: A spatial presentation of the mean reporting rates (%) for threatened and near-threatened bird taxa recorded from the quarter degree squares on the study area.

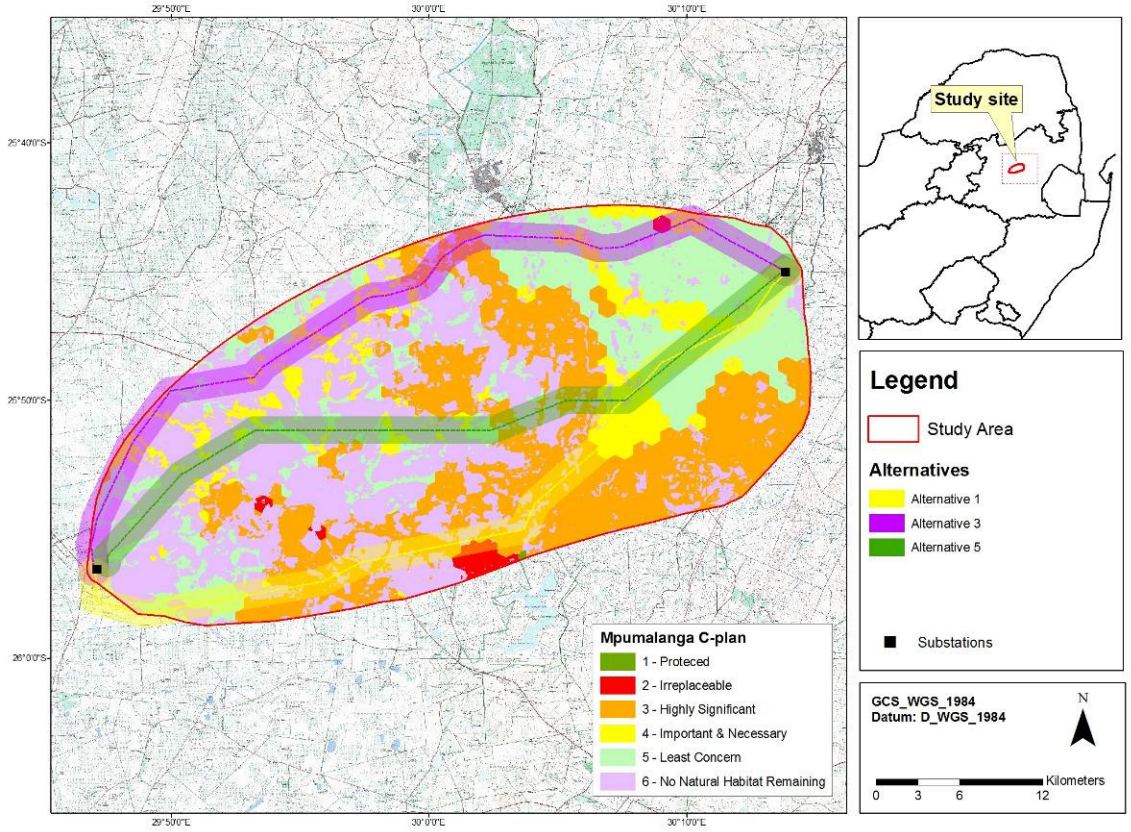

Figure 16: A spatial presentation of the Mpumalanga conservation plan. Note that areas classified as irreplaceable (red) refer to areas with a high occurrence of crane and flamingo species.

Table 4: An overview of the percentage cover of sensitive habitat per transmission line alternative.

Sensitivity Categories	Alternative 1 Hectares	Alternative 3 Hectares	Alternative 5 Hectares
Irreplaceable	181.8	113.0	-
Highly Significant	3173.5	743.7	855.0
Important & Necessary	1048.2	1614.4	1193.8
Least Concern	3285.9	3875.2	3134.4
No natural habitat remaining	2665.9	4489.6	5299.3
TOTALS	**10355.4**	**10835.8**	**10482.5**
Irreplaceable	1.8	1.0	-
Highly Significant	30.6	6.8	8.2
Important & Necessary	10.1	14.9	11.4
Least Concern	31.7	**35.8**	29.9
No natural habitat remaining	25.7	41.4	**50.6**
TOTALS	**100.00%**	**100.00**	**100.00**
Combined sensitivity (Irreplaceable, highly significant & important & necessary)	**42.5**	22.7	19.6

