SOLAR RESERVE SA (PTY) LTD

Proposed Construction of a 132kV Power Line and Associated Infrastructure for the evacuation of power from the Proposed Kalkaar Concentrating Solar Thermal Power Project on the Remainder of Portion 1 of the Farm Kalkaar 389 near Jacobsdal, Free State and Northern Cape Provinces

Impact Assessment Report

DEA Reference No.: 14/12/16/3/3/1/1577
Issue Date: 9 December 2016
Revision No.: 3
Project Number: 13620 – Kalkaar Power Line

Date:	9 December 2016
Document Title:	Proposed Construction of a 132kV Power Line and Associated Infrastructure for the evacuation of power from the Proposed Kalkaar Concentrating Solar Thermal Power Project on the Remainder of Portion 1 of the Farm Kalkaar 389 near Jacobsdal, Free State and Northern Cape Provinces:Impact Assessment Report
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Revision Number:	3
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SOLARRESERVE SOUTH AFRICA (PTY) LTD

PROPOSED CONSTRUCTION OF A 132KV POWER LINE AND ASSOCIATED INFRASTRUCTURE FOR THE EVACUATION OF POWER FROM THE PROPOSED KALKAAR CONCENTRATING SOLAR THERMAL POWER PROJECT ON THE REMAINDER OF PORTION 1 OF THE FARM KALKAAR 389 NEAR JACOBSDAL, FREE STATE AND NORTHERN CAPE PROVINCES

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IMPACT ASSESSMENT REPORT

1 INTRODUCTION

SolarReserve South Africa (Pty) Ltd ('**SolarReserve**') has appointed SiVEST Environmental Division as the independent Environmental Assessment Practitioner ('EAP') to undertake the Basic Assessment process for the proposed 132kV Power Line and associated infrastructure (the '**Power line Project**') for the evacuation of power from the proposed Kalkaar Concentrating Solar Thermal Power Project (the "**CSP Project**") on the Remainder of Portion 1 of the Farm Kalkaar 389 near Jacobsdal in the Free State Province and Northern Cape Provinces (the **CSP Project Site'**).

On the 3rd of September 2015, SolarReserve received an environmental authorisation (EA – DEA Ref: 14/12/16/3/3/2/660) for the CSP Project.

In order to evacuate the electricity generated by the CSP Project, a grid connection solution was assessed by SolarReserve. And as such a Basic Assessment (BA) processes was initiated for the proposed Power Line Project.

The preferred evacuation point for the electricity generated by the CSP Project is from the Jacobsdal Substation via the Project Substation (which is situated on the CSP Project Site) and terminating at the Kimberley Distribution Substation ('**KDS**') to Boundary Substation near Kimberley. As such, in order to evacuate the electricity generated by the CSP Project, this environmental authorisation process was undertaken to assess the environmental feasibility of the proposed Power line Project to the aforementioned interconnection point. Importantly, it must be noted that the grid connection solution proposed for the CSP Project will only be finalised by Eskom at the Budget Quote stage of Eskom's Load and Demand Network Integration Studies. The preliminary Load and Demand Network Integration Studies have however shown that Eskom may require that the CSP Project is to evacuate power not only via the KDS to the Boundary Substation but also to the Jacobsdal Substation.

This Basic Impact Assessment has been conducted in line with the EIA Regulations (Appendix 1) of Government Notice (GN) R.982 and takes into account the description of the significance of all environmental impacts including;

(i) cumulative impacts;
(ii) the nature, significance and consequences of the impact and risk;
(iii) the extent and duration of the impact and risk;
(iv) the probability of the impact and risk occurring;
(v) the degree to which the impact and risk can be reversed;
(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and
(vii) the degree to which the impact and risk can be avoided, managed or mitigated.

2 METHODOLOGY FOR IMPACT ASSESSMENT

The Impact Assessment Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

2.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 2**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

2.2 Impact Rating System

Impact assessment takes into account the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, a proposal for mitigating or optimising of an impact is detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

2.2.1 Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Description

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).

2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).

2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY/ MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.

4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".

74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Table 2: Rating of impacts

IMPACT TABLE FORMAT		
Environmental Parameter	A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water	
Issue/Impact/Environmental Effect/Nature	A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water	
Extent	A brief description indicating the chances of the impact occurring	
Probability	A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity	
Reversibility	A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water	
Irreplaceable loss of resources	A brief description of the degree in which irreplaceable resources are likely to be lost	
Duration	A brief description of the amount of time the proposed activity is likely to take to its completion	
Cumulative effect	A brief description of whether the impact will be exacerbated as a result of the proposed activity	
Intensity/magnitude	A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily	
Significance Rating	A brief description of the importance of an impact which in turn dictates the level of mitigation required	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	1
Probability	4	1
Reversibility	4	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	4	1
Intensity/magnitude	4	1
Significance rating	-96 (high negative)	-6 (low negative)

IMPACT TABLE FORMAT	
Mitigation measures	Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analysing the significance. These measures will be detailed in the EMPr.

3 ENVIRONMENTAL IMPACT ASSESSMENT

Several specialist studies were conducted during the BA to identify the issues associated with the proposed development. These include:

- Biodiversity (fauna and flora);
- Avifauna;
- Wetlands;
- Soils and Agricultural Potential;
- Heritage and Palaeontology;
- Visual; and
- Socio-Economic.

The environmental impacts that may result from the proposed 132kV power line and associated infrastructure are summarised below according to each environmental aspect. The impact of the proposed developed on the biophysical and social environment are indicated, as well as the constraints that the environment will impose on the development. In addition, the impact significance of the proposed development on each environmental aspect during the various project phase, both before and after mitigation measures, are provided.

3.1 Biodiversity Impacts

A Biodiversity Impact Assessment was conducted by Simon Todd of Simon Todd Consulting. The report is included in **Appendix D1**. A summary of the main findings of the assessment are outlined below.

3.1.1 Broad-Scale Vegetation Patterns

According to the national vegetation map **(Mucina & Rutherford 2006)**, there are several vegetation types within the power line corridors (**Figure 1)**. The majority of the routes to Kimberly are within the Kimberly Thornveld and Northern Upper Karoo vegetation types, while the option to Jacobsdal is limited largely to

Northern Upper Karoo. There are however also limited extents of Highveld Salt Pans and Vaalbos Rocky Shrubland within the corridors. These are each described in greater detail below.

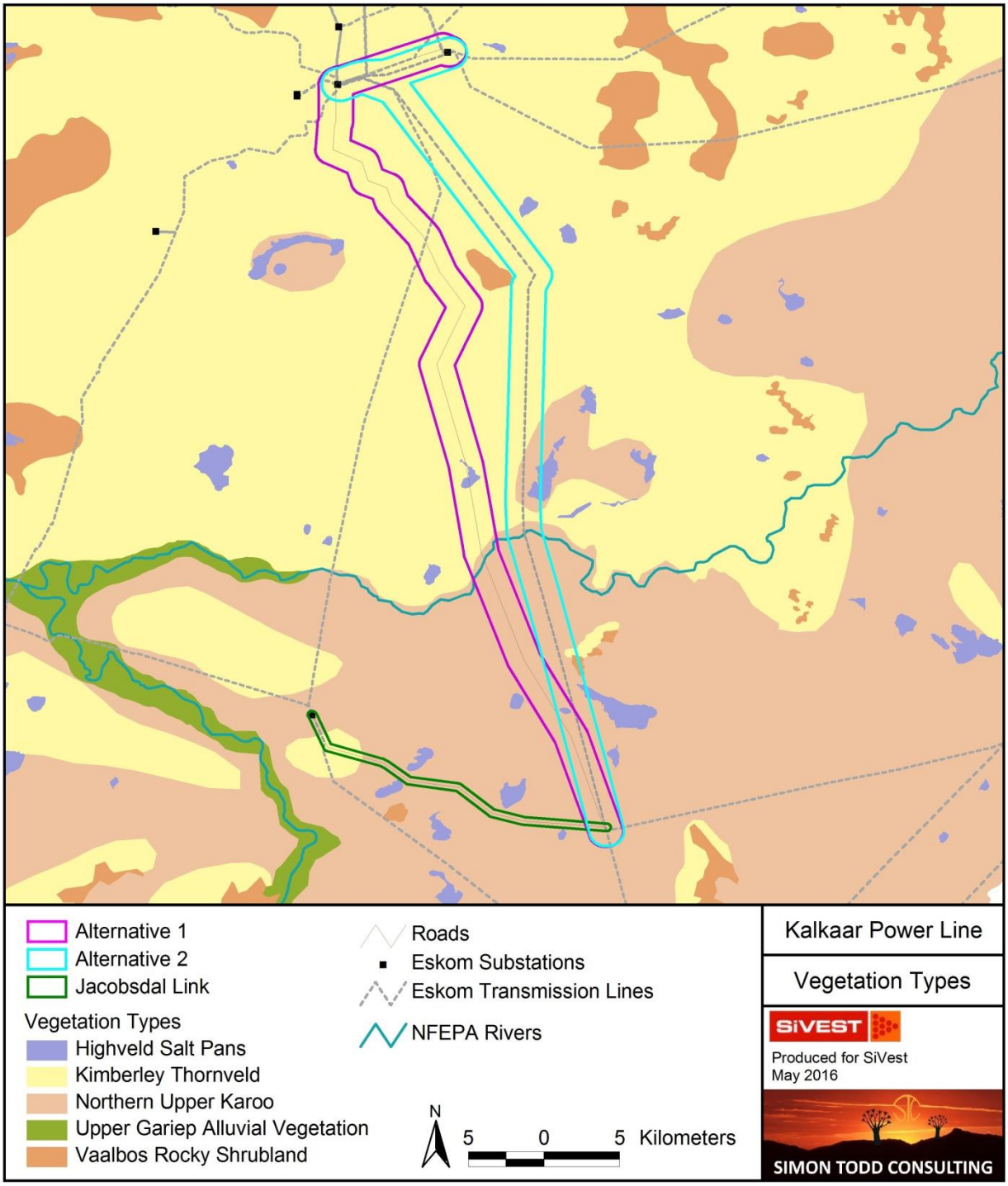


Figure 1. Extract of the national vegetation map (Mucina & Rutherford 2006) for the study area. Rivers and delineated by the National Freshwater Ecosystem Priority Areas Assessment (Nel *et al*., 2011) are also depicted

Kimberley Thornveld is an extensive vegetation type that occupies 19 512 km² of the Northern Cape, Free State and North-West province, within the Kimberly, Hartswater, Bloemhof and Hoopstad districts as well as substtiotial parts of the Warrenton, Christiana, Taung, Boshof and Barkley West districts. The vegetation type consists of open or irregular plains with a with developed tree layer of *Acacia erioloba*, *Acacia tortillis*, *Acacia karoo* and *Boscia albitrunca* with a well developed shrubs layer including occasional dense stands of *Tarchonanthus champhoratus* and *Acacia mellifera*. Kimberly Thornveld is usually associated with deep sandy to loamy soils of the Hutton soil form on the Ae and Ah land types.

Kimberly Thornveld is classified as Least Threatened and 82.3% of the original extent is still intact, transformation for cultivation being the primary impact to date. Only 2% is however formally conserved. Important and dominant species usually characteristic of this vegetation type include trees such as *Acacia erioloba*, *Acacia karoo*, *Acacia mellifera*, *Acacia tortilis*, *Searsia lancea*, *Tarchonanthus camphoratus*, *Ehretia rigida* and *Grewia flava*; shrubs such as *Lycium hirsutum*, *Lycium cinereum*, *Rhus tridactyla*, *Acacia hebeclada*, *Hermannia comosa* and *Melolobium mincrophyllum*; grasses such as *Eragrostis lehmanniana*, *Aristida canescens*, *Cymbopogon pospischilli*, *Digitaria eriantha*, *Enneapogon cenchroides*, *Heteropogon contortus*, *Themeda triadra*. Biogeographically important species which are endemic to the region include *Blepharis marginata*, *Euphorbia bergii*, *Panicum kalaharense*, *Lithops aucampiae* subsp *aucampiae*, *Helichrysum arenicola*, *Neauradopsis bechuanensis* and *Tridentea marientalensis* subsp *marientalensis*. This is the dominant vegetation type within the northern half of Alternative 2 and 2 and is mapped as sole vegetation type north of the Modder River, although the site visit revealed that it does not extend as far south as this.

Northern Upper Karoo is one of the most extensive vegetation types in the country and occupies over 40 000 km2 of the interior karoo. This vegetation type occurs on the upper karoo plateau from Prieska, Vosburg and Carnarvon in the west to Phillipstown, Petrusville and Petrusburg in the east. It is bordered by Niekerkshoop, Douglas and Petrusburg in the north and by Carnarvon, Pampoenpoort and De Aar in the south. Northern Upper Karoo is usually an open shrubland dominated by low karoo shrubs and grasses with larger elements such as Acacia mellifera more prominent in the north. Soils and geology are not very specific and consist of shales of the Volksrust formation and the Prince Albert Formation, as well as Dwyka Group diamictites, while there are also dolerite sills and sheets in places. Large areas are also covered by superficial deposits of calcrete from the Kalahari Group. Soils are variable and may be deeper sandy soils or shallow soils of the Glenrosa and Mispah forms. Land types are mainly Ae, Ag and Fc. Four plant species are known to be endemic to the vegetation type, *Lithops hookeriana*, *Stomatium pluridens*, *Galenia exigua* and *Manulea deserticola*. Although Northern Upper Karoo is mapped as being bounded by the Modder River, there are extensive areas north of the river on shallow calcrete plains that correspond much more closely with this vegetation type than the Kimberly Thornveld that these areas are mapped as.

Although Vaalbos Rocky Shrubland is not mapped along the corridors, the rocky hills in the area corresond with this unit and only the largest outcrops have been mapped within the Vegmap. Vaalbos Rocky Shrubland occurs in the Northern Cape and Free State along rocky ridges and outcrops within the Kimberly Tornveld and Northern Upper Karoo vegetation units, east of the confluence of the Vaal and Orange Rivers. It consists of evergreen shrub communities dominated by *Tarchonanthus camphoratus*, *Olea europea* subsp. *africana*, *Euclea crispa*, *Acacia tortilis*, *Diospyros lycioides*, *Searsia lancea*, *Zizyphus mucronata*, *Searsia burchellii* and

Buddleja saligna. Vaalbos Rocky Shrubland has a limited extent of only 1451km2 but has not been significantly impacted by transformation and is not threatened, it is partly conserved within the Mokala National Park.

The Highveld Salt Pans vegetation unit occurs in the Northern Cape, Eastern Cape, North-West, Free State and Gauteng and occurs scattered across the broad grassland/karoo and grassland/savanna interface roughly between Mafikeng/Koster in the north and Britstown/Middelburg in the south. These are usually depressions usually containing temporary water bodies, which transition from being fresh in the wet season and progressing to saline systems as the dry season pregresses and evaporation intensifies. Important species include shrubs such as *Atriplex vestita*, *Pentzia globosa*, *Salsola glabrescens* and *Lycium cinereum*; grasses such as *Cynodon dactylon*, *Chloris virgata*, *Diplachne fusca*, *Eragrostis bicolor*, *E.chloromelas*, *Hemarthria altissima*, *Panicum coloratum*, *Sporobolus fimbriatus* and *S.ioclados*. This vegetation type has an extent of 1160km2 and although it is not threatened, it has been heavily impacted by livestock grazing and is vulernable disturbances such as road building which affect the hydrological regime of the pans. There are several pans along the power line corridors and they should be avoided as much as possible, especially the larger pans which hold water on a regular basis and are important for fauna including birds such as waders and flamingos which frequent these features.

3.1.2 Habitats

A number of different habitats are traversed by the power line options and these are described in brief below.

3.1.2.1 Kimberly Thornveld

Although this vegetation unit is mapped as being largely restricted to the north of the Modder River, in practice, it occurs as a mosaic with the Northern Upper Karoo with the latter being prevalent in areas of shallow soils, especially on calcrete, while Kimberly Thornveld is prevalent on deeper sandy and dolerite-derived soils. In sandy areas, *Acacia erioloba* (**Figure 2**) tends to be dominant, while in areas with more clay in the soil, *Acacia tortillis* and *Searsia lancea* tend to be dominant, while other trees present include *Acacia mellifera*, *Acacia hebeclada*, *Zizyphus mucronata* and *Ehretia alba* (**Figure 3**). The density of the tree layer is variable and there are some areas that are virtually free of trees and other areas with a very high density. The grass layer is variable and affected to a large extent by the prevailing land use. Dominant and common species include *Schmidtia pappophoroides*, *Cenchrus cilliata*, *Themeda triandra*, *Stipagrostis uniplumis* var. *uniplumis* and *Aristida stipitata*. Common shrubs include *Selago saxatilis*, *Hermannia tomentosa*, *Lycium cinereum*, *Pentzia globosa* and forbs such as *Hirpicium echinus*, *Monsonia angustifolia* and *Sesamum capense*. Protected trees present in these areas include *Boscia albitrunca* and *Acacia erioloba*. While *Acacia erioloba* is dense in some areas and are likely to be impacted by the power line servitude, *Boscia albitrunca* is less common and ccurs as widely scattered individuals.

Figure 2. Kimberly Thornveld near to the Eskom Boundary substation, with *Searsia lancea*, *Acacia tortillis*, *Acacia erioloba* and *Acacia hebeclada* prevalent. The grass layer is dominated by *Schmidtia pappophoroides*

Figure 3. Kimberly Thornveld near to the N14, showing an area with a high tree density, mostly of *Searsia lancea*, but *Acacia erioloba*, *Zizyphus mucronata* and *Acacia tortillis* are also present. The green in the foreground is a recent fire scar

3.1.2.2 Northern Upper Karoo

There are extensive tracts of homogenous Northern Upper Karoo type vegetation present at the site, distributed mainly south of the Modder River (**Figure 4**), but also north of the river in areas of shallow soils (**Figure 5**). It is largely devoid of trees except where there are deeper soils present where it transitions towards Kimberly Thornveld or where there are rocky outcrops present which can also be better described as Vaalbos Rocky Shrubland. In general, this vegetation unit characterised by extensive plains with low shrubby or grassy vegetation. Common and dominant species include shrubs such as *Pentzia globosa*, *Pentzia incana*, *Eriocephalus spinescens*, *Rosenia humilis*, *Lycium cinereum*, *Aptosimum marlothii*, *Asparagus glaucus*, *Salsola calluna*, *Salsola rabieana* and grasses such as *Aristida adscensionis*, *Enneapogon desvauxii*, *Eragrostis lehmanniana* and *Tragus koelerioides*. Trees are generally rare but may occur along drainage lines and on rocky hills and include *Acacia mellifera*, *Acacia tortillis* and *Acacia karoo*.

Figure 4. Examples of Northern Upper Karoo from the Kalkaar-Kimberly options, from the area south of the Modder River, showing the homogenous nature of the vegetation

Figure 5. Examples of Northern Upper Karoo from the Kalkaar-Kimberly routes, taken north of the Modder River, cleary showing the prevalence of this vegetation unit in this area, which is currently mapped as Kimberly Thornveld.

3.1.2.3 Vaalbos Rocky Shrubland

Although very little of this vegetation unit has been mapped in the area by **Mucina and Rutherford (2006)**, it is much more common than the map suggests and occurs on numerous small rocky outcrops that are present throughout the study area (**Figure 6**). These are diverse areas and are also considered important for fauna, especially reptiles and small mammals which find shelter in the rocky habitat. This habitat usually has more trees than the surrounding plains although it is not always the case. Common trees and tall shrubs include *Acacia mellifera*, *Acacia tortillis*, *Eherthia rigida*, *Searsia burchelli*, *Diospyros lycioides*, *Rhigozum obovatum* and *Euclea crispa*. The grass layer usually consists of species such as *Themeda triandra*, *Heteropogon contortus*, *Digitaria eriantha* and *Enneapogon scoparius*.

Figure 6. Vaalbos Rocky Shrubland occurs as numerous isolated rocky outcrops within the corridors and most of these areas are not currently mapped within the national vegetation map.

3.1.2.4 Pans

There are numerous small to moderate sized pans along the power line routes between Kalkaar and the Boundary substation (**Figure 7**). Some of these are not well developed and probably very rarely hold water but rather represent run-on areas where water collects on a reasonably temporary basis. Some of the larger pans are however well developed and clearly hold water on a regular basis and represent ecologically important features of the area that contain a variety of associated temporary water organisms (**Figure 8**) and attract many waders and water birds. Apart from the terrestrial impacts, the presence of numerous birds in these areas increases the potential for avifaunal impacts in the vicinity of these areas and the pans should be avoided as much as possible. The areas around the pans are usually heavily grazed and the vegetation very short and often lawn-like as a result. Common and typical species present include *Cynodon dactylon*, *Eragrostis bicolor*, *Hemarthria altissima*, *Panicum coloratum* and *Sporobolus fimbriatus* and *S.ioclados*. Shrubs present around the fringes of the pans include *Lycium cinereum*, *Atriplex vestita*, *Pentzia globosa* and *Salsola glabrescens*.

Figure 7. Left, a well developed pan system which holds water on a regular basis and right a poorly developed system where water collects only during large events. The vicinity of the larger pan should be avoided as much as possible

Figure 8. Fairy shrimps present in one of the pans along the power line routes between Kalkaar and Boundary substation. These organisms hatch out after the pan is flooded and complete their life cycles within a few weeks. The eggs may survive for years in the dry mud of the pan before emerging again

3.1.2.5 Modder River

Both options to Kimberly traverse the Modder River which is considered a sensitive feature due to the ecological significance of this area as a corridor for fauna as well as the unique aquatic habitats present here that are not represented elsewhere in the landscape of the area. The river is however heavily impacted by agricultural activities and due to heavy abstraction it does not flow on a perennial basis. The banks of the river are well vegetated with woody species, mostly *Acacia karoo* with *Salix mucronata* and *Tamarix usneoides*, while there may be large stands of *Phragmites australis* in some reaches (**Figure 9**). There is also a lot of disturbance and alien invasion along the river, with various *Eucalyptus* species, *Prosopis* spp. and kikuyu being prevalent. Although the river is sensitive, it is not very wide and it is likely that the power line will be able to span the river with little impact on the river itself.

Figure 9. The Modder River, with dense riparian vegetation. Although this has been impacted by agricultural activities in many areas the banks usually retain some woody vegetation. Dominant species include reeds Phragmites australis and trees such as *Salix mucronata*, *Acacia karoo* and *Tamarix usneoides*. There are usually a variety of alien species present as well, especially *Eucalyptus* species, Kikuyu and *Prosopis*

3.1.3 Listed & Protected Plant Species

According to the SANBI SIBIS database, more than 500 indigenous plant species have been recorded from the quarter degree squares 2824 DB, DD and 2924 BB. This however includes only 3 species of conservation concern as listed below in **Table 3**. Only Acacia erioloba can be confirmed present and occurs mostly in the north of the site in the areas of savanna on deeper sands near Kimberly. Aloinopsis rubrolineata occurs in areas of exposed calcrete and may occur in the central section of the routes between Kimberly and Kalkaar where such habitat is present, but was not observed. There are however also additional species present which are either protected under the National Forests Act such as *Boscia albitrunca* and *Acacia erioloba* or protected under the Northern Cape Nature Conservation Act of 2009, which includes *Boscia foetida*, all *Mesembryanthemaceae*, all species within the *Euphorbiaceae*, *Oxalidaceae*, *Iridaceae*, all species within the genera *Nemesia* and *Jamesbrittenia*. The overall impact on listed and protected species would be low after mitigation and avoidance and no highly significant impacts on such species are anticipated.

Table 3. Listed species which may occur within the power line corridors, including their IUCN status and the likelihood that they occur at the site

Family	Species	IUCN Status	Likelihood
FABACEAE	Acacia erioloba	Declining	Confirmed
HYACINTHACEAE	Drimia sanguinea	NT	Possible
MESEMBRYANTHEMACEAE	Aloinopsis rubrolineata	Rare	Possible

3.1.4 Critical Biodiversity Areas & Broad-Scale Processes

No fine-scale conservation planning has been conducted for the area and as a result, no Critical Biodiversity Areas or Ecological Support Areas have been defined for the study area. The site does not fall within an NPAES focus area, indicating that the site is not a known broad-scale conservation priority. Although the footprint of power lines can be kept low, there are likely to be sections where large trees are present that will need to be cleared, so the major impact of the development is likely to be on such trees rather than the lower vegetation strata which would be little affected. As the ground layer can be kep intact and the footprint in terms of vegetation clearing would be low, the impact of the development of the Kalkaar 132kV power line is not likely to result in significant disruption of any broad-scale ecological processes.

The density of renewable energy development in the Kimberly area is moderate, with several approved projects currently being built or nearing construction (**Figure 10**). The main source of habitat loss in the area is however due to agricultural practices with extensive clearing for irrigated croplands along the Modder River as well as dryland cropping scattered across the area. Although many of the dryland cropping areas have been abandoned, the full complement of biodiversity is slow to return to such areas. It is likely that the cumulative impact due to renewable energy development will increase significantly in the future. Due the low footprint of low voltage power lines, the contribution of the Kalkaar 132kV lines to cumulative impact in the

area is not considered highly significant in the context of the surrounding landscape and the large-scale impacts on habitat loss resulting from agriculture, mining and renewable energy plants. Although power lines may generate significant cumulative impact on avifaunal, the long-term interaction with terrestrial biodiversity is low after mitigation and the contribution of the current development to cumulative impact on the area is low and would not generate significant long-term impact.

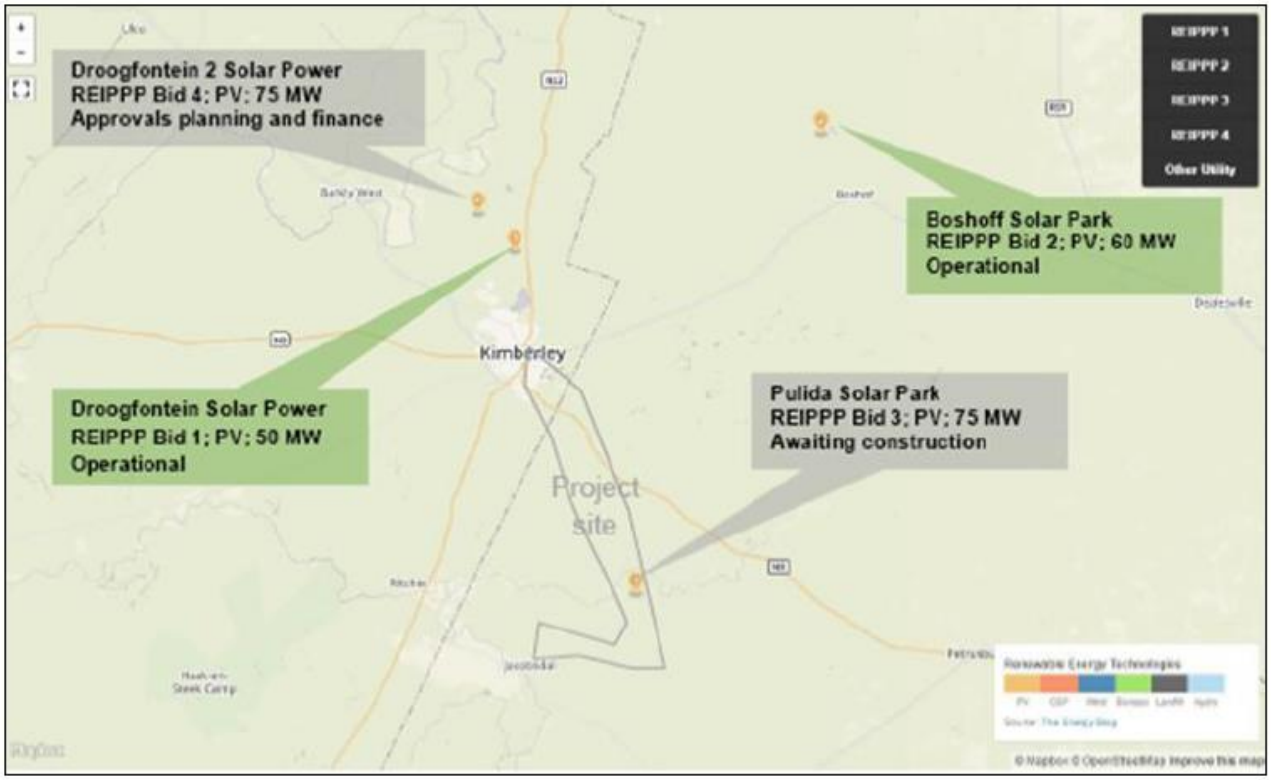


Figure 10. Existing solar projects in the vicinity of the Kalkaar project and grid connections

3.1.5 Faunal Communities

3.1.5.1 Mammals

According to the MammalMap database, 51 mammals have been recorded from the quarter degree squares traversed by the power line options. However, as many as 20 of these are large mammals, introduced or maintained for game farming operations and are not considered relevant to the current study as these are managed populations regulated and confined by landowners. The remaining 30 are free ranging species which occur naturally in the area. There are however some free ranging species present in the area such as Warthog which did not occur naturally in the area but have been introduced and have established populations in the area. The area is also well know for the abundance of some of the less common nocturnal desert and savanna

such as aardwolf *Proteles cristatus*, black-footed cat *Felis nigripes* (Vulnerable), Cape fox *Vulpes chama* and aardvark *Orycteropus afer*.

Five listed terrestrial mammals may occur in the area, the Honey Badger *Mellivora capensis* (Endangered), Brown Hyaena *Hyaena brunnea* (Near Threatened), Black-footed cat *Felis nigripes* (Vulnerable), South African Hedgehog *Atelerix frontalis* (Near Threatened) and the Serval *Leptailurus serval* (Near Threatened). Due to the prevalence of game farming in the area, most of these species have been recorded or are likely to be present in the area on account of the favourable land use. The footprint of the power lines would be low and would not amount to significant long-term habitat loss for any of these species as the ground layer of grasses or low shrubs would not be impacted by the development.

In terms of habitats, there are several different habitats that can be recognised within the affected area, this includes savanna bushveld mostly in the northern areas around Kimberly, but also some areas in the south near to Jacobsdal, rocky hills scattered across the site, karroid shrublands on shallow soils mostly in the central section of the routes between Kimberly and Kalkaar, the Modder River and adjacent floodplains and the pans which are of relatively limited extent but widely scattered across the area. Sensitive areas include the rocky hills which would be important for small mammals and the vicinity of the Modder River which provdes habitat for species associated with water or dense vegetation such as Water Mongoose.

3.1.5.2 Reptiles

According to the SARCA database, 31 reptile species are known from the area suggesting that the reptile diversity within the site is likely to be fairly low. Species observed in the area include the Cape Skink *Trachylepis capensis*, Ground Agama *Agama aculeata aculeata*, Spotted Sand Lizard *Pedioplanis lineoocellata* and Leopard Tortoise *Stigmochelys pardalis*. There are no listed species known from the area. Important areas for reptiles are likely to include the rocky outcrops which are likely to be important for snakes, lizards and geckos, while the densely vegetated areas along the Modder River are also likely to be important for snakes as well as other species which favour dense cover.

Although the development of the power line would result in some habitat loss or degradation, this this likely to be of limited extent and the overall impact on reptiles are likely to be local in nature and of low intensity and are not likely to be of broader significance.

3.1.5.3 Amphibians

The site lies within the distribution range of 10 amphibian species. The only listed species which may occur in the area is the Giant Bullfrog *Pyxicephalus adspersus* which is listed as Near Threatened. Although it has not been recorded from the affected area, it is common in the wider area on account of the large number of pans in the area, which are the breeding habitat of the Giant Bullfrog. Apart from the pans, the Modder River is also likely to be important for frogs and is probably the only perennial water at the site. Although there are

a variety of farm dams in the area, these are not perennial and would be used for breeding by toads but probably do not contain species which rely on perennial water such as the Cape River Frog. Due to the low footprint of the power lines, the impact on important amphibian habitats is likely to be low. The major risk factor for amphibians would be pollution, especially due to petrochemical spills associated with the operation of heavy vehicles during construction.

3.1.6 Site Sensitivity Assessment

The ecological sensitivity map of the Kalkaar corridor alternatives is illustrated below in **Figure 11**. There is not a lot difference between the two power line corridor alternatives from Kalkaar to Kimberly (**Table 4**). In the absence of existing Eskom power lines, Corridor 2 Alternative 1 would probably be considered the preferred alternative due to the lower overall extent of high and medium-high sensitivity features along the route and the greater scope for avoidance. However, there is an existing power line along Corridor 2 Alternative 2 and if the same servitude can be used for access to the new line, then this would clearly the be preferred alternative as this would reduce the overall extent of disturbance and would also not create a new line of disturbance and impact along the new alignment. The major sensitive features along the routes that would require mitigation or avoidance includes the pans, where the line should be routed to avoid these features where possible, the areas of high tree density and the rocky hills. Although the Modder River is considered highly sensitive, the extent of this is low and the power line should easily be able to span the sensitive sections. Alternative 1 also passes adjacent to the Benfontein Nature Reserve in the section where it runs next to the N8 and while there would not be direct impact on the Nature Reserve, this is an important area for avifauna, some of which may be susceptible to collisions or electrocution with power lines, but this is outside the scope of the current study. The Jacobsdal link (Corridor 1) has not very high sensitivity sections along the route although there are some significant sections which traverse rocky hills where some impact on protected tree species is likely. The major impact associated with the power lines would be habitat loss due to the establishment of the power line and in the long-term clearing of the power line servitude in areas where there is currently a high tree density. In areas of karroid shrubland or open grassland, the power line would not be likely to generate a high impact as the ground layer would not be impacted by clearing and footprint can be minimised.

Table 4. The length (m) of centrelines associated with each alternative within the different sensitivity classes along each route option

Sensitivity	Corridor 2 Alternative 1	Corridor 2 Alternative 2	Corridor 1 Jacobsdal Link
Very High	154	127	
High	1 082	1318	399
Medium-High	2 180	2 640	167
Medium	14 266	13 125	3 308
Medium-Low	31 467	39 053	15 842
Transformed/Low	12 414	5 982	44

	61 563	62 244	19 760

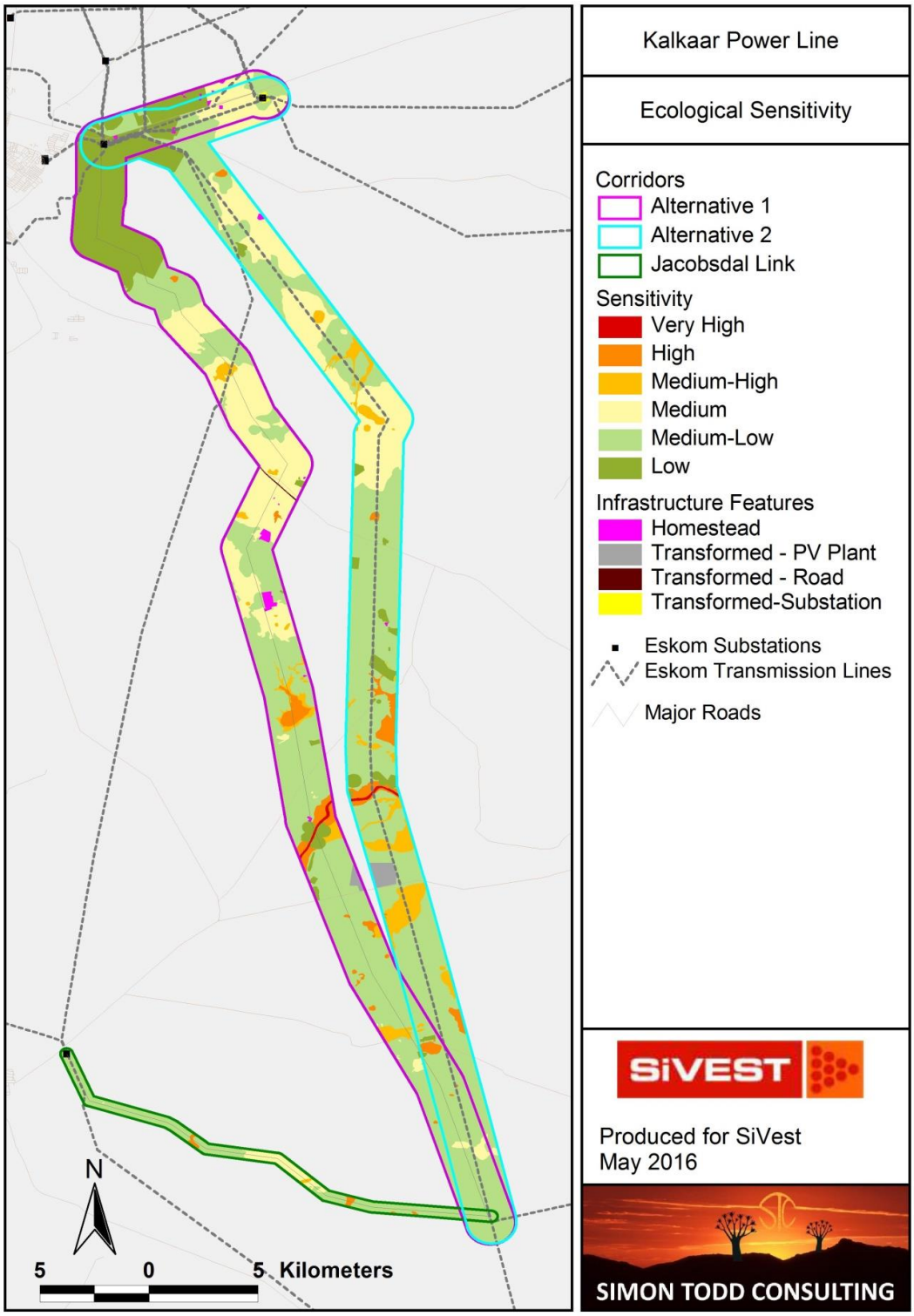


Figure 11. Ecological sensitivity map of the proposed power line corridors from Kalkaar to Kimberly or to Jacobsdal

3.1.7 Impact Assessment

3.1.7.1 Planning Phase impacts

There are no impacts that are likely to be created as a result of project planning.

3.1.7.2 Construction Phase impacts

3.1.7.2.1 Impacts on vegetation and protected plant species

Although direct impact to most sensitive features such as pans and rocky hills can be minimised or avoided, some vegetation loss will occur regardless of mitigation and avoidance and it is also likely that at individuals of listed or protected plant species will be impacted by the development (**Table 5**) of the power line and associated infrastructure. The abundance of protected species such as Acacia erioloba and Boscia albitrunca is high along some parts of the power line route and some impact on these species is likely, especially if the whole servitude is cleared of woody vegetation.

Table 5. Impacts on vegetation and protected plant species

Impacts on vegetation and protected plant species	
Environmental Parameter	Vegetation and protected plant species
Issue/Impact/Environmental Effect/Nature	Vegetation clearing for access roads, pylon foundations and potentially clearing beneath the servitudes will impact vegetation and protected plant species and in particular *Acacia erioloba* and *Boscia albitrunca*.
Extent	The extent of the impact will be restricted the power line servitude and as such would be local in nature.
Probability	This impact will definitely occur as some vegetation clearing will be required, and it is possible that significant numbers of trees may need to be cleared from beneath the line, in addition clearing for pylon foundation areas and some clearing for access tracks will also be required.
Reversibility	This impact is not highly reversible as it would take a long time for any cleared trees to be replaced and any individuals of other protected species would not spontaneously return either.

Impacts on vegetation and protected plant species		
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources.	
Duration	The construction phase itself will be of short duration, but the resulting impact would persist for a long time.	
Cumulative effect	The clearing would contribute to vegetation impacts in the area, but the contribution would be low given the small total footprint of the power line.	
Intensity/magnitude	The intensity of the impact would be moderate to high, depending on how much vegetation was cleared.	
Significance Rating	Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	4	3
Reversibility	2	2
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	-48 (medium negative)	-24 (low negative)
Mitigation measures	There should be a preconstruction walk-through of the power line route to identify species of conservation concern that should be avoided or translocated where possible and practicable. Areas of dense stands of protected trees should be avoided where possible and practicable. The minimum amount of woody vegetation should be cleared to conform to Eskom standards.	

3.1.7.2.2 Direct Faunal impacts

Increased levels of noise, pollution, disturbance and human presence will be detrimental to fauna during construction (**Table 6**). Sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed. Some mammals or reptiles would be vulnerable to illegal collection or poaching during the construction phase as a result of the presence of construction personnel or greater site access.

Table 6. Impacts on fauna during construction

Impacts on fauna during construction		
Environmental Parameter	Faunal impacts due to construction activities	
Issue/Impact/Environmental Effect/Nature	Vegetation clearing, the use of heavy machinery and human presence along the power line route during construction is likely to negatively affect resident fauna.	
Extent	The extent of the impact will be restricted the power line servitude and as such would be local in nature.	
Probability	This impact is likely to occur to a greater or lesser degree.	
Reversibility	This impact is largely reversible and it is only habitat loss that is not considered easily reversible.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources in terms of fauna.	
Duration	The construction phase itself will be of short duration and it is not likely that significant impact would persist beyond this time frame.	
Cumulative effect	The clearing would contribute to cumulative habitat loss for fauna in the area, but the contribution would be low and localised given the small footprint of the power line.	
Intensity/magnitude	The intensity of the impact would be moderate to low.	
Significance Rating	As construction would be relatively rapid and impact to important faunal habitats such as the vicinity of the Modder River can be minimised, it is not likely that significant long-term impact on fauna would be generated.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-10 (low negative)
Mitigation measures	The power line should be routed to avoid the pans as much as possible. The footprint of the power line should be kept as low as possible and construction staff should undergo	

Impacts on fauna during construction	
	environmental induction to ensure that they are aware of fauna-related issues and that no fauna are harmed during construction.

3.1.7.3 Operation Phase impacts

3.1.7.3.1 Degradation of ecosystems

Maintenance activities such as vegetation clearing as well as the large amount of disturbance created during construction will leave the site vulnerable to degradation through alien plant invasion and soil erosion (**Table 7**). In addition, the disturbed areas will also be vulnerable to alien plant invasion, especially woody species such as *Propsopis glandulosa*, which was observed to be present in the area at a low density, but which could quickly invade disturbed areas. Areas near to wetlands and watercourses are usually particularly vulnerable to alien plant invasion and disturbance in these areas should be kept to a minimum to reduce this risk.

Table 7. Ecosystem degradation

Operational Impact 1. Ecosystem Degradation	
Environmental Parameter	Degradation of ecosystems may occur along the power lines.
Issue/Impact/Environmental Effect/Nature	Disturbance created during construction as well as maintenance activities such as servitude clearing may lead to alien plant invasion or erosion and other forms of degradation.
Extent	The extent of the impact will be restricted the power line servitude and as such would be local in nature.
Probability	This impact has a high probability of occurring if mitigation and avoidance measures are not put in place. The disturbed areas along the power lines will be vulnerable to erosion and the invasion of alien plants following construction, while the use of herbicides or other vegetation control measures during maintenance activities would lead to similar impacts.
Reversibility	Moderate as significant degradation such as severe erosion can be difficult to reverse. .
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources, unless there was significant degradation, which is unlikely with the application of mitigation and avoidance.

Operational Impact 1. Ecosystem Degradation		
Duration	This impact would occur sporadically whenever the power line servitudes were cleared of vegetation or otherwise disturbed and this would potentially occur for the duration of the lifespan of the power lines.	
Cumulative effect	This would contribute to degradation impacts in the area, but the contribution would be relatively small given the size of the contribution compared to other impacts in the area, such as mining.	
Intensity/magnitude	The intensity of the impact would be moderate to low.	
Significance Rating	Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-30 (medium negative)	-11 (low negative)
Mitigation measures	Regular erosion and alien plant control along the power line servitude. During operation and maintenance of the power line servitude, alien species especially large woody species such as *Propsopis glandulosa* should be cleared from the power line servitude, but indigenous species such as *Boscia albitunca* and *Boscia foetida*, should not be cleared as they do not pose a fire risk. If any indigenous trees are too tall to comply with safety standards they can be trimmed to an acceptable height and it is not necessary to cut down the trees.	

3.1.7.4 Decommissioing and Closure Phase impacts

3.1.7.4.1 Direct Faunal impacts

Increased levels of noise, pollution, disturbance and human presence will be detrimental to fauna during decommissioning (**Table 8**). Sensitive and shy fauna would move away from the area during decomissioning as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the decomissioning activities and might be killed. Some mammals or reptiles would be vulnerable to illegal collection or poaching during this phase as a result of the presence of construction personnel or greater site access.

Table 8. Impacts on fauna due to decommissioning

Decommissioning Impact 1. Impacts on fauna due to decommissioning		
Environmental Parameter	Faunal impacts due to decommissioning activities	
Issue/Impact/Environmental Effect/Nature	Vegetation clearing, the use of heavy machinery and human presence along the power line route during decommissioning is likely to negatively affect resident fauna.	
Extent	The extent of the impact will be restricted the power line servitude and as such would be local in nature.	
Probability	This impact is likely to occur to a greater or lesser degree.	
Reversibility	This impact is largely reversible and would be restricted largely to the period when the activity was taking place.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources in terms of fauna.	
Duration	The construction phase itself will be of short duration and it is not likely that significant impact would persist beyond this time frame.	
Cumulative effect	The clearing would contribute to cumulative habitat loss for fauna in the area, but the contribution would be low given the small footprint of the power line.	
Intensity/magnitude	The intensity of the impact would be moderate to low.	
Significance Rating	As decommissioning would be relatively rapid and there are no habitats present that are considered highly sensitive from a faunal perspective, it is not likely that significant long-term impact on fauna would be generated.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2

Decommissioning Impact 1. Impacts on fauna due to decommissioning		
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-10 (low negative)
Mitigation measures	Disturbance during decommissioning should be kept as low as possible. Staff should undergo environmental induction to ensure that they are aware of fauna-related issues and that no fauna are harmed during decommissioning activities.	

3.1.7.4.2 Degradation of ecosystems

It is likely that decommissioning will generate moderate levels of disturbance that will leave the site vulnerable to degradation through alien plant invasion and soil erosion (**Table 9**). Parts of the power line corridors are on steep ground or in areas vulernable to erosion impact and disturbance without follow-up maintenance activities would pose a risk of generating soil erosion and alien plant invasion problems in these areas. In addition, the use of heavy machinery to remove the infrastructure would also pose a risk of degradation through pollution impacts.

Table 9. Ecosystem degradation due to decommissioning activities

Decommissioning Impact 2. Ecosystem degradation due to decommissioning activities	
Environmental Parameter	Degradation of ecosystems may occur along the power lines following decommissioning.
Issue/Impact/Environmental Effect/Nature	Disturbance created during decommissioning may lead to alien plant invasion or erosion and other forms of degradation.
Extent	The extent of the impact will be restricted the power line servitude and as such would be local in nature.
Probability	This impact is likely to occur as the servitude will be vulnerable to invasion of alien plants and other impacts following decommissioning if a lot of disturbance is generated at this time.
Reversibility	Moderate to high depending on the nature of the disturbance along the power lines.
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources, unless there was significant degradation.

Decommissioning Impact 2. Ecosystem degradation due to decommissioning activities		
Duration	This impact would be likely to occur for a short period following decommissioning, but the effects could persist for decades, if there is not follow-up control.	
Cumulative effect	This would contribute to degradation impacts in the area, but the contribution would be likely to be low.	
Intensity/magnitude	The intensity of the impact would be moderate to low.	
Significance Rating	Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	2
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-28 (low negative)	-11 (low negative)
Mitigation measures	As the pylons are steel structures with concrete foundations, they are not easily removed and so it is likely that decommissioning would result in some disturbance along the power line route, which should be reduced as far as possible. The use various tools to dismantle the pylons may also pose a fire risk if these generate sparks or have open flames.	

3.2 Avifauna Impacts

An Avifaunal Assessment was conducted by Chris van Rooyen from Chris van Rooyen Consulting and is included in **Appendix D2**. A summary of the main findings of the assessment are outlined below.

3.2.1 Important Bird Areas

The study area extends for approximately 50km from the Skietpan Switching Station approximately 18km east of Jacobsdal in the western Free State to the Boundary substation outside Kimberley, just inside the borders

of the Free State Province. None of the proposed corridors overlap with any Important Bird Areas (IBAs), but three IBAs are located within 11km from the Boundary substation:

- Benfontein (SA 033);
- Dronfield Farm (SA 031); and
- Kamfers Dam (SA 032).

Dronfield Nature Reserve is situated on the central plateau of South Africa along the N12, c. 5 km north of Kimberley. The annual average rainfall in this semi-arid region is 400 mm. The reserve falls within the Savanna Biome and is close to the western edge of the Grassland Biome. One vegetation type, Kimberley Thornveld, is present. The thornveld is partly open savanna, comprising camel thorn *Vachellia* (formerly Vachellia) erioloba trees in tall, tufted grasses, and semi-open to closed mixed-Vachellia woodland. Most of the terrestrial habitat remains in a natural state, with less than 5% of the area transformed by the development of utility lines, homesteads, pump houses, cattle posts, farm dams, mining floors, dumps and quarries. At least 221 bird species have been recorded during SABAP2 in the six pentads incorporating Dronfield. About 181 of these species have been confirmed in this IBA. Dronfield supports large numbers of breeding White-backed Vulture *Gyps africanus*. The Dronfield breeding colony comprises 41% of the breeding pairs in the Kimberley region. The numbers of this species and its breeding success have largely remained stable over the past 20 years. However, the past five years have shown a slight decline in breeding success, which was at its lowest in 2012. In contrast, the 2014 breeding season produced a record 68 chicks out of the 99 breeding attempts, a 69% success rate that is significantly higher than the 22-year average of 59%. Lesser Flamingo *Phoeniconaias minor* occurs on the pan when it is seasonally inundated. European Roller *Coracias garrulus* is occasionally seen. Globally threatened species are White-backed Vulture (200–300 birds, 99 breeding pairs); Lappet-faced Vulture *Torgos tracheliotos* (four birds), Secretarybird *Sagittarius serpentarius* (two breeding pairs), Kori Bustard *Ardeotis kori*, Martial Eagle *Polemaetus bellicosus* (2–3 breeding pairs) and Lesser Flamingo. The only regionally threatened bird species is Tawny Eagle *Aquila rapax* (two residents) (Marnewick *et al.* 2015).

Benfontein is situated 14 km south-east of Kimberley and consists of flat plains on the central South African plateau at an altitude of about 1 180 m a.s.l. A large calcrete pan (300 ha in size and c. 6 km in length) in the north-west fills with water during good rains, creating a fertile shallow wetland. The vegetation is mostly semi-open savanna of the Savanna Biome, with the Nama Karoo Biome present around the pan. Most of the terrestrial habitats remain in a natural state, with some transformation due to farm buildings, a farm dam, old dumps, a large borrow pit and eroded areas. This IBA supports small numbers of breeding White-backed Vulture *Gyps africanus*, Blue Crane *Anthropoides paradiseus* and Blue Korhaan *Eupodotis caerulescens*. The farm also holds several biome-restricted assemblage species and congregatory species, including Lesser Flamingo *Phoeniconaias minor*. At least 242 species have been recorded during SABAP2 in the five pentads covering this IBA, but at the time of its assessment it had not been well atlased. More than 16 years of CWAC data have revealed that there are high levels of fluctuation in waterbird numbers and species seasonally and annually. This is due to the ephemeral nature of Benfontein Pan, which only holds water for several months during above-average rainfall years. More than 1 700 waterbirds are present during years of high rainfall, and 65 waterbird species have been recorded on the pan. Of these, 44 species are regularly present. Dominant species in terms of numbers and duration of presence are Black-winged Stilt *Himantopus himantopus*, Cape Shoveler *Anas smithii* and South African Shelduck *Tadorna cana*. Species groups that occur in limited numbers, or for short periods, include primarily herons, grebes, flamingos, ibises and storks) (Marnewick *et al.*

2015). Globally threatened species are White-backed Vulture, Blue Crane, Lesser Flamingo, Blue Korhaan, Secretarybird *Sagittarius serpentarius* and Ludwig's Bustard. Regionally threatened birds are Tawny Eagle *Aquila rapax* and Greater Flamingo *Phoenicopterus roseus*. (Marnewick *et al.* 2015).

Kamfers Dam is located 6 km north of Kimberley in the ecotone where three major biomes – Kalahari Savanna, Grassland and Nama Karoo – meet. The dam is natural in origin as it forms part of the central South African pan system known as the Highveld Salt Pans. It is an ephemeral (non-perennial), endorheic pan of c. 500 ha in extent, receiving water from its 160-km² catchment, 30–40 megalitres of partially treated sewage effluent from Kimberley per day and half of the town's storm-water runoff. Over the past 15 years it has been transformed from an ephemeral pan to a permanent wetland due to a steady increase in sewage effluent inflow. The partially treated sewage effluent has caused this aquatic ecosystem to become eutrophic and rich in phosphates and other minerals, resulting in the establishment of extensive reedbeds and sedges. The waterbody's alkalinity has increased significantly. The sewage also promotes the growth of up to 26 species of phytoplankton (algae) in the dam, of which the blue-green algae *Arthrospira fusiformis* and diatoms *Cyclotella* spp. are usually the most abundant. As a consequence, this IBA supports large numbers of waterbirds. In such dynamic aquatic ecosystems, waterbird species and numbers change with fluctuating water quality and water levels. Most of the terrestrial habitats remain in a natural state, with some transformation due to two railway lines, roads, farm buildings and a farm dam, sewerage works, an ash dump and eroded areas. This IBA provides a reliable refuge for waterbirds in a semi-arid area where wetlands are scarce. Kamfers Dam regularly holds more than 20 000 birds. A special feature is the large numbers of Greater Flamingo *Phoenicopterus roseus* and Lesser Flamingo *Phoeniconaias minor* that are found throughout the year. This IBA supports probably the largest permanent population of Lesser Flamingos in southern Africa. At least 63 waterbird species have been recorded at Kamfers Dam, and 243 species have been reported during SABAP2. The most abundant waterbirds in recent years are Lesser Flamingo, Greater Flamingo and Grey-headed Gull *Chroicocephalus cirrocephalus*. The highest number of waterbirds counted was 84 919 individuals in 2006. Of these, 81 664 were Lesser Flamingos. African Marsh Harrier *Circus ranivorus* and Chestnut-banded Plover *Charadrius pallidus* occur at Kamfers Dam. The dam also occasionally holds large numbers of Black-necked Grebe *Podiceps nigricollis* and South African Shelduck *Tadorna cana*. Globally threatened birds are Lesser Flamingo (10 000 to 80 000) and Chestnut-banded Plover. Regionally threatened birds are Greater Flamingo (1 200 to 4 800). (Marnewick *et al.* 2015).

See **Figure 12** for map indicating the location of the IBAs

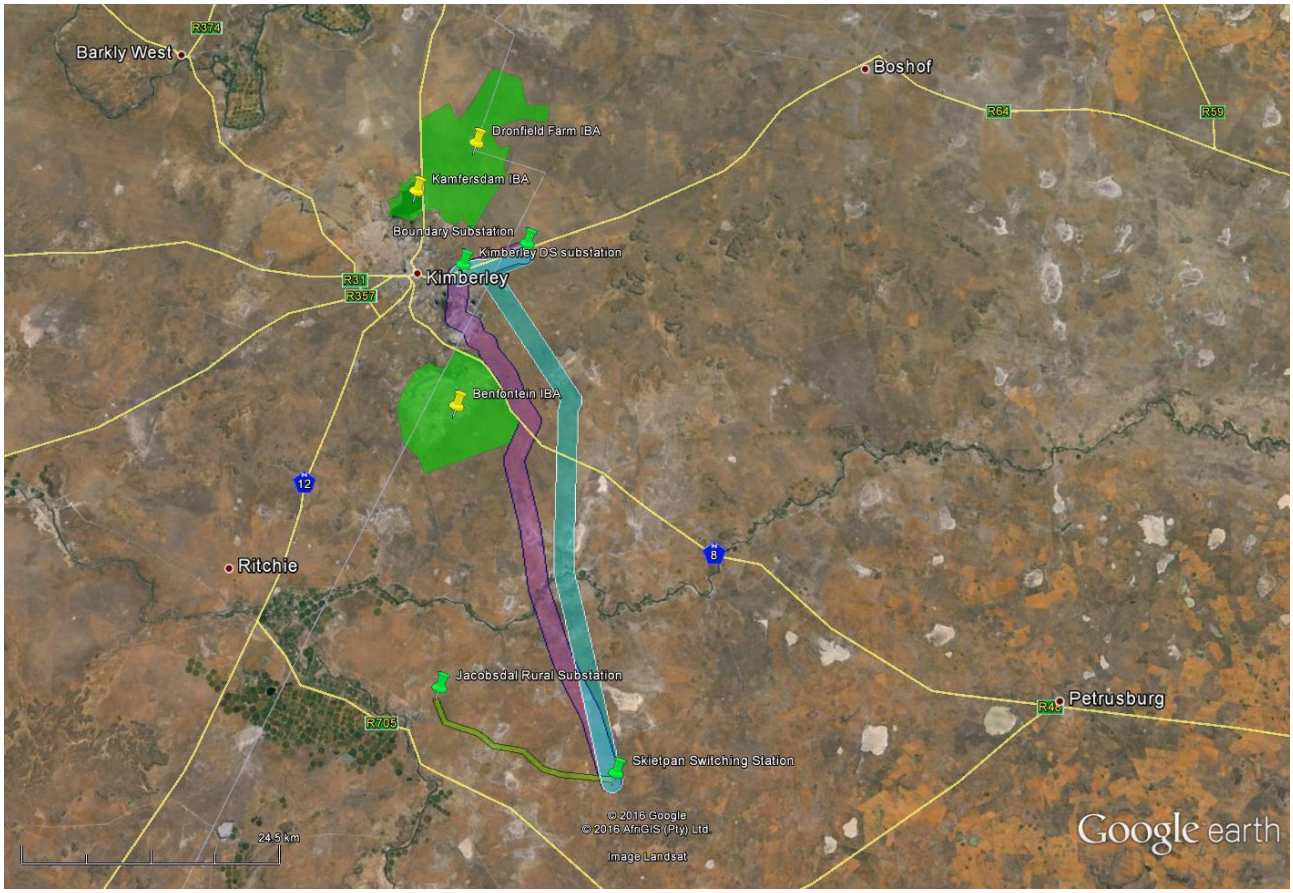


Figure 12. The location of IBA's (green) relative to the proposed powerline corridors

3.2.2 Coordinated Avifaunal Roadcount (CAR) Data

The Co-ordinated Avifaunal Roadcounts (CAR) project monitors the populations of 21 species of large 'terrestrial' birds in agricultural habitats. Although CAR road counts do not give an absolute count of the all the individuals in a population, they do provide a measure of relative abundance in a particular area. There is one 70km CAR route, FS40, which falls within the study area, and this route was counted 13 times between 2003 and 2014. A summary of the counts is provided below in **Table 10**.

Table 10: Summary of CAR counts for route FS40

Route	Blue Crane	Black-headed Heron	Ludwig's Bustard	Northern Black Korhaan	Secretarybird	Spur-winged Goose	Blue Korhaan
FS40	2	4	0	15	1	0	0
FS40	0	0	0	69	0	12	0
F S 40	0	0	0	55	2	0	0
FS40	0	0	0	9	0	0	2
FS 40	0	0	0	14	0	0	0
FS40	2	0	8	15	0	7	0
FS40	0	0	0	8	0	0	0
FS40	0	0	0	19	0	0	0
FS40	2	0	0	38	2	0	2
FS40	0	0	0	25	8	27	0
FS40	0	0	0	18	2	0	4
FS40	0	0	0	19	0	1	0
FS40	0	1	0	45	0	0	0
Total	6.00	5.00	8.00	349.00	15.00	47.00	8.00
Birds /km	**0.09**	**0.07**	**0.11**	**4.99**	**0.21**	**0.67**	**0.11**

The CAR data for route FS40 shows that large terrestrial species are generally rare in the study area, except Northern Black Korhaan, which is not a Red Data species.

3.2.3 Primary vegetation divisions (biomes)

The study area extends primarily over two primary vegetation divisions, namely Savanna (woodland), and Nama Karoo (**Mucina & Rutherford 2006**). It is generally accepted that vegetation structure, rather than the actual plant species, influences bird species distribution and abundance (**Harrison *et al.* 1997**). From an avifaunal perspective, the Atlas of southern African Birds (SABAP1) recognises six primary vegetation divisions or biomes within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (**Harrison *et al.* 1997**). These vegetation descriptions do not focus on lists of plant species, but rather on factors which are relevant to bird distribution. The criteria used by the SABAP1 authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations.

3.2.4 Description of bird habitat classes

Whilst much of the distribution and abundance of the bird species in the study area can be explained by the composition of the natural vegetation, it is as important to also examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of power line sensitive species. These are sometimes evident at a much smaller spatial scale than the biome types (**Figure 13**), and are determined by a host of factors such as vegetation type, topography, land use and man-made infrastructure. For purposes of the analysis in this report, the following bird habitat classes were defined (vegetation descriptions based largely on **Harrison *et al.* 1997** and **Mucina & Rutherford, 2006**) (**Figure 14**).

3.2.4.1 Savanna

The northern two thirds of the study area are situated in savanna, and consists of Kimberley Thornveld with a few isolated areas of Vaalbos Rocky Shrubland, which only occurs on solitary hills and scattered ridges. Kimberley Thornveld is an open savanna, with Umbrella Thorn *Vachellia tortilis* and Camel Thorn *V. erioloba* the dominant tree species, and scattered individuals of Shepherd's Tree *Boscia albitrunca* and Sweet Thorn *Vachellia karroo*. The shrub layer is poorly to moderately developed in places and individuals of Camphor Tree *Tarchonanthus camphoratus*, Spike-flowered Black Thorn *Vachellia mellifera*, Wild Raisin *Grewia flava* and *Lycium hirsutum* occur widely scattered. The grass layer is fairly well developed and grasses such as Redgrass *Themeda triandra*, Common Nine-awn Grass *Enneapogon cenchroides*, Lehmann's Lovegrass *Eragrostis lehmanniana*, *Elionurus muticus* and *Cymbopogon plurinodis* are conspicuous. It is confined to sandy plains. The summer rainfall is 400 to 500 mm per year. Temperature varies between -8°C and 41°C, with an average of 19°C. The powerline sensitive Red Data avifauna is typically arid woodland species i.e. Lappet-faced Vulture, White-backed Vulture, Cape Vulture, Tawny Eagle, Martial Eagle, Lanner Falcon, Verreaux's Eagle (ridges and koppies), European Roller and Kori Bustard.

3.2.4.2 Nama Karoo

Nama Karoo is dominated by low shrubs and grasses; peak rainfall occurs in summer. Trees, e.g. *Vachellia karroo* and alien species such as Mesquite *Proposis glandulosa* are mainly restricted to watercourses, where fairly luxurious stands can develop. The vegetation type in study area is Northern Upper Karoo which consists of shrubland dominated by dwarf karoo shrubs, grasses and *Vachellia mellifera* and some other low trees. (**Mucina & Rutherford 2006**). Rainfall in the study area averages around 400mm per year in autumn, with mean maximum and minimum monthly temperatures approximately 37.9°C in January and -3.6°C in July. The Nama Karoo biome supports a particularly high diversity of bird species endemic to Southern Africa, particularly in the family *Alaudidae* (Larks). Its avifauna typically comprises ground-dwelling species of open habitats. Many typical karroid species are nomads, able to use resources that are patchy in time and space (**Barnes, 1998**). Red Data species that are associated with Karoo habitat in the study area are Ludwig's Bustard, Kori Bustard, Martial Eagle, Secretarybird, Blue Crane, Black Harrier, Blue Korhaan, Burchell's Courser and Lanner Falcon.

3.2.4.3 Pans

An important feature of the arid landscape where the proposed power lines are located is the presence of pans. Pans are endorheic wetlands having closed drainage systems; water usually flows in from small catchments but with no outflow from the pan basins themselves. They are characteristic of poorly drained, relatively flat and dry regions. Water loss is mainly through evaporation, sometimes resulting in saline conditions, especially in the most arid regions. Water depth is shallow (<3m), and flooding characteristically ephemeral (**Harrison *et al*. 1997**). When flooded, pans are important for a variety of powerline sensitive Red

Data species which occur in the study area e.g. Greater Flamingo, Lesser Flamingo, Blue Crane, Abdim's Stork, Chestnut-banded Plover, Maccao Duck and Yellow-billed Stork. Pans are also used by raptors and vultures for drinking and bathing. Burchell's Coursers occur along the pan fringes and on dry pans.

3.2.4.4 Vulture breeding areas

A notable feature of the study area is the large number of breeding White-backed Vultures which are in loose colonies over several areas within a 50km radius around Kimberley. These colonies are situated in savanna areas where there are scattered, large Camel Thorn trees. The most important breeding colonies known at this stage are Dronfield, Riet River, Paardeberg, Secretarius, Rivermead and Susanna. The total number of breeding pairs is estimated at around 240 pairs with a total of 650 individual birds across all the colonies (**Murn *et al.* 2002**). The Susanna colony is the colony which is most likely to be potentially impacted by the proposed powerline. There is also a small colony of White-backed Vultures approximately 10km outside Jacobsdal, consisting of about 5 breeding pairs (**R. Visagie pers.comm**).

3.2.4.5 Agricultural lands

The study area contains very few agricultural lands, because the land-use is mostly grazing. However, there are a few irrigated agricultural lands, mostly lucerne pivots along the Modder River. Agricultural lands completely destroy the structure of the original vegetation, but some birds do benefit from this transformation. Blue Crane and Abdim's Stork are the Red Data species most likely to utilise agricultural lands in the study area.

3.2.4.6 Rivers

The study area is bisected by one major river, the Modder River, which is important for a variety of waterbirds, including Red Data Black Stork and Yellow-billed Stork, while Abdim's Stork are attracted to adjacent floodplain areas. Rivers are also corridors for woodland, which Kori Bustard often associate with.

3.2.4.7 Ridges

The majority of the proposed alignments are located in topographically flat plains. However, in places the study area does contain ridges and koppies, mostly in the central part of the study area. These areas are potentially suitable roosting and breeding habitat for a number of Red Data power line sensitive species, e.g. Black Stork, Lanner Falcon, and Verreaux's Eagle.

3.2.4.8 High Voltage lines

High voltage lines were treated as a distinct bird habitat because they serve as an important roosting substrate for some species, particularly vultures, in the study area. The Jacobsdal-Kimberley 132kV line and the Kimberley – Koffiefontein 132kV lines bisect the study area from north to south. Several high voltage lines run between Kimberley DS Substation and Boundary MTS.

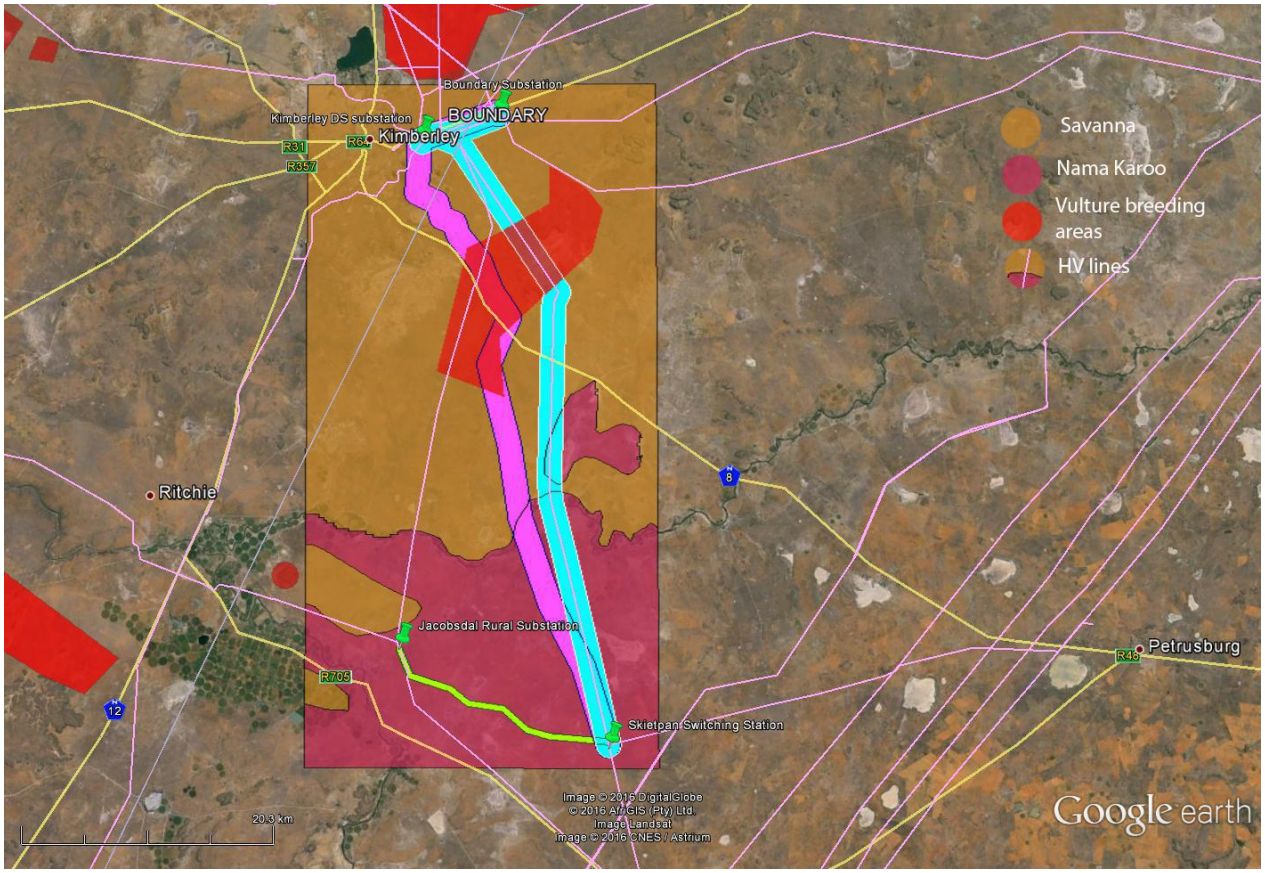


Figure 13. Biomes, vulture breeding areas and high voltage (HV) lines

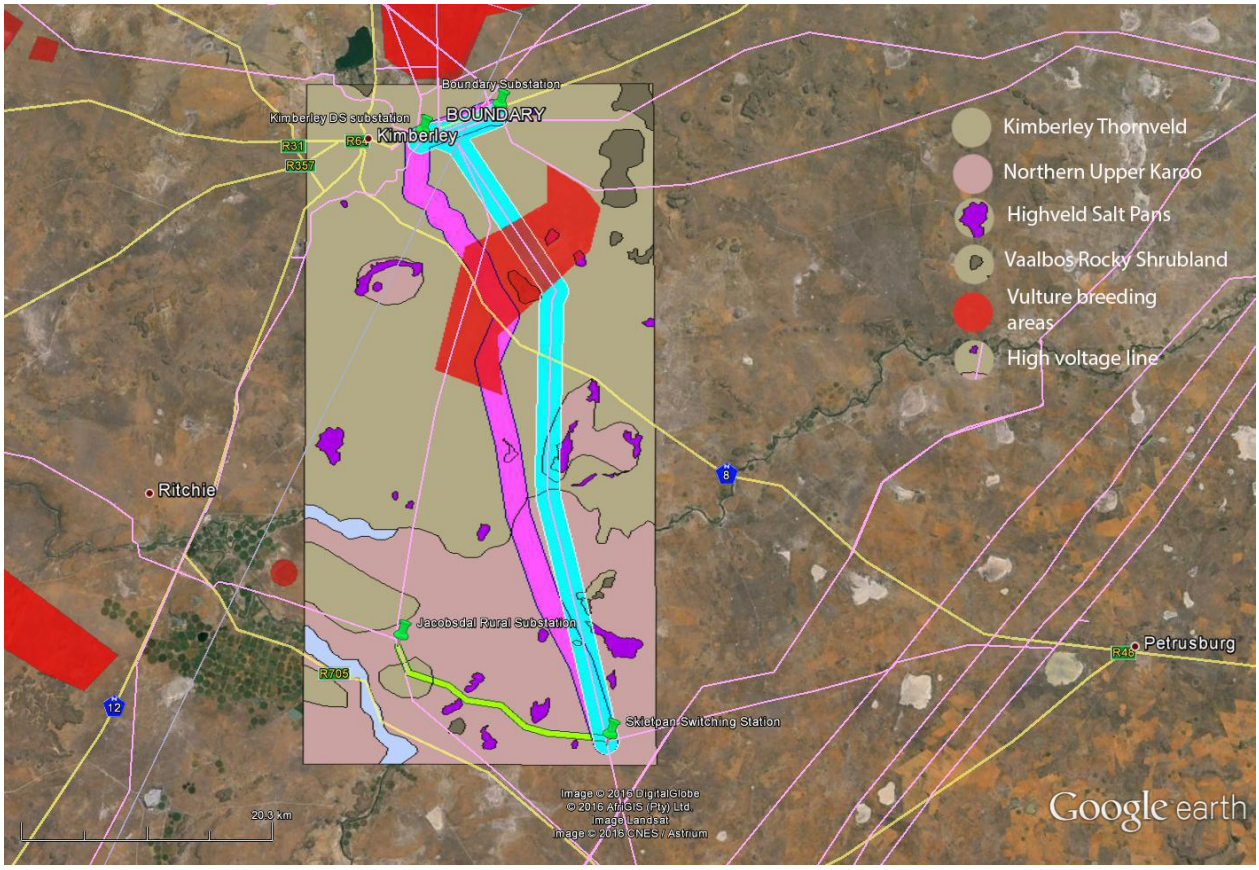


Figure 14. Vegetation types, vulture breeding areas and high voltage (HV) lines

3.2.5 Avifauna in the Study Area

An estimated 313 species could potentially occur in the study area, of which 28 are classified as Red Data species.

Potential impacts on Red Data species are listed in **Table 11** below.

Table 11. Red Data species potentially occurring in the study area

EN = Endangered VU = Vulnerable NT = Near-threatened LC = Least concern

Species	Taxonomic name	SABAP2 reporting rate % in 2900_2450 (9 pentad block)	SABAP2 reporting rate % in 2845_2450 (9 pentad block)	Global Red Data status	SA Red Data status	Savanna	Nama Karoo	Pans	Rivers	Agricultural lands	Vulture colonies	Ridges	Electrocutions	Collisions	Displacement through disturbance	Displacement through habitat destruction
Crane, Blue	*Anthropoides paradiseus*	11.11	15	VU	NT		x	x		x				x		
Eagle, Martial	*Polemaetus bellicosus*	0	1	VU	EN	x	x	x								
Harrier, Black	*Circus maurus*	0	0	VU	EN		x									
Secretarybird	*Sagittarius serpentarius*	5.56	19	VU	VU	x	x							x		
Bustard, Kori	*Ardeotis kori*	5.56	1	NT	NT	x	x		x					x		
Duck, Maccoa	*Oxyura maccoa*	0	11	NT	NT			x								
Falcon, Red-footed	*Falco vespertinus*	0	0	NT	NT	x	x									
Flamingo, Lesser	*Phoenicopterus minor*	0	27	NT	NT			x						x		
Korhaan, Blue	*Eupodotis caerulescens*	5.56	2	NT	LC		x							x		
Plover, Chestnut-banded	*Charadrius pallidus*	0	0	NT	NT			x								
Sandpiper, Curlew	*Calidris ferruginea*	0	4	NT	LC			x								
Courser, Burchell's	*Cursorius rufus*	0	10	LC	VU		x	x								
Eagle, Tawny	*Aquila rapax*	0	12	LC	EN	x	x	x								
Eagle, Verreaux's	*Aquila verreauxii*	0	2	LC	VU							x				
Falcon, Lanner	*Falco biarmicus*	5.56	2	LC	VU	x	x					x				
Flamingo, Greater	*Phoenicopterus ruber*	0	25	LC	NT			x						x		
Marsh-harrier, African	*Circus ranivorus*	0	0	LC	EN			x	x							
Painted-snipe, Greater	*Rostratula benghalensis*	0	1	LC	NT			x								
Pipit, African Rock	*Anthus crenatus*	0	1	LC	NT							x				
Roller, European	*Coracias garrulus*	5.56	0	LC	NT	x										
Stork, Abdim's	*Ciconia abdimii*	11.11	0	LC	NT			x	x	x				x		
Stork, Black	*Ciconia nigra*	0	0	LC	VU			x	x			x		x		
Stork, Marabou	*Leptoptilos crumeniferus*	0	0	LC	NT	x		x	x					x		
Stork, Yellow-billed	*Mycteria ibis*	0	1	LC	EN			x	x					x		
Bustard, Ludwig's	*Neotis ludwigii*	5.56	6	EN	EN		x			x				x		
Vulture, Cape	*Gyps coprotheres*	0	1	EN	EN	x	x	x					x	x		
Vulture, Lappet-faced	*Torgos tracheliotus*	0	4	EN	EN	x	x	x			x		x	x	x	x
Vulture, White-backed	*Gyps africanus*	33.33	33	CR	CR	x	x	x			x		x	x	x	x

3.2.6 Description of Expected Impacts

3.2.7 Displacement of priority species due to disturbance and habitat transformation during the construction and de-commissioning of the 132kV sub-transmission line (construction and de-commissioning)

The noise and movement associated with the construction of the 132kV sub-transmission line will have a temporary displacement impact on some Red Data species in the Nama Karoo biome. Larger, sensitive terrestrial species such as Ludwig's Bustard, Karoo Korhaan, Secretarybird, Blue Crane and Kori Bustard are most likely to be most affected by this temporary impact in the Nama Karoo biome. Due to the nature of the vegetation, very little if any vegetation clearing will be required. Loss of habitat is therefore likely to be minimal and should not materially affect any priority species.

In the savanna biome, large terrestrial Red Data species which may most likely be affected by this impact are Kori Bustard and Secretarybird. The alternative corridors also borders the Benfontein IBA and transects the Susanna White-backed Vulture breeding area. This could impact on breeding White-back Vultures and possibly Secretarybird through disturbance and habitat transformation through the removal of potential nesting substrate i.e. Camel Thorn trees *Vachellia erioloba.*

3.2.8 Collisions with the earthwire of the 132kV power line (operational)

The most likely Red Data species candidates for collision mortality on the proposed 132kV power line are large terrestrial species i.e. Ludwig's Bustards, Karoo Korhaan, Kori Bustard, Blue Korhaan, Blue Crane and Secretarybird. Greater and Lesser Flamingo (and other non-Red Data waterbirds such as Spur-winged Goose) may also be at risk when commuting between the large pans which are scattered on both sides of the proposed alignment. The latter situation may also occur if Blue Cranes and Abdim's Stork roost in the pans when they hold water after good rains.

3.2.9 Electrocution

For the Jacobsdal Corridor 1, Vultures are unlikely to occur regularly along the proposed alignment, but sporadic occurrence cannot be ruled out. For the two remaining alternaives (Corridor 2 Alternatives 1 and 2), vultures are likely to occur regularly along the proposed alignment where it bisects the Susanna White-backed Vulture breeding area. The only envisaged high risk scenario would be when a carcass becomes available within a few hundred metres of the line, attracting vultures which may cluster on a few poles. If a very large bird like a White-backed Vulture attempts to perch on the stand-off insulators, it could potentially touch both the conductor and the earthed pole simultaneously potentially resulting in a phase – earth electrocution, especially if more than one attempts to perch on the same insulator. In

general, this will be a rare event as the vulture(s) would normally perch at the top of the pole on the built-in bird perch. The possibility can however not be ruled out.

3.2.10 Impact Assessments

3.2.10.1 Construction Phase

Table 12: Impact summary table for displacement of priority species due to disturbance and habitat transformation associated with construction of the 132kV power line

CONSTRUCTION: 132KV POWER LINE CORRIDOR 1		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to disturbance and habitat transformation associated with construction of the 132kV power line.*	
Extent	*Local = 1*	
Probability	*Probable = 3 The impact will likely occur.*	
Reversibility	*Completely reversible = 1 It is likely that the displacement impact will be temporary and will be mitigated through natural processes after the completion of the construction.*	
Irreplaceable loss of resources	*Marginal loss of resource = 2 The displacement impact should affect only a small number of birds and only temporarily.*	
Duration	*Short term = 1 The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).*	
Cumulative effect	*Low cumulative impact = 2 The impact would result in insignificant cumulative effects.*	
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*10 x 2 = 18* *Negative low impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2

Reversibility	1	1
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	-20 (low negative)	-18 (low negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the study area should be strictly controlled to prevent unnecessary disturbance of Red Data species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Existing access roads should be used optimally where possible and the construction of new roads should be kept to a minimum.*	

Table 13. Impact summary table for displacement of priority species due to disturbance and habitat transformation associated with construction of the 132kV power line

CONSTRUCTION: 132KV POWER LINE CORRIDOR 2 OPTION 1	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to disturbance and habitat transformation associated with construction of the 132kV power line.*
Extent	*Local = 2 The displacement impact could affect the local population of White-backed Vultures around Kimberley.*
Probability	*Probable = 3 The impact will likely occur.*
Reversibility	*Partly reversible = 2 It is possible that the vultures could resume breeding when the construction is completed.*
Irreplaceable loss of resources	*Significant loss of resources = 3 The disturbance could lead to vultures permanently abandoning the colony.*
Duration	*Medium term = 2 The impact could continue for 2 – 10 years, if the birds abandon the colony.*
Cumulative effect	*High cumulative impact = 4 The cumulative impact of the loss of any pair of breeding White-backed Vultures is regionally significant. (see also discussion on cumulative impacts below)*
Intensity/magnitude	*High = 3 At a regional level the functioning of the vulture population could be significantly affected.*
Significance Rating	*16 x 3 = 48* *Negative medium impact*

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	1
Reversibility	2	1
Irreplaceable loss	3	2
Duration	2	1
Cumulative effect	4	2
Intensity/magnitude	3	3
Significance rating	-34 (medium negative)	-18 (low negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the study area should be strictly controlled to prevent unnecessary disturbance of Red Data species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Existing access roads should be used optimally where possible and the construction of new roads should be kept to a minimum.* • *Prior to the construction of the line, a walk-through must be conducted to ascertain if any White-backed Vulture breeding pairs will be impacted by the construction activities. If any breeding pairs are potentially at risk, the construction will have to be timed to fall outside the breeding season.* • *No trees containing White-backed Vulture nests may be removed.*	

Table 14. Impact summary table for displacement of priority species due to disturbance and habitat transformation associated with construction of the 132kV power line

CONSTRUCTION: 132KV POWER LINE CORRIDOR 2 OPTION 2	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to disturbance and habitat transformation associated with construction of the 132kV power line.*
Extent	*Local = 2 The displacement impact could affect the local population of White-backed Vultures around Kimberley.*
Probability	*Probable = 3 The impact will likely occur.*
Reversibility	*Partly reversible = 2 It is possible that the vultures could resume breeding when the construction is completed.*

Irreplaceable loss of resources	*Significant loss of resources = 3 The disturbance could lead to vultures permanently abandoning the colony.*	
Duration	*Medium term = 2 The impact could continue for 2 – 10 years, if the birds abandon the colony.*	
Cumulative effect	*High cumulative impact = 4 The cumulative impact of the loss of any pair of breeding White-backed Vultures is regionally significant. (see also discussion on cumulative impacts below)*	
Intensity/magnitude	*High = 3 At a regional level the functioning of the vulture population could be significantly affected.*	
Significance Rating	*16 x 3 = 48* *Negative medium impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	1
Reversibility	2	1
Irreplaceable loss	3	2
Duration	2	1
Cumulative effect	4	2
Intensity/magnitude	3	3
Significance rating	-34 (medium negative)	-18 (low negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the study area should be strictly controlled to prevent unnecessary disturbance of Red Data species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Existing access roads should be used optimally where possible and the construction of new roads should be kept to a minimum.* • *Prior to the construction of the line, a walk-through must be conducted to ascertain if any White-backed Vulture breeding pairs will be impacted by the construction activities. If any breeding pairs are potentially at risk, the construction will have to be timed to fall outside the breeding season.* • *No trees containing White-backed Vulture nests may be removed.*	

3.2.10.2 Operational Phase

Table 15: Impact summary table for collisions of priority species with the proposed 132kV line

OPERATION: 132KV POWER LINE CORRIDOR 1		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Collisions of Red Data species with the proposed 132kV line.*	
Extent	*Regional = 3 The collision mortality may affect regional populations of some highly mobile Red Data species e.g. Ludwig's Bustard, Lesser Flamingo and Greater Flamingo.*	
Probability	*Probable = 3 The impact will likely occur.*	
Reversibility	*Partly reversible = 2 The application of anti-collision measures will help to reduce the impact, but it will not be reversed.*	
Irreplaceable loss of resources	*Significant loss of resources = 3 The impact of collision mortality could be significant for some large terrestrial Red Data species.*	
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*	
Cumulative effect	*Moderate cumulative impact = 3 (see also discussion on cumulative impacts below)*	
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*17 x 2 = 34* *Negative medium impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	3	3
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	-34 (medium negative)	-28 (low negative)
Mitigation measures	• *The 132kV grid connection should be inspected at least once a quarter for a minimum of three years by the avifaunal specialist to establish if there is any significant collision mortality in line with Eskom's Avifaunal procedures. Thereafter the frequency of*	

	inspections will be informed by the results of the first three years. • *The detailed protocol to be followed for the inspections will be compiled by the avifaunal specialist prior to the first inspection.* • *The power line should be marked with Bird Flight Diverters (BFDs) for its entire length on the earth wire of the line, alternating black and white or as per agreement with independent Avifaunal specialist and Eskom.* • *See Appendix 4 for the type of BFD which is recommended.*

Table 16: Impact summary table for collisions of priority species with the proposed 132kV line

OPERATION: 132KV POWER LINE CORRIDOR 2 OPTION 1		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Collisions of Red Data species with the proposed 132kV line.*	
Extent	*Regional = 3 The collision mortality may affect regional populations of some highly mobile Red Data species e.g. Ludwig's Bustard, Lesser Flamingo, Greater Flamingo and White-backed Vultures.*	
Probability	*Definite = 4 The impact will certainly occur.*	
Reversibility	*Partly reversible = 2 The application of anti-collision measures will help to reduce the impact, but it will not be reversed.*	
Irreplaceable loss of resources	*Significant loss of resources = 3 The impact of collision mortality could be significant for some large terrestrial Red Data species and vultures.*	
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*	
Cumulative effect	*High cumulative impact = 4 (see also discussion on cumulative impacts below)*	
Intensity/magnitude	*High = 3 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*19 x 3 = 57* *Negative high impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	3	3
Probability	4	3

Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	4	3
Intensity/magnitude	3	2
Significance rating	-57 (high negative)	-32 (medium negative)
Mitigation measures	• *The 132kV grid connection should be inspected at least once a quarter for a minimum of three years by the avifaunal specialist to establish if there is any significant collision mortality in line with Eskom's Avifaunal procedures. Thereafter the frequency of inspections will be informed by the results of the first three years.* • *The detailed protocol to be followed for the inspections will be compiled by the avifaunal specialist prior to the first inspection.* • *The power line should be marked with Bird Flight Diverters (BFDs) for its entire length on the earth wire of the line, alternating black and white or as per agreement with independent Avifaunal specialist and Eskom. See Appendix 4 for the type of BFD which is recommended.*	

Table 17: Impact summary table for collisions of priority species with the proposed 132kV line