3.3.3 The regional significance of the study area

The study area comprehends the southern extent of the Steenkampsberg Important Bird Area (IBA SA016; Barnes 1998; see Figure 17). The area is partially protected and consists of approximately 150 private farms in the Belfast and Dullstroom region (Barnes, 1998). However, it is proclaimed to provide protection to two important wetland systems namely the Lakensvleispruit and the Veloren Valei system. The area is well known for holding significant numbers of both globally and nationally threatened bird species (15 species globally threatened and 10 species nationally threatened), including many species restricted to the Afrotropical Highlands (Barnes, 1998). It is evident from Figure 17 that Alternative 3 and 5 correspond to Steenkampsberg IBA, while Alternative 1 is located to the south of the IBA.

The study area is also part of BirdLife's Highlands and Wetlands Birding Route with a number of 'birder-friendly' establishments located within the boundaries of the Steenkampsberg Important Bird Area. Many of these farms provide secure breeding habitat for a variety of threatened and range-restricted bird species (www.birdingroutes.co.za).

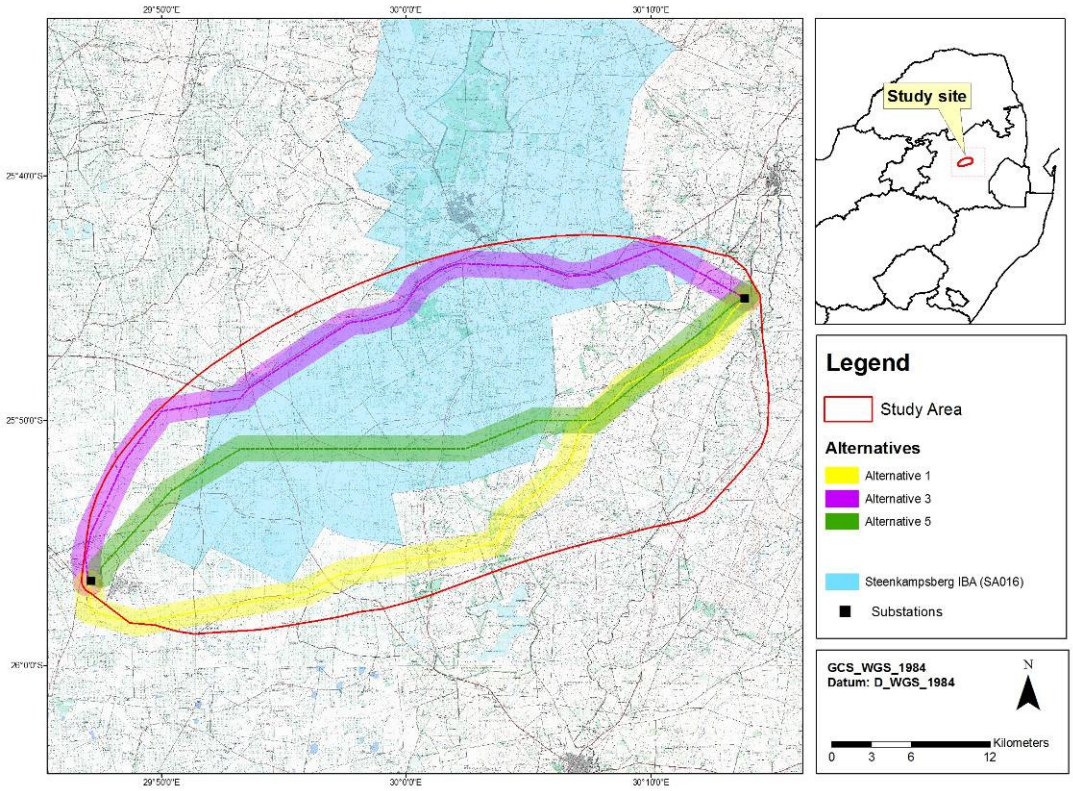

Figure 17: The spatial location of the Steenkampsberg Important Bird Area in relation to the study area and the three alternative corridors.