OPERATION: 132KV POWER LINE CORRIDOR 2 OPTION 2	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Collisions of Red Data species with the proposed 132kV line.*
Extent	*Regional = 3 The collision mortality may affect regional populations of some highly mobile Red Data species e.g. Ludwig's Bustard, Lesser Flamingo, Greater Flamingo and White-backed Vultures.*
Probability	*Definite = 4 The impact will certainly occur.*
Reversibility	*Partly reversible = 2 The application of anti-collision measures will help to reduce the impact, but it will not be reversed.*
Irreplaceable loss of resources	*Significant loss of resources = 3 The impact of collision mortality could be significant for some large terrestrial Red Data species and vultures.*
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*
Cumulative effect	*High cumulative impact = 4 (see also discussion on cumulative impacts below)*

Intensity/magnitude	*High = 3 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*18 x 3 = 54* *Negative high impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	3	3
Probability	4	3
Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	4	3
Intensity/magnitude	3	2
Significance rating	-57 (high negative)	-32 (medium negative)
Mitigation measures	• *The 132kV grid connection should be inspected at least once a quarter for a minimum of three years by the avifaunal specialist to establish if there is any significant collision mortality in line with Eskom's Avifaunal procedures. Thereafter the frequency of inspections will be informed by the results of the first three years.* • *The detailed protocol to be followed for the inspections will be compiled by the avifaunal specialist prior to the first inspection.* • *The power line should be marked with Bird Flight Diverters (BFDs) for its entire length on the earth wire of the line, alternating black and white or as per agreement with independent Avifaunal specialist and Eskom. See Appendix 4 for the type of BFD which is recommended.*	

Table 18: Impact summary table for electrocutions of priority species on the proposed 132kV line and associated infrastructure

OPERATION: 132KV POWER LINE CORRIDOR 1	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Electrocutions of Red Data species on the proposed 132kV line.*
Extent	*Regional = 3 The electrocution mortality may affect regional populations of White-backed Vultures.*
Probability	*Possible = 2 The impact may occur.*
Reversibility	*Partly reversible = 2 The application of anti-electrocution measures will help to reduce the impact, but it will not be reversed.*

Irreplaceable loss of resources	*Significant loss of resources = 3 The impact of electrocution mortality could be significant for some large terrestrial Red Data species.*	
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*	
Cumulative effect	*Moderate cumulative impact = 3 (see also discussion on cumulative impacts below)*	
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*16 x 2 = 32* *Negative medium impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	3	3
Probability	2	1
Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	-34 (medium negative)	-26 (low negative)
Mitigation measures	• *The 132kV grid connection should be inspected at least once a quarter for a minimum of three years by the avifaunal specialist to establish if there is any significant electrocution mortality in line with Eskom's Avifaunal procedures. Thereafter the frequency of inspections will be informed by the results of the first three years.* • *The detailed protocol to be followed for the inspections will be compiled by the avifaunal specialist prior to the first inspection.* • *All the steel monopoles should be fitted with bird perches. See Appendix 3 for the recommended bird perch.*	

Table 19: Impact summary table for electrocutions of priority species on the proposed 132kV line and associated infrastructure

OPERATION: 132KV POWER LINE CORRIDOR 2 OPTION 1	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Electrocutions of Red Data species on the proposed 132kV line.*

Extent	*Regional = 3 The electrocution mortality may affect regional populations of White-backed Vultures.*	
Probability	*Probable = 3 The impact will likely occur.*	
Reversibility	*Partly reversible = 2 The application of anti-electrocution measures will help to reduce the impact, but it will not be reversed.*	
Irreplaceable loss of resources	*Significant loss of resources = 3 The impact of electrocution mortality could be significant for some large terrestrial Red Data species.*	
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*	
Cumulative effect	*High cumulative impact = 4 (see also discussion on cumulative impacts below)*	
Intensity/magnitude	*Medium = 3 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*18 x 3 = 54* *Negative high impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	3	3
Probability	3	1
Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	4	2
Intensity/magnitude	3	2
Significance rating	-54 (high negative)	-26 (low negative)
Mitigation measures	• *The 132kV grid connection should be inspected at least once a quarter for a minimum of three years by the avifaunal specialist to establish if there is any significant electrocution mortality in line with Eskom's Avifaunal procedures. Thereafter the frequency of inspections will be informed by the results of the first three years.* • *The detailed protocol to be followed for the inspections will be compiled by the avifaunal specialist prior to the first inspection.* • *All the steel monopoles should be fitted with bird perches. See Appendix 3 for the recommended bird perch.*	

Table 20: Impact summary table for electrocutions of priority species on the proposed 132kV line and associated infrastructure

OPERATION: 132KV POWER LINE CORRIDOR 2 OPTION 2		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Electrocutions of Red Data species on the proposed 132kV line.*	
Extent	*Regional = 3 The electrocution mortality may affect regional populations of White-backed Vultures.*	
Probability	*Probable = 3 The impact will likely occur.*	
Reversibility	*Partly reversible = 2 The application of anti-electrocution measures will help to reduce the impact, but it will not be reversed.*	
Irreplaceable loss of resources	*Significant loss of resources = 3 The impact of electrocution mortality could be significant for some large terrestrial Red Data species.*	
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*	
Cumulative effect	*High cumulative impact = 4 (see also discussion on cumulative impacts below)*	
Intensity/magnitude	*Medium = 3 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*18 x 3 = 54* *Negative high impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	3	3
Probability	3	1
Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	4	2
Intensity/magnitude	3	2
Significance rating	-54 (high negative)	-26 (low negative)
Mitigation measures	• *The 132kV grid connection should be inspected at least once a quarter for a minimum of three years by the avifaunal specialist to establish if there is any significant electrocution mortality in line with Eskom's Avifaunal procedures. Thereafter the frequency of inspections will be informed by the results of the first three years.*	

	• *The detailed protocol to be followed for the inspections will be compiled by the avifaunal specialist prior to the first inspection.* • *All the steel monopoles should be fitted with bird perches. See Appendix 3 for the recommended bird perch.*

3.2.10.3 De-commissioning Phase

Table 21: Impact summary table for displacement of priority species due to disturbance and habitat transformation associated with de-commissioning of the 132kV power line

DE-COMMISSIONING: 132KV POWER LINE CORRIDOR 1	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to disturbance and habitat transformation associated with de-commissioning of the 132kV power line.*
Extent	*Local = 1*
Probability	*Probable = 3 The impact will likely occur.*
Reversibility	*Completely reversible = 1 It is likely that the displacement impact will be temporality and will be mitigated through natural processes after the completion of the de-commissioning.*
Irreplaceable loss of resources	*Marginal loss of resource = 2 The displacement impact should affect only a small number of birds and only temporarily.*
Duration	*Short term = 1 The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the de-commissioning phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short de-commissioning period and a limited recovery time after de-commissioning, thereafter it will be entirely negated (0 – 2 years).*
Cumulative effect	*Low cumulative impact = 2 The impact would result in insignificant cumulative effects.*
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*
Significance Rating	*10 x 2 = 20* *Negative low impact*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	1	1
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	-20 (low negative)	-18 (low negative)
Mitigation measures	• *De-commissioning activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the study area should be strictly controlled to prevent unnecessary disturbance of Red Data species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Existing access roads should be used optimally where possible and the construction of new roads should be kept to a minimum.*	

Table 22: Impact summary table for displacement of priority species due to disturbance and habitat transformation associated with de-commissioning of the 132kV power line

DE-COMMISSIONING: 132KV POWER LINE CORRIDOR 2 OPTION 1	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to disturbance and habitat transformation associated with short de-commissioning of the 132kV power line.*
Extent	*Local = 2 The displacement impact could affect the local population of White-backed Vultures around Kimberley.*
Probability	*Probable = 3 The impact will likely occur.*
Reversibility	*Partly reversible = 2 It is possible that the vultures could resume breeding when the short de-commissioning is completed.*
Irreplaceable loss of resources	*Significant loss of resources = 3 The disturbance could lead to vultures permanently abandoning the colony.*
Duration	*Medium term = 2 The impact could continue for 2 – 10 years, if the birds abandon the colony.*
Cumulative effect	*High cumulative impact = 4 The cumulative impact of the loss of any pair of breeding White-backed Vultures is*

	regionally significant. (see also discussion on cumulative impacts below)	
Intensity/magnitude	*High = 3 At a regional level the functioning of the vulture population could be significantly affected.*	
Significance Rating	*16 x 3 = 48* *Negative medium impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	1
Reversibility	2	1
Irreplaceable loss	3	2
Duration	2	1
Cumulative effect	4	2
Intensity/magnitude	3	3
Significance rating	-34 (medium negative)	-18 (low negative)
Mitigation measures	• *De-commissioning activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the study area should be strictly controlled to prevent unnecessary disturbance of Red Data species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Existing access roads should be used optimally where possible and the construction of new roads should be kept to a minimum.* • *Prior to the de-commissioning of the line, a walk-through must be conducted to ascertain of any White-backed Vulture breeding pairs will be impacted by the de-commissioning activities. If any breeding pairs are potentially at risk, the de-commissioning will have to be timed to fall outside the breeding season.*	

Table 23: Impact summary table for displacement of priority species due to disturbance and habitat transformation associated with de-commissioning of the 132kV power line

DE-COMMISSIONING: 132KV POWER LINE CORRIDOR 2 OPTION 2	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of Red Data species due to disturbance and habitat transformation associated with de-commissioning of the 132kV power line.*

Extent	*Local = 2 The displacement impact could affect the local population of White-backed Vultures around Kimberley.*	
Probability	*Probable = 3 The impact will likely occur.*	
Reversibility	*Partly reversible = 2 It is possible that the vultures could resume breeding when the de-commissioning is completed.*	
Irreplaceable loss of resources	*Significant loss of resources = 3 The disturbance could lead to vultures permanently abandoning the colony.*	
Duration	*Medium term = 2 The impact could continue for 2 – 10 years, if the birds abandon the colony.*	
Cumulative effect	*High cumulative impact = 4 The cumulative impact of the loss of any pair of breeding White-backed Vultures is regionally significant. (see also discussion on cumulative impacts below)*	
Intensity/magnitude	*High = 3 At a regional level the functioning of the vulture population could be significantly affected.*	
Significance Rating	*16 x 3 = 48* *Negative medium impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	1
Reversibility	2	1
Irreplaceable loss	3	2
Duration	2	1
Cumulative effect	4	2
Intensity/magnitude	3	3
Significance rating	-34 (medium negative)	-18 (low negative)
Mitigation measures	• *De-commissioning activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the study area should be strictly controlled to prevent unnecessary disturbance of Red Data species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Existing access roads should be used optimally where possible and the construction of new roads should be kept to a minimum.* • *Prior to the de-commissioning of the line, a walk-through must be conducted to ascertain of any White-backed Vulture breeding pairs will be impacted by the de-commissioning activities. If any breeding pairs are potentially at risk, the de-*	

	commissioning will have to be timed to fall outside the breeding season.

3.3 Wetland Impacts

A Freshwater Assessment was conducted by Stephen Van Staden and Christel Pretorius from Scientific Aquatic Services and is included in **Appendix D3**. A summary of the main findings of the assessment are outlined below.

3.3.1 Results

During the course of the assessment, it was determined that two main hydrogeomorphic (HGM) units occur within the areas covered by the linear development, namely well-developed riparian systems (the Modder River) and several depressions that differ in size. The majority depression features did resemble pan features and is expected to be seasonal to intermittent systems, holding water after heavy rainfall events. At the time of the site visit, all the pans were dry.

Due to the vast number of pan features present, and the relatively homogeneous characteristics of these resources, the small pans (ranging in size from 0.9ha to 20ha) were grouped as a HGM unit and the five large pans (or portions of large pans) (LP 1 – 5), ranging in size from 58ha to 401ha, were grouped as a HGM unit, for the purposes of the assessment, and were not assessed individually. The riparian system was, however assessed as individual features.

These freshwater resources were identified and categorised according to the method provided by **Ollis *et. al*. (2013)**. The results of the freshwater resources characterisation are presented in the table below.

Table 24: Characterisation of the resources identified in close proximity to the powerline route

Resource	Level 3: Landscape unit	Level 4: HGM Type
Modder River	**Valley:** The typically gently sloping, lowest surface of a valley.	**River:** A linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
Pans (Large and Small)	**Plain:** an extensive area of low relief. These areas are generally characterised by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located within a valley. Gradient is typically less than 0.01 or 1:100.	**Depression:** a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.

In addition to the above mentioned freshwater resources, several preferential paths of diffuse surface runoff were also identified. These features are not considered to be freshwater resources as it did not

have any freshwater resource characteristics. These features were identified due to greener vegetation and evidence of soil flow paths (**Figure 15**).

Figure 15. An example of a preferential path of diffuse surface runoff encountered during the site assessment

It is shown in **Figure 16** and **Figure 17** below, the locality of the freshwater resources identified during the site assessment in relation to the proposed linear development.

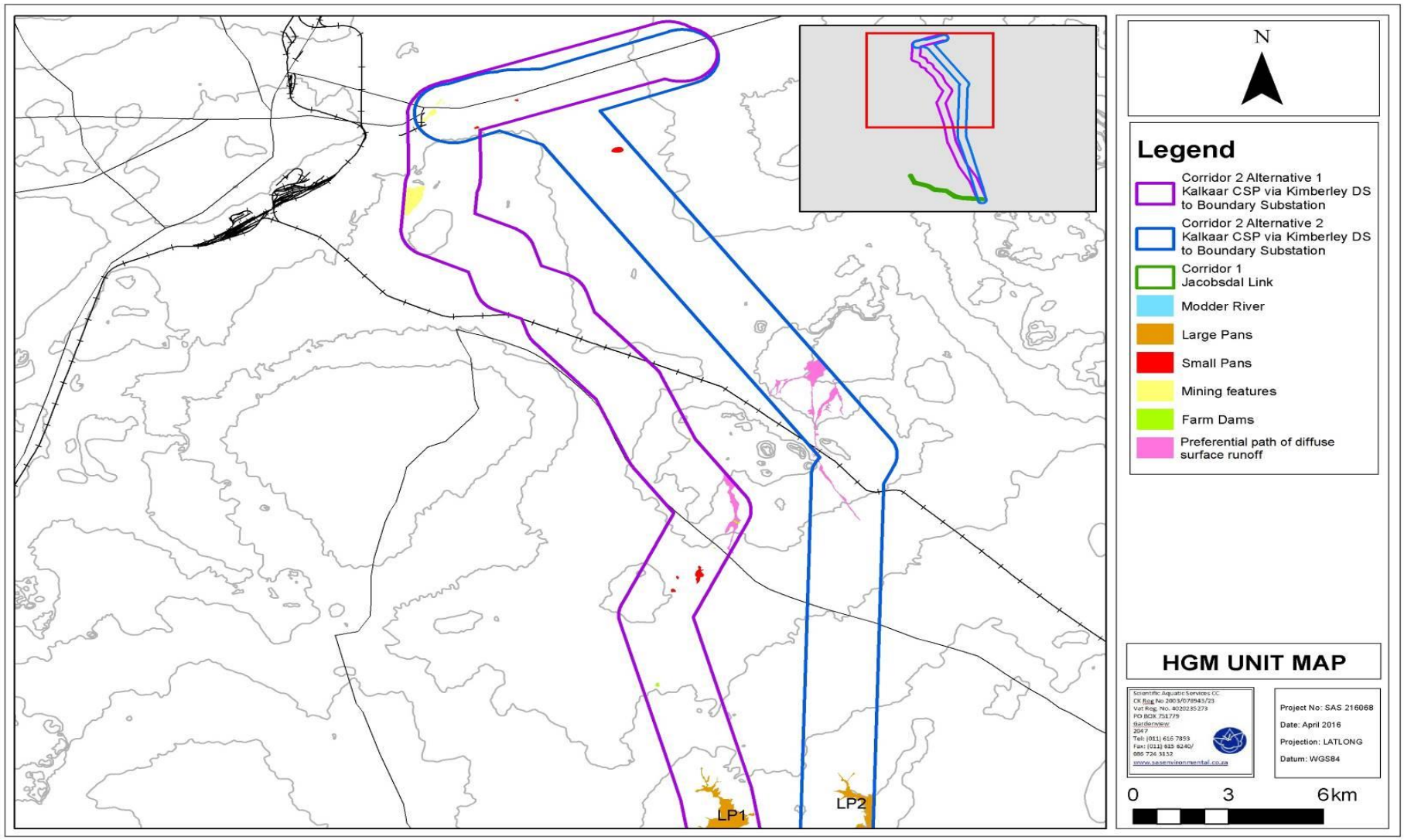


Figure 16: The location of the freshwater resources associated with the northern portion of the linear development

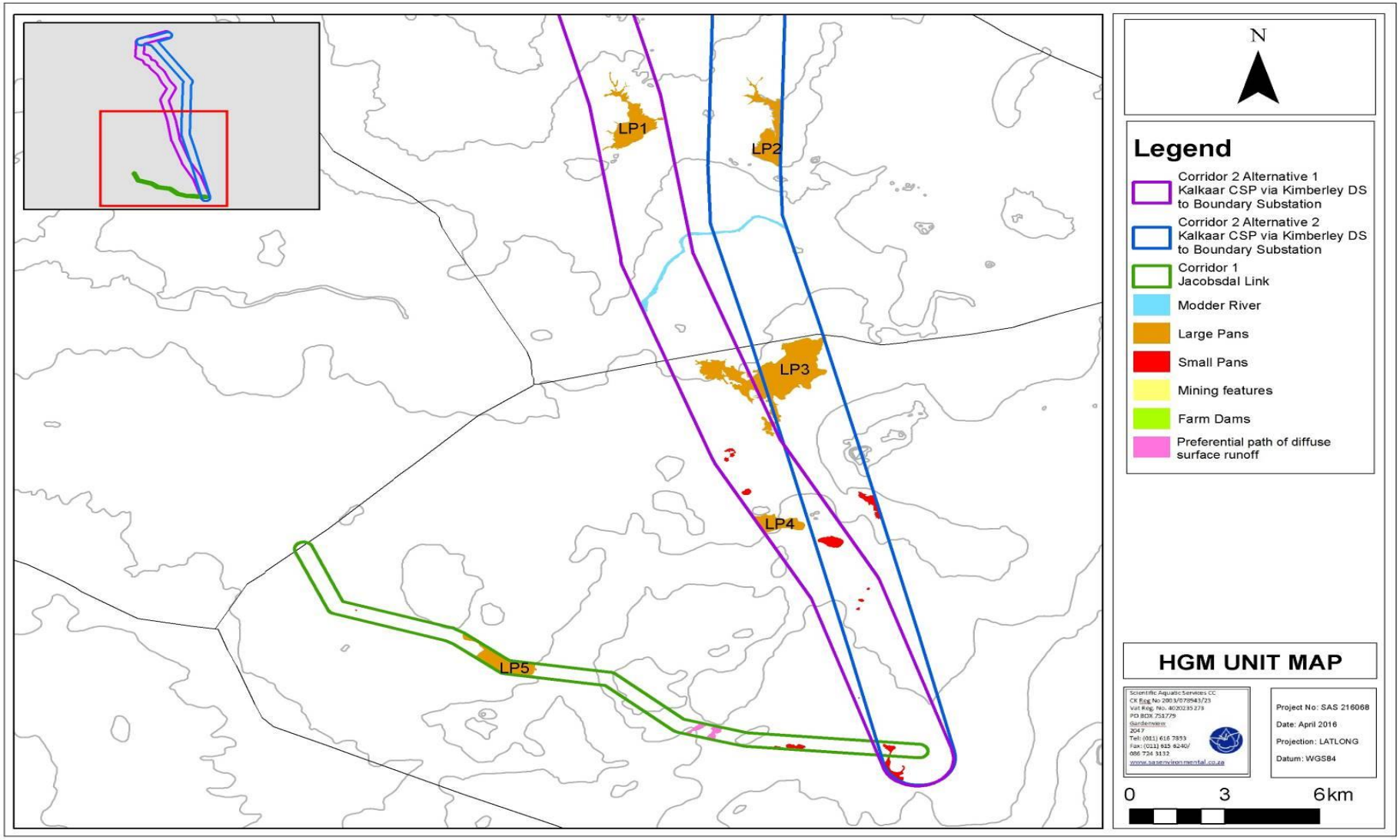


Figure 17: The location of the freshwater resources associated with the southern portion of the linear development

3.3.2 Field Verification Results

Following a site visit that was undertaken, assessments were done in order to determine the following:

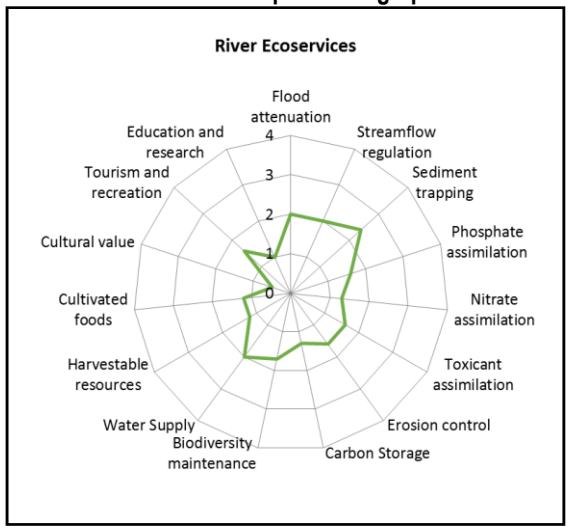
- PES which incorporates aspects such as hydrology, vegetation and geomorphology;
- Service provision which incorporates biodiversity maintenance, flood attenuation, streamflow regulation and assimilation, to name a few;
- EIS is based on consideration of the overall ecology of the receiving environment, although the results obtained from the assessment of PES and service provision of the resources is also taken into consideration as part of the EIS assessment;
- An appropriate REC for the enhancement of the resources; and
- Assessment of impacts of the presence of the powerline on the resources.

The results of the assessment are presented in **Table 25** to **Table 27** below.

Table 25: Summary of the Modder River assessment

Resource: Modder River

Ecological & socio-cultural service provision graph:



HGM Unit	River	**Fatal Flaw?**	**N**	**Photograph notes**	Vegetation still persists around this feature despite erosion and agricultural runoff entering the river. Large stands of *Phragmites australis* occurs on the banks of the river (left).
PES discussion	**PES Category: C** Agricultural runoff, bank incision and erosion contributes to modified hydrological patterns of the system. Erosion and bank incision due to trampling by livestock, leading to increased sediment inputs, altered vegetation due to historic disturbances.	**Watercourse characteristics:** **a) Hydraulic regime** Increased runoff from agricultural fields and cleared areas beyond the river bank vegetation. Abstraction of water does occur for irrigation of adjacent agricultural fields.			
Ecoservice provision	**Moderately Low**: Considered important for sediment trapping, flood attenuation and streamflow regulation. Not important in terms of cultural value or for education and research.	**b) Water quality** Water quality is potentially affected by runoff from agricultural practices.			
EIS discussion	**EIS Category C:** This river has undergone moderate changes to ecosystem processes, and loss of natural habitats has taken place, however the natural habitat remains predominantly intact	**c) Geomorphology and sediment balance** Due to the erodibility of the soils, increased sediment input is expected from the diffuse surface flows and erosion channels/gullies leading into the river.			
REC Category	**Category C:** This river is considered to be ecologically impacted on. This REC category indicates that management measures should be implemented to ensure that present levels of ecological services and functioning of this feature are retained and are not permitted to deteriorate further.	**d) Habitat and biota** The habitat has been moderately modified. However, despite the bank incision and removal of vegetation beyond the river bank, some indigenous vegetation still persists along the river. Although no faunal species were observed on site, the feature could provide a degree of habitat to avifaunal species, due to dense patches of reeds and trees.			

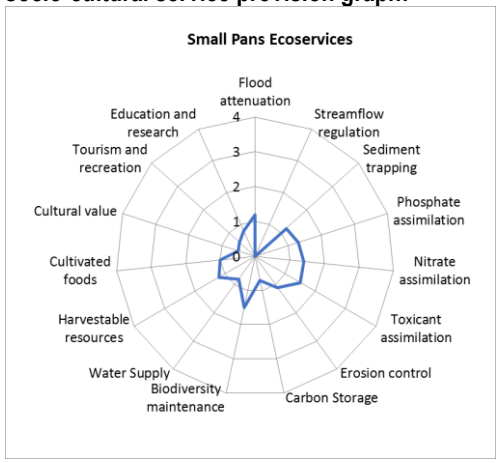
Impact significance prior to mitigation	**Low Negative**	Possible impacts include (but are not limited to): clearing of riparian vegetation leading to exposed soils & related erosion. Sedimentation, proliferation of alien vegetation and earthworks related to construction activities can cause runoff & alteration of runoff patterns. Dumping of hazardous & non-hazardous waste (including waste material spills & refuse deposits in riparian areas); ongoing disturbances to soils & vegetation during general maintenance activities leading to ongoing erosion, sedimentation of the river and continued alien floral proliferation.	**Business case, Conclusion and Mitigation Requirements:** The Modder River are traversed by both alternatives of Corridor 2. The perceived impacts of the construction of the proposed powerline are deemed to be of low significance, particularly if strict mitigation measures, are implemented. Wherever possible, placement of support infrastructure should be planned in such a way so as to avoid riparian habitat, the banks of the Modder River (as there is evidence of incision and erosion) and the associated buffer zones.
Impact significance post mitigation	**Low Negative**		

Table 26: Summary of the Large Pans assessment

<table>
<tr><td colspan="2">Resource: Large Pans</td><td colspan="4"></td></tr>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td colspan="4">  </td></tr>
<tr><td>HGM Unit</td><td>Depression (Including pans)</td><td>Fatal Flaw?</td><td>N</td><td>Photograph notes</td><td>Large pan (LP1) indicating the calcrete on the surface with limited vegetation, and more established grass vegetation towards the inside of the pan.</td></tr>
<tr><td>PES discussion</td><td>PES Category: C
Most of these pans had very little to no vegetation present. This is due to a calcrete layer being at the surface and a soil layer being largely absent. Wherever some patches of vegetation (mostly grasses) does occur, it has been severely grazed and trampled. The degraded state of the vegetation and the lack of surface water, limits this features ability to provide breeding and foraging habitat to any fauna species. Some of these pans (LP 1,2 & 5) are being traversed by roads, which cause some erosion gully formation.</td><td colspan="4">Watercourse characteristics:
a) Hydraulic regime
All large pans are unlikely to be linked to the adjacent areas by means of surface hydraulic connectivity due to their topographic isolation, being separated by roads or due to bare calcrete areas surrounding the pans. However, the possibility of a geohydrological link to the surrounding areas should not be excluded without the relevant specialist study being undertaken.</td></tr>
<tr><td>Ecoservice Provision</td><td>Moderately Low: Considered important for toxicant removal, nitrate and phosphate assimilation. Not considered important for streamflow regulation, tourism and recreational activities or be of cultural value.</td><td colspan="4">b) Water quality
No surface water was present at time of assessment; however, water quality may be enriched with nutrients due to livestock grazing in the pans. Due to the endorheic nature of these pans, it is expected that pooling of water within the pans and the subsequent evaporation of water, leads to an accumulation of salt within the pan.</td></tr>
<tr><td>EIS discussion</td><td>EIS Category C: Species richness is considered to be very low and the moderately low functionality, places these pans in an EIS category C.</td><td colspan="4">c) Geomorphology and sediment balance
The gentle slope of the pans and livestock trampling may result in increased sedimentation from diffuse flows into the pans.</td></tr>
<tr><td>REC Category</td><td>Category C: These pans are already modified due to grazing and trampling, this management class will prevent any further degradation whilst enhancing the PES of the pans.</td><td colspan="4">d) Habitat and biota
Characterised by relatively uniform topography, extensive trampling and grazing are present, surrounding terrestrial areas are bare and thus sediment balance is likely to be altered.</td></tr>
</table>

Impact significance prior to mitigation	**Low Negative**	Possible impacts include (but are not limited to): site clearing, disturbance of soils & removal of habitat; compaction of soils due to construction activities; movement of construction vehicles & road construction within the pans; dumping waste & construction material within pans leading to proliferation of alien vegetation; further disturbance of soils & on-going erosion as part of maintenance activities; and ineffective rehabilitation may lead to habitat transformation & alien vegetation encroachment.	**Business case, Conclusion and Mitigation Requirements:** All of the proposed corridors traverses large pans (or portions thereof). Due to the altered state of these pans, impacts from the proposed linear development are expected to be of low significance, particularly if strict mitigation measures, are implemented. Wherever possible, placement of the towers on which the powerlines will be guyed on, should be planned in such a way so as to avoid being constructed within the pans and their associated buffer zones.
Impact significance post mitigation	**Low Negative**		

Table 27: Summary of the Small Pans assessment

<table>
<tr><td colspan="2">Resource: Small Pans</td><td colspan="4"></td></tr>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td colspan="4">   </td></tr>
<tr><td>HGM Unit</td><td>Depression (Including pans)</td><td>Fatal Flaw?</td><td>N</td><td>Photograph notes</td><td>Small pans with grass coverage; in both photos it is evident that these pans are overgrazed. Photo on the left is an example where the pan is being used as a feeding point.</td></tr>
<tr><td>PES discussion</td><td>PES Category: C Patches of grass were most dominant within these pans. Subsequently, most of these pans were heavily grazed and trampled by livestock and game, as most of these pans were located on game farms. The degraded state of the vegetation and the lack of surface water, limits this features ability to provide breeding and foraging habitat to any fauna species.</td><td colspan="4">Watercourse characteristics:
a) Hydraulic regime
Most of the small pans are unlikely to be linked to the adjacent areas by means of surface hydraulic connectivity due to their topographic isolation. However, the possibility of a geohydrological link to the surrounding areas should not be excluded without the relevant specialist study being undertaken.</td></tr>
<tr><td>Ecoservice Provision</td><td>Moderately Low: Due to the relatively small size of the majority of these pans, as well as their endoheric nature, their capacity to provide certain ecological services is greatly reduced. Considered important for toxicant removal and nitrate and phosphate assimilation. Not considered important for streamflow regulation, tourism and recreational activities or be of cultural value</td><td colspan="4">b) Water quality
No surface water was present at time of assessment; however, water quality may be enriched with nutrients due to livestock grazing in the pans. Due to the endorheic nature of these pans, it is expected that pooling of water within the pans and the subsequent evaporation of water, leads to an accumulation of salt within the pan.</td></tr>
<tr><td>EIS discussion</td><td>EIS Category C: Due to the extensive grazing and trampling, the species richness is considered to be very low and thus also cause a decrease in the functionality of these features.</td><td colspan="4">c) Geomorphology and sediment balance
The gentle slope of the pans and livestock trampling may result in increased sedimentation from diffuse flows into the pan.</td></tr>
<tr><td>REC Category</td><td>Category C: These pans are already modified due to grazing and trampling, this management class will prevent any further degradation whilst enhancing the PES of the pans.</td><td colspan="4">d) Habitat and biota
Characterised by relatively uniform topography, extensive trampling and grazing are present since some pans are used as feeding lots and where water toughs are situated in.</td></tr>
</table>

Impact significance prior to mitigation	**Low Negative**	Possible impacts include (but are not limited to): site clearing, disturbance of soils & removal of habitat; compaction of soils due to construction activities; movement of construction vehicles & road construction within the pans; dumping waste & construction material within pans leading to proliferation of alien vegetation; further disturbance of soils & on-going erosion as part of maintenance activities; and ineffective rehabilitation may lead to habitat transformation & alien vegetation encroachment.	**Business case, Conclusion and Mitigation Requirements:** All of the proposed corridors traverse several small pans. Due to the altered state of these pans, impacts from the proposed linear development are expected to be of low significance, particularly if strict mitigation measures, are implemented. Wherever possible, placement of the towers on which the powerlines will be routed on, should be planned in such a way so as to avoid being constructed within the pans and their associated buffer zones.
Impact significance post mitigation	**Low Negative**		

3.3.3 Freshwater Resource Delineation and Sensitivity Mapping

3.3.3.1 Delineation

Prior to the site visit, points of interest were identified during the desktop phase of the study, and verified during the field survey, according to the guidelines advocated by DWAF (2005 and 2008). The freshwater resource delineations as presented in this report are regarded as a best estimate of the temporary zone boundaries based on the site conditions present at the time; however, use was made of historical and current digital satellite imagery to further aid in the delineation of the freshwater resources.

During the assessment, the following indicators were used to ascertain the boundaries of the temporary zones of the freshwater resources identified:

- Terrain units were used to determine in which parts of the landscape freshwater resources would most likely occur in;
- The soil form indicator (**Figure 18**) was used to determine the presence of soils that are associated with prolonged and frequent saturation, as well as variation in the depth of the saturated soil zone within 50cm of the soil surface. This indicator was used to identify gleyed soils, where the soil is a greyish/greenish/bluish colour due to the leaching out of iron. This factor was utilised to aid in determining the location of the freshwater feature zones and their boundaries.
- The vegetation indicator was used where possible in the identification of the freshwater feature boundary through the identification of the distribution of both facultative and obligate wetland vegetation associated with soils that are frequently saturated. Key species utilised included *Chloris virgata* and *Aristida* spp. (**Figure 19**). Changes in vegetation density and levels of greening were also considered during the delineation process. Figure 20 provided a typical example of how vegetation can be used to identify the boundary of the different pans; and
- Surface water was noted within the freshwater resources permanent zone, where present.

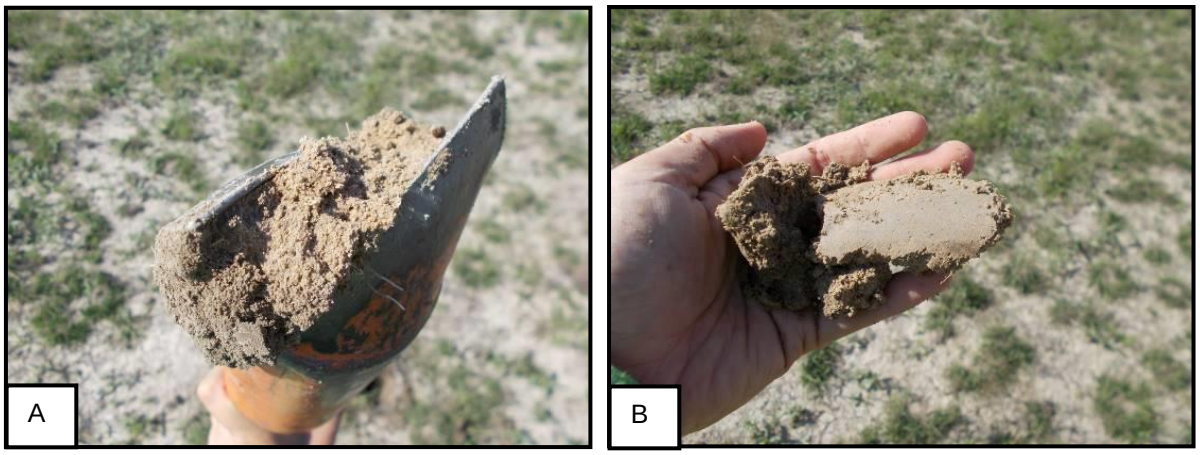


Figure 18. Representative photograph of a soil sample taken within LP 1. No mottling was present within the soil sample (A), but gleying was evident (B)

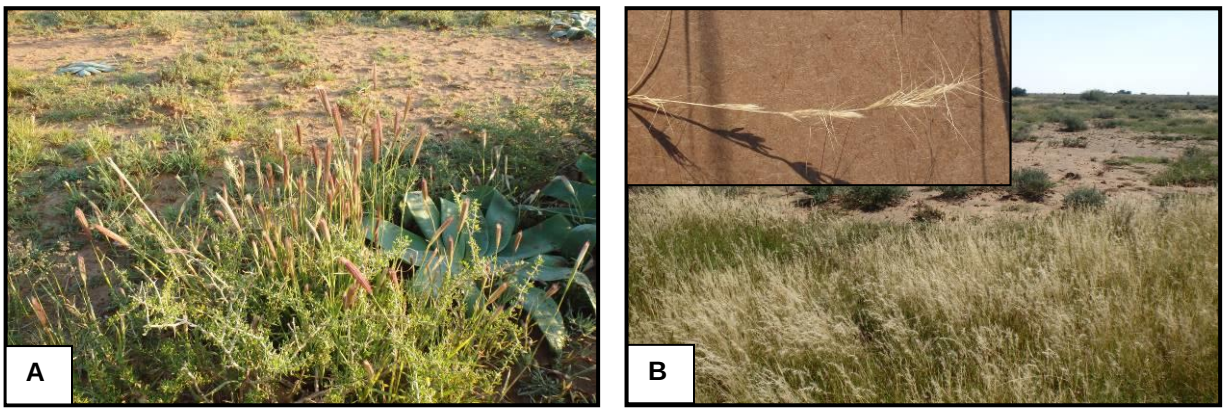


Figure 19. Representative photographs of some of the floral species utilised as indicators to delineate the freshwater resources within the linear development. (A = *Chloris virgata*; B = *Aristida* spp.)

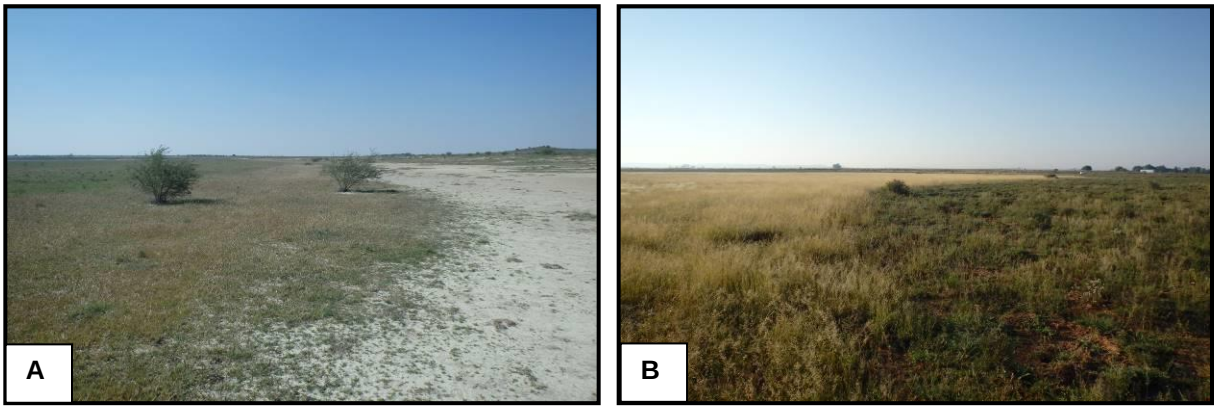


Figure 20. Photographs depicting the how vegetation can be used to identify the boundary of small pans (A) and those of large pans (B)

3.3.4 Freshwater Impacts

Three aspects of riparian ecology are considered when assessing the impacts of the proposed linear development and related activities: loss of habitat and ecological structure, changes to ecological and sociocultural service provision, and hydrological function and sediment balance.

3.3.4.1 Loss of Habitat and Ecological Condition

The Modder River and all of the pans identified within the proposed linear development are all considered to be modified and does not provide important ecological functions. The pans are mainly impacted on by grazing and trampling from livestock and game, and the Modder River by adjacent agricultural activities and historical incision. Thus, these features are not particularly sensitive to changes in habitat condition

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 28** to **Table 30** below.

Table 28. Rating of Impacts of the on the Modder River: Impact 1

Environmental Parameter	***Loss of riparian habitat and ecological structure***
Issue/Impact/Environmental Effect/Nature	*The following impacts, which will occur during all phases of the project, which will have a negative effect on the habitat and ecological structure of the Modder River:* • *Site clearing, the removal of vegetation, and associated disturbances to soils, leading to increased runoff and erosion and consequent sedimentation of riparian habitat;* • *Earthworks within riparian habitats and in the vicinity of these areas leading to increased runoff and erosion and altered runoff patterns;* • *Dumping of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the riparian areas; and* • *Ongoing disturbances to soils and vegetation during general maintenance activities leading to ongoing erosion, sedimentation of riparian resources and continued alien vegetation proliferation.*

Environmental Parameter	***Loss of riparian habitat and ecological structure***	
Extent	*Site; localized impacts where towers may potentially be constructed within, or in close proximity to, riparian habitat.*	
Probability	*Probable; due to the extent of corridor 2 and each of its alternative routes under consideration, traversing over the Modder River, it is unlikely that impacts can be completely avoided.*	
Reversibility	*Partly reversible; only some degree of intact riparian habitat still remains within and along the Modder River, and whilst a complete loss of riparian habitat is possible, the extent of loss can be limited and with careful mitigation, reinstated to functional levels.*	
Irreplaceable loss of resources	*Marginal loss of resource; whilst it is highly recommended that no towers be placed directly within the riparian habitat of the Modder River, should it be necessary to do so due to engineering requirements, marginal loss of riparian habitat in the form of vegetation losses may occur.*	
Duration	*Medium term; the effects of habitat and ecological structure losses may, without mitigation, take some time for natural processes to counteract.*	
Cumulative effect	*Medium cumulative impacts; this may be reduced to negligible cumulative impacts with careful placement of towers, i.e. the final layout must take into account the locality of the Modder River, and as much as possible, avoid placement of towers within riparian habitat.*	
Intensity/magnitude	*Medium; with good mitigation, however this can be reduced to low intensity/magnitude if the recommended mitigation measures are implemented, i.e. avoid placement of towers within the riparian zone, as this will necessitate clearing of vegetation, which may in turn lead to sedimentation of the system and proliferation of alien vegetation.*	
Significance Rating	*Prior to mitigation, perceived impacts on the loss of riparian habitat and ecological structure will be of low significance; however, with careful planning and strict implementation of mitigation measures, this impact significance can be further reduced, ensuring that the proposed activities have minimal effect on the receiving environment.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2

Environmental Parameter	***Loss of riparian habitat and ecological structure***	
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-7 (low negative)
Mitigation measures	*General "good practice" mitigation measures applicable to a project of this nature are provided in Appendix F of this report, and these must be implemented in conjunction with those stipulated here.* • *Careful planning of the placement of towers, taking into consideration the locality of riparian habitats and as much as possible, avoid placement of towers within riparian habitat, and powerlines are preferably to span over the relevant resource.* • *Where it is impossible to avoid placing infrastructure within riparian habitat, flow connectivity must be retained by preventing fragmentation of the riparian habitat;* • *Ensure that no canalization or further incision of the riparian resource takes place as a result of the construction activities;* • *Vegetation clearing prior to construction must be minimized and the area re-seeded following construction with indigenous/endemic species to aid in the natural recovery of vegetation.* • *Clearing/felling of woody vegetation should be limited to trees/shrubs above the maximum permitted clearance height, and the understory should not be cleared. Where possible, crossing points should be chosen to avoid large riparian trees.* • *An alien vegetation control programme should form part of the Environmental Management Programme (EMPr).* • *Exposed soils to be protected with suitable geotextile coverings, such as hessian sheets, at all times during the construction phase, and no stockpiling of soils is to take place within the riparian zone or associated buffer zone.* • *No lay down areas should be placed within riparian corridors, and no construction right of ways should be created through*	

Environmental Parameter	***Loss of riparian habitat and ecological structure***
	or across watercourses (other than where existing roads / accesses cross watercourses).

Table 29: Rating of Impacts of the on large pans: Impact 1

Environmental Parameter	***Loss of riparian habitat and ecological structure***
Issue/Impact/Environmental Effect/Nature	*The following impacts, which will occur during all phases of the project, which will have a negative effect on the habitat and ecological structure of the freshwater resources:* • *Site clearing, disturbance of soils and the removal of freshwater habitat* • *Compaction of soils due to construction activities* • *Movement of construction vehicles as well as access road construction within the freshwater resource zones* • *Dumping waste and construction material within freshwater resource leading to proliferation of alien vegetation species* • *Further disturbance of soils and on-going erosion as part of maintenance activities* • *Ineffective rehabilitation may lead to habitat transformation and alien vegetation encroachment.*
Extent	*Site; Due to the large size of these pans, the extent of the impact will be determined by the locality of the towers on which the powerline will be routed on. Even though the footprint of these towers is small, the construction thereof will require some degree of habitat interference (vegetation removal, soil disturbance). However, only some areas within the pans will be affected, and if the mitigation measures are implemented the extent of this impact will be minimal.*
Probability	*Definite; due to the extent of corridor 2 and each of its alternative routes under consideration, as well as the extent of the large pans occurring in all the corridors, which will be traversed, it is unlikely that impacts can be completely avoided.*
Reversibility	*Barley reversible; impacts regarding this project will have an ongoing impact, and only if intense mitigation measures are adhered to when the towers are constructed within the large pans, the impacts thereof would be minimal.*
Irreplaceable loss of resources	*Marginal loss of resource; it is highly recommended that no towers be placed directly within the large pans, should it be necessary to do so due to engineering requirements, only a marginal loss of habitat is expected since the vegetation of these*

Environmental Parameter	***Loss of riparian habitat and ecological structure***	
	pans has already been severely grazed and already has very little habitat capacity.	
Duration	*Medium term; impacts regarding the construction activities will last up to one year. Thereafter, the effects of habitat and ecological structure losses may, without mitigation, take some time for natural processes to counteract.*	
Cumulative effect	*Medium cumulative impacts; considering the already impacted on state of the habitat of the large pans, the impact will result in medium cumulative effects on the large pans. This may be reduced to negligible cumulative impacts with careful placement of the towers, i.e. the final layout must take into account the locality of the large pans, and as much as possible, avoid placement of towers within these pans.*	
Intensity/magnitude	*Medium; considering the already impacted on state of the habitat of the large pans, the impacts on the quality, use and integrity of the habitat of the large pans will most probably further degrade the ecological structure of the pans. However, with good mitigation this can be reduced to low intensity/magnitude.*	
Significance Rating	*Prior to mitigation, perceived impacts on the loss of riparian habitat and ecological structure will be of low significance; however, with careful planning and strict implementation of mitigation measures, this impact significance can be further reduced, ensuring that the proposed activities have minimal effect on the receiving environment.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	2
Reversibility	3	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-30 (medium negative)	-7 (low negative)
Mitigation measures	*General "good practice" mitigation measures applicable to a project of this nature are provided in Appendix F of this report, and these must be implemented in conjunction with those stipulated here.* • *As much indigenous vegetation growth should be promoted within the freshwater resource zones to protect soils;*	

Environmental Parameter	***Loss of riparian habitat and ecological structure***
	• *Ensure that vegetation clearing and indiscriminate vehicle driving does not occur within demarcated areas;* • *Minimize construction footprints prior to commencement of the construction and control the edge effects from construction activities;* • *An alien vegetation control programme should form part of the Environmental Management Programme (EMPr) and ensure establishment of indigenous species within areas where alien vegetation was identified;* • *As far as possible, all construction activities should occur in the low flow season, during the drier winter months;* • *Desilt the pans affected by construction activities;* • *Any area where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible to keep the freshwater resources habitat and its ecological structure in place.*

Table 30: Rating of Impacts of the on small pans: Impact 1

Environmental Parameter	***Loss of riparian habitat and ecological structure***
Issue/Impact/Environmental Effect/Nature	*The following impacts, which will occur during all phases of the project, which will have a negative effect on the habitat and ecological structure of the freshwater resources:* • *Site clearing, disturbance of soils and the removal of freshwater habitat* • *Compaction of soils due to construction activities* • *Movement of construction vehicles as well as access road construction within the freshwater resource zones* • *Dumping waste and construction material within freshwater resource leading to proliferation of alien vegetation species* • *Further disturbance of soils and on-going erosion as part of maintenance activities* • *Ineffective rehabilitation may lead to habitat transformation and alien vegetation encroachment.*
Extent	*Site; Due to the relative small size of these pans, the extent of the impact will be determined by the locality of the towers on which the powerline will be guyed on. Even though the footprint of these towers is small, the construction thereof will require some degree of habitat interference (vegetation removal, soil disturbance). However, only some areas within the pans will be affected, and if the mitigation measures are implemented the extent of this impact will be minimal.*

Environmental Parameter	***Loss of riparian habitat and ecological structure***	
Probability	*Probable; due to the extent of corridor 2 and each of its alternative routes under consideration, as well as the extent of the small pans occurring in all the corridors, which will be traversed, it is unlikely that impacts can be completely avoided.*	
Reversibility	*Partly reversible; only if intense mitigation measures are adhered to when the towers are constructed within the small pans. These mitigation measures will ensure that habitats are re-established (vegetation establishment and soil must be ripped) and reinstated to functional levels.*	
Irreplaceable loss of resources	*Marginal loss of resource; it is highly recommended that no towers be placed directly within the small pans, should it be necessary to do so due to engineering requirements, only a marginal loss of habitat is expected since the vegetation of these pans has already been severely grazed and already has very little habitat capacity.*	
Duration	*Medium term; impacts regarding the construction activities will last up to one year. Thereafter, the effects of habitat and ecological structure losses may, without mitigation, take some time for natural processes to counteract.*	
Cumulative effect	*Medium cumulative impacts; considering the already impacted on state of the habitat of the small pans, the impact will result in medium cumulative effects on the small pans. This may be reduced to negligible cumulative impacts with careful placement of the towers, i.e. the final layout must take into account the locality of the small pans, and as much as possible, avoid placement of towers within these pans.*	
Intensity/magnitude	*Medium; considering the already impacted on state of the habitat of the small pans, the impacts on the quality, use and integrity of the habitat of the small pans, will most probably further degrade the ecological structure of the pans. However, with good mitigation this can be reduced to low intensity/magnitude.*	
Significance Rating	*Prior to mitigation, perceived impacts on the loss of riparian habitat and ecological structure will be of low significance; however, with careful planning and strict implementation of mitigation measures, this impact significance can be further reduced, ensuring that the proposed activities have minimal effect on the receiving environment.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1

Environmental Parameter	***Loss of riparian habitat and ecological structure***	
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-7 (low negative)
Mitigation measures	*General "good practice" mitigation measures applicable to a project of this nature are provided in Appendix F of this report, and these must be implemented in conjunction with those stipulated here.* • *As much indigenous vegetation growth should be promoted within the freshwater resource zones to protect soils;* • *Ensure that vegetation clearing and indiscriminate vehicle driving does not occur within demarcated areas;* • *Minimize construction footprints prior to commencement of the construction and control the edge effects from construction activities;* • *An alien vegetation control programme should form part of the Environmental Management Programme (EMPr) and ensure establishment of indigenous species within areas where alien vegetation was identified;* • *As far as possible, all construction activities should occur in the low flow season, during the drier winter months;* • *Desilt the pans affected by construction activities; and* • *Any area where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible to keep the freshwater resources habitat and its ecological structure in place.*	

3.3.4.2 Changes to Ecological Sociocultural Service Provision

The placement of the towers on which the powerline will be guyed on will ultimately determine the impact of the project on the freshwater resources identified within the proposed linear development. If these towers are constructed within the freshwater resources itself, there will be an influence on its ecological structure, its functionality and hydrology. More such impacts are expected, especially in large pans, where two or more towers might be constructed within the pans due to engineering requirements. It is therefore deemed important to ensure that careful planning of the placement of the support towers takes place in order to minimise the risk of placing infrastructure unnecessarily within any of the freshwater resources. Wherever possible, it is highly recommended that the linear development spans over the Modder River, with the placement of towers situated as far from the

active channel of the Modder River as possible, and every effort should be made to prevent placement of towers within the pans itself or within its associated buffer zone.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 28** to **Table 30** below.

Table 31. Rating of Impacts of the on the Modder River: Impact 2

Environmental Parameter	***Impacts on ecological and sociocultural service provision***
Issue/Impact/Environmental Effect/Nature	*The following impacts, which will occur during all phases of the project, which will have a negative effect on the ecological and sociocultural service provisioning of the Modder River:* • *Site clearing and further removal of vegetation impacting on the biodiversity maintenance of the freshwater environments; the overall sediment balance and the ability to control erosion* • *Draining water from the river for construction purposes, resulting in loss of streamflow regulation services* • *Alteration of natural hydrological regime, impacting on flood attenuation and streamflow regulation capabilities* • *Loss of phosphate, nitrate and toxicant removal abilities due to vegetation clearing* • *Inability to support biodiversity as a result of changes to water quality, increased sedimentation and alteration of natural hydrological regimes* • *Loss of vegetation resulting in a loss of breeding and foraging habitat and overall biodiversity.* • *Insufficient aftercare and maintenance leading to ongoing erosion, gully formation and increased sedimentation due to poor management; and* • *Increased water runoff into wetland areas due to unvegetated areas overlooked after construction.*
Extent	*Site; localized impacts where towers may potentially be constructed within, or in close proximity to, the riparian habitat.*
Probability	*Probable; due to the extent of corridor 2 and each of its alternative routes under consideration, traversing over the Modder River, it is unlikely that impacts can be completely avoided.*
Reversibility	*Partly reversible; as this river already has a moderately low functionality and impacts on the Modder River may possibly result in the complete loss of this functionality, the extent of loss can be limited and with careful mitigation, reinstated to sufficient functional levels.*
Irreplaceable loss of resources	*Marginal loss of resource; whilst it is highly recommended that no towers be placed directly within the riparian habitat of the Modder River, should it be necessary to do so due to engineering*

Environmental Parameter	***Impacts on ecological and sociocultural service provision***	
	requirements, marginal loss of the Modder Rivers functionality in the form of disruptions to its ability to attenuate floods, regulate streamflow and maintain the sediment balance, may occur.	
Duration	*Medium term; the effects on the ecological and sociocultural functionality may, without mitigation, take some time for natural processes to counteract.*	
Cumulative effect	*Medium cumulative impacts; this may be reduced to negligible cumulative impacts with careful placement of towers, i.e. the final layout must take into account the locality of the Modder River, and as much as possible, avoid placement of towers within riparian habitat.*	
Intensity/magnitude	*Medium; with good mitigation, however this can be reduced to low intensity/magnitude if the recommended mitigation measures are implemented, i.e. avoid placement of towers within the riparian zone, as this will necessitate clearing of vegetation, which may in turn lead to sedimentation of the system and changes to its ability to trap sediment and attenuate floods.*	
Significance Rating	*Prior to mitigation, perceived impacts on the ecological and sociocultural functionality will be of low significance; however, with careful planning and strict implementation of mitigation measures, this impact significance can be further reduced, ensuring that the proposed activities have minimal effect on the receiving environment.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-7 (low negative)
Mitigation measures	General “good practice” mitigation measures applicable to a project of this nature are provided in Appendix F of this report, and these must be implemented in conjunction with those stipulated here.	

Environmental Parameter	***Impacts on ecological and sociocultural service provision***
	• Careful planning of the placement of towers, taking into consideration the locality of riparian habitats and as much as possible, avoid placement of towers within riparian habitat, and powerlines are preferably to span over the relevant resource. • During construction, use techniques which support the hydrology and sediment control functions of the freshwater resource; • As much vegetation growth should be promoted within the freshwater resource to protect the soils thereof; • Limit excavations to a limited extent to ensure that drainage patterns within the feature returns to normal as soon as possible after construction; • Restrict construction to the drier winter months if possible to avoid sedimentation of the freshwater feature and to minimize disturbance of the features and its hydraulic function. • Monitor the freshwater resource areas for erosion and incision; and • Implement an alien vegetation control program within freshwater resource and ensure establishment of indigenous species within areas where alien vegetation was identified.

Table 32: Rating of Impacts of the on large pans: Impact 2

Environmental Parameter	***Impacts on ecological and sociocultural service provision***
Issue/Impact/Environmental Effect/Nature	*The following impacts, which will occur during all phases of the project, which will have a negative effect on the ecological and sociocultural service provisioning of the large pans:* • *Site clearing and removal of the remaining vegetation will impact on the pans ability to maintain biodiversity;* • *Overall sediment balance and the ability to control erosion will be impacted on;* • *Alteration of natural hydrological regime will alter the pans capability to regulate flows entering the pans;* • *Loss of phosphate, nitrate and toxicant removal abilities due to vegetation clearing;* • *Inability to support biodiversity as a result of changes to water quality, increased sedimentation and alteration of natural hydrological regimes* • *Loss of vegetation resulting in a loss of breeding and foraging habitat and overall biodiversity.* • *Insufficient aftercare and maintenance leading to ongoing erosion, gully formation and increased sedimentation due to poor management; and*

Environmental Parameter	***Impacts on ecological and sociocultural service provision***
	• *Increased water runoff into pans due to unvegetated areas overlooked after construction.*
Extent	*Site; Due to the large size of these pans, the extent of the impact will be determined by the locality of the towers on which the powerline will be guyed on. Even though the footprint of these towers are small, the construction thereof will require some degree of disturbance to the functionality of these pans. However, only some areas within the pans will be affected, and if the mitigation measures are implemented the extent of this impact will be minimal.*
Probability	*Definite; due to the extent of corridor 2 and each of its alternative routes under consideration, as well as the extent of the large pans occurring in all the corridors, which will be traversed, it is unlikely that impacts can be completely avoided.*
Reversibility	*Barley reversible; impacts regarding this project will have an ongoing impact, and only if intense mitigation measures are adhered to when the towers are constructed within the large pans, the impacts thereof would be minimal.*
Irreplaceable loss of resources	*Marginal loss of resource; it is highly recommended that no towers be placed directly within the large pans, should it be necessary to do so due to engineering requirements, only a marginal loss of habitat is expected since the vegetation of these pans have already been severely grazed and the functionality thereof been lowered.*
Duration	*Medium term; impacts regarding the construction activities will last up to one year. Thereafter, the effects on the ecological and sociocultural functionality, without mitigation, will take some time for the pans natural processes to normalise.*
Cumulative effect	*Medium cumulative impacts; considering the already low ecological and sociological functionality of the large pans, the impact will result in medium cumulative effects on the large pans. This may be reduced to negligible cumulative impacts with careful placement of the towers, i.e. the final layout must take into account the locality of the large pans, and as much as possible, avoid placement of towers within these pans.*
Intensity/magnitude	*Medium; considering the already lowered functionality of the large pans, the impacts on the quality and integrity thereof will most probably be further degraded. However, with good mitigation this can be reduced to low intensity/magnitude.*
Significance Rating	*Prior to mitigation, perceived impacts on the ecological and sociocultural functionality will be of low significance; however, with careful planning and strict implementation of mitigation measures,*

Environmental Parameter	***Impacts on ecological and sociocultural service provision***	
	this impact significance can be further reduced, ensuring that the proposed activities have minimal effect on the receiving environment.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	2
Reversibility	3	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-30 (medium negative)	-7 (low negative)
Mitigation measures	*General "good practice" mitigation measures applicable to a project of this nature are provided in Appendix F of this report, and these must be implemented in conjunction with those stipulated here.* • *As much indigenous vegetation growth should be promoted within the large pans to protect soils and limit the possible changes to the sediment balance of the pans;* • *Ensure that vegetation clearing and indiscriminate vehicle driving does not occur within demarcated areas, as to limit soil compaction;* • *Minimize construction footprints prior to commencement of the construction and control the edge effects from construction activities;* • *An alien vegetation control programme should form part of the Environmental Management Programme (EMPr) and ensure establishment of indigenous species within areas where alien vegetation was identified;* • *As far as possible, all construction activities should occur in the low flow season, during the drier winter months; and* • *Desilt the pans affected by construction activities;* • *Any area where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible to keep the freshwater resources habitat and its ecological structure in place.*	

Table 33: Rating of Impacts of the on small pans: Impact 2

Environmental Parameter	***Impacts on ecological and sociocultural service provision***
Issue/Impact/Environmental Effect/Nature	*The following impacts, which will occur during all phases of the project, which will have a negative effect on the ecological and sociocultural service provisioning of the small pans:* • *Site clearing and removal of the remaining vegetation will impact on the pans ability to maintain biodiversity;* • *Overall sediment balance and the ability to control erosion will be impacted on;* • *Alteration of natural hydrological regime will alter the pans capability to regulate flows entering the pans;* • *Loss of phosphate, nitrate and toxicant removal abilities due to vegetation clearing;* • *Inability to support biodiversity as a result of changes to water quality, increased sedimentation and alteration of natural hydrological regimes* • *Loss of vegetation resulting in a loss of breeding and foraging habitat and overall biodiversity.* • *Insufficient aftercare and maintenance leading to ongoing erosion, gully formation and increased sedimentation due to poor management; and* • *Increased water runoff into pans due to unvegetated areas overlooked after construction.*
Extent	*Site; Due to the small size of these pans, the extent of the impact will be determined by the locality of the towers on which the powerline will be guyed on. Even though the footprint of these towers are small, the construction thereof will require some degree of disturbance to the functionality of these pans. However, only some areas within the pans will be affected, and if the mitigation measures are implemented the extent of this impact will be minimal.*
Probability	*Probable; due to the extent of corridor 2 and each of its alternative routes under consideration, as well as the extent of the small pans occurring in all the corridors, which will be traversed, it is unlikely that impacts can be completely avoided.*
Reversibility	*Partly reversible; only if intense mitigation measures are adhered to when the towers are constructed within the small pans. These mitigation measures will ensure that the pans functionality is reinstated (i.e. establishment of vegetation, erosion control parameters).*
Irreplaceable loss of resources	*Marginal loss of resource; it is highly recommended that no towers be placed directly within the small pans, should it be necessary to do so due to engineering requirements, only a marginal loss of habitat is expected since the vegetation of these pans have*

Environmental Parameter	***Impacts on ecological and sociocultural service provision***	
	already been severely grazed and the functionality thereof been lowered.	
Duration	*Medium term; impacts regarding the construction activities will last up to one year. Thereafter, the effects on the ecological and sociocultural functionality, without mitigation, will take some time for the pans natural processes to normalize.*	
Cumulative effect	*Medium cumulative impacts; considering the already low ecological and sociological functionality of the small pans, the impact will result in medium cumulative effects on the small pans. This may be reduced to negligible cumulative impacts with careful placement of the towers, i.e. the final layout must take into account the locality of the small pans, and as much as possible, avoid placement of towers within these pans.*	
Intensity/magnitude	*Medium; considering the already lowered functionality of the small pans, the impacts on the quality and integrity thereof will most probably be further degraded. However, with good mitigation this can be reduced to low intensity/magnitude.*	
Significance Rating	*Prior to mitigation, perceived impacts on the ecological and sociocultural functionality will be of low significance; however, with careful planning and strict implementation of mitigation measures, this impact significance can be further reduced, ensuring that the proposed activities have minimal effect on the receiving environment.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-7 (low negative)
Mitigation measures	*General "good practice" mitigation measures applicable to a project of this nature are provided in Appendix F of this report, and these must be implemented in conjunction with those stipulated here.* • *As much indigenous vegetation growth should be promoted within the small pans to protect soils and limit the possible changes to the sediment balance of the pans;*	

Environmental Parameter	***Impacts on ecological and sociocultural service provision***
	• *Ensure that vegetation clearing and indiscriminate vehicle driving does not occur within demarcated areas, as to limit soil compaction;* • *Minimize construction footprints prior to commencement of the construction and control the edge effects from construction activities;* • *An alien vegetation control programme should form part of the Environmental Management Programme (EMPr) and ensure establishment of indigenous species within areas where alien vegetation was identified;* • *Desilt the pans affected by construction activities;* • *As far as possible, all construction activities should occur in the low flow season, during the drier winter months.* • *Any area where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible to keep the freshwater resources habitat and its ecological structure in place.*

3.3.4.3 Hydrological Function and Sediment Balance

The placement of the towers on which the powerline will be guyed on will ultimately determine the impact of the project on the freshwater resources identified within the proposed linear development. If these towers are constructed within the freshwater resources itself, there will be an influence on its ecological structure, its functionality and hydrology. More such impacts are expected, especially in large pans, where two or more towers might be constructed within the pans due to engineering requirements. It is therefore deemed important to ensure that careful planning of the placement of the support towers takes place in order to minimise the risk of placing infrastructure unnecessarily within any of the freshwater resources. Wherever possible, it is highly recommended that the linear development spans over the Modder River, with the placement of towers situated as far from the active channel of the Modder River as possible, and every effort should be made to prevent placement of towers within the pans itself or within its associated buffer zone.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 34** to **Table 36** below.

Table 34. Rating of Impacts of the on the Modder River: Impact 3

Environmental Parameter	***Freshwater resources hydrological function and sediment balance***
Issue/Impact/Environmental Effect/Nature	*The following impacts, which will occur during all phases of the project, which will have a negative effect on the habitat and ecological structure of the Modder River:* • *Site clearing and further removal of vegetation resulting in increased runoff which leads to erosion and alteration of the geomorphology of the Modder River;* • *Excavations of the erodible soils, leading to canalization of the Modder River banks, sheet erosion and gully formation;* • *Movement of construction vehicles within the freshwater environments resulting in soil compaction* • *Topsoil stockpiling adjacent to the freshwater resources and runoff from stockpiles leading to sedimentation of the system;* • *Streamflow diversion and draining water from the Modder River resulting in the alteration of hydrological zones;* • *Vegetation trampling during maintenance activities; and* • *Indiscriminate driving within the freshwater resource areas resulting in soil compaction.*
Extent	*Site; localized impacts where towers may potentially be constructed within, or in close proximity to the riparian habitat.*
Probability	*Probable; due to the extent of corridor 2 and each of its alternative routes under consideration, traversing over the Modder River, it is unlikely that impacts on the hydrology of the Modder River can be completely avoided.*
Reversibility	*Partly reversible; the hydrological functioning of the Modder River is already impacted on by historical incision, it is possible that the impact of the proposed linear development will further impact on the hydrology. However, the extent of the impacts can be limited and with careful mitigation, reinstated to functional levels.*
Irreplaceable loss of resources	*Marginal loss of resource; whilst it is highly recommended that no towers be placed directly within the riparian habitat of the Modder River, should it be necessary to do so due to engineering requirements, marginal changes to the hydrology might occur.*
Duration	*Medium term; the effects on the hydrological functioning of the Modder River may, without mitigation, take some time for natural hydrological functioning to occur.*
Cumulative effect	*Medium cumulative impacts; this may be reduced to negligible cumulative impacts with careful placement of towers, i.e. the final layout must take into account the locality of the Modder River, and*

Environmental Parameter	***Freshwater resources hydrological function and sediment balance***	
	as much as possible, avoid placement of towers within the riparian habitat.	
Intensity/magnitude	*Medium; with good mitigation however this can be reduced to low intensity/magnitude if the recommended mitigation measures are implemented, i.e. avoid placement of towers within the riparian zone, as this will change flow patterns of the river.*	
Significance Rating	*Prior to mitigation, perceived impacts on the hydrological functioning will be of low significance; however, with careful planning and strict implementation of mitigation measures, this impact significance can be further reduced, ensuring that the proposed activities have minimal effect on the receiving environment.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-7 (low negative)
Mitigation measures	*General "good practice" mitigation measures applicable to a project of this nature are provided in Appendix F of this report, and these must be implemented in conjunction with those stipulated here:* • *Any construction-related waste must not be placed in the vicinity of the freshwater resource;* • *As much vegetation growth should be promoted within the freshwater resource to protect soils;* • *Limit the footprint area of the construction activity to what is absolutely essential in order to minimize environmental damage;* • *Upon completion of the construction phase the disturbed area and any areas of soil compaction, should be rehabilitated through reprofiling and revegetation;* • *Desilt the freshwater resource areas affected by construction activities;*	

Environmental Parameter	***Freshwater resources hydrological function and sediment balance***
	• *Dumped soil must be removed and the area must be levelled to avoid sedimentation of the features from runoff; and* • *Vehicles should not be driven indiscriminately within the freshwater resource areas during maintenance activities to prevent soil compaction*.

Table 35: Rating of Impacts of the on large pans: Impact 3

Environmental Parameter	***Freshwater resources hydrological function and sediment balance***
Issue/Impact/Environmental Effect/Nature	*The following impacts, which will occur during all phases of the project, which will have a negative effect on the hydrological functioning of the large pans:* • *Site clearing and further removal of vegetation resulting in increased runoff which leads to erosion and alteration of the geomorphology of the pans;* • *Excavations within the pans could alter the roughness of the surface, impacting of the water flow velocity and pathways of diffuse flows and resulting in sheet erosion or gully formation;* • *Movement of construction vehicles within the pans could result in soil compaction and vegetation trampling; and* • *Topsoil stockpiling adjacent to the pans and runoff from stockpiles leading to changes to the sediment balance of the pans.*
Extent	*Site; Due to the large size of these pans, the extent of the impact will be determined by the locality of the towers on which the powerline will be guyed on. Even though the footprint of these towers are small, the construction thereof will require some degree of disturbance to the hydrology of these pans. However, only some areas within the pans will be affected, and if the mitigation measures are implemented the extent of this impact will be minimal.*
Probability	*Definite; due to the extent of corridor 2 and each of its alternative routes under consideration, as well as the extent of the large pans occurring in all the corridors, which will be traversed, it is unlikely that impacts can be completely avoided.*
Reversibility	*Barley reversible; impacts regarding this project will have an ongoing impact, and only if intense mitigation measures are adhered to when the towers are constructed within the large pans, the impacts thereof would be minimal.*

Environmental Parameter	***Freshwater resources hydrological function and sediment balance***	
Irreplaceable loss of resources	*Marginal loss of resource; it is highly recommended that no towers be placed directly within the large pans, should it be necessary to do so due to engineering requirements, only a marginal influence on the hydrological functioning is expected.*	
Duration	*Medium term; impacts regarding the construction activities will last up to one year. Thereafter, the effects on the hydrological functioning of the pans, without mitigation, will take some time for the pans natural hydrological processes to normalize.*	
Cumulative effect	*Medium cumulative impacts; this may be reduced to negligible cumulative impacts with careful placement of the towers, i.e. the final layout must take into account the locality of the large pans, and as much as possible, avoid placement of towers within these pans to avoid impacts on the flow of water into the pans.*	
Intensity/magnitude	*Medium; the impacts on the quality and integrity of the hydrological functioning of these large pans can be reduced, with good mitigation implementation.*	
Significance Rating	*Prior to mitigation, perceived impacts on the hydrological functioning of the large pans will be of low significance; however, with careful planning and strict implementation of mitigation measures, this impact significance can be further reduced, ensuring that the proposed activities have minimal effect on the receiving environment.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	2
Reversibility	3	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-30 (medium negative)	-7 (low negative)
Mitigation measures	*General "good practice" mitigation measures applicable to a project of this nature are provided in Appendix F of this report, and these must be implemented in conjunction with those stipulated here.* • *Any construction-related waste must not be placed within or in the vicinity of the large pans, this will minimize possible effects on water flow into the pans;* • *As much vegetation growth should be promoted within the freshwater resource to protect soils and to encourage water retention and flood attenuation;*	

Environmental Parameter	***Freshwater resources hydrological function and sediment balance***
	• *Limit the footprint area of the construction activity to what is absolutely essential in order to minimize environmental damage;* • *Upon completion of the construction phase the disturbed areas and compacted soils should be rehabilitated through reprofiling and revegetation;* • *Desilt the pans affected by construction activities;* • *Dumped soil must be removed and the area must be levelled to avoid sedimentation of the pans from runoff; and* • *Vehicles should not be driven indiscriminately within the freshwater resource areas during maintenance activities to prevent soil compaction*.

Table 36: Rating of Impacts of the on small pans: Impact 3

Environmental Parameter	***Freshwater resources hydrological function and sediment balance***
Issue/Impact/Environmental Effect/Nature	*The following impacts, which will occur during all phases of the project, which will have a negative effect on the hydrological functioning of the small pans:* • *Site clearing and further removal of vegetation resulting in increased runoff which leads to erosion and alteration of the geomorphology of the pans;* • *Excavations within the pans could alter the roughness of the surface, impacting of the water flow velocity and pathways of diffuse flows and resulting in sheet erosion or gully formation;* • *Movement of construction vehicles within the pans could result in soil compaction and vegetation trampling; and* • *Topsoil stockpiling adjacent to the pans and runoff from stockpiles leading to changes to the sediment balance of the pans.*
Extent	*Site; Due to the small size of these pans, the extent of the impact will be determined by the locality of the towers on which the powerline will be guyed on. Even though the footprint of these towers are small, the construction thereof will require some degree of disturbance to the hydrology of these pans. However, only some areas within the pans will be affected, and if the mitigation measures are implemented the extent of this impact will be minimal.*
Probability	*Probable; due to the extent of corridor 2 and each of its alternative routes under consideration, as well as the extent of*

Environmental Parameter	***Freshwater resources hydrological function and sediment balance***	
	the small pans occurring in all the corridors, which will be traversed, it is unlikely that impacts can be completely avoided.	
Reversibility	*Partly reversible; only if intense mitigation measures are adhered to when the towers are constructed within the small pans. These mitigation measures will ensure that the pans hydrologic functioning is reinstated (i.e. removal of all rumble or obstructions that can alter the flow of water into the pan).*	
Irreplaceable loss of resources	*Marginal loss of resource; it is highly recommended that no towers be placed directly within the small pans, should it be necessary to do so due to engineering requirements, only a marginal influence on the hydrological functioning is expected.*	
Duration	*Medium term; impacts regarding the construction activities will last up to one year. Thereafter, the effects on the hydrological functioning of the pans, without mitigation, will take some time for the pans natural hydrological processes to normalize.*	
Cumulative effect	*Medium cumulative impacts; this may be reduced to negligible cumulative impacts with careful placement of the towers, i.e. the final layout must take into account the locality of the small pans, and as much as possible, avoid placement of towers within these pans to avoid impacts on the flow of water into the pans.*	
Intensity/magnitude	*Medium; the impacts on the quality and integrity of the hydrological functioning of these small pans can be reduced, with good mitigation implementation.*	
Significance Rating	*Prior to mitigation, perceived impacts on the hydrological functioning of the small pans will be of low significance; however, with careful planning and strict implementation of mitigation measures, this impact significance can be further reduced, ensuring that the proposed activities have minimal effect on the receiving environment.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-7 (low negative)

Environmental Parameter	***Freshwater resources hydrological function and sediment balance***
Mitigation measures	*General "good practice" mitigation measures applicable to a project of this nature are provided in Appendix F of this report, and these must be implemented in conjunction with those stipulated here.* • *Any construction-related waste must not be placed within or in the vicinity of the small pans, this will minimize possible effects on water flow into the pans;* • *As much vegetation growth should be promoted within the freshwater resource to protect soils and to encourage water retention and flood attenuation;* • *Limit the footprint area of the construction activity to what is absolutely essential in order to minimize environmental damage;* • *Upon completion of the construction phase the disturbed areas and compacted soils should be rehabilitated through reprofiling and revegetation;* • *Desilt the pans affected by construction activities;* • *Dumped soil must be removed and the area must be levelled to avoid sedimentation of the pans from runoff; and* • *Vehicles should not be driven indiscriminately within the freshwater resource areas during maintenance activities to prevent soil compaction*.

3.4 Soils and Agricultural Potential Impacts

A Soils and Agricultural Potential Assessment was conducted by Johann Lanz an independent consultant and is included in **Appendix D4**. A summary of the main findings of the assessment are outlined below.

3.4.1 Climate and water availability

Rainfall for the site is given as 367 mm, of which 75%, falls from November to April (Paterson, 2011). Rainfall is erratic, both locally and seasonally and therefore cannot be relied on for agriculture. One of the most important climate parameter for agriculture in a South African context is moisture availability, which is the ratio of rainfall to evapotranspiration. Moisture availability is classified into 6 categories across the country (see **Table 37**). The site falls into the second driest 5th category, which is labelled as a severe limitation to agriculture.

The proposed corridor crosses the Modder River, where there is some irrigated cultivation. For the rest only water for stock, supplied from wind pumps, is available.

Table 37. The classification of moisture availability climate classes for summer rainfall areas across South Africa (Agricultural Research Council, Undated)

Climate class	Moisture availability (Rainfall/0.25 PET)	Description of agricultural limitation
C1	>34	None to slight
C2	27-34	Slight
C3	19-26	Moderate
C4	12-18	Moderate to severe
C5	6-12	Severe
C6	<6	Very severe

3.4.2 Terrain, topography and drainage

The proposed development is located on level plains with some relief, at an altitude of between 1,140 and 1,230 meters. Slope is less than 1% across the site. A satellite image map of the site is shown in **Figure 21**.

The underlying geology is tillite (Dwyka Group), shale and mudstone (Ecca Group) covered partially by surface limestone and red wind-blown sand. Dolerite intrusions also occur.

The only perennial water course in the study area is the Modder River.

3.4.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. There are five land types across the site, Ae45, Ag148; Fb1; Ae49; and Ae15 (see **Figure 21**). Soils on these land types are predominantly shallow to moderately deep, loamy sands on underlying rock or hard-pan carbonate. The soils would fall into the Lithic and Calcic soil groups according to the classification of **Fey (2010)**.

The soils are classified as having low to moderate susceptibility to water erosion (class 5), and as susceptible to wind erosion (class 2) because of their sandy texture.

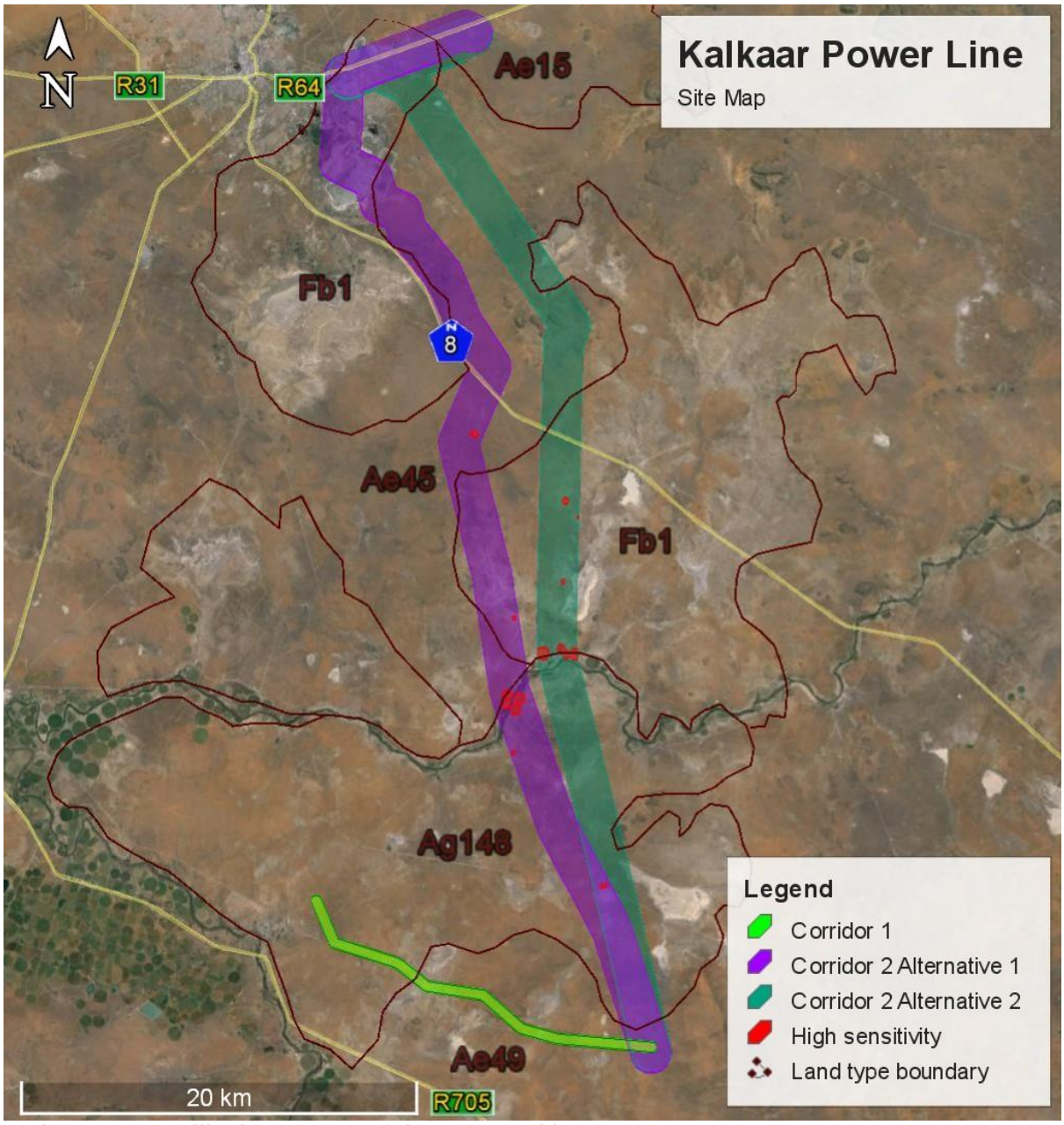


Figure 21. Satellite image map of the proposed layout

3.4.4 Agricultural capability

Land capability is the combination of soil suitability and climate factors. The land capability of the site varies according to land type from class 5 to class 7, which is from non-arable, moderate potential grazing land to non-arable, low potential grazing land. The limitations to agriculture are aridity and lack of access to water plus shallow soil depth. Because of these constraints, agricultural land use is restricted to grazing only (except where irrigation is viable along the Modder River). The natural grazing capacity is predominantly 14-17 hectares per animal unit, but it is lower (18-21) in parts of the site.

3.4.5 Land use and development on and surrounding the site

The site is located within a cattle farming agricultural region and the only agricultural activity on the site, except for some small irrigation areas along the Modder River, is grazing.

3.4.6 Status of the land

The biome classification for the site is Kimberley Thornveld in the north and Northern Upper Karoo in the south.

3.4.7 Possible land use options for the site

Because of the extreme aridity constraints, as well as large areas of shallow, poor soils, agricultural land use is restricted to grazing only, except in very limited areas where irrigation is an option.

3.4.8 Agricultural sensitivity

Agricultural conditions and potential are fairly uniform across the majority of the site and the choice of placement of infrastructure therefore has no influence on the significance of agricultural impacts. However where the corridors cross the Modder River, the power lines must avoid crossing any centre pivot irrigation lands. Centre pivot irrigation cannot operate under power lines. Any infrastructure on the ground must also be sited to avoid these areas. A minimum buffer of 25 metres

must be allowed between any power line and a centre pivot. In both the corridor alternatives there is space to route the power lines where they will not disturb centre pivot lands.

3.4.9 Impact Assessment

3.4.10 Construction Phase

The impacts can be summarised as follows:

Table 38: Loss of agricultural land use

IMPACT TABLE FORMAT		
Environmental Parameter	Soils and Agricutlural Potential	
Issue/Impact/Environmental Effect/Nature	Loss of agricultural land use	
Extent	Site	
Probability	Definite	
Reversibility	Completely reversible	
Irreplaceable loss of resources	No loss of resources	
Duration	Long term	
Cumulative effect	Negligible	
Intensity/magnitude	Low	
Significance Rating	Low and negative	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1

IMPACT TABLE FORMAT		
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-11 (negative low)	-11 (negative low)
Mitigation measures	None	

Table 39: Soil erosion

IMPACT TABLE FORMAT		
Environmental Parameter	Soils and Agricutlural Potential	
Issue/Impact/Environmental Effect/Nature	Soil erosion	
Extent	Site	
Probability	Possible	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss of resources	
Duration	Long term	
Cumulative effect	Negligible	
Intensity/magnitude	Medium	
Significance Rating	Low and negative	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	1	1

IMPACT TABLE FORMAT		
Intensity/magnitude	2	1
Significance rating	-22 (negative low)	-10 (negative low)
Mitigation measures	Implement an effective system of run-off control, where it is required, that collects and safely disseminates all potential accumulations of run-off water and thereby prevents potential down slope erosion. This should be in place and maintained during all phases of the development. Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site to stabilize the soil against erosion.	

Table 40: Loss of topsoil

IMPACT TABLE FORMAT		
Environmental Parameter	Soils and Agricutlural Potential	
Issue/Impact/Environmental Effect/Nature	Loss of topsoil	
Extent	Site	
Probability	Possible	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss of resources	
Duration	Long term	
Cumulative effect	Negligible	
Intensity/magnitude	Medium	
Significance Rating	Low and negative	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1

IMPACT TABLE FORMAT		
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-22 (negative low)	-10 (negative low)
Mitigation measures	Strip and stockpile topsoil from all areas where soil will be disturbed below surface. After cessation of disturbance, re-spread topsoil over the surface. Dispose of any sub-surface spoils from excavations where they will not impact on agricultural land (for example use as road surfacing), or where they can be effectively covered with topsoil.	

Table 41: Degradation of grazing

IMPACT TABLE FORMAT		
Environmental Parameter	Soils and Agricutlural Potential	
Issue/Impact/Environmental Effect/Nature	Degradation of grazing	
Extent	Site	
Probability	Possible	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss of resources	
Duration	Medium term	
Cumulative effect	Negligible	
Intensity/magnitude	Low	
Significance Rating	Low and negative	
	Pre-mitigation impact rating	Post mitigation impact rating

IMPACT TABLE FORMAT		
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-22 (negative low)	-9 (negative low)
Mitigation measures	Minimize road footprint and control vehicle access on roads only. Control dust as per standard construction site practice.	

3.4.11 Operation Phase

The impacts can be summarised as follows:

Table 42: Loss of agricultural land use

IMPACT TABLE FORMAT	
Environmental Parameter	Soils and Agricutlura Potential
Issue/Impact/Environmental Effect/Nature	Loss of agricultural land use
Extent	Site
Probability	Definite
Reversibility	Completely reversible
Irreplaceable loss of resources	No loss of resources
Duration	Long term
Cumulative effect	Negligible
Intensity/magnitude	Low
Significance Rating	Low and negative

IMPACT TABLE FORMAT		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-11 (negative low)	-11 (negative low)
Mitigation measures	None	

3.5 Heritage and Palaeontology Impacts

A Heritage Impact Assessment was conducted by Wouter Fourie, with Palaeontological input from Gideon Groenewald of PGS Heritage and is included in **Appendix D5**. A summary of the main findings of the assessment are outlined below.

3.5.1 Background Research

The aim of the archival background research is to identify possible heritage resources that could be encountered during fieldwork, as summarised in **Table 43**.