3.3.4 Bird impacts

Potential bird impacts regarding transmission lines comprise of electrocution, collision and disturbances caused during the construction and maintenance of transmission lines. These were discussed in some detail earlier on in this report. A summary table of impacts are provided under Appendix 2.

- *Electrocution*

It is recommended from an avifaunal perspective that the "cross-rope suspension" type be implemented for the proposed line. This design poses little electrocution risk due to the large clearances between the live components and the earth wires. Electrocution by means of bird streaming is also less likely to occur due to an absence of suitable perching areas above the conductors. The main risk associated with this design is collision.

- *Collision*

The following bird species, based on the availability of habitat types and their densities in the area, could potentially collide with the earth wires of the proposed transmission line:

- *Short upland and rocky undulating grassland*: Wattled Crane, Blue Crane, Grey Crowned Crane, Southern Bald Ibis, Denham's Bustard, White-bellied Korhaan, Blue Korhaan, Secretarybird, White Stork, Abdim's Stork, Black Stork, Cattle Egret and Northern Black Korhaan;
- *Secondary and grazed grassland*: Blue Crane, Grey Crowed Crane, Blue Korhaan, Secretarybird, Blue Korhaan, Northern Black Korhaan and Black-headed Heron;
- *Arable land, pastures and cultivated land*: Secretarybird, Grey Crowned Crane, Blue Crane, Blue Korhaan, White Stork, Abdim's Stork, Cattle Egret, Spur-winged Goose and Egyptian Goose;
- *Riparian/drainage line crossings*: African Fish Eagle including a number of wading birds (herons, storks), waterfowl (Egyptian Goose and African Black Duck) and waterbirds such as cormorants, darters and ibises;
- *Upland seep crossings*: Wattled Crane, Blue Crane, Grey Crowned Crane and African Marsh Harrier;
- *Impoundment crossings*: Grey Crowned Crane, storks, African Fish Eagle and a variety of other waterbird species such as ducks and geese, cormorants, darters, ibises, coots, kingfishers and herons; and
- *Endorheic pans*: Greater Flamingo, Lesser Flamingo and a variety of other waterbird species such as ducks and geese, cormorants, darters, ibises, coots, kingfishers and herons.

- *Loss of habitat*

Habitat destruction is not considered to be a major impact since many of the bird species will temporarily vacate the area during the construction phase. However, road construction, the construction of pylons and stringing operations within or in close proximity of wetland areas and primary upland grassland could displace crane species or threatened passerine species (e.g. Yellow-breasted Pipit *Anthus chloris* and Rudd's Lark *Heteromirafra ruddi*). The latter species were observed on the north-eastern parts of the study area, thereby highlighting the importance of the upland grassland seres in sustaining localised populations of threatened passerine bird species. Typical species likely to be affected include:

- Wattled Crane, Blue Crane, Grey Crowned Crane, Denham's Bustard, White-bellied Korhaan, Secretarybird, Black-winged Lapwing, Marsh Owl, African Grass-owl, African Marsh Harrier, Broad-tailed Warbler, White-winged Flufftail (rare), Yellow-breasted Pipit and Rudd's Lark.

- *Disturbances caused by construction/decommissioning activities and maintenance of the transmission line*

It is inevitable that disturbances during construction and maintenance will occur. *These will especially be significant near or in close proximity to crane breeding sites where the abandoning of nests or displacement thereof is highly possible.* Although it is not anticipated to pose a significant impact on bird species, special care should also be exercised during the crossing of wetland systems (especially upland seeps) and upland primary grassland to prevent unnecessary disturbances caused to potential breeding and roosting species such as the Yellow-breasted Pipit, Rudd's Lark, White-bellied Korhaan and Denham's Bustard.

- *Hunting, poaching and the illegal trade of birds*

It is possible during the construction phase that the labour force or even visitors to the area could capture cranes (especially nesting birds, eggs or juveniles) for reasons such as food, muthi or trade. Crane species, especially Wattled and Grey Crowned are highly prised in private collections and the possibility of theft cannot be ruled out.