Table 43 - Summary of History of the Jacobsdal Area

DATE	DESCRIPTION
2.5 million to 250 000 years ago	The Earlier Stone Age (ESA). The Earlier Stone Age is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these technological phases is known as Oldowan which is associated with crude flakes and hammer stones and dates to approximately 2 million years ago. The second technological phase in the Earlier Stone Age of Southern Africa is known as the Acheulian and comprises more refined and better made stone artefacts such as the cleaver and bifacial handaxe. The Acheulian phase dates back to

	approximately 1.5 million years ago. No recorded sites were located during the desktop study.
250 000 to 40 000 years ago	The Middle Stone Age (MSA). The Middle Stone Age is the second oldest phase identified in South Africa's archaeological history. It is associated with flakes, points and blades manufactured by means of the prepared core technique. No recorded sites were located during the desktop study.
40 000 years ago to the historic past	The Later Stone Age is the third phase in South Africa's Stone Age history. It is associated with an abundance of very small stone artefacts (microliths). The Later Stone Age is also associated with rock engravings and rock paintings. Rock engravings are known from the wider vicinity of the study area (Bergh, 1998). Burkitt (1928) mentions two Late Stone Age sites on the farm Brakfontein, 24km from Fauresmith on the Koffiefontein Road: one yielded Smithfield lithics and the other yielded Fauresmith lithics. A site with engravings is mentioned on a koppie called Afvallingskop, located on the road from Koffiefontein to Jacobsdal, just outside Koffiefontein. This koppie had many boulders strewn over the flat top which had been engraved.
AD 200 - 900	Early Iron Age (EIA). No recorded sites were located during the desktop study.
AD 900 - 1300	Middle Iron Age (MIA). No recorded sites were located during the desktop study.
AD 1300 - 1840	Late Iron Age (LIA). A specific type of settlement known as "Type R" settlements is limited to the Riet River between Kalkfontein Dam in the east and the hilly country around the village of Plooysburg in the west, a distance of some 130 km. Maggs (1971) has identified a large number, consisting of at least 78 settlement units, in the eastern half of this area between Kalkfontein Dam and the town of Jacobsdal. From here there is a gap of about 50 km until the settlement at Driekops Eiland is reached. In this area north and west of Plooysburg are an additional six or more settlement units. (Maggs, 1971)
AD 1859	Historical period. The town of Jacobsdal derives its name from Christoffel Jacobs who made a portion of his farm Kalkfontein available for the establishment of the town. The layout of the town commenced in 1859 and the town obtained municipal status in 1860. The Riet River irrigation settlement starts about 3 km west of the town and extends 15 km upstream to the confluence of the Riet and Modder Rivers (Webley & Orton, 2012). Several provincial heritage sites are located in and around the town of Jacobsdal, as recorded on the SAHRA database SAHRIS. These include the following: Magersfontein Burgher Memorial, on the farm Magersfontein 219; Anglo-Boer War Blockhouse, on the road to Paardeberg; Nederduitse Gereformeerde Church, Andries Pretorius Street; Jacobsdal (SAHRIS)
1899-1902 South Africa War	Jacobsdal saw a great deal of military action during the Second Anglo-Boer War of 1899-1902 because it was close to the strategic towns of Kimberley and Mafeking. The wounded from the battles of Belmont/Graspan, Modder River, Magersfontein and Paardeberg were all nursed in the town. There are a number of important memorials and buildings in town, including the Burger Monument in front of the Dutch Reformed Church, erected in memory of the deceased at the Battle of Roodelaagte (or Graspan) on 25 November.1899. The town also has a cairn memorial erected by the Boers of Jacobsdal in November 1899 before departing for the battle of Graspan. The Dutch Reformed Church, consecrated in 1879 and enlarged in 1930, was used as a hospital during the Anglo Boer War. The oldest grave in the Jacobsdal Cemetary dates from 1859. British War graves and monuments can be found dating from the Anglo Boer War (1899 - 1902) (Webley & Orton, 2012).

	The Battles of Modder River and Magersfontein both occurred in late 1899. The battle of Modder River was an immediate precursor to the battle of Magersfontein in relation to the Boer siege of Kimberley. The Boers had dug themselves in on the Northern bank of the Modder River close to its confluence with the Riet. However, the Commonwealth forces eventually forced the Boers to retreat after an intense artillery fire. Notwithstanding, the Boers held up the British advance for 10 days and entrenched themselves at a series of low dolerite hills called Magersfontein The site of the Battle of Modder River is marked by a Commonwealth War Graves cemetery (Hart, 2003) At Magersfontein, the Boers in their trenches at the base of the hills opened fire on the British forces at a range of 400m. The result was some 700 Commonwealth troop fatalities. After two days of fierce fighting, the British Forces retreated to Modder River camp to await reinforcements before attempting to reach Kimberly. Magersfontein was a huge shock for the Commonwealth army. Today Magersfontein battle site is one of the best preserved (Hart, 2003). The town of Jacobsdal played a key role in most of these engagements, being at first the Boer headquarters and later taken over by the British for the same purpose (Hart, 2003)

The following heritage sites were identified in and around Jacobsdal from the Letsemeng Local Municipality web-site (http://www.letsemeng.gov.za/index.php/council/76-uncategorised/58-jacobsdal):

- British Block House (Fort) – The blockhouse with its unique architecture was built in 1900 on the road to Paardeberg. It was declared a national monument in 1983.
- Burger Monument – In front of the Dutch Reformed Church - erected in memory of the deceased at the Battle of Roodelaagte 25.11.1899 under command of D.S. Lubbe.
- Cairn – Heap of stones (Klipstapel) – It was erected by the Boers from Jacobsdal in November 1899 before departing for the battle of Roodelaagte (Graspan). Each boer engraved his name on a stone and these stones were used to build the monument. The monument can be reached by a walking trail from the Agricultural School.
- Dutch Reformed Church – Consecrated in 1879 and enlarged in 1930, was used as a hospital during the Anglo Boer War - now a national monument. A Bullet hole in the front door is evidence of the many skirmishes which took place between Boer and Brit in the area.
- Jacobsdal Cemetery (at the end of De Villiers St) – The oldest grave date from 1859. British War graves and monuments can be found dating from the Anglo Boer War (1899 - 1902). Some "Boers" that fought the Magersfontein battle were reburied at Magersfontein which included Commandant D.S. Lubbe's grave (1923).
- Jacobs Farmhouse – It is the first dwelling that was built in the area where Jacobsdal is today. It was built by Mr C.J. Jacobs. The house is situated in Sarel Cilliers St next to First National Bank.
- Magersfontein Battlefield & Museum – 20 km North-west of Jacobsdal.
- Old Market Square – The market square was where the city hall is today and it was used as a British soldier's lager. A big battle took place on 25 October 1900. Boers fired at the British from behind a stone wall which still stands today.

- Paardeberg (18 - 27 February 1900) – By means of a wide flanking movement to avoid the Boers at Magersfontein, Lord Roberts succeeded in relieving Kimberley on 15 February 1900. Due to his precarious position, Cronje was forced to fall back to Bloemfontein along the Modder River. He was denied crossing Vendusiedrif due to the British onslaught with the result that the Boers entrenched themselves on both sides of the river. 40000 British troops supported by 100 guns besieged the small Boer force of 4000 men, women and children. After 10 days of continuous bombardment, the Boer force surrendered on 27 February 1900. Majuba was at last revenged.
- "Tuishuis" – The old fashioned dwelling, still with its original wallpaper, was used during religious ceremonies. It is situated directly opposite the southern entrance of the Dutch Reformed Church.

Further to the above, a large scale study conducted as part of the renewable energy development zones (CSIR, 2013) identified areas of heritage sensitivity that could be of significance for developments in the area between Jacobsdal and Kimberley. These sensitivities include, watercourses and pans, ridges, battlefields and blockhouses as well as palaeontological sensitive areas.

Significant sensitive areas situated inside or just bordering some of the proposed alignments areas at the old Kimberley cemetery on the outskirts of Kimberley, but just inside Corridor 2 Alternative 1 (**Figure 22**). During the Siege of Kimberley, the Boer forces had numerous fortifications around the town. Three such areas have been demarcated from historical maps, and occur in the northern sections of both Corridor 2 Alternative 1 and 2.

Two block house alignments central to securing the Kimberley and larger Free State are during the South African War crosses both alignments; the Kimberley Boshoff line in the north and the Modderrivier to Krugersdrift line in the south.

A few ridges that are usually associated with archaeological remains such as engraving have also been demarcated in the southern section of both alignments.

Studies completed in the general study area:

- Morris, D. 2014. Proposed Blackwood Solara Energy Facility on portion 1 of Padamsfontein 1593, south east of Kimberley.
- Rossouw, L. 2013. Phase 1 Palaeontological Impact Assessment on portion 1 of Padamsfontein 1593, south east of Kimberley.
- Morris, D. 2014. Proposed Boundary Solar Energy Facility on the farm Kareeboom 1716, east of Kimberley.
- Rossouw, L. 2014. Phase 1 Palaeontological Impact Assessment for the Proposed Boundary Solar Energy Facility on the farm Kareeboom 1716, east of Kimberley.

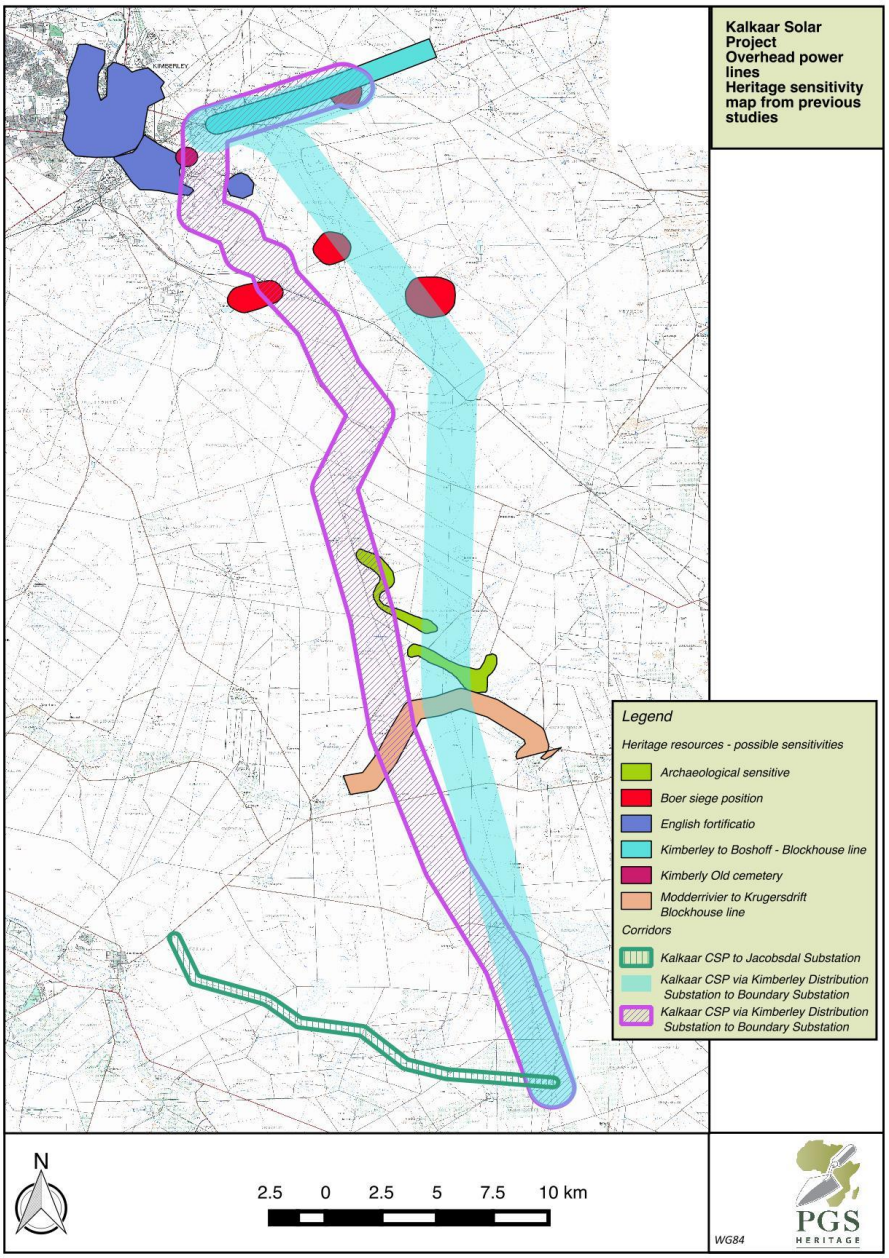


Figure 22. Heritage sensitive areas from previous studies

3.5.2 Palaeontology

Ms. Elize Butler (2016) completed a Paleontological Impact Assessment (PIA). A summary of the findings is included below.

"*The development footprint is completely underlain by lower Permian sediments of the Ecca Group of the Karoo Basin (White Hill and Prince Albert Formations), Late Permian Volksrust Formation, and the Karoo Dolerite Suite and Quaternary deposits. The development footprint as a whole is a fairly flat lying terrain with grassy vegetation cover in places as well as a few thorn trees. The Karoo dolerite Suite is unfossiliferous and the sensitivity in the Quaternary sediments is low. Although the palaeontological sensitivity of the Whitehill, Prince Albert and Volksrust Formations is rated as high to very high, scarcity of fossil-bearing sediments and lack of exposure at the proposed sites indicate that the impact on palaeontological material is negligible and regarded as insignificant*." (Butler, 2016).

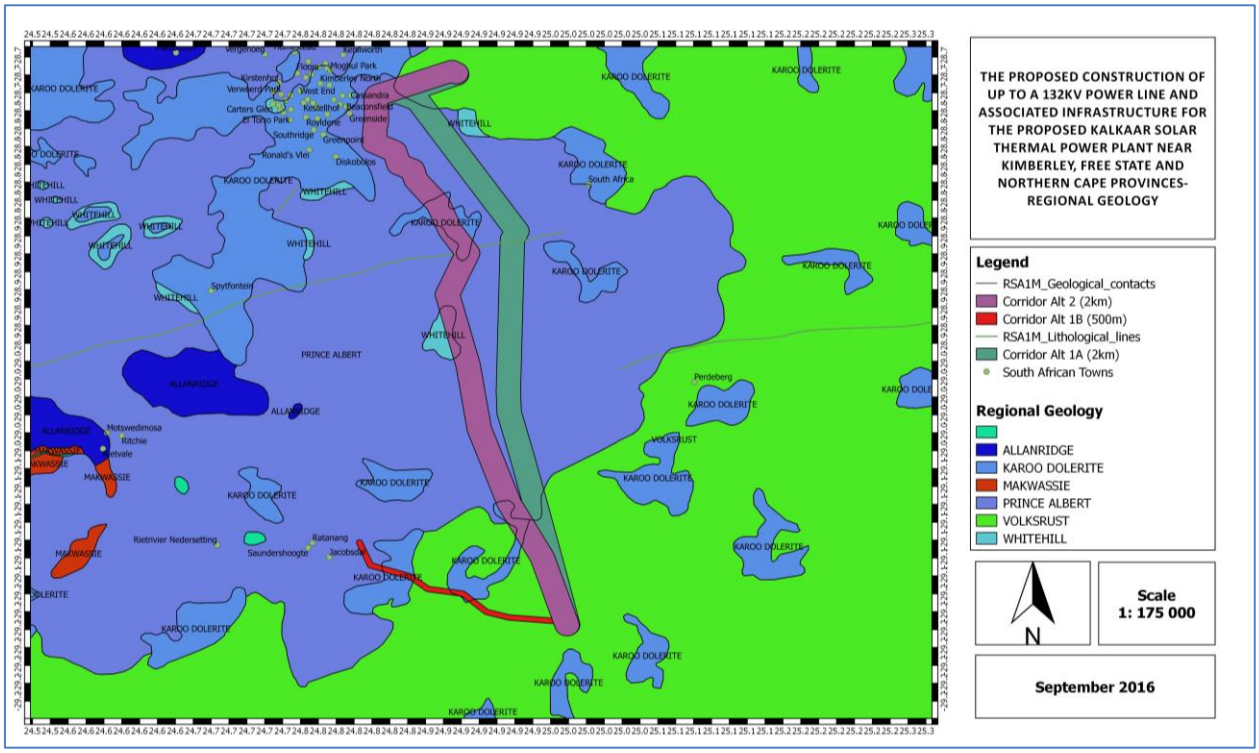


Figure 23. The surface geology of the Power line Project (Butler, 2016)

3.5.3 Focussed fieldwork on possible heritage sensitive areas from the desktop assessment

As indicated in Section 5, some significant sensitive areas are situated inside or just bordering some of the proposed alignments area the old Kimberley cemetery on the outskirts of Kimberley but just inside the Corridor 2 Alternative 1 (purple corridor – **Figure 22**). During the Siege of Kimberley, the Boer forces had numerous fortifications around the town. Three such area has been demarcated from historical maps, and occur in the northern sections of both Corridor 2 Alternative 1 (purple corridor) and 2 (blue corridor).

Two block house alignments central to securing the Kimberley and larger Free State are during the South African War crosses both alignments; the Kimberley Boshoff line in the north and the Modderrivier to Krugersdrift line in the south.

A few ridges that are usually associated with archaeological remains such as engraving have also been demarcated in the southern section of both alignments.

Additional fieldwork was conducted in August 2016 to assess some of these areas as part of the HIA update. **Table 44** indicates the areas surveyed and the findings.

Table 44 - Surveyed sensitive areas

Area	Survey status	Findings
Kimberley historic cemetery	Surveyed in August 2016	Historic Jewish cemetery identified and discussed in this report as **Kal1** and **Kal 2**. (Section 6.2)
Possible Boer Siege fortifications	Additional areas not previously surveyed were assessed.	No fortifications found.
Blockhouse line on Modder Rivier	Was assed during original survey.	No fortifications found.
Blockhouse line Kimberley to Boshoff	Assessed and surveyed during August 2016.	No fortifications found.

3.5.4 Fieldwork Findings

Fieldwork was carried out by an archaeologist who drove and walked along the proposed corridors to locate heritage resources and to identify other likely places where heritage resources might be found. Surveys were carried out along the length of all three corridors. The area is rich in historical and archaeological sites that occur within and around the proposed powerline route corridors (e.g. **Figure 24** and **Figure 25**).

Figure 24. Drawer full of Early and Middle Stone Age stone artefacts collected on the farm Rooifontein No 211 (Ptn 1) over the years by Mr J. Reichert and family

Figure 25. Eroded area on Chavonne No 364 that has a large scatter of Middle Stone Age artefacts. The area is just outside the 500 m wide Corridor 1 Jacobsdal Link

3.5.4.1 Site Kal1 and Kal2

GPS: S 28° 45' 23.5" E 24° 48' 18.1" – Kal1

GPS: S 28° 45' 18.4" E 24° 48' 20.3"" – Kal1

The site was accessed with the help of security of the De Beers mining company. The resource consists of the remains of the historic Jewish cemetery dating from the late 1800s to early 1900s. The cemetery is about 6 hectares in size. It is no longer in use and not maintained.

A small ruin that was most probably a small chapel or sinagoge is also present on the site. The site does have a berm around the southern and western sections.

Figure 26. General view of the cemetery

Figure 27. General view of the cemetery

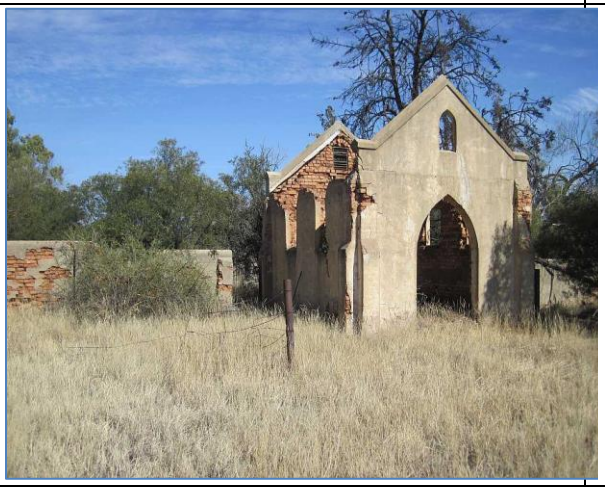


Figure 28. View of chapel ruin	

The site is rated as Grade 3A (Conservation; Mitigation not advised) the site is associated with the history of Kimberley and will have a strong link to some prominent figure of the diamond rush era. A distance of at least 50 m should be maintained from any development associated with the project.

Mitigation:

- Development should be limited to 50 m from the graveyard.

The following sites were recorded during the survey (refer to Error! Reference source not found. for map). They occur mainly in the Corridor 2 Alternative 1 corridor north and south of the Modder River.

3.5.4.2 Site BEZ 001

GPS: S 29° 00' 49.6" E 24° 54' 25.2"

This is a graveyard on Bezuidenhoutskraal No 53 on the northern bank of the Modder River. There are currently eight graves, including a single fenced grave with headstone. The rest currently have no headstones, but are decorated with mugs that perhaps were used as vases filled with flowers to place on the grave. The graveyard is still in use.

The site is rated as Grade 3A (Conservation; Mitigation not advised) because the graveyard is still in use. A distance of at least 20 m should be maintained from any development associated with the project.

Mitigation:
Mitigation is not advised. Development should be limited to 20 m from the graveyard.

Figure 29. Site BEZ 001 is a graveyard that is still in use. It is recommended that any development within 20 m of the graveyard be avoided

3.5.4.3 Site BEZ 002

GPS: S 29° 00' 49.0" E 24° 54' 25.7"

This is a second graveyard on Bezuidenhoutskraal No 53. It is about five meters east of BEZ 001; it is neglected and overgrown and it was not possible to determine how many graves are located here (but there at least six burials).

The site is rated as Grade 4A (high/medium significance). Mitigation would therefore be required if the powerlines or associated structures or roads to encroach upon the graveyard.

Mitigation:
The process of grave relocation—negotiations with relatives, notifications, permits, identification of an acceptable alternative site for reburial, exhumation and reburial-- would need to be followed.

Figure 30. Site BEZ 002 is a neglected graveyard, probably no longer in use

3.5.4.4 Site KLP 001

GPS: S 29° 02' 49.4" E 24° 53' 42.9"

This is a graveyard of about 400 square metres in area on Klipdrift no 20 Rem. It is very neglected and overgrown by trees. There are at least five burials with headstones. Three of the burials date to the early 20th century (1907, 1908, 1930). There is also at least one burial without a headstone, marked with packed stones.

The site is rated as Grade 4A (high/medium significance). Mitigation would therefore be required if the powerlines or associated structures or roads to encroach upon the graveyard.

Mitigation:
The process of grave relocation—negotiations with relatives, notifications, permits, identification of an acceptable alternative site for reburial, exhumation and reburial—would need to be followed.

Figure 31. Overgrown graveyard (Site KLP 001)

3.5.4.5 Site KLP 002

GPS: S 29° 02' 52.1" E 24° 53' 27.6"

This is a graveyard that currently comprises about 14 graves in area of 0,168 ha. The graveyard is still in use.

The site is rated as Grade 3A (Conservation; Mitigation not advised) because it is still in use.

Mitigation:
Mitigation is not advised, development should be limited to 20 m from the graveyard.

Figure 32. Graveyard that is still in use (Site KLP 002). It is recommended that the graveyard be conserved and that no development take place closer than 20 m to the site

3.5.4.6 Site KLP 003

GPS: S 29° 03' 02.1" E 24° 53' 51.2"

These are the remains of a kraal built of stone, about 5 m by 3 m, on Klipdrift No 20 Rem. The walls are no longer standing.

The site is rated as Grade 4C (medium significance).

Mitigation:
The site should be recorded before destruction.

Figure 33. The remains of a kraal built of stone (Site KLP 003)

3.5.4.7 Site KLP 004

GPS: S 29° 03' 02.0" E 24° 53' 52.4"

These are the remains of a kraal built of stone, about 5 m by 3 m, on Klipdrift No 20 Rem. The walls are no longer standing.

The site is rated as Grade 4C (medium significance).

Mitigation:
The site should be recorded before destruction.

Figure 34. Remains of a kraal (Site KLP 004)

3.5.4.8 Site KLP 005

GPS: S 29° 03' 02.1" E 24° 53' 51.4"

These are the remains of a walled building about 2 m by 2 m on Klipdrift No 20 Rem. Only the foundations remain.

The site is rated as Grade 4C (medium significance).

Mitigation:
The site should be recorded before destruction.

Figure 35. Remains of walled structure broken down to its foundations (KLP 005)

3.5.4.9 Site KLP 006

GPS: S 29° 03' 01.0" E 24° 53' 54.4"

Remains of an old disused rubbish heap, now flattened, on Klipdrift No 20 Rem.

The site is rated as Grade 4B (medium significance).

Mitigation:
The site should be recorded before destruction.

Figure 36. Possible ceiling fixture found on ash heap on Rem of Klipdrift No 20 (KLP 006)

3.5.4.10 Site KLP 007

GPS: S 29° 02' 49.2" E 24° 54' 02.3"

Heavily patinated pecked engraving of unidentified motif on dolerite boulder on Klipdrift No 20 Rem. There is also some heavily patinated scratching over a portion of the pecked engraving.

The site is rated as Grade 3A (high/medium significance). Mitigation is not advised,

Mitigation:
Mitigation not advised. Development should be limited to 20 m from the engraved boulder.

Figure 37. Engraved dolerite boulder (Site KLP 007)

3.5.4.11 Site KLP 008

GPS: S 29° 02' 50.1" E 24° 54' 02.4"

A flat area about 9 by 10 m built against a small hill covered with dolerite boulders and enclosed by two rows of large dolerite boulders that meet at right angles. These are identified as the remains of kraal walls.

The site is rated as Grade 4B (medium significance).

Mitigation:
It is advised that the alignment of the OHL be kept at least 50 meters away from this site. If not possible the following mitigation will be required:
The site should be recorded before destruction.

Figure 38. Outline of a rectangular kraal structure (KLP 008)

3.5.4.12 Site KLP 009

GPS: S 29° 02' 50.1" E 24° 54' 02.4"

A circular area on top of a low rise; the area is about 5 m wide that has been cleared of most of the boulders in order to create an enclosure.

The site is rated as Grade 4B (medium significance).

Mitigation:
It is advised that the alignment of the OHL be kept at least 50 meters away from this site. If not possible the following mitigation will be required:
The site should be recorded before destruction.

Figure 39 – Circular enclosure on low rise (KLP 009)

3.5.4.13 Site KLP 010

GPS: S 29° 03' 54.7" E 24° 55' 36.4"

Rectangular structure on Klipdrift No 20 Ptn 1 with internal dividing wall in the middle, constructed using roughly dressed locally occurring white stone blocks. The structure may be the remains of two kraals dating to the nineteenth century. It is within about 10 m of the ruins of farmhouse built of the same material. The kraals are probably part of a 19th century homestead

The site is rated as Grade 4A (high/medium significance, mitigation required).

Mitigation:
It is advised that the alignment of the OHL be kept at least 50 meters away from this site. If not possible the following mitigation will be required:
Research needs to be done into the historical significance of the kraals and the other structures that comprise the homestead.
The homestead should be mapped, laser-scanned and photographed. The documentation should be archived where it is accessible to the public.

Figure 40. Possible kraals built of locally sourced, roughly dressed stone (KLP 010)

3.5.4.14 Site KLP 011

GPS: S 29° 03' 53.6" E 24° 55' 33.9"

Circular arrangement of roughly dressed white stones about 1 m in diameter on Klipdrift No 20 Ptn 1. The structure is part of a cluster of structures that probably comprise a 19th century homestead.

The structure is rated 4A (high/medium significance, mitigation required).

Mitigation:
It is advised that the alignment of the OHL be kept at least 50 meters away from this site. If not possible the following mitigation will be required:
Research needs to be done into the historical significance of this circular structure and the other structures that comprise the homestead.
The homestead should be mapped, laser-scanned and photographed. The documentation should be archived where it is accessible to the public.

Figure 41. Circular structure of stones (KLP 011)

3.5.4.15 Site KLP 012

GPS: S 29° 03' 54.4" E 24° 55' 33.4"

Ruin of a house on Klipdrift No 20 Ptn 1. The house is in ruins but the layout is still visible and some of the walls are still standing. The house probably dates from the nineteenth century and is associated with a possible kraal (KLP 010), a circular structure (KLP 011) and a spring that has been dug open (KLP 013).

The structure is rated 4A (high/medium significance, mitigation required).

Mitigation:
It is advised that the alignment of the OHL be kept at least 50 meters away from this site. If not possible the following mitigation will be required:
Research needs to be done into the historical significance of this house and the other structures that comprise the homestead.
The homestead should be mapped, laser-scanned and photographed. The documentation should be archived where it is accessible to the public.

Figure 42. Ruined house possibly 19th century, built of local stone (KLP 012)

3.5.4.16 Site KLP 013

GPS: S 29° 04' 08.9" E 24° 55' 31.5"

A spring that has been dug open so that the water is accessible (Klipdrift No 20 Ptn 1).

The structure is rated 4A (high/medium significance, mitigation required).

Mitigation:
It is advised that the alignment of the OHL be kept at least 50 meters away from this site. If not possible the following mitigation will be required:
Research needs to be done into the historical significance of this house and the other structures that comprise the homestead.
The homestead should be mapped, laser-scanned and photographed. The documentation should be archived where it is accessible to the public.

Figure 43. Spring that has been dug open (KLP 013). It is probably part of the nearby homestead (KLP 010-012)

3.5.4.17 Site JDX 001

GPS: S 28° 58' 50.8" E 24° 53' 59.6"

Graves on Judex No 240, in the Beeskamp on top of a hill. One grave that is bordered with cement bricks contains two burials according to the headstones (Maria and Waylit Mokweni died 1997 and 1987 respectively). There is at least one other grave, without a headstone, to the right.

The site is rated as Grade 4A (high/medium significance). Mitigation would therefore be required if the powerlines or associated structures or roads encroach closer than 20 m upon the graveyard.

Mitigation:
It is advised that the alignment of the OHL be kept at least 50 meters away from this site. If not possible the following mitigation will be required:
The process of grave relocation—negotiations with relatives, notifications, permits, identification of an acceptable alternative site for reburial, exhumation and reburial-- would need to be followed.

Figure 44. Graves on Judex No 240 (JDX 001)

3.5.4.18 Site JDX 002

GPS: S 28° 58' 51.2" E 24° 53' 54.9"

Circular enclosures made on the northern side of a hill by clearing away boulders and leaving behind a ring of boulders. May have been used as a camp and/or a small kraal.

The site is rated as Grade 4B (medium significance).

Mitigation:
It is advised that the alignment of the OHL be kept at least 50 meters away from this site. If not possible the following mitigation will be required:
The site should be recorded before destruction.

Figure 45. Circular enclosure of dolerite hilltop (JDX 002)

3.5.4.19 Site JDX 003

GPS: S 28° 58' 51.2" E 24° 53' 54.9"

Two scraped engravings on a rock; at right is an ostrich, at left an unidentified animal with four legs (perhaps an elephant. On the farm Judex No 240, in the Beeskamp.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

Figure 46. Two scraped engravings: an ostrich at right. Unknown animal at left (JDX 003)

3.5.4.20 Site JDX 004

GPS: S 28° 58' 52.2" E 24° 53' 54.5"

An engraved dolerite boulder with at least five circular motifs about 50 mm in diameter towards the top of the rock and a pecked right-facing four-legged animal with horns lower down on the rock. In the Beeskamp on Judex No 240.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

Figure 47. Engraved dolerite boulder with at least five circular motifs and a pecked right-facing four-legged animal with horns (JDX 004)

3.5.4.21 Site JDX 005

GPS: S 28° 59' 15.7" E 24° 53' 17.0"
Scraped engraving of a right-facing eland on dolerite boulder on a small hill overlooking a pan in the Boskamp on Judex No 240.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

Figure 48. Scraped engraving of a right-facing eland (JDX 005)

3.5.4.22 Site JDX 006

GPS: S 28° 59' 13.1" E 24° 53' 16.3"

Engraved boulder on the same small hill in the Boskamp as JDX 005, on Judex No 240. On one side of the boulder there is a patinated scraped engraving of a left-facing, small and slender species of antelope with a pair of short wavy horns. On top of the boulder is a much more noticeable scraped image of a left-facing four-legged animal, perhaps an antelope, but with curious and unrealistically splayed hooves.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

Figure 49. Engraving of a possible antelope with curious and unrealistically splayed hooves (JDX 006)

3.5.4.23 Site JDX 007

GPS: S 28° 59' 13.1" E 24° 53' 16.4"

Scraped engraving of left-facing rhinoceros (perhaps a black rhino) and two anthropomorphic figures on the same small hill in the Boskamp on Judex No 240 as JDX 005 and 006.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

Figure 50. Engraving of a rhinoceros (JDX 007)

3.5.4.24 Site JDX 008

GPS: S 28° 59' 13.2" E 24° 53' 16.6"

Scraped engraving of an anthropomorph on a dolerite boulder on the same small hill in the Boskamp on Judex No 240 as JDX 005, 006 and 007.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

Figure 51. Scraped engraving of dancing anthropomorph (JDX 008)

3.5.4.25 Site JDX 009

GPS: S 28° 59' 12.9" E 24° 53' 16.3"

Pecked engraving of an elliptical outline with a short straight line on either end; on the same small hill in the Boskamp on Judex No 240 as JDX 006, 007, and 008.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

Figure 52. Engraving of an elliptical shape with two short, straight lines at either end (JDX 009)

3.5.4.26 Site JDX 010

GPS: S 28° 59' 13."2 E 24° 53' 16.6"

Scraped engraving of anthropomorph on dolerite boulder on the same hill in the Boskamp on Judex No 240 as JDX 006, 007, 008, and 009.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

3.5.4.27 Site JDX 011

GPS: S 28° 58' 59.1" E 24° 53' 38.3"

Scraped engraving of a left-facing eland on a dolerite boulder on a small hill in the Boskamp.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

Figure 53. Engraving of an eland (JDX 011)

3.5.4.28 Site JDX 012

GPS: S 28° 58' 59.0" E 24° 53' 38.5"

Scraped engraving of a right-facing eland on a dolerite boulder on a small hill in the Boskamp on Judex No 240. This engraving is three metres east of JDX 012, also an eland engraving.

The engraved boulder is rated as Grade 3A (high significance, mitigation not advised).

Mitigation:
Mitigation not advised. Development should be restricted to 20 m from the engraved boulder.

Figure 54. Engraving of an eland (JDX 012)

3.5.5 Heritage and Palaeontology Impact Assessment

Altogether, 27 heritage resources were identified along Corridor 2 Alternative 1. These comprise graves, historical ruins (houses, kraals and associated infrastructure), archaeological resources (artefacts and rock art). It is therefore inevitable that more heritage resources will be found within the corridors. It is recommended that graveyards still in use and all the hilltops with rock art are should be avoided; a 20 m limit on development around these sites should be observed. Other structures require documentation before destruction can be permitted. Currently, the corridor most impacted by the presence of heritage resources in those parts of Corridor 2 Alternative 1 north and south of the Modder River.

It must be kept in mind that the fieldwork could in no way identify all archaeological sites within the development footprint and as such the fieldwork has shown that the possibility of encountering other Stone Age archaeological sites (including rock engravings on hilltops), historical structures and graves is extremely high. If development can stay 20 m away from graveyards that are currently in use and avoid crossing hilltops where engravings are concentrated impact of development will be considerably decreased.

The following set of tables (**Table 45** to **Table 48**) provide an assessment of the impact on heritage resources within the development foot print

Table 45. Rating of impacts – chance finds

IMPACT TABLE		
Environmental Parameter	*Heritage Resources*	
Issue/Impact/Environmental Effect/Nature	*The possibility of encountering previously unidentified heritage resources. As well as the impact on the identified archaeological sites*	
Extent	*Will impact on the footprint area of the development*	
Probability	*The fieldwork has shown that such a predicted impact will definitely occur*	
Reversibility	*Due to the nature of archaeological sites the impact is seen as irreversible, however mitigation could enable the collection of enough information to preserve the data from such a site*	
Irreplaceable loss of resources	*The development could lead to significant losses in unidentified and unmitigated site*	
Duration	*The impact on heritage resources such as archaeological sites will be permanent*	
Cumulative effect	*As the type of development impact on a large area, and other similar development in the area will also impact on archaeological sites the cumulative impact is seen as having a medium negative impact.*	
Intensity/magnitude	*The large scale impact on archaeological sites and will require mitigation work.*	
Significance Rating	*The overall significance rating for the impact on heritage resources is seen as high pre-mitigation. This can be attributed to the very definite possibility of encountering more archaeological sites as shown through fieldwork. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a low impact rating.*	
	Pre-mitigation impact rating	Post mitigation impact rating

Extent	1	1
Probability	2	1
Reversibility	4	2
Irreplaceable loss	4	2
Duration	3	1
Cumulative effect	3	1
Intensity/magnitude	4	1
Significance rating	-68 (negative High Impact)	-8 (low negative)
Mitigation measures	*Training of ECO by archaeologist - 2 days* *Induction of all contractor staff by Archaeologist - 1-2 days* *Implementation of chance find procedure when something is identified by the ECO* *Mitigation through archaeological excavations and collection*	

Table 46. Rating of Impacts – Rock Engravings

IMPACT TABLE	
Environmental Parameter	*Heritage Resources*
Issue/Impact/Environmental Effect/Nature	*The possibility of encountering previously unidentified engravings. As well as the impact on the identified engraving sites*
Extent	*Will impact on the footprint area of the development*
Probability	*The fieldwork has shown that such a predicted impact will definitely occur*
Reversibility	*Due to the nature of engraving sites the impact is seen as irreversible, however mitigation could enable the collection of enough information to preserve the data from such a site*
Irreplaceable loss of resources	*The development could lead to significant losses in unidentified and unmitigated site*
Duration	*The impact on heritage resources such as archaeological sites will be permanent*
Cumulative effect	*As the type of development impact on a large area, and other similar development in the area will also impact on engraving sites the cumulative impact is seen as having a medium negative impact.*

Intensity/magnitude	*The large scale impact on engraving sites and will require mitigation work.*	
Significance Rating	*The overall significance rating for the impact on heritage resources is seen as high pre-mitigation. This can be attributed to the very definite possibility of encountering more archaeological sites as shown through fieldwork. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a low impact rating.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	4	2
Irreplaceable loss	4	2
Duration	3	1
Cumulative effect	3	1
Intensity/magnitude	4	1
Significance rating	-68 (negative High Impact)	-8 (low negative)
Mitigation measures	*Training of ECO by archaeologist - 2 days* *Induction of all contractor staff by Archaeologist - 1-2 days* *Implementation of chance find procedure when something is identified by the ECO.* *Mitigation through archaeological excavations and collection*	

Table 47. Rating of Impacts – cemeteries and graves

IMPACT TABLE	
Environmental Parameter	*Heritage Resources*
Issue/Impact/Environmental Effect/Nature	*The possibility of encountering previously unidentified graves and cemeteries. As well as the impact on the identified archaeological sites*
Extent	*Will impact on the footprint area of the development*

Probability	*The fieldwork has shown that such a predicted impact will definitely occur*	
Reversibility	*Due to the nature of graves and cemeteries the impact is seen as irreversible, however mitigation could enable the collection of enough information to preserve the data from such a site*	
Irreplaceable loss of resources	*The development could lead to significant losses in unidentified and unmitigated site*	
Duration	*The impact on heritage resources such as graves and cemeteries will be permanent*	
Cumulative effect	*As the type of development impact on a large area, and other similar development in the area will also impact on archaeological sites the cumulative impact is seen as having a medium negative impact.*	
Intensity/magnitude	*The large scale impact on graves and cemeteries and will require mitigation work.*	
Significance Rating	*The overall significance rating for the impact on heritage resources is seen as high pre-mitigation. This can be attributed to the very definite possibility of encountering more graves and cemeteries as shown through fieldwork. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a low impact rating.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	4	2
Irreplaceable loss	4	2
Duration	3	1
Cumulative effect	3	1
Intensity/magnitude	4	1
Significance rating	-68 (negative High Impact)	-8 (low negative)
Mitigation measures	*Training of ECO by archaeologist - 2 days* *Induction of all contractor staff by Archaeologist - 1-2 days*	

	Implementation of chance find procedure when something is identified by the ECO. *Walk-down of final power line route*

Table 48. Rating of Impacts – Palaeontology

IMPACT TABLE	
Environmental Parameter	*Impact on the Palaeontology Heritage (fossils) of the development footprint*
Issue/Impact/Environmental Effect/Nature	*The excavations and site clearance during the construction phase will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb, damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific research.* *This impact is likely to occur only during the construction phase. No impacts are expected to occur during the operation phase.*
Extent	*Corridor 1: Kalkaar CSP to Jacobsdal Substation (approximately 20km in length);* *Corridor 2 Alternative 1: Kalkaar CSP via Kimberley Distribution Substation to Boundary Substation (approximately 62km in length); and* *Corridor 2 Alternative 2: Kalkaar CSP via Kimberley Distribution Substation to Boundary Substation (approximately 62km in length*
Probability	*During the site visit to the development area no fossils were detected. Although the sensitivity of the Formations a considered to be high to very high. The probability of significant impacts on palaeontological heritage during the construction phase is low.*
Reversibility	*Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would represent a positive impact from a scientific perspective. The possibility*

	of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category	
Irreplaceable loss of resources	*Stratigraphic and geographical distribution of fossils within the relevant formations (see findings) has been documented in the literature. During a field assessment fossils were not detected on the development footprint, but the possibility that these fossils actually could occur is a possibility (windblown aeolian deposits). By taking a precautionary approach, a significant loss of fossil resources is expected.*	
Duration	*The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent*	
Cumulative effect	*Low Cumulative Impact* *The cumulative effect of the development area within the proposed location is considered to be low*	
Intensity/magnitude	*Probable significant impacts on palaeontological heritage during the construction phase are high, but the intensity of the impact on fossil heritage is rated as low*	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	4	1
Cumulative effect	2	1
Intensity/magnitude	2	1

Significance rating	-20 (low negative)	-6 (low negative)
Mitigation measures	*Recommended mitigation of the inevitable damage and destruction of fossil within the proposed development area would involve the surveying, recording, description and collecting of fossils within the development footprint by a professional palaeontologist. This work should take place after initial vegetation clearance has taken place but before the ground is levelled for construction* *Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would represent a positive impact from a scientific perspective. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures. If damage mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category.* *Not deemed necessary unless fossils are uncovered during the construction phase.*	

The overall impact evaluation has shown that the pre-mitigation impact on heritage resources is rated as High negative, however the implementation of the recommended mitigation measures will reduce this impact to a low negative impact.

3.6 Visual Impacts

A Visual Impact Assessment (VIA) was conducted by Stephan Jacobs and Andrea Gibb from SiVEST and is included in **Appendix D6**. A summary of the main findings of the assessment are outlined below.

The physical and land use related characteristics are outlined below as they are important factors contributing to the visibility of a development and visual character of the study area. Defining the visual character is an important part of assessing visual impacts as it establishes the visual baseline

or existing visual environment in which the development would be constructed. The visual impact of a development is measured according to this visual baseline by establishing the degree to which the development would contrast or conform with the visual character of the surrounding area.

3.6.1 Physical and Land Use Characteristics

3.6.1.1 Topography

The nature of the topography is a strong factor influencing the types of vistas typically present in an area. The topography in the study area is mainly characterised by a mix of relatively flat plains with gentle undulations. Greater relief is also present in the form of high mountains and koppies/hills. Mountains and hills with steep slopes can be found outside the study area in areas to the north-east, north-west and south-east of. A lower lying valley dominates in areas surrounding the Modder River (**Figure 55**).

A representation of the typical views from within the study area has been provided in **Figure 56** below.

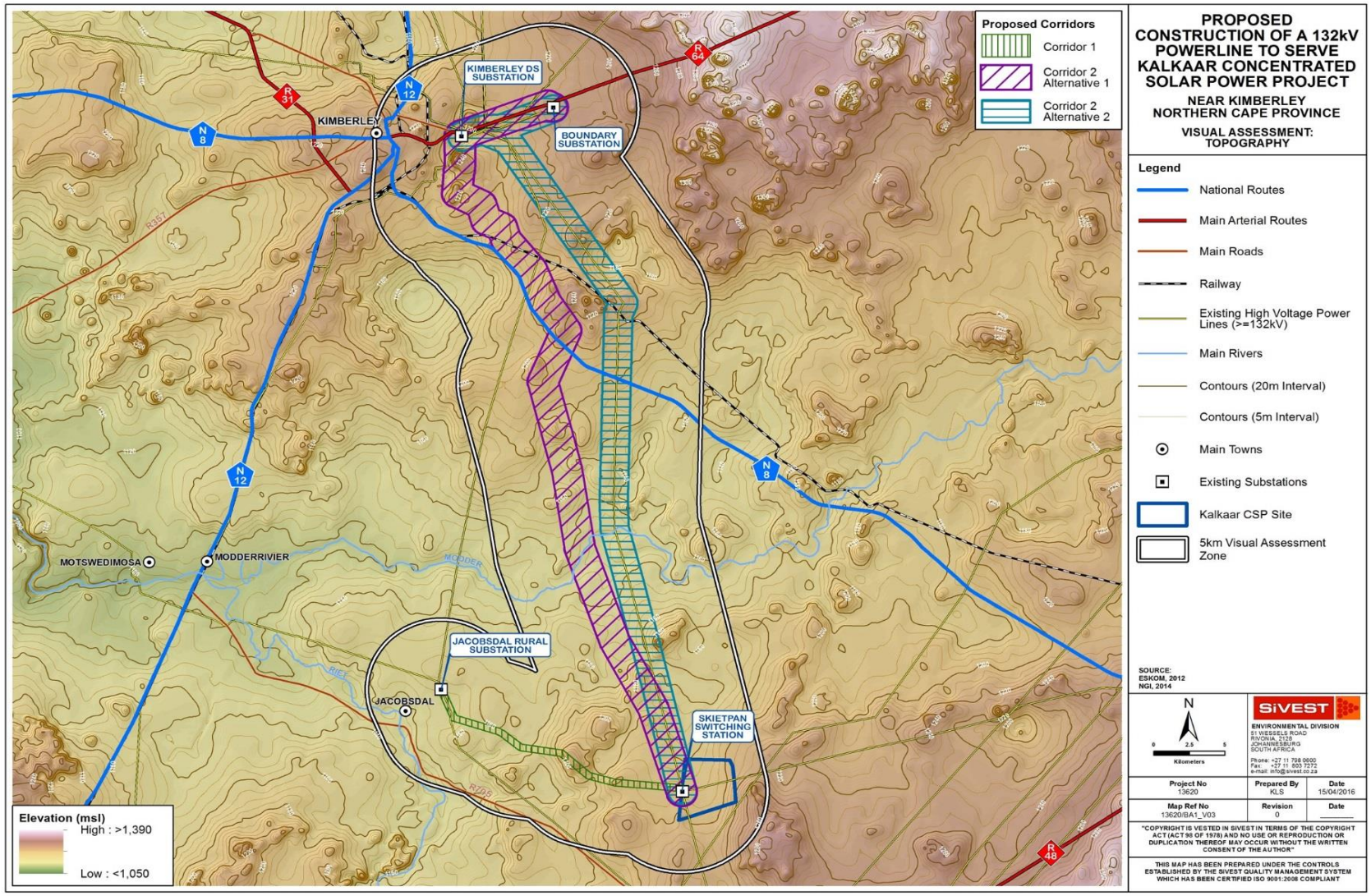


Figure 55. Map showing the topography within the study area

Figure 56. View from within the study area showing the typically flat to gently undulating character of the landscape

Visual Implications

The predominantly flat to gently undulating nature of the topography is a strong factor influencing the types of vistas typically present. The proposed development is expected to be visible from most parts of the study area, however rising ground will partially block views and limit viewsheds, Views toward the proposed development will also be directly affected by the position of the viewer within the landscape. Wider vistas will typically be experienced from higher-lying areas or hilltops, whereas views will be constrained if the viewer is located in the lower lying valley along the Modder River. It should however be noted that where mountains and hills/koppies/ridges are located between the viewer and the proposed development, the visibility would be restricted from areas where there is no direct line of sight. The proposed power line would however still be visible from higher locations. The visibility of the proposed power line and associated infrastructure is also dependent on the prevailing land use and land cover, which is discussed in more detail below.

3.6.1.2 Land use and land cover

The land use in the study area is characterised by mainly natural or undeveloped areas, which are partially used as grazing land for livestock. The main urban/ built-up/residential areas include the city of Kimberley located in the north-western reaches of the study area and the town of Jacobsdal which is found south-western corner of the study area. In addition, high levels of mining activities can be found near the town of Kimberley in the north-west of the study area. An urban small holdings area can also be found in the north of the study area, near the town of Kimberley. Commercial cultivation is concentrated along the Modder River in the south of the study area as well as in areas near the town of Jacobsdal in the south and south-west of the study area respectively. In the central and southern parts of the study area, natural intact vegetation also prevails and limited transformation / urban development is present in this area (**Figure 58**). It should be noted that an industrial development is present in the south of the study area, near the Modder River, in the form of the Pulida Solar energy facility which is currently under construction (**Figure 59**).

A map indicating the land use within the study area is provided in **Figure 57** below.

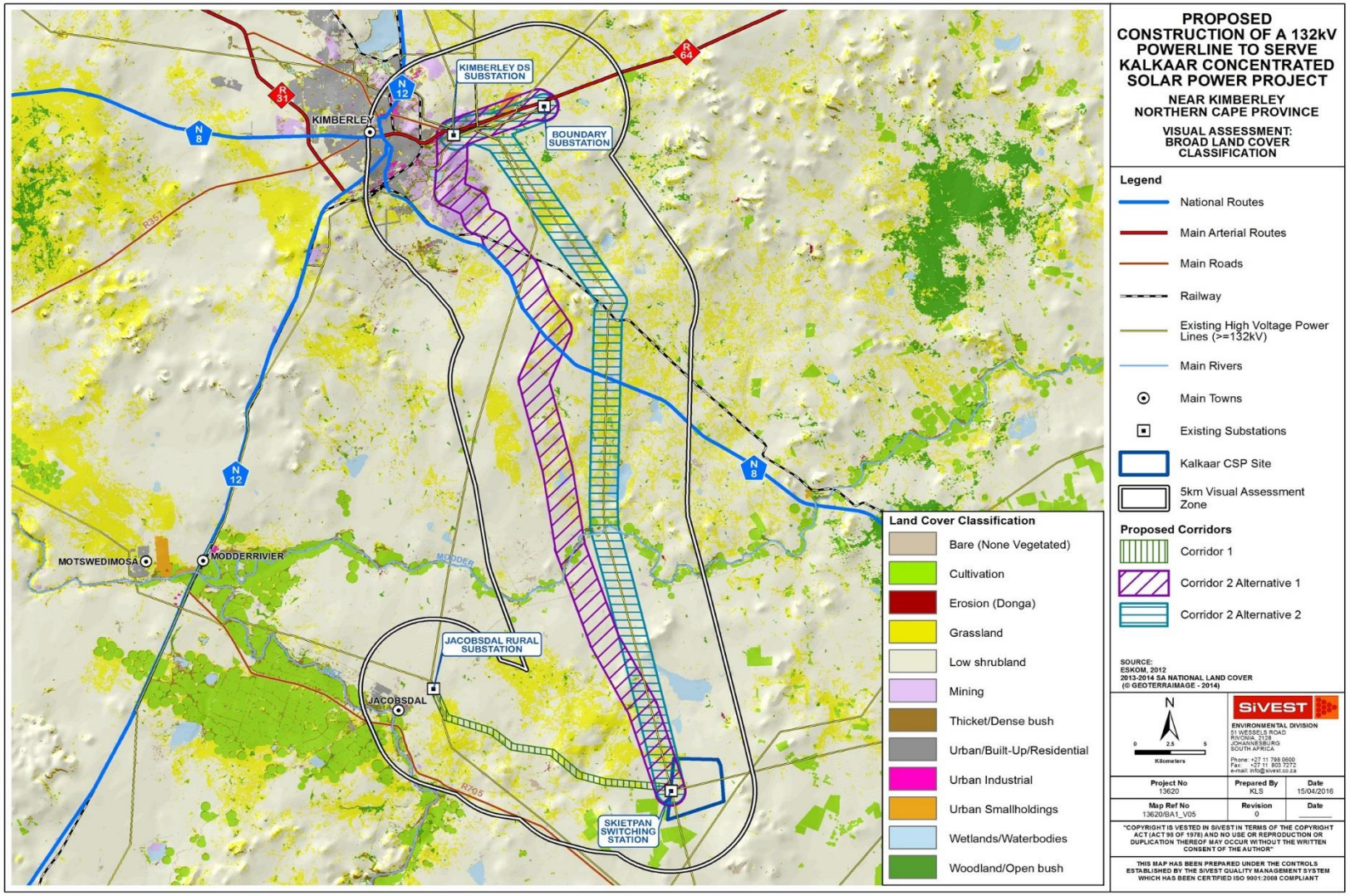


Figure 57. Map showing the land use within the study area

Figure 58. View from one of the central parts of the study area showing the prevailing natural intact vegetation and limited transformation / urban development present

Figure 59: View of the Pulida Solar energy facility which is currently under construction near the Modder River in the south of the study area

Dominant anthropogenic elements within the study area include; the N8 and N12 national roads, the R64 provincial road, the R705 regional road, a railway line traversing the study area in a north-west south-east alignment, several isolated farmsteads, several existing high voltage electrical power lines, a solar energy facility which is under construction (Pulida Solar energy facility), several existing Eskom Substations, telecommunication lines, guest houses, lodges, resorts, tourism facilities and a network of gravel access roads.

The Benfontein Nature Reserve is located directly east of the provincial boundary between the Free State and Northern Cape Provinces in the northern part of the study area. This reserve contributes to the natural visual character within this area as the prevailing natural intact Thornveld vegetation is conserved within it.

According to **Mucina and Rutherford (2006)**, the study area falls within the Nama-Karoo and Savannah biomes. In addition, the Modder River and other smaller parts of the study area are characterised by the Inland Azonal Vegetation biome. Several vegetation units can be found within

the study area, namely the Northern Upper Karoo, Upper Gariep Alluvial Vegetation, Highveld Salt Pans, Kimberley Thornveld and Vaalbos Rocky Shrubland. It should be noted that the northern and central parts of the study area are dominated by the Kimberley Thornveld vegetation unit with patches of Highveld Salt Pans and Vaalbos Rocky Shrubland being found on higher lying terrain. The southern part of the study area is however dominated by the Northern Upper Karoo vegetation unit with patches of the Highveld Salt Pans and Vaalbos Rocky Srubland vegetation units also prevailing on higher lying terrain. As previously mentioned, the Modder River is dominated by Inland Azonal Vegetation, more specifically the Upper Gariep Alluvial Vegetation vegetation unit.

The description of Vegetation and Landscape Features as contained in Mucina and Rutherford (2006) are provided below for the above-mentioned vegetation units.

- **Northern Upper Karoo**

The vegetation and landscape features of the Northern Upper Karoo vegetation unit are characterised by shrubland dominated by dwarf Karoo shrubs, grasses and some other low trees. The terrain is typically flat to gently sloping, with isolated hills and many interspersed pans.

- **Upper Gariep Alluvial Vegetation**

The vegetation and landscape features of this vegetation unit are characterised by flat alluvial terraces supporting a complex of riparian thickets (gallery forests), flooded grasslands, reed beds and ephemeral herblands populating mainly sand banks within the river and on its banks.

- **Highveld Salt Pans**

The vegetation and landscape features of the Highveld Salt Pans vegetation unit are characterised by depressions in the plateau landscape containing temporary (and less frequently also permanent) water bodies. Central parts of the pans are often seasonally inundated and sometimes with floating macrophyte vegetation or the vegetation cover develops on drained bottoms of the pans and forms typical concentric zonation patterns. On the pan edges, open to sparse grassy dwarf shrubland may develop, especially when the pan is under heavy grazing pressure.

- **Kimberley Thornveld**

The vegetation and landscape features of this vegetation unit are characterised by plains which are often slightly irregular with a well-developed tree layer and a well-developed shrub layer. The grass layer is open with much uncovered soil.

- **Vaalbos Rocky Shrubland**

The vegetation and landscape features are characterised by slopes and elevated hills and ridges within plains of mainly the Kimberley Thornveld vegetation unit, also in the vicinity of the Northern Upper Karoo vegetation unit. Evergreen shrub communities prevail and sheltered cool sites include trees. On the foot slopes of the dolerite hills, where calcrete-rich soils occur, shrubs and small trees can be dominant.

A map indicating the vegetation types found within the study area is provided in **Figure 60** below.

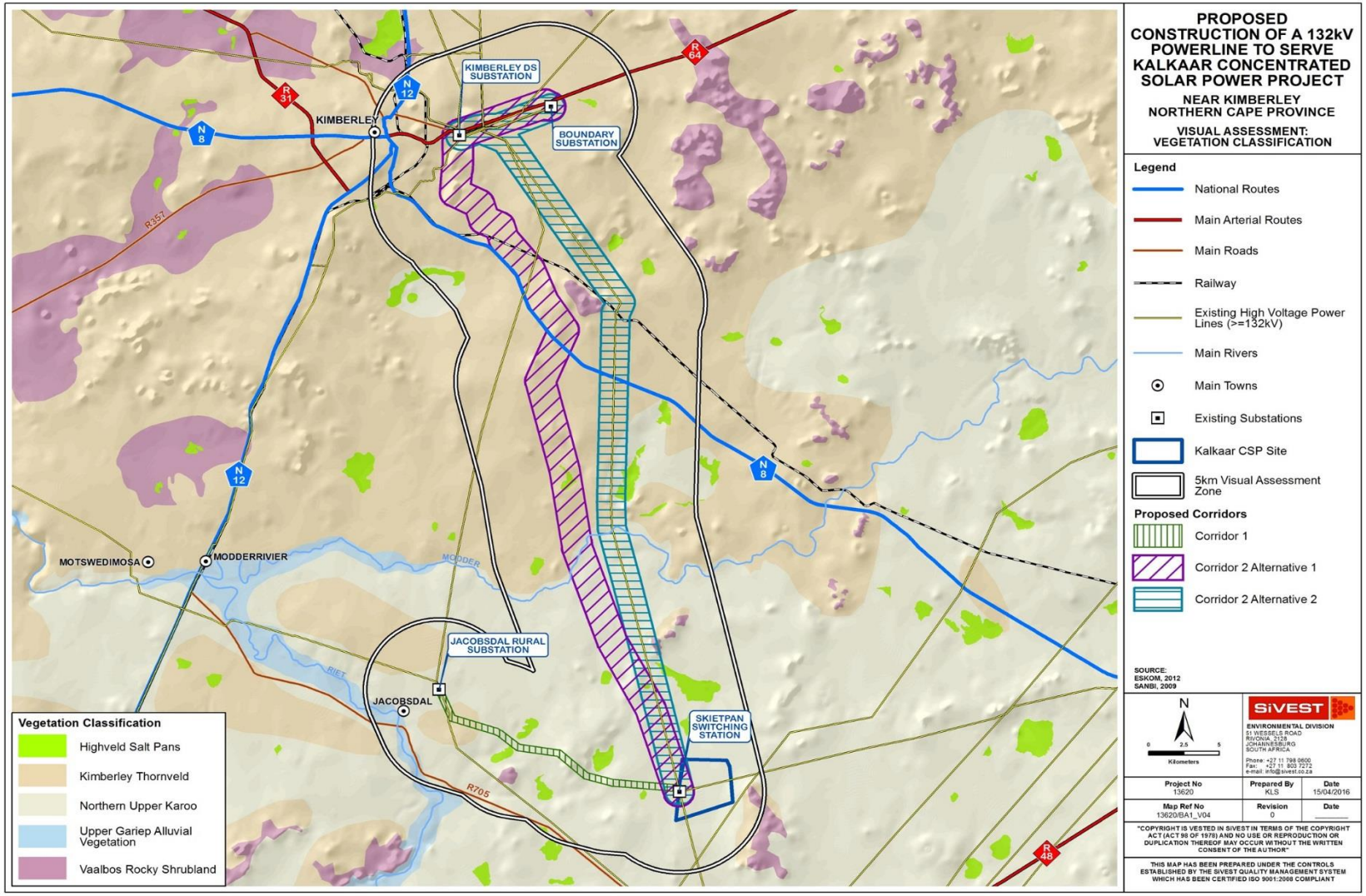


Figure 60. Map showing the vegetation types within the study area

As mentioned above, much of the study area is characterised by natural unimproved vegetation, which is partially used as grazing land for cattle and other livestock (**Figure 61**). Only in areas where commercial cultivation and urban development prevails has the natural vegetation been removed or altered (**Figure 70**). Human impact on the natural vegetation is also evident in the form of some tall exotic trees, particularly occurring in clusters surrounding farmsteads (**Figure 62**).

Built form, in areas where livestock rearing and cultivation occurs, is limited to isolated farmsteads, gravel access roads, ancillary farm buildings, telephone lines, windmills, fences and the remnants of old workers' dwellings.

Figure 61. Typical vegetation cover found within majority of the study area

Figure 62. Example of tall trees that have been established around a farmhouse

Visual Implications

The prevailing natural vegetation would offer some visual screening. In areas where the low shrub layer and open areas of cultivated fields / grasslands prevail there would be wide-open vistas across the study area. In the northern parts of the study area near Kimberley a significant amount of relatively tall trees and shrubs are present (**Figure 63**), as well as in areas along the Modder River. In these areas the vegetation would provide sufficient visual screening to restrict views of the proposed power line. In addition, in areas around farmsteads and/or dwellings where exotic trees have been established the vegetation is also expected to provide sufficient visual screening to restrict views of the proposed development. Despite the presence of natural intact vegetation within majority of the study area, existing electrical infrastructure, mining activities and other human transformation as a result of the urban development in Kimberley and Jacobsdal have altered the visual character in the area, thus influencing the degree to which the development would contrast with the surrounding environment. The relatively low density of human habitation, presence of pastoral elements and natural vegetation cover across the southern and central portions of the study area would give the viewer the general impression of a largely natural rural setting. In the

northern and western partsof the study area, specifically near Kimberley and Jacbosdal, human transformation and urban development are more evident, and thus the visual character in these areas is typical of a built-up urban environment. Once constructed the Pulida Solar energy facility would be a prominent industrial element that is visible from most areas within the southern parts of the study area and which will reduce the degree to which the power line will contrast with the surrounding environment.

The influence of the level of human transformation on the visual character of the area is described in more detail below.

Figure 63: View from the northern part of the study area near Kimberley where the presence of relatively tall trees and shrubs are expected to provide sufficient visual screening to restrict views of the proposed power line

3.6.2 Visual Character

Visual character can be defined based on the level of change or transformation from a completely natural setting, which would represent a natural baseline in which there is little evidence of human transformation of the landscape. Varying degrees of human transformation of a landscape would engender differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being at the opposite end of the scale to a largely natural undisturbed landscape. Visual character is also influenced by the presence of built infrastructure such as buildings, roads and other objects such as electrical infrastructure.

As stated above, natural vegetation still prevails across most of the study area and anthropogenic elements include those typical of a rural or pastoral environment. However, the anthropogenic elements present near Kimberley and Jacobsdal in the far north and south-west of the study area include those typical of built-up urban environments. Overall, the most prominent anthropogenic elements present in the study area include a railway line, high voltage (132kV and greater) power lines, telecommunication lines, several Eskom Substations and the Pulida Solar energy facility. The presence of this infrastructure is an important factor in this context, as the introduction of the proposed power line would result in less degradation where other infrastructure is already present. Other than the visually transformed urban areas in the northern and south-western parts of the study area surrounding Kimberley and Jacobsdal, majority of the study area has a pastoral visual character, typical of a rural environment where the natural vegetation has mostly been retained (**Figure 64**).

Figure 64. Typical visual character and degree of transformation within majority of the study area

As mentioned above, the presence of infrastructure and other built form is an important factor in the context of potential visual impacts. The central and southern parts of the study area are characterised by natural landscapes with low levels of anthropogenic transformation and urban development. These areas are mainly characterised by pastoral elements, and are therefore expected to be more sensitive to the visual impacts associated with the proposed development. It should however be noted that existing industrial form and electrical infrastructure (namely the Pulida Solar energy facility, high voltage power lines and existing Eskom substations) are present within these areas and is therefore expected to lessen the visual contrast created by the proposed power line (**Figure 65**).

Figure 65. Typical visual character and degree of transformation in the more natural / scenic parts of the study area. High voltage power lines are visible within these parts of the study area.

As previously mentioned, the Pulida Solar energy facility is currently being constructed near the Modder River, within the more natural / scenic parts of the study area (**Figure 66**). This facility would significantly alter the visual character and baseline in this part of the study area once constructed. This solar energy facility consist of a large concentration of solar panels which are expected to make the facility highly visible. The scale of this infrastructure would mean that the visual character would be transformed from the current natural / rural character giving this area a more industrial-type quality, which would be much less sensitive to the introduction of the proposed power line.

Figure 66. View of the Pulida Solar energy facility which is being constructed near the Modder River within the more natural / scenic parts of the study area

In addition, the existing Eskom substations (such as the Jacobsdal Rural Substation) can be found within the more natural / scenic areas of the study area (**Figure 67**). These substations are made up of relatively large structures and are expected to alter the scenic character of the surrounding area and lessen the visual contrast created by the proposed power line.

Figure 67. View of Jacobsdal Rural Substation within the more natural / scenic parts of the study area

Commercial cultivation and livestock farming can also be found within the study area and is concentrated along the Modder River in the south of the study area (**Figure 68**). These areas are considered to have a rural or pastoral character that is relatively scenic, other than the typical agricultural infrastructure and elements present, natural vegetation still prevails and there are low levels of visual degradation. Despite the relatively scenic quality of the environment, the proposed power line is not expected to have a high visual contrast within this area due to the presence of the existing power line that runs directly within Corridor 2 Alternative 2 and is within close proximity to Corridor 2 Alternative 1 and due to the presence of other anthropogenic elements associated with the farming practices which prevail in this area (e.g. centre pivots).

Figure 68. Typical view of the commercial cultivation that is concentrated along the Modder River in the south of the study area

The northern and south-western parts of the study area are characterised by a more visually degraded landscape, which is mainly attributed to the towns of Kimberley and Jacobsdal, as well as the associated residential communities. In addition, large scale mining activities taking place near the town of Kimberley has contributed to visually degrading the landscape in the north of the study area (**Figure 69**). As such, the visual character in the northern and south-western parts of the study area are visually degraded, typical of peri-urban environments (**Figure 70**). The proposed power line would create less visual contrast in these parts of the study area due to the existing electrical infrastructure already present as well as the high levels of anthropogenic transformation and urban or industrial development.

Figure 69. Typical view of the large scale mining activities and electrical infrastructure near the town of Kimberley in the northern section of the study area

Figure 70. View toward the city of Kimberley showing the typical visual character and degree of transformation found within the northern parts of the study area

The scenic quality of the landscape is also an important factor that contributes to the visual character or inherent sense of place. Visual appeal is often associated with unique natural features or distinct variations in form. As such, the mountainous terrain and hills scattered throughout the study are in the northern, north-eastern, north-western and south-eastern parts (**Figure 71**), as well as the Modder River (**Figure 72**) are important features that would increase the scenic appeal and visual interest in the area. It should however be noted that the Pulida Solar energy facility is being constructed near the Modder River and is expected to reduce the scenic quality of the surrounding area.

Figure 71. View of the mountainous terrain in the northern part of the study area

Figure 72. View east from a bridge that crosses a section of the Modder River in the south of the study area

Overall the visual character and 'sense of place' differs throughout the study area due to the varying degrees of transformation. Therefore the proposed power line would result in varying degrees of visual contrast depending on the location of the viewer within the study area and the nature of the surrounding views at each location.

As mentioned above, the visual character of the surrounding landscape is also an important factor to be considered when assessing the sensitivity of the study area to the proposed power line. It determines the degree to which the development would contrast or conform with the surrounding area and influences the ability of that area to absorb development without noticeable intrusion or change.

3.6.3 Potentially Sensitive Visual Receptors

A sensitive receptor location is defined as a location, from where receptors would potentially be adversely impacted by a proposed development. This takes into account a subjective factor on behalf of the viewer – i.e. whether the viewer would consider the impact as a negative impact. As described above, the adverse impact is often associated with the alteration of the visual character of the area in terms of the intrusion of the proposed power line or associated infrastructure into a 'view', which may affect the 'sense of place'. The identification of sensitive receptors locations has been undertaken based on a number of factors, which include:

- the visual character of the area, especially taking into account visually scenic areas and rural areas.
- the presence of leisure-based (esp. nature-based) tourism or sites of cultural / historical value in the area.
- the presence of sites / routes that are valued for their scenic quality and 'sense of place'.
- the presence of routes that are used to access tourism sites or places of cultural / historical value.
- feedback from interested and affected parties, as raised during the public participation process conducted as part of the wider BA study

A distinction must be made between a potentially sensitive receptor location and a sensitive receptor location. Potentially sensitive receptor locations include sites of human habitation located within natural areas that were identified via desktop means. These sites are regarded as potentially sensitive as the degree of visual impact experienced will vary from one inhabitant to another, as it is largely based on the viewer's perception and sentiments toward the development. The viewer's sentiments are usually dependent on the type of facility and standard use, which could not be established at a desktop level. These sites typically include; residential dwellings and farmsteads located within relatively natural settings with limited visual transformation.

Sensitive receptor locations include various sites typically valued by society for various reasons, which were verified during the field investigation. These receptors are therefore likely to be adversely affected by the visual intrusion of the proposed development. They include tourism facilities, and other sites that may be valued for their scenic quality or cultural / historical value.

Table 49 below provides details of the visually sensitive tourism, historical or culturally significant sensitive receptor locations that were identified within the study area during the field investigation.

Table 49. Visually sensitive tourism, historical or culturally significant receptor locations identified within the study area

NAME	COORDINATES	RECEPTOR TYPE	DISTANCE FROM THE DEVELOPMENT
Gum Tree Lodge	28°44'17.06"S 24°48'27.14"E	Backpacking and hostelling	Situated inside Corridor 2 Alternative 1 and Corridor 2 Alternative 2
Memorial to the Pioneers of Aviation & Pioneers of Aviation Museum	28°48'46.20"S 24°47'11.07"E	National monument and Museum	Approximately 3.2km
Felidae Centre	28°54'52.82"S 24°57'44.85"E	Predator Park / Tourism facility	Approximately 2.5km
Benfontein Nature Reserve	28°49'26.30"S 24°49'7.60"E	Recreational tourism facility offering night game drives	Approximately 40m (Directly adjacent Corridor 2 Alternative 1)
Bass Paradise	29°8'29.04"S 24°46'11.66"E	Bass fishing facility	Approximately 3.5km

In many cases, roads, along which people travel, are considered as sensitive receptors. The primary thoroughfares in the study area include the N8 and N12 national roads, as well as the R64 provincial road and R705 regional road. The N8 is one of the primary access roads into Kimberley from the north-west and south-east, and carries much of the local access traffic to and from the town. Although the N12 forms part of the Diamond Route, which links eight (8) important sites across the northern parts of South Africa, it is not regarded to be a sensitive road, as the study area has been highly transformed due to the urban development, mining activities and extensive infrastructure in the area where this road is routed. The N8 is regarded as a sensitive receptor road as it is the primary thoroughfare which connects the city of Kimberley in the Northern Cape with the city of Bloemfontein in the Free State and is also used to access the mountainous Kingdom of Lesotho.

The R64 provincial road connects Kimberley with Bloemfontein via Boshof and Dealesville, and will thus carry much of the local access traffic to and from these towns. The R705 regional road crosses into the Free State and passes through the town of Jacobsdal in the south-west. This road is therefore used as one of the primary access roads into Jacobsdal and carries much of the local access traffic to and from the town. The R64 and R705 do not form part of any tourism routes and are therefore not typically valued or utilised for their scenic or tourism potential. As a result, these roads are also not classed as sensitive receptor roads.

In addition to the visually sensitive tourism, historical or culturally significant receptor locations indicated in **Table 49** above, several potentially sensitive farmsteads and/or dwellings were identified via desktop means. The degree of visual impact experienced from these farmsteads and/or dwellings will vary from one inhabitant to another, as it is largely based on the viewer's perception. Factors influencing the degree of visual impact experienced by the viewer include the following:

- Value placed by the viewer on the natural scenic characteristics of the area.
- The viewer's sentiments toward the proposed structures. These may be positive (a symbol of progression) or negative (foreign objects degrading the natural landscape).
- Degree to which the viewer will accept a change in the typical character of the surrounding area.

These were identified via desktop means as part of the visual sensitivity analysis and the zones of visual exposure.

It is important to note that the owner of the Remainder of the Farm Uitkyk no. 102 and the Farm Banksfontein no. 136 has expressed his concerns regarding the proposed power line traversing his two farmsteads. It was found that Corridor 2 Alternative 1 (blue route provided in the image below) is aligned to pass just west of the dwelling located on Remainder of the Farm Uitkyk no. 102. In addition, Corridor 2 Alternative 1 will traverse Portion 2 of the Farm Banksfontein no. 136 (**Figure 73**). The owner of these two properties has expressed great concern regarding the fact that the proposed power line will traverse his properties and will pass just west of his dwelling. The landowner has stated that this will be aesthetically unacceptable and has subsequently requested that his two (2) properties should be avoided as far as possible. All the dwellings on these farms were regarded as potentially sensitive receptor locations and have been taken into consideration when determining the zones of visual contrast as part of the visual sensitivity and visual impact analysis (refer to **section** 3.6.4.2). In addition, as the negative sentiments of the viewer residing on these farms is known, the location of this receptor was taken into account when comparatively assessing the power line corridor alternatives.

A photo of the dwelling located on Remainder of the Farm Uitkyk no. 102 has been provided in **Figure 74** below.

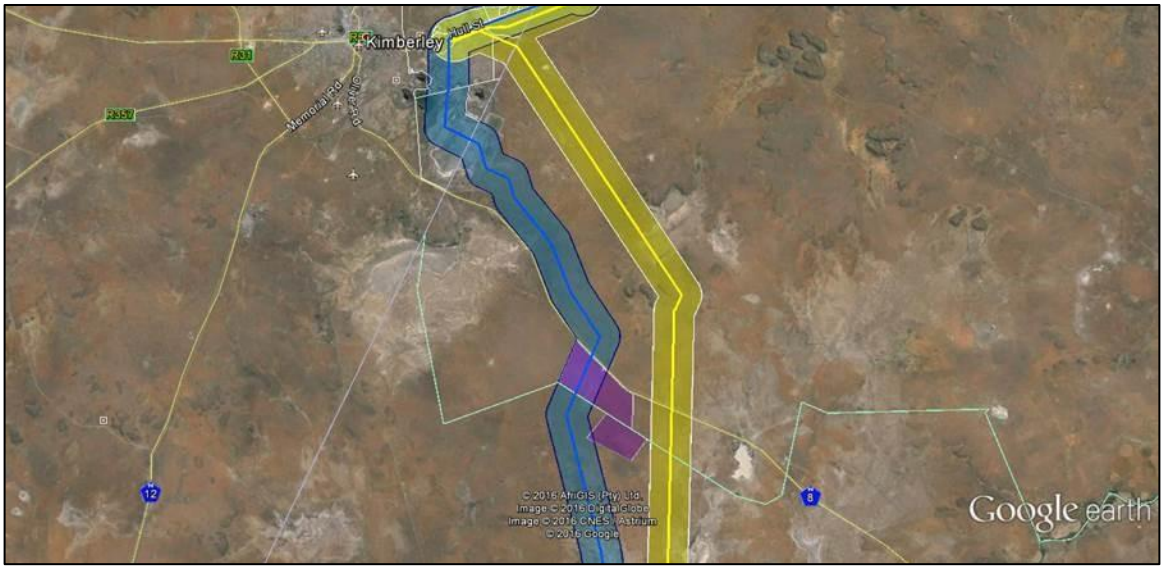


Figure 73. Map showing the location of the Remainder of the Farm Uitkyk no. 102 and Portion 2 of the Farm Banksfontein no. 136 in relation to the proposed Power Line Corridor 2 Alternative 1 (Blue)

Figure 74. Photo of the dwelling located on Remainder of the Farm Uitkyk no. 102

3.6.3.1 Sensitive Receptor Impact Rating

As several visually sensitive tourism, historical or culturally significant receptor locations were identified during the fieldwork, an analysis was carried out in order to assess the impact of the proposed development on these visually sensitive receptor locations. A matrix which takes into account a number of factors has been developed (**Table 50**), and has been applied to each receptor location.

The matrix has been based on a number of factors as listed below:

- Distance of receptor away from the proposed development (distance banding)
- Primary focus / orientation of the receptor
- Presence of screening factors (topography, vegetation etc.)
- Visual character and sensitivity of the surrounding area
- Visual contrast of the development with the landscape pattern and form

These factors are considered to be the most important factors when assessing the visual impact of a proposed development on a sensitive receptor in this context. It must be remembered that the experiencing of visual impacts is a complex and qualitative phenomenon, and thus difficult to accurately quantify; thus the matrix should be seen as a representation of the likely visual impact at a receptor location.

Table 50. Visual assessment matrix used to rate the impact of the proposed development on visually sensitive receptor locations

	VISUAL IMPACT RATING			
VISUAL FACTOR	**HIGH**	**MEDIUM**	**LOW**	**OVERRIDING FACTOR: NEGLIGIBLE**
Distance of receptor away from proposed development	0 < 500m **Score: 3**	500m < 1km **Score: 2**	1km < 2km **Score: 1**	2km <
Primary focus / orientation of receptor	'Arc of view' directly towards the proposed development **Score: 3**	'Arc of view' partially towards the proposed development / no primary orientation **Score: 2**	'Arc of view' in opposite direction of the proposed development **Score: 1**	
Presence of screening factors	No screening factors – development highly visible **Score: 3**	Screening factors partially obscure the development **Score: 2**	Screening factors obscure most of the development **Score: 1**	Screening factors completely block any views towards the development, i.e. the development is not within the viewshed
Visual character and sensitivity of the area / surrounding views	**Scenic:** Highly natural; almost no visually 'degrading' factors, the area is valued for its scenic quality and is **highly sensitive to change** **Score: 3**	**Rural / pastoral:** Mostly natural with typical rural infrastructure present, the area is valued for its uninhabited nature and is **potentially sensitive to change** **Score: 2**	**Transformed:** Presence of industrial-type infrastructure (e.g. urban areas and outlying residential areas), not highly valued and **not sensitive to change** **Score: 1**	
Visual Contrast	**High contrast** with the pattern and form of the natural landscape elements (vegetation and land form), typical land use and/or human elements (infrastructural form) **Score: 3**	**Moderate contrast** with the pattern and form of the natural landscape elements (vegetation and land form), typical land use and/or human elements (infrastructural form) **Score: 2**	**Corresponds** with the pattern and form of the natural landscape elements (vegetation and land form), typical land use and/or human elements (infrastructural form) **Score: 1**	

Categories of impact:

High Visual Impact = 13-15 Medium Visual Impact = 9 -12 Low Visual Impact = 5-8

As described above, distance of the viewer / receptor location away from the proposed development is an important factor in the context of experiencing of visual impacts. A high impact rating has thus been assigned to receptor locations that are located within 0<500m of the proposed development. Beyond 2km, the proposed development would appear to merge with the elements on the horizon and the visual impact is rated as negligible. Any receptor location beyond this distance has therefore been assigned an overriding negligible impact rating. As such, despite the impact rating assigned to the other visual factors, the overall impact rating would remain negligible, as the proposed development would not visually influence any receptors located more than 2km from the development.

The orientation of a receptor becomes important in many cases, as the receptor location is typically oriented in a certain direction, e.g. with views towards a certain area from a highly frequented area like a porch or garden. The visual impact of a development could thus be potentially much greater if the development intruded into such a view, and thus the highest rating has been given to a situation where the proposed development would cross directly across an 'arc of view / orientation' – i.e. the 180º panorama in a certain direction. Where the receptor does not have a primary orientation, such as a residential community where the dwellings are focused in different directions, a medium rating has been assigned.

The presence of screening factors is equally important in this context as the distance away from the proposed development. Screening factors can be vegetation, buildings, as well as topography. For example, a grove of trees located between a receptor location and an object could completely shield the object from the receptor. Topography (relative elevation and aspect) plays a similar role as a receptor location in a deep or incised valley will have a very limited viewshed and may not be able to view an object that is in close proximity, but not in its viewshed. As such, the complete screening of the proposed development has also been assigned an overriding negligible impact rating, as the proposed development would not impose any impact on the receptor.

The visual character of the surrounding area and views has also been considered in the matrix, as introducing a proposed development into a natural area may adversely affect or degrade scenic views experienced by receptors. Although pastoral' or rural landscapes often have a relative density of anthropogenic (human) infrastructure (e.g. fences, centre pivots, buildings such as barns and farmhouses), views of these landscape are often perceived as sensitive to visual impacts, compared to visual impacts of more industrial or large-scale infrastructure. A moderate rating is thus assigned to the visual character of these views. Transformed industrial landscapes have been assigned a low impact rating as a new development is unlikely to be regarded as negative within this context.

The visual contrast of a proposed development refers to the degree to which the development would be congruent with the surrounding environment. It is based whether or not the proposed development would conform with the land use, settlement density, structural scale, form and pattern of natural elements that define the structure of the surrounding landscape. The visual compatibility is an important factor to be considered when assessing the impact of the proposed development on receptors within a specific context. A development that is incongruent with the surrounding area could have a significant visual impact on sensitive receptors as it may change the visual character of the landscape.

It should be noted that this rating matrix is a relatively simplified way to assign a likely representative visual impact, which allows a number of factors to be considered. Part of its limitation lies in the quantitative assessment of what is largely a qualitative or subjective impact.

Table 51 to **Table 55** below present the results of the visual impact matrix.

Table 51. Visual impact on Gum Tree Lodge

VISUAL FACTOR	RATING
Distance of receptor away from proposed development	**HIGH:** The receptor is located inside two (2) of the proposed power line corridor alternatives, namely Corridor 2 Alternative 1 and Corridor 2 Alternative 2.
Primary focus / orientation of receptor	**MEDIUM:** No primary orientation. The accommodation facilities are orientated in different directions.
Presence of screening factors	**LOW:** The surrounding tall trees and other vegetation is expected to block out most views of the proposed development from the accommodation facilities (**Figure 75**).
Visual character and sensitivity of the area / surrounding views	**MEDIUM:** Despite the presence of intact natural vegetation within the immediate vicinity of the Lodge, the surrounding area has been partly transformed by industrial activities such as mining. Due to the presence of this industrial-type infrastructure, nearby urban areas, outlying residential areas and mining infrastructure, the surrounding area is not highly valued for its scenic character and is therefore not highly sensitive to change.
Visual Contrast	**LOW:** The area surrounding the lodge has already been largely transformed by existing electrical infrastructure which include several high voltage power lines and a distribution substation. Therefore, where the proposed development is visible from within the Lodge, it would correspond with the typical vertical infrastructural elements already present. The degree of contrast would however vary depending on the alignment of the proposed power line in relation to the existing power lines and the proximity of the power line to the lodge.

Figure 75. Typical view toward the development from the backpacker accommodation facilities of the Gum Tree Lodge

Table 52. Visual impact on the Memorial to the Pioneers of Aviation & Pioneers of Aviation Museum

VISUAL FACTOR	RATING
Distance of receptor away from proposed development	**NEGLIGIBLE:** The receptor is located approximately 3.2km from the proposed development.
Primary focus / orientation of receptor	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon. It should however be noted that the museum building is oriented to the north-east, directly towards the proposed development (**Figure 76**).
Presence of screening factors	**N/A:** Despite the lack of a significant amount of tall trees and other vegetative screening factors that will obscure views toward the proposed development, the topographical undulations are likely to screen views towards the proposed development. In addition, the overall impact rating would remain negligible as the proposed

	development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.
Visual character and sensitivity of the area / surrounding views	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.
Visual Contrast	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.

Figure 76. Typical view toward the proposed development from the museum building situated next to the Memorial to the Pioneers of Aviation

Table 53. Visual impact on the Felidae Centre

VISUAL FACTOR	RATING
Distance of receptor away from proposed development	**NEGLIGIBLE:** The receptor is located approximately 2.5km from the proposed development.
Primary focus / orientation of receptor	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.
Presence of screening factors	**N/A:** Despite the lack of a significant amount of tall trees and other vegetative screening factors the overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon (**Figure 77**).
Visual character and sensitivity of the area / surrounding views	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.
Visual Contrast	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.

Figure 77. Typical view toward the proposed development from the Felidae Centre. Note the existing high voltage power lines located within Corridor 2 Alternative 2 are not evident from this distance

Table 54. Visual impact on the Benfontein Nature Reserve

VISUAL FACTOR	RATING
Distance of receptor away from proposed development	**HIGH:** The receptor is located approximately 40m from the proposed development (directly adjacent Corridor 2 Alternative 1).
Primary focus / orientation of receptor	**MEDIUM:** No primary orientation. The roads within the reserve will be oriented in different directions, however it should be noted that most views will focus inwards in order to appreciate the natural scenery and wildlife within the reserve.
Presence of screening factors	**MEDIUM:** The surrounding tall trees and other vegetation would obscure some views of the proposed power line (**Figure 78**). However, the power line would still be visible from large portions of the nature reserve, due to the prevailing flat terrain and scattered nature of the tall trees and shrubs. The wooded vegetation cover becomes particularly sparse in the central parts of the reserve (**Figure 79**).

Visual character and sensitivity of the area / surrounding views	**MEDIUM:** The reserve is characterised by a natural landscape with minimal degradation. Views towards the development however reflect a largely undeveloped area that has been partially transformed due to the presence of an existing high voltage power line which traverses the reserve and other anthropogenic elements, which include the N8 road, railway line and telephone poles.
Visual Contrast	**MEDIUM:** The area within and surrounding the reserve has been partially transformed due to the presence of an existing high voltage ower line and other anthropogenic elements, however the proposed power line is still likely to have a moderate contrast with the surrounding natural landscape.

It is important to note that although Benfontein Nature Reserve is regarded as a visually sensitive receptor location, the reserve could not be accessed during the field investigation. As a result, the visual impact of the proposed development on Benfontein Nature Reserve was investigated via desktop means, making use of Google Earth.

Figure 78. Typical Kimberley Thornveld vegetation cover within Benfontein Nature Reserve. Views toward the proposed power line are expected to be partially screened from these areas (Google earth street view photograph)

Figure 79. Sparse wooded vegetation cover within the central parts of Benfontein Nature Reserve. Views toward the proposed power line are expected to be wide open from these areas (Google earth street view photograph)

Table 55. Visual impact on Bass Paradise

VISUAL FACTOR	RATING
Distance of receptor away from proposed development	**NEGLIGIBLE:** The receptor is located approximately 4km form the proposed development.
Primary focus / orientation of receptor	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.
Presence of screening factors	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.
Visual character and sensitivity of the area / surrounding views	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.
Visual Contrast	**N/A:** The overall impact rating would remain negligible as the proposed development would be significantly diminished from this distance and would appear to merge with the elements on the horizon.

It is important to note that although Bass Paradise is regarded as a visually sensitive receptor location, access to this facility was not granted during the time of the field investigation. As a result, the visual impact of the proposed development on Bass Paradise was not investigated and assessed in detail. This facility was however found to be situated more than 2km from the proposed

development. Bass Paradise is therefore not expected to be adversely impacted by the proposed construction of the power line and associated infrastructure even though it is considered to be a leisure based activity that could attract tourists and other visitors which may perceive the proposed development as an unwelcome visual intrusion.

Figure 80. Photo of the entrance of Bass Paradise which is situated near Jacobsdal in the south-west of the study area. Access to this facility was not granted during the time of the field investigation

A summary of the above impact ratings are provided in **Table 56** below.

Table 56: Visual impact summary of the proposed development on visually sensitive receptor locations

Receptor Location	Distance	Orientation	Screening	Character / Sensitivity	Contrast	OVERALL IMPACT RATING
Gum Tree Lodge	High (3)	Medium (2)	Low (1)	Medium (2)	Low (1)	**MEDIUM**
Memorial to the Pioneers of Aviation & Pioneers of Aviation Museum	**OVERRIDING FACTOR: NEGLIGIBLE**					
Felidae Centre	**OVERRIDING FACTOR: NEGLIGIBLE**					
Benfontein Nature Reserve	High (3)	Medium (2)	Medium (2)	Medium (2)	Medium (2)	**MEDIUM**
Bass Paradise	**OVERRIDING FACTOR: NEGLIGIBLE**					

3.6.4 Visual Sensitivity Analysis

Visual Sensitivity can be defined as the inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (visual character), spatial distribution of potential receptors, and the likely value judgements of these receptors towards the new development, which are usually based on the perceived aesthetic appeal of the area. In order to assist with the visual assessment, a visual sensitivity analysis was undertaken to classify the study area into zones of visual sensitivity. Initially the land use and visual transformation within the study area was investigated to establish zones of visual contrast. Highly transformed urban areas were classified into areas of low visual contrast and natural areas were classified into zones of high visual contrast. Zones of visual exposure were thereafter established based on the presence of potential receptors or viewers within the study area. The results the visual contrast and visual exposure assessments were thereafter overlaid according to a set weighting criteria in order to classify the entire study area according to zones of high, moderate and low visual sensitivity.

3.6.4.1 Zones of Visual Contrast

The visual contrast refers to the degree to which the proposed development would be congruent with the surrounding environment. It is based on whether or not the proposed development would conform with the land use, settlement density, forms and patterns of elements that define the structure of the surrounding landscape. The visual contrast is an important factor to be considered when assessing the sensitivity of a specific area to a proposed development, as a development that contrasts with the surrounding area may change the visual character of that landscape. This could have a significant visual impact on visually sensitive receptors or important vantage points within the study area.

Based on the land use, visual character and existing power lines in the surrounding landscape, the area was assessed to determine the degree to which the proposed power line development is visually compatible with the surrounding environment. In the context of this proposed power line development, the presence or absence of existing power lines is an important factor influencing the level of visual contrast. For example in a largely natural area, the presence of an existing power line would introduce a distinct linear element into the landscape, therefore the addition of another power line would result in significantly less visual contrast. The study area was therefore classified into the following zones of visual contrast:

- **High** – Undeveloped / natural / rural areas (Rating Score = C3)
- **Moderate** – Areas within 100m from intensive agricultural lands / cultivated fields **OR** areas within 500m from an existing power line / railway line **OR** areas within 1km from major cities or towns (i.e. Kimberley) **OR** areas within 500m from minor transformed urban / built-up areas / mining areas (i.e. Alexanderfontein Hotel, Jacobsdal, Ratanang) **OR** areas within 5km from the Kalkaar CSP plant **OR** areas within 2.5km from the Pulida Solar Project (Rating Score = C2)
- **Low** – Areas within 500m from major cities or towns (i.e. Kimberley) **OR** areas within 250m from minor transformed urban / built-up areas / mining areas (i.e. Alexanderfontein Hotel, Jacobsdal, Ratanang) **OR** areas within 100m from an existing power line / railway line OR areas within 1km from the Kalkaar CSP plant **OR** areas within 500m from the Pulida Solar Project (Rating Score = C1)

***NOTE:** **where there is an overlap (e.g. within 1km of a CSP plant in a natural area), the zone of Low visual contrast will take preference over Moderate and High, likewise, Moderate will take preference over High.**

The outcome of the visual contrast assessment for each proposed power line is provided in **Figure 81** below.

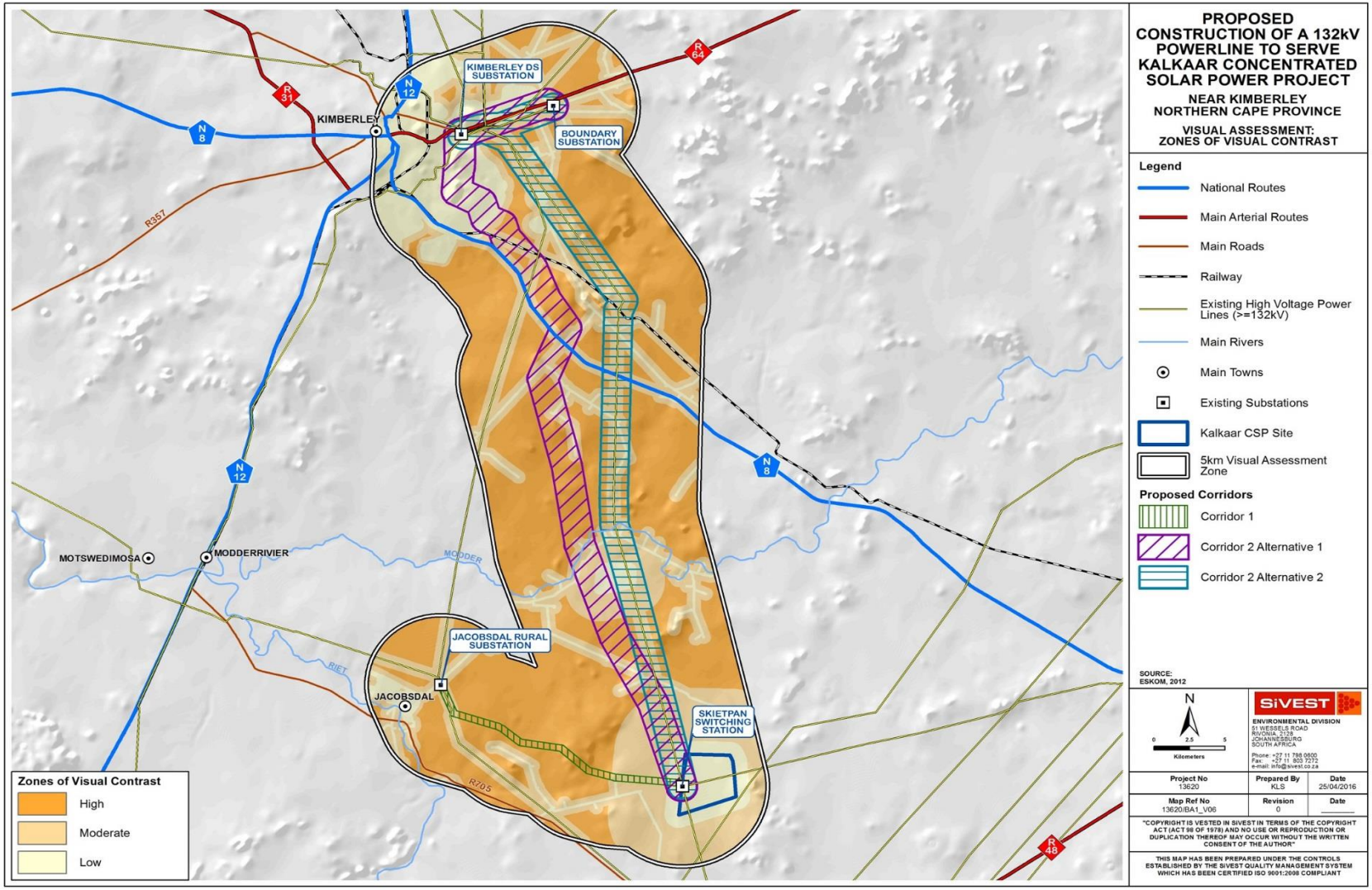


Figure 81. Zones of visual contrast

3.6.4.2 Zones of Visual Exposure

In order to classify the level of visual exposure that the proposed development may have on potentially sensitive visual receptors, distance bands were assigned to each visual receptor identified either via desktop means or field-based observation. This assumes the worst-case scenario in which all potential receptor locations are considered to be sensitive to the proposed development.

In this way the study area was classified according to zones of visual exposure, or areas within which the visual receptors would be exposed to varying degrees of visual impact. The study area was classified into zones of visual exposure as follows:

- **High** – 0-500m of a receptor (Rating Score = E3)
- **Moderate** – 501-1000m of a receptor (Rating Score = E2)
- **Low** – 1001-2000m of a receptor (Rating Score = E1)
- **Negligible** – 2000m < of a receptor (Rating Score = E0)

The outcome of the visual exposure assessment for each proposed power line is provided in **Figure 82** below.

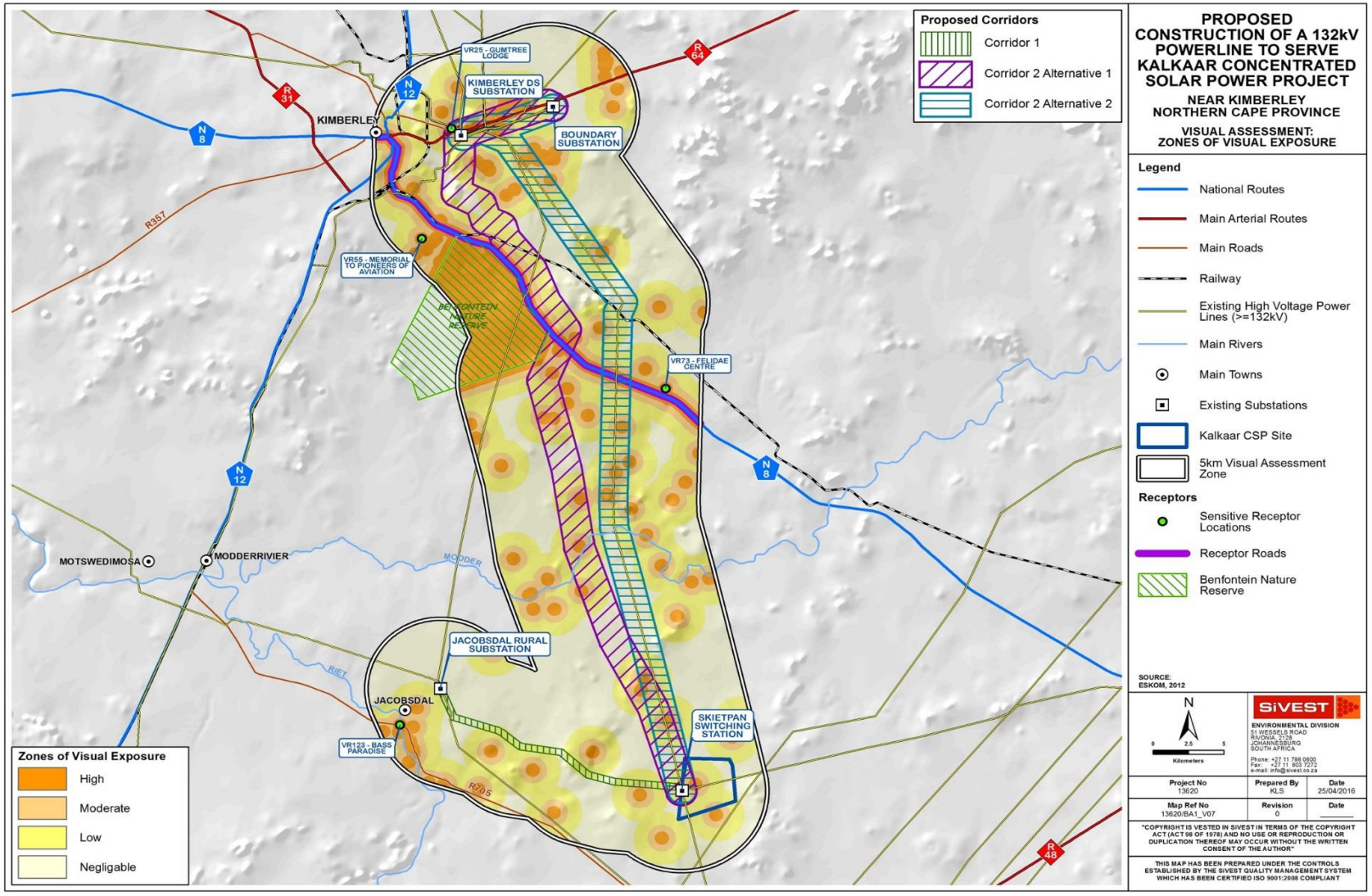


Figure 82. Zones of visual exposure

3.6.4.3 Conclusion: Zones of Visual Sensitivity

By combining the results of the visual contrast and visual exposure assessments above, the entire study area was broken up into the following zones of visual sensitivity:

- **High** – 5-6: Due to the natural character of the surrounding views and the close proximity of visual receptors, the introduction of a new power line is likely to be perceived negatively by receptors in this zone. The proposed power line would be considered to be a visual intrusion and may elicit opposition from these receptors.
- **Moderate** – 4: Presence of visual receptors within relatively close proximity to the proposed power line, however the partially transformed visual character of the area or the presence of existing power lines within this zone would result in moderate negative perception towards the new development as a source of visual impact.
- **Low** – 2-3: Presence of receptors, but due the transformed visual character of the area, the presence of existing power lines or the distance of the receptor from the proposed power line, the receptors within this zone are likely to have a limited negative perception toward the development.
- **Negligible** – 1: Due to the transformed visual character of the area, the extensive distance of the receptor from the proposed power line or the location of the receptor outside the viewshed, the visual impact would be insignificant and there is unlikely to be any negative opposition toward the proposed power line.

Key

E3 +C1 =4	**E3 +C2 = 5**	**E3 +C3 = 6**
E2 +C1 = 3	**E2 +C2 = 4**	**E2 +C3 = 5**
E1 +C1 = 2	**E1 +C2 = 3**	**E1 +C3 = 4**
E0 +C1 = 1	**E0 +C2 = 0**	**E0 +C3 = 0**

The overall outcome of the visual sensitivity analysis for the study area is provided in **Figure 83** below.

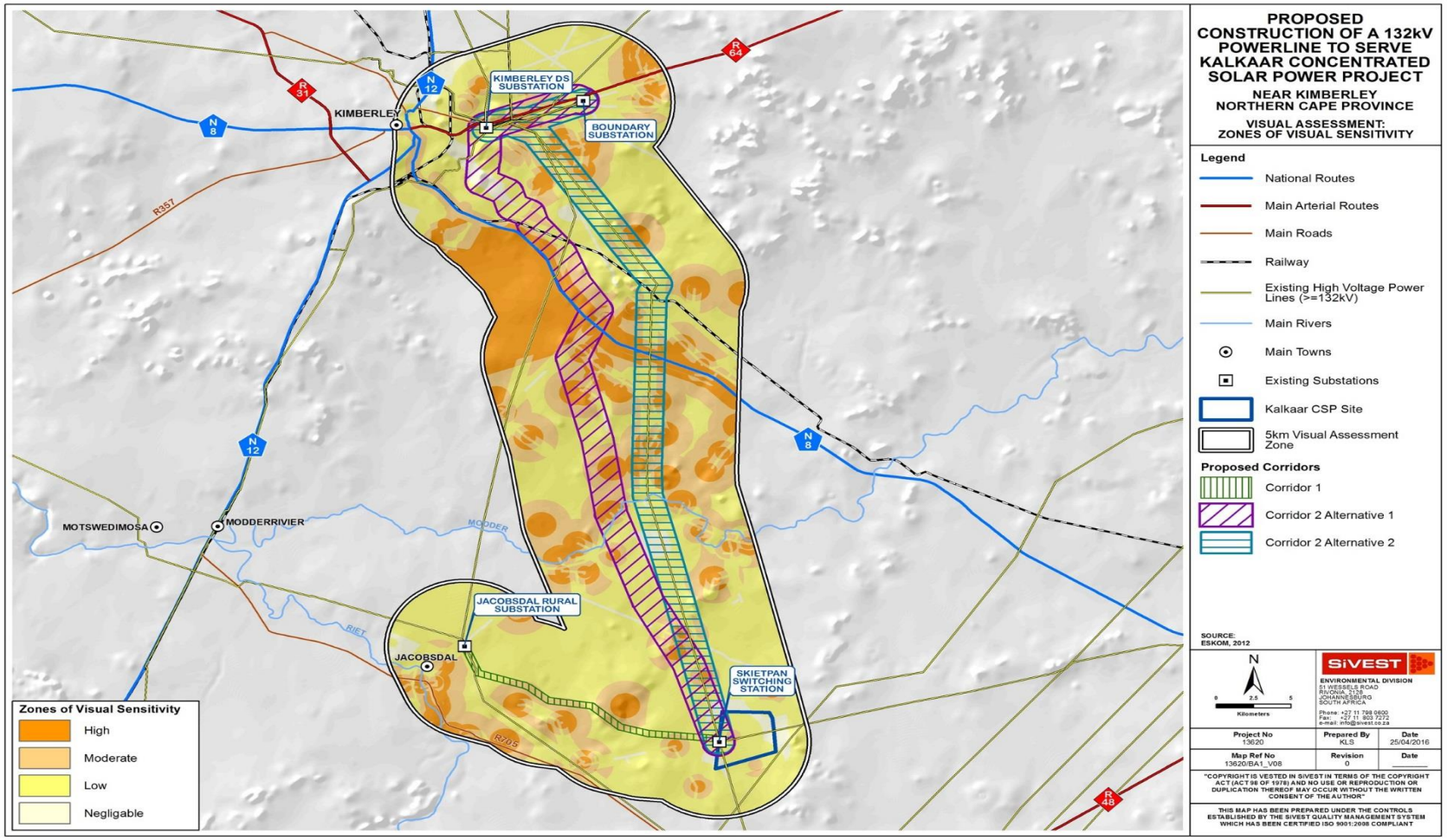


Figure 83. Zones of visual sensitivity

3.6.5 Visual impact analysis

Based on the results of the visual sensitivity analysis above, the study area was classified into zones of potential visual impact. This was done in order to assess and compare the various proposed power line corridor alternatives from a visual perspective. The analysis involved rating the study area into zones of visual influence based on the fact that the visual impact of the proposed power line would diminish exponentially as one moves further away from the development. The results the visual sensitivity and visual influence assessments were thereafter overlaid according to a set weighting criteria in order to classify the entire study area according to zones of visual impact.

3.6.5.1 Zones of Visual Sensitivity

In order to conduct the visual impact analysis, the ratings for the above-mentioned zones of visual sensitivity were converted into the following scores:

- **High** – 5-6 = S3
- **Moderate** – 4 = S2
- **Low** – 1-3 = S1
- **Negligible** – S0

3.6.5.2 Zones of Visual Influence

Distance bands were used to assign zones of visual influence for the proposed power line, as the visibility of the proposed power line would diminish exponentially over distance. As such, the proposed power line would be more visible to receptors located within a short distance and these receptors would experience a higher adverse visual impact than those located at a moderate or long distance from the proposed power line. The entire study area was assigned a zone of visual influence i.e. high, moderate or low.

Based on the height and scale of the project, the radii chosen to assign these zones of visual influence (distance bands from the proposed development / development alternatives) are as follows:

- **High** – 0-500m of the proposed development (Rating Score = I3)
- **Moderate** – 501-1000m of the proposed development (Rating Score = I2)
- **Low** – 1001-2000m of the proposed development (Rating Score =I1)

- **Negligible** – 2000m< of the proposed development (Rating Score = I0)

The outcome of the visual influence assessment for each proposed power line is provided in **Figure 84** below.

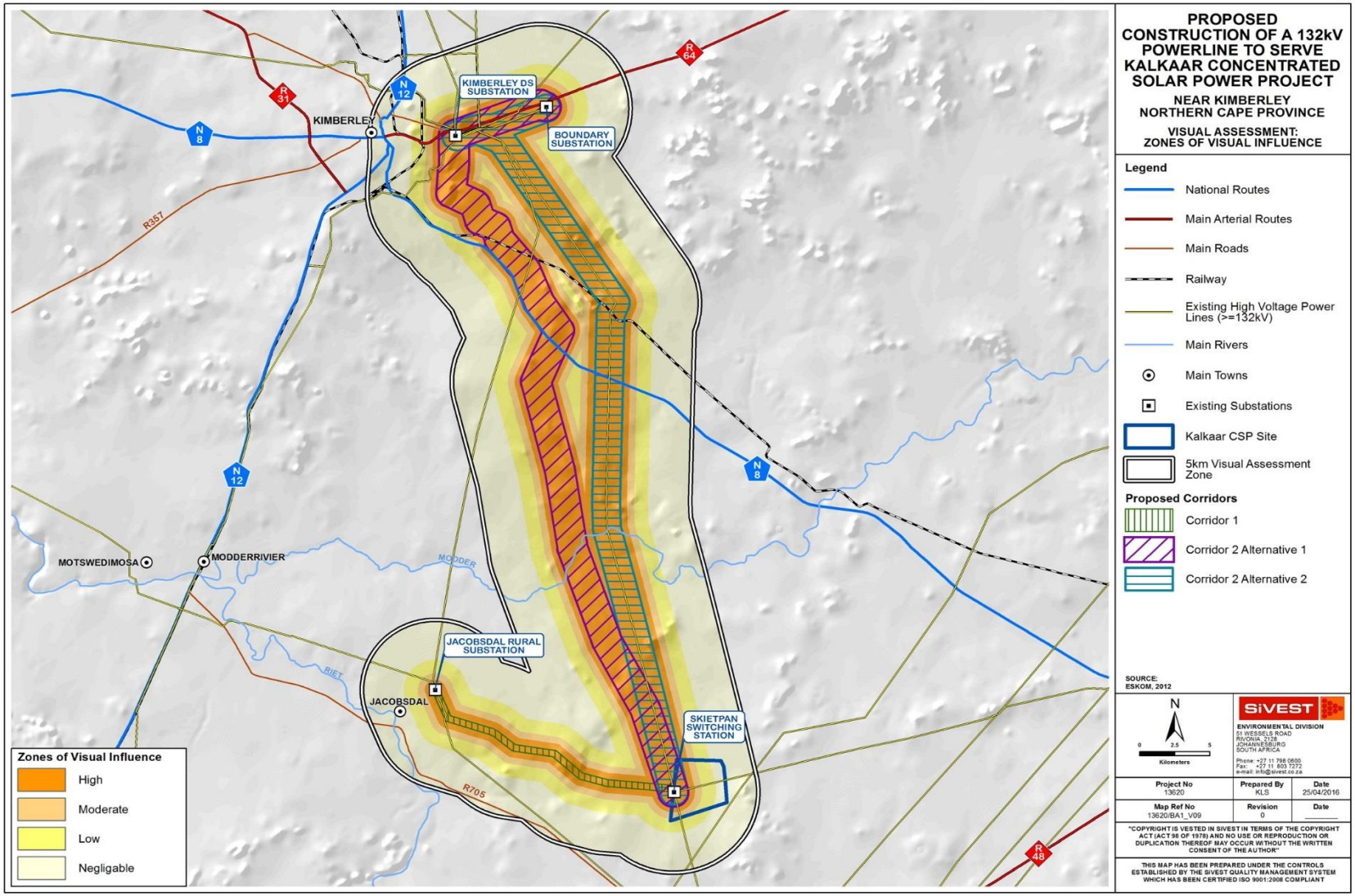


Figure 84. Zones of visual influence

3.6.5.3 Conclusion: Zones of Visual Impact

By combining the results of the visual sensitivity and visual influence assessments above, the entire study area was broken up into the following zones of visual impact:

- **High** – 6: Natural areas, in close proximity to the proposed power line, and where potential visual receptors are present.
- **Moderate** – 4-5: Areas where visual receptors are present in natural areas further away from the development, or in close proximity to the development within partially transformed areas or where existing power lines are present.
- **Low** – 2-3: Area where visual receptors are present in partially transformed areas further away from the development, or where existing power lines are present.
- **Negligible** – 0-1: Areas where no potential visual receptors present at a long distance from the proposed power line.

Key

I3 +S0 =3	**I3 +S1 =4**	**I3 +S2 = 5**	**I3 +S3 = 6**
I2 +S0 = 2	**I2 +S1 = 3**	**I2 +S2 = 4**	**I2 +S3 = 5**
I1 +S0 = 1	**I1 +S1 = 2**	**I1 +S2 = 3**	**I1 +S3 = 4**
I0 +S0 = 0	**I0 +S1 = 1**	**I0 +S2 = 2**	**I0 +S3 = 3**

The overall outcome of the visual impact analysis for the proposed power line and substation is provided in **Figure 85** below. As indicated, a negligible or low visual impact would typically be experienced from most areas beyond 1km from the proposed development. This is mostly due to the large amounts of visual degradation and transformation present in the northern and south-western parts of the study area, the location of the Kalkaar CSP site and presence of existing infrastructural elements within an area that is not heavily populated. Within 1km of the proposed development a moderate visual impact would typically be experienced as the proposed power line line would be more visible to the visual receptors present within this area. The presence of existing power lines and other infrastructure would make the proposed development less incongruent.

Table 57 below provides details of the zone of visual impact that each visually sensitive, tourism, historical or culturally significant receptor location, is located within i.e. the typical impact to be experienced from each visually sensitive receptor location. The table should be considered in conjunction with the impact ratings provided in **Table 56** above, as the screening provided by the terrain, existing infrastructure and tall wooded vegetation was not factored into the visual impact analysis. In addition, the impact of the proposed development on the visually sensitive receptors takes the primary orientation of each receptor into account. Therefore, just because a receptor is located within a zone of high visual impact does not necessarily mean the development would have a high impact on the receptor. Lastly, the analysis takes into account the fact that the visibility of

the proposed power line would diminish exponentially over distance. For example while the impact of the development on the Benfontein Nature Reserve was rated as medium, the reserve traverses a zone of low, moderate and high visual impact. The zones of visual impact, therefore provide a broad classification of potential visual impact that is likely to be experienced from different areas of the study area and assists with determining the overall significance of the proposed development.

Table 57. Visually sensitive tourism, historical or culturally significant receptors in relation to the zones of visual impact

NAME	RECEPTOR TYPE	ZONE OF VISUAL IMPACT
Gum Tree Lodge	Backpacking and hostelling	Moderate
Memorial to the Pioneers of Aviation & Pioneers of Aviation Museum	National Monument and Museum	Low
Felidae Centre	Predator Park / Tourism facility	Low
Benfontein Nature Reserve	Recreational tourism facility offering night game drives	High, Moderate and Low
Bass Paradise	Bass fishing facility	Low

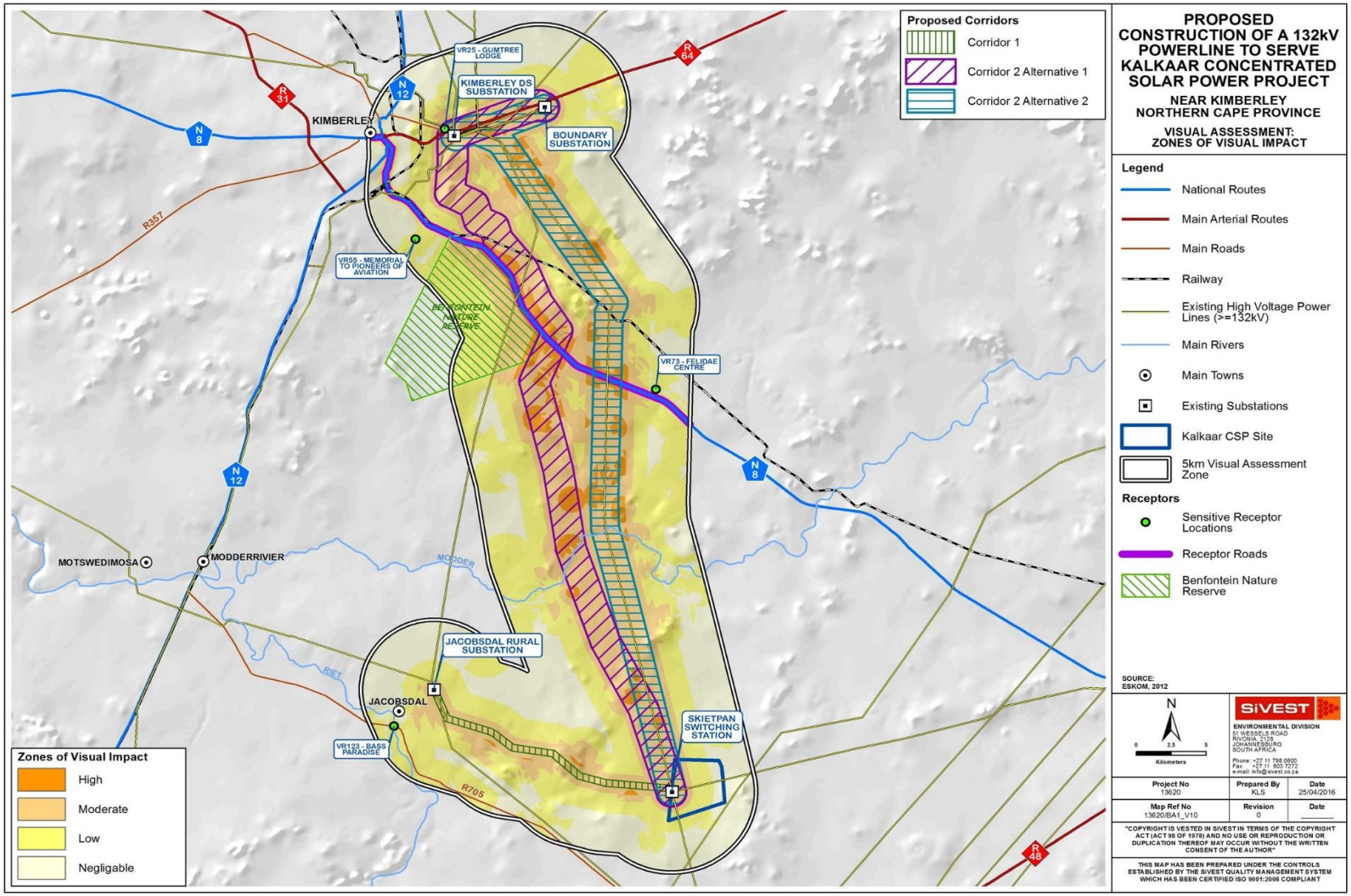


Figure 85. Zones of visual impact

3.6.6 Visual Impact Rating

3.6.6.1 Construction Phase

Table 58. Visual impact rating for the proposed 132kV power line and associated infrastructure during construction

VISUAL IMPACT	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	Large construction vehicles and equipment during the construction phase will alter the natural character of the study area and expose visual receptors to visual impacts associated with the construction phase. The construction activities may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. A network of gravel access roads will be required in order to provide access to the proposed power line. Considering the relatively flat nature of the terrain within the study area, it is likely that the visual impact associated with these roads would be limited to the impact of clearing the vegetation. However, if these roads are not maintained correctly during the construction phase, construction vehicles travelling along the gravel access roads could increase dust emissions and expose surrounding farmstead to dust plumes. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. The visual intrusion of the construction activities associated with the proposed power line and associated infrastructure could adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the N8 road as well as visitors at the Gum Tree Lodge, Memorial to the Pioneers of Aviation & Pioneers of Aviation Museum, the Felidae Centre, the Benfontein Nature Reserve and Bass Paradise. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. Additionally, temporarily stockpiling soil during construction may alter the generally flat landscape. Wind

	blowing over these disturbed areas could therefore result in dust which would have a visual impact. The clearing of vegetation will most likely also be required for the installation of the infrastructure associated with the proposed power line. This is expected to result in the generation of dust, alter the natural character of the surrounding area and therefore create a visual impact.	
Extent (geographical)	Local/district (2)	
Probability	Probable (3)	
Reversibility	Completely reversible (1)	
Irreplaceable loss of resources	Marginal loss (2)	
Duration	Short term (1)	
Cumulative effect	Medium cumulative effects (3)	
Intensity/magnitude	Medium (2)	
Significance Rating	**Prior to mitigation measures:** Low negative impact **After mitigation measures:** Low negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	1	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-24 (negative low)	-20 (negative low)
	▪ Carefully plan to reduce the construction period. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. ▪ Vegetation clearing should take place in a phased manner. ▪ Maintain a neat construction site by removing rubble and waste materials regularly. ▪ Make use of existing gravel access roads where possible. ▪ Limit the number of vehicles and trucks travelling to and from the proposed site. ▪ Ensure that dust suppression techniques are implemented on all gravel access roads.	

Mitigation measures	▪ Ensure that dust suppression is implemented in all areas where vegetation clearing has taken place. ▪ Ensure that dust suppression techniques are implemented on all soil stockpiles. ▪ Select the alternatives that will have the least impact on visual receptors. ▪ Route / align the proposed power line to completely avoid any farmsteads / homesteads / dwellings.

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

3.6.6.2 Operation Phase

Table 59. Visual impact rating for the proposed 132kV power line and associated infrastructure during operation

IMPACT TABLE	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	The proposed 132kV power line and associated infrastructure could exert a visual impact by altering the visual character of the surrounding area and exposing sensitive visual receptor locations to visual impacts. The proposed development may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. This is especially true for the power line towers, which are tall structures and will most likely be visible for greater distances. However, where existing power lines are present the visual environment would already be visually 'degraded' and thus the introduction of a new power line in this setting may be considered to be less of a visual impact than if no existing built infrastructure were visible. A network of gravel access roads will be required in order to provide access to the proposed power line. Considering the largely flat nature of the terrain on the site, it is likely that the visual impact associated with these roads would be limited to the impact of clearing the vegetation. However, if these roads are not maintained correctly, maintenance vehicles travelling along the gravel access roads could increase dust emissions and expose

	surrounding farmstead to dust plumes. In addition, maintenance vehicles may also need to access the proposed power line and associated infrastructure via gravel access roads and are also expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Security and operational lighting might be required for the proposed substation associated with the power line. This could result in light pollution and glare, which could be an annoyance to surrounding viewers. The visual intrusion of the proposed 132kV power line and associated infrastructure could also adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the N8 road as well as visitors at the Gum Tree Lodge, Memorial to the Pioneers of Aviation & Pioneers of Aviation Museum, the Felidae Centre, the Benfontein Nature Reserve and Bass Paradise.	
Extent	Local/district (2)	
Probability	Definite (4)	
Reversibility	Barely reversible (3)	
Irreplaceable loss of resources	Marginal (2)	
Duration	Long term (3)	
Cumulative effect	Medium cumulative effects (3)	
Intensity/magnitude	Medium (2)	
Significance Rating	**Prior to mitigation measures:** Medium negative impact **After mitigation measures:** Medium negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2

Significance rating	-34 (medium negative)	-34 (medium negative)
Mitigation measures	▪ Light fittings for security at night should reflect the light toward the ground and prevent light spill. ▪ As far as possible, limit the amount of security and operational lighting present at the two (2) bay substations. ▪ If possible, the control room should not be illuminated at night. ▪ As far as possible, limit the number of maintenance vehicles which are allowed to access the substation site and power line access roads. ▪ The control room should be painted with natural tones that fit with the surrounding environment. ▪ Ensure that dust suppression techniques are implemented on all gravel access roads. ▪ Align power lines to run parallel to existing power lines and other linear elements, where possible. ▪ Avoid crossing areas of high elevation, especially ridges, koppies or hills, where possible. ▪ Non-reflective surfaces should be utilised where possible.	

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

3.6.6.3 Decommissioning Phase

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase.

3.7 Social-economic Impacts

A Social Impact Assessment was conducted by Elena Broughton of Urban-Econ Development Economists and is included in **Appendix D7**. A summary of the main findings of the assessment are outlined below.

3.7.1 Study area's composition and locational factors

3.7.1.1 Spatial context and regional linkages

The Letsemeng Local Municipality (LLM) is one of the four local municipalities comprising the Xhariep DM. It comprises of five towns (Jacobsdal, Petrusburg, Koffiefontein, Luckhoff and Oppermansgronde) and forms the western boundary of the Xhariep District. It borders the Northern and Western Cape Provinces and is renowned for diamond, salt and slate mining as well as irrigation farming along the Orange Riet Canal and Van der Kloof Dam (Letsemeng Local Municipality, 2016).

The N8 route runs across the area to the north and links Kimberley and Bloemfontein via Petrusburg. The Port Elizabeth railway line starts at Koffiefontein and connects at Springfontein, with the Johannesburg/Cape Town railway line to continue in an easterly direction towards Port Elizabeth. The five towns are connected with tarred road infrastructure via Koffiefontein. The R705 links Jacobsdal with Koffiefontein, while the R48 links Petrusburg, Koffiefontein and Luckhoff in a north-south direction. The R704 links Koffiefontein, Fauresmith and Jagersfontein with one another (Letsemeng Local Municipality, 2016).

The Sol Plaatjie Local Municipality (SPM) is one of the four municipalities comprising the Frances Baard DM. it has a geographical area of 3 145km² and comprises of the urban areas of Kimberley, Ritchie and surrounding villages and farms. Kimberley is the administrative centre of the municipality. Sol Plaatjie Local Municipality is the largest local municipality in the Frances Baard District Municipality in terms of population size.

There are two national roads which run through the SPM area, namely the N8 between Bloemfontein and Groblershoop and the N12 between Three Sisters and Witbank. The current poor state of the N12 within the North West Province causes traffic between Johannesburg and Cape Town to rather take the N1 via Bloemfontein and therefore, bypass Kimberley. A well-developed rail infrastructure exists in the SPM area. Kimberley serves as a satellite depot handling containers, cars and bulk traffic. There is however no commuter rail service available. The Kimberley airport has national status and is limited to daily air services between Johannesburg and Cape Town (Koplan; Africon, 2009).

The Tokologo Local Municipality (TLM) is located within the Lejweleputswa District Municipality's area of jurisdiction. Tokologo Local Municipality area covers 9 326km² and consists of three former Transitional Local Councils namely, Boshof, Dealesville and Hertzogville, as well as a portion of a

former Transitional Rural Council (Modderval), which contained approximately 1 480 farms (Tokologo Local Municipality, 2016).

The major road and transport corridor system that carries the main traffic flows and therefore, business opportunities through the municipality includes the R59 to Hoopstad and the R64 that connects Bloemfontein, Dealesville, Boshof and Kimberley to each other.

3.7.1.1.1 Towns and settlements

The closest major towns to the proposed project powerline corridors are Jacobsdal in the Free State and Kimberley in the Northern Cape.

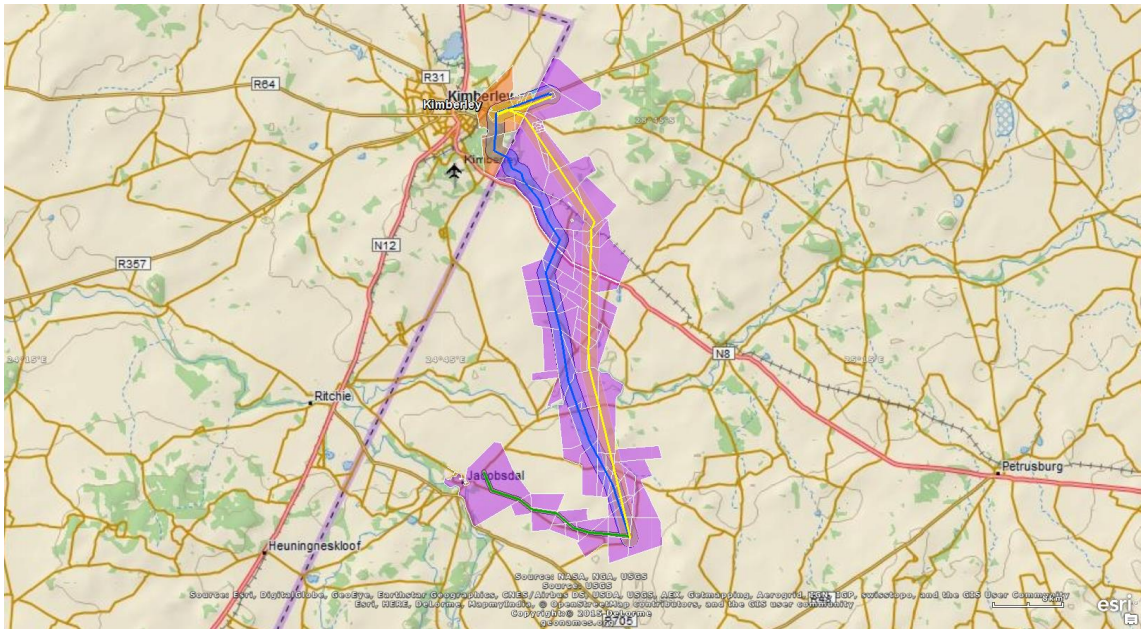


Figure 86. Towns and settlements closest to the project sites (Google Maps, 2016)

Jacobsdal/Ratanang serve as an economic growth and tourism development node within the Letsemeng Municipality and is situated approximately 45km northwest of Koffiefontein. Access to the town is gained from the R705 route between Koffiefontein and Modder Rivier. According to the Letsemeng LM IDP, the town's main social and economic functions are:

- To serve as a regional agricultural services centre;
- To serve as a key regional tourist destination;
- To serve as a main regional agro-processing Centre; and
- Social functions such as residence, education and medical services;

Kimberley is the capital of the Northern Cape Province of South Africa and is also the seat of the Provincial Legislature for the Northern Cape and the Provincial Administration. Kimberley is situated closer to towns of significance in the neighbouring provinces such as Bloemfontein (175km) and Welkom (329km) in the Free State and Klerksdorp (302km) in the North West than to towns in the Northern Cape such as Upington (402km). It is located approximately 110 km east of the confluence of the Vaal and Orange Rivers. The city has considerable historical significance due to its diamond mining past Kimberley. It services the mining and agricultural sectors of the region.

3.7.1.1.2 Resources and land capability

Within the Sol Plaatjie LM economic activities consist of retailers and industries, as well as mining and farming. Agricultural land is mostly used for game, sheep and cattle farming, and cash crops such as lucerne, grapes, cotton and soybeans. Mining is still an integral part of the economy.
The town is most famous for the Big Hole, an open mine, which was dug by hand during the diamond rush of the late 1880s and which is now a major tourist attraction.

The Letsemeng municipality covers an area of 10 192 km² of which 87.5 % has remained as natural habitat. There are two formal land-based protected areas in the municipality, namely the Kalkfontein Dam Nature Reserve and the Rolfontein Nature Reserve. These two reserves cover 11 380.9 hectares(ha) of the municipal area. Most of the Letsemeng jurisdiction consists of lowlands with hills. Slightly irregular plains and pans characterise the Jacobsdal, Petrusburg, Koffiefontein and Luckhoff areas. The municipality's IDP describes Letsemeng as an agriculture rich area. The municipal area also has mining activities, with diamond minerals being the major natural resource.

3.7.2 Demographic Profile

The population of any geographical area is the cornerstone of the development process, as it affects the economic growth through the provision of labour and entrepreneurial skills, and determines the demand for the production output. Examining population dynamics is essential in gaining an accurate perspective of those who are likely to be affected by any prospective development or project.

The Sol Plaatjie LM is home to approximately 248 041 people, with a total of 95 931 households according to the Census 2011. The population has increased by 18.8% from 201 466 in 2001. A large portion (98.8%) of the population in the LM resides in urban areas, while the rest (1.2%) live on farms. The large proportion of people living in the urban area can be explained by the ease of access to opportunities and services within the larger urban centres, in this case Kimberley.

Kimberley is home to 96 982 people residing in 24 390 households. At the same time, the Letsemeng and Tokologo LMs have populations of 38 629 and 28 987, respectively. Jacobsdal's population is estimated as 3 503 (1 002 households).

The dominant population group in the Sol Plaatjie LM is Black people (60.8%) followed by Coloured people who make up 28% of the population. In Kimberley, 41% of the population is Black while 37.5% is coloured. Within the Letsemeng and Tokologo municipalities, 67.7% and 84.5% of the population, respectively is black. There is almost an even split between the Black and Coloured population of Jacobsdal (48.1% and 36.7%, respectively). The municipality's gender ratios are not very skewed, the female population accounts for slightly more of the population compared to the male population in the Sol Plaatjie LM, Tokologo LM and Kimberley, while the opposite is true for the Letsemeng LM and Jacobsdal.

The youth (age 15-34) make up the majority of the people living in the primary study areas, with 31.7%, followed by the group between the ages of 35 and 64 years. Considering the working age group that is between the ages of 15 and 64, all study areas have slightly bigger percentage of working age females than males with the exception of Letsemeng LM and Jacobsdal. The population in the study areas is characterised by a high dependency ratio (between 47.8% and 58.7%).

3.7.3 Economy

The structure of the economy and the composition of its employment provide valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector are also important for the economic impact results' interpretation, as it allows the assessment of the extent to which the proposed activity would change the economy, its structure, and trends of specific sectors.

The Sol Plaatjie economy is relatively larger than the other economies under analysis; in 2013 it was valued at R16 532 million in current prices. This translates to a per capita Gross Domestic Product (GDP) of R66 650. The Letsemeng and Tokologo economies were valued at R1 927 million and R986 million in 2013 current prices, respectively. The per capita GDP for these local municipalities is considerably lower than that of the Sol Plaatjie LM with R49 885 for Letsemeng LM and R34 015 for Tokologo LM. Over a period of ten years (2003-2013), the SPM economy grew at a Compounded Average Growth Rate (CAGR) of 2.6% per year while that of the LLM grew at 2.5% per year. Although the TLM has the smallest economy, its economy grew at a higher rate of 3.3% over the same period. The comparatively high growth rate in the TLM can be attributed to the growth recorded in the wholesale, trade, and accommodation, utilities and community and personal services sectors (Quantec, 2016).

In terms of economic activities, the economy of the SPM depends heavily on the tertiary sector, which made up 84.3% of GDP-R in 2013. The largest single contributing sector is the government services sector. The economy of Letsemeng is also largely dependent on the tertiary sector; the finance and business services sector makes the most significant contribution to the local economy (19.4%), this sector's GDP generates just more than a quarter of the LM's GDP. The primary sector is also a significant contributor to the LM's economy; in 2013, agriculture contributed 12.7% to Letsemeng's GDP while mining contributed 10.3%. Within the TLM, it is evident from the manufacturing sector's contribution to the GDP of 28.6% that there is a significant amount of processing of the primary commodity output in agriculture and mining that takes place. The secondary sector significantly contributes to the LM's GDP. Other significant contributors to the LM's economy include finance and business services (16.2%), personal services (10.2%) and trade sectors (9.8%) (Quantec, 2016).

Table 60. Economic structure of the delineated study areas

Economic Sector	Sol Plaatjie LM		Letsemeng LM		Tokologo LM	
	GDP in current prices (R'm)	% of GDP	GDP in current prices (R'm)	% of GDP	GDP in current prices (R'm)	% of GDP
Agriculture	R 112	0.7%	R 246	12.7%	R 96	9.8%
Mining and quarrying	R 1,592	9.6%	R 199	10.3%	R 72	7.4%
Manufacturing	R 396	2.4%	R 185	9.6%	R 282	28.6%
Electricity, gas and water	R 276	1.7%	R 102	5.3%	R 17	1.8%
Construction	R 221	1.3%	R 53	2.8%	R 18	1.8%
Trade	R 2,367	14.3%	R 102	5.3%	R 97	9.8%
Transport and communication	R 1,718	10.4%	R 129	6.7%	R 69	7.0%
Finance and business services	R 3,037	18.4%	R 374	19.4%	R 160	16.2%
Personal services	R 2,118	12.8%	R 217	11.3%	R 100	10.2%
General government	R 4,696	28.4%	R 320	16.6%	R 73	7.4%
TOTAL	**R 16,532**	**100.0%**	**R 1,927**	**100.0%**	**R 986**	**100.0%**

Source: (Quantec, 2016)

3.7.4 Labour Force and Employment Structure

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs and improve their standard of living. As such, employment and unemployment rates are important indicators of socio-economic well-being.

The Census 2011 data indicates that the Sol Plaatjie LM had about 164 394 people in the working-age population. Of these, 93 190 people were economically active; while roughly 43% of the working age population were not economically active (NEA); that is, persons aged 15–64 years who are neither employed nor unemployed at the time of the survey, including discouraged job seekers. The employed labour in the LM was estimated at 63 454; while the unemployed population was estimated at 29 736, reflecting an unemployment rate of 31.9%. This was the highest recorded unemployment rate among the delineated study areas (**Table 61**).

Table 61. Labour force of the delineated study areas

Indicator	Sol Plaatjie LM	Letsemeng LM	Tokologo LM	Kimberley	Jacobsdal
Working age population	164 394	25 098	18 205	65 641	2 296
Non-economically active population	71 204	13 146	8 955	24 944	1 177
Labour force	93 190	11 952	9 250	40 697	1 119
Employed	63 454	9 351	6 713	31 645	813
Unemployed	29 736	2 601	2 537	9 052	306
Unemployment rate	31.9%	21.8%	27.4%	22.2%	27.3%
Labour force participation rate	56.7%	47.6%	50.8%	62.0%	48.7%

Source: (Stats SA, 2016)

In the Kimberley, 31 645 of the working age population were employed, with 9 052 of them unemployed. This means that 22.2% of the labour force in Kimberley was unemployed. On the other hand, 24 944 (38%) of the working age population were not economically active. In Jacobsdal, the unemployment rate was higher, at 27.3%.

Between 54% and 76% of the employed within the delineated study areas were employed in the formal sector. The Letsemeng LM recorded the highest percentage of informal employment opportunities (31.4%). Private households provided for between 11.3% and 22.1% of the employment opportunities in the study areas. In Kimberley, 75.9% of the employment opportunities were provided by the formal sector and only 10.8% came from the informal sector. In Jacobsdal, 60.4% of the population is employed in the formal sector while 18.8% of the employment opportunities come from the informal sector.

Table 62 below indicates the contribution of economic sectors to employment in the local municipalities.

Table 62. Employment structure

Economic Sector	Sol Plaatjie LM		Letsemeng LM		Tokologo LM	
	Number	% of total employment	Number	% of total employment	Number	% of total employment
Agriculture	1 714	2.3%	3 977	32.8%	1 276	21.6%
Mining and quarrying	2 715	3.6%	195	1.6%	66	1.1%
Manufacturing	2 532	3.3%	691	5.7%	863	14.6%
Electricity, gas and water	229	0.3%	93	0.8%	14	0.2%
Construction	3 910	5.2%	956	7.9%	343	5.8%
Trade	13 477	17.8%	731	6.0%	829	14.1%
Transport and communication	2 651	3.5%	301	2.5%	203	3.4%
Finance and business services	11 292	14.9%	1 303	10.7%	458	7.8%
Personal services	12034	15.9%	2 681	22.1%	1 420	24.1%
General government	25 201	33.3%	1 209	10.0%	427	7.2%
TOTAL	**75 755**	**100.0%**	**12 135**	**100.0%**	**5 895**	**100.0%**

Source: (Quantec, 2016)

In terms of skills levels, about 24.5% of the formally employed population in the Sol Plaatjie LM is highly skilled while 45% is skilled, and the remaining 30% is semi-skilled and unskilled. The majority of the employed population in Letsemeng (62.5%) and Tokologo (58.3%) is either semi-skilled or unskilled. Only 12% of the employed population in these areas is highly skilled. As the construction of power lines requires highly skilled personnel, possibly these will be sourced from Sol Plaatjie LM.

3.7.5 Income

According to the 2011 Census, literacy levels in Kimberley and Sol Plaatjie are relatively high as compared to the other study areas. The low literacy levels in the other study areas indicate communities that are less employable than Kimberley. Approximately 16.4%, 20.2 and 22.2% of Letsemeng's, Tokologo's and Jacobsdal's respective populations, aged 20 years and older, have had no access to formal education, while 4.5% of the population of Kimberley has had no schooling. In the SPM and Kimberley, 28.6% and 29.9% of the population aged 20 years and older, successfully completed matric, with 10.3% and 17% achieving a higher education respectively. In Letsemeng, Tokologo and Jacobsdal, only 18.1%, 17.4% and 17.7% of the respective population, aged 20 and older, have obtained a matric certificate. Low levels of education among people are generally associated with low levels of employability due to the low levels of skills that these people

possess. Education is therefore, important as it can afford one an opportunity to have a decent job that in turn leads to a better standard of living and therefore, reduces the scourge of poverty.

Household income levels vary from settlement to settlement within the study areas. The SPM and Kimberley are clear examples of the phenomenon that the higher the percentage of educated people in a given community, the higher the monthly average household income. 9.6% of households in the TLM have no income, while about two thirds have an average monthly income of less than R3 200. This means that these households are unable to afford a basic minimum standard of living and are experiencing relatively low living standards and poor quality of life.

Table 63. Household income levels

Study area	No income	<R3 200	Weighted average monthly HH income (2015 prices)
Sol Plaatjie LM	11.8%	43.8%	R11 291
Letsemeng LM	10.2%	58.9%	R6 205
Tokologo LM	9.6%	65.6%	R5 545
Kimberley	9.0%	31.9%	R17 764
Jacobsdal	10.0%	56.7%	R7 577

Source: Urban-Econ calculations based on Census 2011 data, 2016

3.7.6 Existing and planned developments in the area

The proposed project is to be located in the area of notable activity when it comes to renewable energy projects. Therefore, when evaluating the potential impacts, the following projects that have already been approved under the RE IPPPP need to be considered:

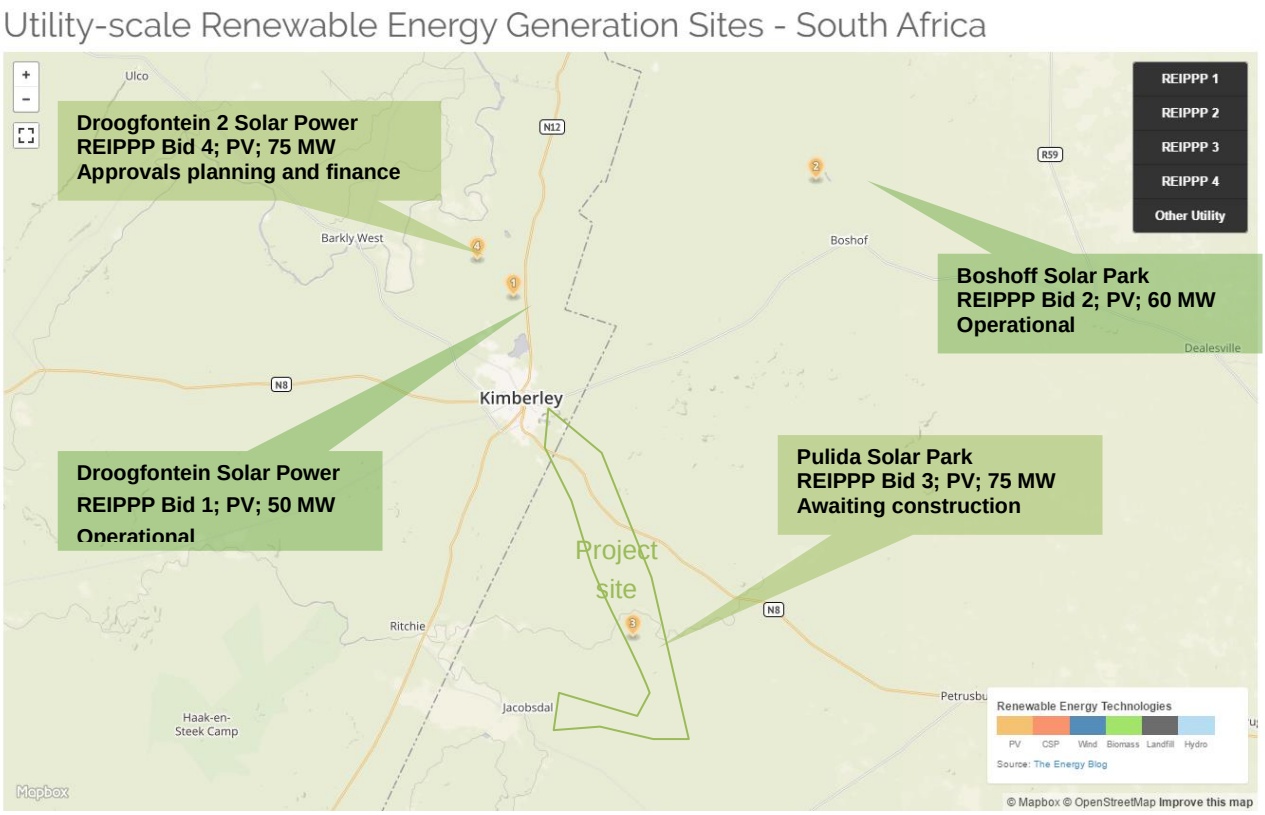


Figure 87. Map of approved for construction and/or operational solar energy projects in the area

From the above, it can be concluded that one solar energy projects approved under RE IPPPP is to be located in direct vicinity of the project site. Other projects are located further up north.

3.7.7 Profile of the zone of influence

3.7.7.1 Land-use and socio-economic profiles

There are approximately 60 farm portions located in the zone of influence of the three power line corridor alternatives. The following diagram illustrates their location relative to the alternatives.

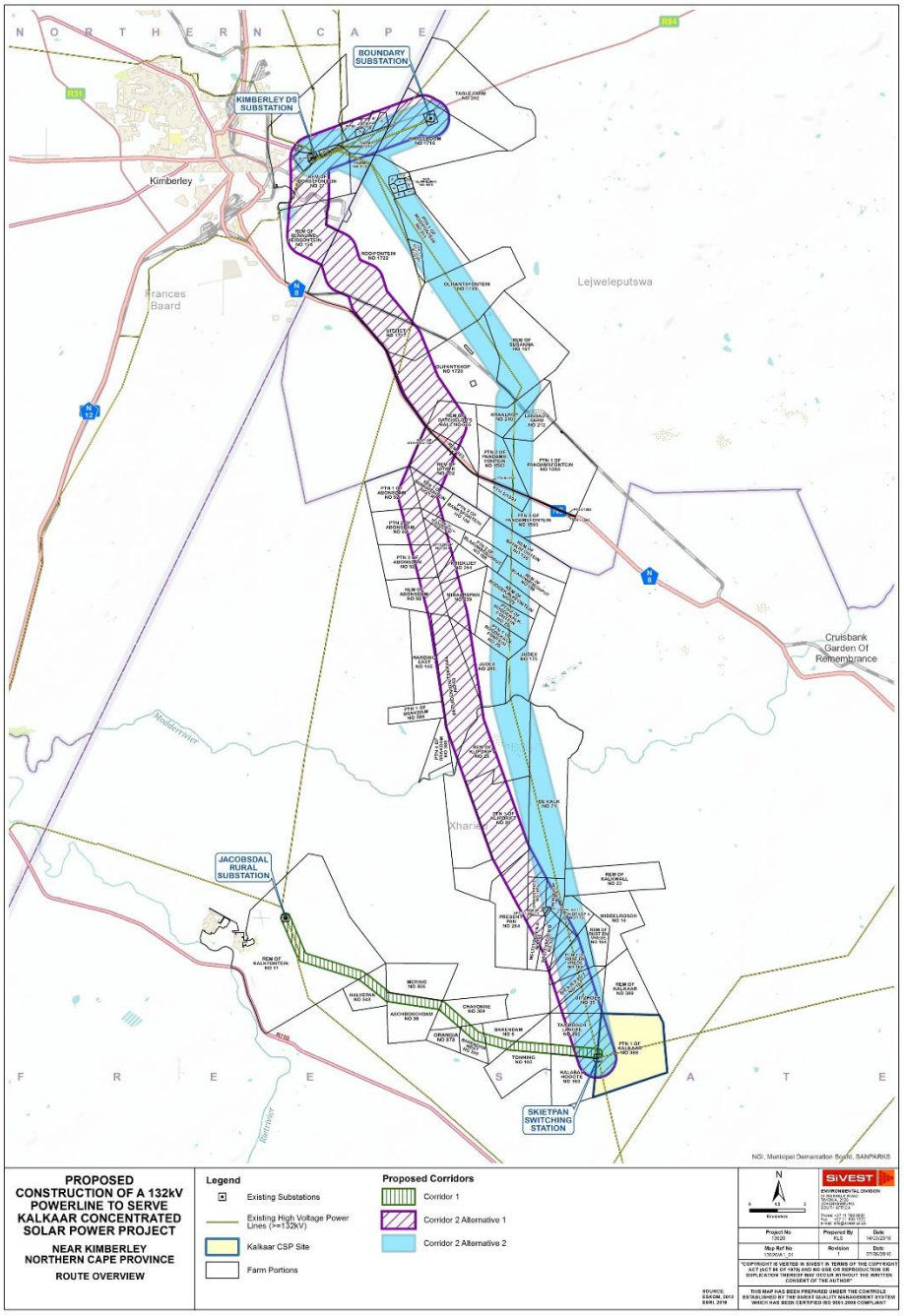


Figure 88. Farm portions within the zone of influence (SiVest Environmental 2016)

3.7.7.2 Review of alternatives

Three site alternatives have been chosen for the proposed power lines. The following table indicates the farm portions that could be impacted by each of these alternatives. It should be highlighted though that the exact location of the power lines within each of the corridors is not yet determined. If power line is developed, a 31m servitude will be required.

Table 64. Farm portions to be affected by each corridor alternative

Farm portion	Corridor 1	Corridor 2 Alternative 1	Corridor 2 Alternative 2
	20 km in length	62 km in length	62 km in length
Portion 2 of Blaauwboschput 186			Yes
Portion 1 of Banksfontein 136		Yes	
Portion 2 of Banksfontein 136		Yes	
Portion 1 and the remainder of Uitkyk 102		Yes	
Portion 1 of Klipdrift 20		Yes	Yes
Remainder of Klipdrift 20		Yes	Yes
Judex 240		Yes	Yes
Harding east 146		Yes	
Remainder of Abonsdam 92		Yes	
Bezuidenhoutskraal 53		Yes	
Portion 1+2 of Roodekalkfontein		Yes	Yes
Minnaarspan 239		Yes	Yes
Portion 3 of Pandamsfontien 1593			Yes
Remainder of Banksfontein 136			Yes
Excelsior 175			Yes
Remainder of Blaauwboschput 186			Yes
Remiander of Roodekalkfontein 25			Yes
Rondekop 107, Rondekop 172,		Yes	Yes
Driekoppies 109,		Yes	Yes
Portion 1 of Opstal 111		Yes	Yes
Remainder of Opstal 111		Yes	Yes
Weltevreden 165, 170, 171.		Yes	Yes
Portion 1+2 of Abonsdam 92		Yes	
Portion 1 of Pandamsfontein 1593			Yes
Tonning 185.	Yes		
Uitzhoek 35,		Yes	Yes
Taaiboschlaagte 160,	Yes	Yes	Yes
Kalbas Hooghte 163,	Yes	Yes	Yes
Biesjes Put 157,		Yes	Yes
Portion 1+remainder of Rust en vrede 164.		Yes	Yes
Bakendam wes 330	Yes		
Laudau's dam 212			Yes
Portion 1 of New klippiesfontein 1635, Rooifontein 211			Yes
Portion 1 and 4 of Brakdam 388	Yes		
Kareeboom 1716	Yes		
Portion 2 of Pandamsfontein 1593			Yes
Spitzkop 241		Yes	

Farm portion	Corridor 1	Corridor 2 Alternative 1	Corridor 2 Alternative 2
	20 km in length	62 km in length	62 km in length
Rem of Kalkwal 23			Yes
Aschboschdam 36	Yes		
Portion 1 Of Speculate 217			Yes
Krieklief 314		Yes	
Portion 1 of Kalkaar 389	Yes	Yes	Yes
Rem Batchelor's Hall 565		Yes	
Portion 2 of New Klippiespan 1635			Yes
Portion 3 Of New Klippiespan 1635			Yes
Portion 4 Of New Klippiespan 1635			Yes
Portion 5 Of New Klippiespan 1635			Yes
Portion 6 Of New Klippiespan 1635			Yes
Portion 7 Of New Klippiespan 1635			Yes
Portion 8 Of New Klippiespan 1635			Yes
Portion 9 Of New Klippiespan 1635			Yes
Portion 10 Of New Klippiespan 1635			Yes
Portion 13 of Dorstfontein 77		Yes	Yes
Portion 3 of Jockey 78		Yes	Yes
Portion 7 of Jockey 78		Yes	Yes
Rem of Jockey 78		Yes	Yes
Farm 211		Yes	Yes
Farm 211	Yes		
Chavonne 364	Yes		
Merino 366	Yes		
Orangia 373	Yes		

The following can be highlighted from the table above:

- The zone of influence for the Corridor 1 Alternative is significantly different from those of Corridor 2 Alternative 1 and Alternative 2. However, all three corridors will affect Portion 1 of Kalkaar 389, Taaiboschlaagte 160 and Kalbas Hooghte 163.
- There are some overlaps in the affected farm portions between Corridor 2 Alternative 1 and Corridor 2 Alternative 2.
- Corridor 1 appears to affect the least number of farm portions.

The following sections describe the socio-economic characteristics of the zone of influence of each alternative, which informs the identification of the preferred route.

3.7.7.2.1 Corridor 1

The Corridor 1 alternative will be 500m in width (250m on either side of the centre line) and 20km in length originating from the Kalkaar CSP and routing to the Jacobsdal Substation. This corridor alternative will affect about 12 farm portions of varying sizes and land-uses. Data could only be obtained for six of the farm portions. The information on the farm portions, for which data was

possible to obtain is sumamrised in the table below; however, it should be noted that the quantitative data given below could be underestimated.

Table 65. Summary of affected farm portions – Corridor 1

Indicator	Description
Length	• 20km
Visibility from the major tourist routes	• No major tourist routes in the area, mostly commercial farming takes place. However, the powerlines will be visible to tourists visiting the affected game farms.
Affected # of farm portions	• 12
Area of affected farm portions	• Over 7 000 hectares
Affected land uses and estimated derived value	• Commercial livestock and/or game breeding • +455 cattle and +1 230 wildlife species (including exotic wildlife) • +R20 million per annum
Total number of people employed	• Temporary: N/A • Permanent: +25
Total number of permanent residents	• +33
Expected changes to socio-economic situation	• Temporary employment creation and local economic impact • Increased traffic volumes during construction • Influx of job seekers to the area
Key concerns raised	• Helicopters will not be able to fly over the farms for game viewing • Negative impact of project on road infrastructure

3.7.7.2.2 Corridor 2 Alternative 1

The Corridor 2 Alternative 1 option is 2km in width (1km on either side of the centre line) and 62km in length originating from the Kalkaar CSP Project site routing via the Kimberley Distribution Substation to the Boundary Substation. This corridor option will affect about 31 farm portions of varying sizes and land-uses. Data could only be obtained for 23 of the farm portions, which gives a fair representation of the current socio-economic situation of the potentially affected area; it should be noted however, that the quantitative data given below could be slightly underestimated.

Table 66. Summary of affected farm portions – Corridor 2 Alternative 1

Indicator	Description
Length	• 62km
Visibility from the major tourist routes	• No major tourist routes in the area, mostly commercial farming takes place. However, the powerlines will be visible to tourists visiting the affected game farms.

Indicator	Description
Affected # of farm portions	• 31
Area of affected farm portions	• Approximately 19 345 hectares
Affected land uses and estimated derived value	• Commercial livestock and/or game breeding • Approximately 1 220 cattle and 720 wildlife/game animals (including exotic wildlife) • +286 tons of meat production per year
Total number of people employed	• Temporary: N/A • Permanent: +37
Total number of permanent residents	• +52
Expected changes to socio-economic situation	• Temporary employment creation and local economic impact • Increased traffic volumes during construction • Influx of job seekers to the area
Key concerns raised	• Livestock theft • Visual impact • Water quality and quantity • Veld fires – caused by smoking construction workers • Negative impact of project on road infrastructure • Impact on fertility of animals

3.7.7.2.3 Corridor 2 Alternative 2

The Corridor 2 Alternative 2 option is 2km in width (1km on either side of the centre line) and 62km in length, and will also originate from the Kalkaar CSP Project site and route via the Kimberley Distribution Substation to the Boundary Substation. This corridor option will affect about 39 farm portions of varying sizes and land-uses. Data could only be obtained for 25 of the farm portions, meaning a response rate of 64%, which gives a fair representation of the current socio-economic situation of the potentially affected area; it should be noted however, that the quantitative data given below could be slightly underestimated.

Table 67. Summary of affected farm portions – Corridor 2 Alternative 2

Indicator	Description
Length	• 62km
Visibility from the major tourist routes	• No major tourist routes in the area, mostly commercial farming takes place. However, the powerlines will be visible to tourists visiting the affected game farms.
Affected # of farm portions	• 39
Area of affected farm portions	• 18 340 hectares
Affected land uses and estimated derived value	• Commercial livestock and/or game breeding • Mixed irrigation farming

Indicator	Description
	• Approximately 1 050 cattle, 1 130 sheep, and 750 wildlife/game animals (including exotic wildlife) • +200 tons of meat production per year
Total number of people employed	• Temporary: 23 • Permanent: 47
Total number of permanent residents	• 71
Expected changes to socio-economic situation	• Sterilisation of land on the farm Klipdrift 20 – resulting from another proposed project • Temporary employment creation and local economic impact • Increased traffic volumes during construction • Influx of job seekers to the area
Key concerns raised	• Security – increase in crime in the area • One farm owner is against the project • Increased traffic volumes during construction, which will have a negative impact on the roads • Helicopters will not be able to fly over the farms for game viewing • Cumulative visual impact in terms of the erection of a power line in addition to the existing power lines • Another proposed project will result in sterilisation of some land – compensation is required for this

The majority of the land owners engaged with during the primary data gathering do not have objections to the development of a power line. Some, though, have raised concerns with respect to the potential effects that the proposed power line may have on their current activities and requested that they are consulted prior the decision on the actual route of a power line is made. The land owners who emphasised the need for consultation included those who were engaged in commercial livestock farming and/or commercial game farming or have agreed to develop solar energy projects on their properties.

Considering the feedback provided by the potentially affected land owners, the potential impacts that will need to be examined include:

- The possible impact on current business activities on the farms;
- The possible impact on future planned developments, specifically the Pulida Solar Park;
- The possible impact on property (i.e. loss of property).

3.7.8 Impact Evaluation and Proposed Mitigation Measures

3.7.8.1 Impact 1: Stimulation of the economy during construction

The erection of power lines and the development of the associated infrastructure (e.g. bay substations, access road, buildings, security fence, etc.) will be associated with the procurement of a wide range of materials and equipment including steel products, cables, electrical components, bricks, cement, etc. Capital expenditure on these will increase the revenue of the businesses supplying the required inputs. In addition, construction-related services will be procured for the erection of the power line and construction of associated infrastructure. Spending on the above-mentioned activities, will lead to the procurement of inputs required for the production of materials and equipment needed for the construction of the project-related components. On the other hand, personal income derived by people benefiting from these activities directly or indirectly will stimulate consumption expenditure in the economy. All of these activities will benefit the national economy by temporarily increasing its output. Importantly, some services, for example construction-related services, may even be localised in the economies of Sol Plaatjie, Letsemeng and Tokologo.

It is estimated that a total of R20 million will be spent on the construction of associated infrastructure. This spending will remain the same regardless of the corridor option selected. However, the longer power line corridor option will be associated with the greater need for materials and therefore, will lead to greater capital requirements and higher economic benefits.

Assuming a cost of constructing a power line equates to about a R2 million per kilometre, the following capital investments will be associated with each corridor alternative in addition to the above-mentioned R20 million to be spent on associated infrastructure:

Alternative	Length	Cost of a power line	Total capital investment	Impact on production nationwide
Kalkaar CSP via Kimberley DS to Boundary Substation Alternative 1	62	R124m	R144m	R432m
Kalkaar CSP via Kimberley DS to Boundary Substation Alternative 2	62	R124m	R144m	R432m

The following table provides an evaluation of the discussed impact:

Table 68. Impact on economic production

Environmental Parameter	*Economic production*	
Issue/Impact/Environmental Effect/Nature	*Capital expenditure on the erection of power lines and construction of associated infrastructure will increase the production in the national economy*	
Extent	*International and national*	
Probability	*The impact will certainly take place*	
Reversibility	*The impact is irreversible as expenditure on procurement of goods and services will not be paid back by the businesses*	
Irreplaceable loss of resources	*No loss of resources could be identified*	
Duration	*Will take not more than 24 months (2 years) to complete*	
Cumulative effect	*South Africa is seeing an unprecedented investment in utilities and associated infrastructure, the trend that is expected to remain in the short-to medium term; however, the value of the proposed development will result in a negligible cumulative effect, which is not expected to have a notable impact on the growth of the economy.*	
Intensity/magnitude	*The envisaged capital investment will stimulate production of businesses nationwide to the value of R432m. This will be created through both direct and multiplier effects. The variances related to the Corridor Alternatives are not sufficient to differentiate among them.*	
Significance Rating	*The impact will have a medium positive significance due to the benefits to be accrued in the economy. It will be the same for both Corridor Alternatives considered, as the production variances related to them are not sufficient to differentiate among them.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4

Reversibility	4	4
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	30 (medium positive)	30 (medium positive)
Mitigation measures	• *Investigate the opportunity to procure services required during construction within the local economy* • *Where practically possible, procure required services from local businesses*	

3.7.8.2 Impact 2: Creation of employment and household income during construction

The erection of power lines and the construction of associated infrastructure will require temporary employment of construction workers, foremen, and engineers on site. It is estimated that between 15 and 30 direct jobs will be created during the construction phase, which will likely to last less than two years. About 45% of these jobs are likely to be filled by people from the local communities. Employment of the individuals, albeit temporarily, will increase their household income and benefit their families.

The following table provides an evaluation of the discussed impact.

Table 69. Impact on employment and income

Environmental Parameter	*Employment and income*
Issue/Impact/Environmental Effect/Nature	*Capital expenditure will result in the creation of temporary direct employment opportunities during construction that also temporarily increase affected households' income*
Extent	*All discussed employment opportunities will be created on site*
Probability	*The impact will definitely take place*
Reversibility	*The impact is irreversible as income derived from the employment will not be paid back to the developer*
Irreplaceable loss of resources	*No loss of resources can be identified*

Duration	*The impact will last for less than 2 years*	
Cumulative effect	*One solar energy project is to be built in the zone of influence; however, the larger region has seen the establishment of at least four other solar energy projects. The development of the proposed power line will increase the construction-related activity, however, its cumulative effect in light of the economic activity observed in the area is not going to be notable.*	
Intensity/magnitude	*The number of jobs created as well as their duration will not be so notable as to result in significant changes in the local or national employment situation. The possible variations among the corridor alternatives in terms of the duration of employment of the number of people employed is not sufficient to assign different intensity scores.*	
Significance Rating	*The impact on direct employment and income will be low as it will affect a relatively small number of households and will last for a very short-term.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	12 (low positive)	12 (low positive)
Mitigation measures	*Maximise job creation and allocation to locals as far as practically possible.*	

3.7.8.3 Impact 3: Strengthening of the national grid capacity

The proposed development of the power line and associated infrastructure will connect the Kalkaar CSP plant to the national grid. This will assist in developing a more dispersed generation in the country, which will in turn increase the national grid capacity.

The following table provides an evaluation of the discussed impact. Where alternatives are rated differently, a note is provided; otherwise, the impact table applies to all alternatives considered.

Table 70. Impact on strengthening of the national grid

Environmental Parameter	*Strengthening of the national grid capacity*	
Issue/Impact/Environmental Effect/Nature	*The proposed power line will connect Kalkaar CSP plant to the national grid, which will result in a more dispersed generation of electricity through the country and reduce transmission losses*	
Extent	*The benefits will of national extent*	
Probability	*The reduction in losses on the transmission network is possible*	
Reversibility	*The impact could be reversed as a result of technical faults or other conditions*	
Irreplaceable loss of resources	*No losses of resources could be identified*	
Duration	*The impact will remain until the decommissioning of the plant, i.e. last for 10-50 years*	
Cumulative effect	*Multiple renewable energy utility projects are being developed in the area and it is estimated that at least 260MW of electricity generating capacity will already be added to the grid in the region surrounding Kimberley by the time the proposed Kalkaar is built. Its connection to the grid, though will further aid in dispersed generation, which could have a notable positive effect on transmission losses.*	
Intensity/magnitude	*Without empirical evidence, the magnitude of the contribution that the proposed connection of the CSP plant to the national grid would have on reduction of transmission losses is not possible to ascertain. Therefore, a conservative approach is followed and a low magnitude is assigned.*	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating

Extent	4	4
Probability	2	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	1	1
Significance rating	16 (low positive)	16 (low positive)
Mitigation measures	*No mitigation measures could be identified for the proposed project to enhance the positive impact*	

3.7.8.4 Impact 4: Impact on current business activities

The area where the proposed Corridors are to be located is primarily used for farming. These activities largely include commercial livestock farming (mainly cattle) and commercial game farming, which in turn comprises of game breeding and game hunting activities. Livestock farming, from a socio-economic perspective, is believed to be not sensitive to the established power lines; however, commercial game farming activities may be negatively impacted by power lines either due to the need to change some of the business practices or due to the visual impact that it creates that may act as a deterrent for tourists visiting the affected farm.

The site visit into the area suggests that the landscape in the area is already impacted by man-made structures, and it has been observed that while power lines are not usually welcomed in rural areas, they are a very common feature of the rural landscape. Importantly, no empirical evidence exists that power lines, especially of lower voltage, have indeed deterred potential tourists from visiting the area. Having said this, the development of the power lines, especially prior the route is chosen, should be done in such a way as to consider the current land uses in the area and avoid creating unnecessary pressure on current activities or imposing unnecessary changes to the existing practices. This implies choosing the route in such a way as to minimise the potential negative effect on the farms that are used for commercial activities that may be more sensitive to the presence of power lines than others, such as commercial game hunting activities and commercial game breeding activities.

Overall, most of the land owners who farm on the potentially affected properties have indicated that they did not object to the establishment of a power line across their properties. However, they emphasised that the route chosen for the power line should be such that would not affect their current commercial activities and business practices, thus requesting to be consulted when it is chosen. Certain land owners though raised a concern over the potential visual impact that the

power lines may create and the fact that they may no longer be able to use helicopters for game management. More specifically, the data gathered with respect to the farms that the power line corridors may traverse suggested the following:

- Corridor 1:
  - Twelve farm portions are to be affected of which five are known to be used for commercial livestock and game breeding.
  - Two of the farm owners have raised a concern over the fact that the power lines may prevent them using helicopters for game managements.
- Corridor 2 Alternative 1:
  - Thirty-one farm portions are to be affected, of which 21 are known to be used for commercial livestock or game farming activities.
  - Land owners of two of the farm portions that were possible to engage with raised a concern over the restriction that power lines may cause for helicopter flights over their game farms for game management.
  - Another two land owners were worried about the negative visual impact that power lines may have on the attractiveness of their farms among tourists interested in game viewing and hunting.
- Corridor 2 Alternative 2:
  - The corridor traverses 39 farm portions, of which 22 are known to be used for commercial livestock and game farming activities.
  - Most of the farms along the corridor are used for game breeding, however, only one of the land owners of the farm portions located along this corridor raised a concern over the fact that helicopters may be prevented from flying for game management.
  - Also, only one of the known farm portions along this corridor is used for game hunting; the owner of that farm portion though raised a concern over the cumulative effect that the power lines will have on the property due to the presence of other transmission infrastructure on his property.

The following table provides an evaluation of the discussed impact. Since all corridor options and alternatives include farms where business practices may be impacted, the assessment applies to all options considered.

Table 71. Impact on current business activities

Environmental Parameter	*Impact on current business activity*	
Issue/Impact/Environmental Effect/Nature	*The area where the proposed power lines are to be located include farms where commercial livestock and game farming activities take place. Depending on the location of power lines, business practices associated with game breeding (i.e. helicopter usage for game management) and game hunting may be negatively impacted.*	
Extent	*The impact is site specific*	
Probability	*The probability of the impact is very small due to the extent of the corridor and the size/servitude of the power line*	
Reversibility	*The impact can be reversed by carefully selecting the route of the power line*	
Irreplaceable loss of resources	*The impact will result in marginal loss of resources (land).*	
Duration	*Will last for the duration of the project's life*	
Cumulative effect	*Considering other solar energy projects planned in the area, which will also require grid connection, the impact may be notable*	
Intensity/magnitude	*The potential losses, if any, are not expected to jeopardize the operations but may be noticeable*	
Significance Rating	*Due to the small extent and probability the significance of the impact is expected to be low.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	1	1
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-22 (low negative)	-8 (low negative)

Mitigation measures	*Due to nature of the businesses of landowners, consultation was identified as important with regard to the final power line alignment routing for the project.*

3.7.8.5 Impact 5: Impact on future developments

One of the farms (i.e. Klipdrift 20) located in the zone of influence has been selected for the construction of the Pulida Solar Park project. The establishment of the power line, therefore, should be done in such a way as to not affect the development of the project by sterilising land in such a way as to conflict with the layout plans for the said project. It would be important to consult with the developer of the solar project to avoid this impact.

The following table provides an evaluation of the discussed impact.

Table 72. Impact on future developments

Environmental Parameter	*Impact on future developments*
Issue/Impact/Environmental Effect/Nature	*Depending on the route chosen, the power line could sterilise the land in a such a way so as to conflict with the layout plans of the said projects.*
Extent	*The impact is site specific*
Probability	*The probability is small as the corridor is vast; furthermore, the development of the power line is likely to be done during or after the solar project is constructed and will therefore need to take into account the layout of the facilities and associated infrastructure*
Reversibility	*The impact is reversible by designing a route that does not conflict with layout plans of the other facilities*
Irreplaceable loss of resources	*No losses of resources*
Duration	*Short-term, until the possible conflicts are resolved*
Cumulative effect	*Although the power line is to be constructed in the area where other similar infrastructure may need to*

	be developed, the cumulative effect on the development of these projects is considered to be non-existent	
Intensity/magnitude	*Without proper consultation and planning the impact may be severe as it may affect the implementation of other solar projects.*	
Significance Rating	*The significance of the impact is expected to be low due to the low extent of the impact and the fact that the project is to be implemented after or during the construction of Pulida Solar Park.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	3	1
Significance rating	-21 (low negative)	-6 (low negative)
Mitigation measures	*Due to nature of the businesses of landowners, consultation was identified as important with regard to the final power line alignment routing for the project.* *The developers/owners of the solar energy park project will also need to be consulted prior the selection of the final power line route and tower positions before construction commences.*	

3.7.8.6 Impact 6: Loss of property

Many of the interviewed farm owners raised concerns with respect to security and potential loss of property during construction as the project will see an influx of workers to the area. These concerns included stock theft, burglaries, and the risk of veld fires as a result of smoking workers.

Considering the distances and the number of farm portions that are to be traversed or affected by the power lines as well as the potential influx of workers, it can be argued that the corridor with the shortest length associated with construction of a power line would be a preferred route as it would minimise the number of farm portions that may be impacted, as well as the duration of exposure to an impact by a farm owner. However, it should be noted that none of the land owners associated with Corridor 1 option, who were possible to interview during the study, raised any concern regarding security of the animals or other crime-related risks. Many of the land owners located along Corridor 2 Alternatives, though, raised concerns over potential theft of livestock and other damages that may be incurred to their properties as a result of presence of construction workers on their farms.

The following table provide evaluation of the discussed impact

Table 73. Impact on property

Environmental Parameter	*Impact on property*	
Issue/Impact/Environmental Effect/Nature	*The impact occurs due to the presence of construction workers on the farms, which may lead to stock theft, loss of livestock due to gates not be closed properly, burglaries, and veld fires.*	
Extent	*Site specific*	
Probability	*The impact is possible*	
Reversibility	*The impact is reversible once construction workers are no longer present on a farm and move out from the area*	
Irreplaceable loss of resources	*This impact could be associated with some losses of personal goods and livestock.*	
Duration	*The impact is expected to last for the construction period only*	
Cumulative effect	*The cumulative impact is expected to be minor, considering that one other project is known to be built in the area*	
Intensity/magnitude	*The impact is expected to be medium as it may be noticeable but is unlikely to complete jeopardise activities on the farms*	
Significance Rating	*Due to the extent and*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1

Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	3	3
Intensity/magnitude	2	1
Significance rating	-22 (low negative)	-9 (low negative)
Mitigation measures	*The alternative chosen should be one where staff control measures can be implemented effectively. The following mitigations are advised to be instituted to minimise and possibly eliminate the impact altogether:* • *Access to the construction site must be strictly controlled.* • *Fire prevention measures must be implemented and fire control equipment must be present at strategic locations within the construction site.* • *Maximise job creation and allocation to locals as far as practically possible. Recruitment of workers should be planned in advance and should not take place on-site. This will reduce the probability of work seekers loitering in the area surrounding the project sites.*	

4 EVALUATION AND RECOMMENDATIONS

It is summarised in **Table 74**, the key recommendations for the environmental issues identified in the BA. In order to achieve appropriate environmental management standards and ensure that the findings of the environmental studies are implemented through practical measures, the recommendations from this BA are included within an Environmental Management Programme (EMPr), which is included in **Appendix G**.

Table 74: Summary of findings and Recommendations

Environmental Parameter	Summary of Major Findings	Recommendations
Biodiversity	In terms of flora, within the area affected by the proposed development, vegetation types that are affected include Kimberly Thornveld and Northern Upper Karoo, Highveld Salt Pans and Vaalbos Rocky Shrubland. Within these vegetation types however, the specific habitats that are actually occurring within the proposed corridor alternatives include the following: ▪ Kimberley Thornveld – Protected and listed species include *Boscia albitrunca and Acacia erioloba*; ▪ Northern Cape Upper Karoo; ▪ Vaalbos Rocky Shrubland; ▪ Pans – Protected and listed species include; ▪ Modder River – the Modder River which is considered a sensitive feature due to the ecological significance of this area as a corridor for fauna as well as the unique aquatic habitats present here that are not represented elsewhere in the landscape of the area. There are three (3) species of conservation concern that are listed in terms of the SANBI SIBIS database (quarter degree squares 2824 DB, DD and 2924 BB). Only *Acacia erioloba* can be confirmed present and occurs mostly in the north of the site in the areas of savanna on deeper sands near Kimberly. *Aloinopsis rubrolineata* occurs in areas of exposed calcrete and may occur in the central section of the routes between Kimberly and Kalkaar where such habitat is present, but was not observed. There are however also additional species present which are either protected under the National Forests Act such as *Boscia albitrunca* and *Acacia erioloba* or protected under the Northern Cape Nature Conservation Act of 2009, which includes *Boscia foetida*, all *Mesembryanthemaceae*, all species within the *Euphorbiaceae*, *Oxalidaceae*, *Iridaceae*, all species within the genera *Nemesia* and *Jamesbrittenia*. In terms of fauna: ▪ 51 mammals have been recorded from the quarter degree squares traversed by the power line options. However, as many as 20 of these	▪ Preconstruction walk-through of power line route to identify and locate species of conservation concern that should be avoided or translocated where possible and practicable. ▪ Affected individuals of protected species which cannot be avoided should be translocated to a safe area on the site prior to construction where possible and practicable. . ▪ There are also additional species present which are either protected under the National Forests Act such as *Boscia albitrunca* and *Acacia erioloba* or protected under the Northern Cape Nature Conservation Act of 2009, which includes *Boscia foetida*, all *Mesembryanthemaceae*, all species within the *Euphorbiaceae*, *Oxalidaceae*, *Iridaceae*, all species within the genera *Nemesia* and *Jamesbrittenia*. ▪ Relevant permits (i.e. plant removal/destruction permit from NCPG DENC or protected tree permits from the Department of Agriculture, Forestry and Fisheries (DAFF)) should be obtained before translocation/destruction/removal of listed and protected plant or tree

	are large mammals, introduced or maintained for game farming operations and are not considered relevant to the current study as these are managed populations regulated and confined by landowners. The remaining 30 are free ranging species which occur naturally in the area. ▪ Five listed terrestrial mammals may occur in the area, the Honey Badger *Mellivora capensis* (Endangered), Brown Hyaena *Hyaena brunnea* (Near Threatened), Black-footed cat *Felis nigripes* (Vulnerable), South African Hedgehog *Atelerix frontalis* (Near Threatened) and the Serval *Leptailurus serval* (Near Threatened). ▪ According to the SARCA database, 31 reptile species are known from the area suggesting that the reptile diversity within the site is likely to be fairly low. Species observed in the area include the Cape Skink *Trachylepis capensis*, Ground Agama *Agama aculeata aculeata*, Spotted Sand Lizard *Pedioplanis lineoocellata* and Leopard Tortoise *Stigmochelys pardalis*. There are no listed species known from the area. ▪ The site lies within the distribution range of 10 amphibian species. The only listed species which may occur in the area is the Giant Bullfrog *Pyxicephalus adspersus* which is listed as Near Threatened. Although it has not been recorded from the affected area, it is common in the wider area on account of the large number of pans in the area, which are the breeding habitat of the Giant Bullfrog. The major impacts of the development of the power line would occur during the construction phase, due to the disturbance of largely intact ecosystems that would take place at this time. Construction phase disturbance would however be transient and while impacts on flora are likely to persist for some time, impacts on fauna during operation would be very low. Due to the low overall footprint of the power line and low operational disturbance levels, impacts associated with the construction and operation of the power line would be local in nature and of low overall significance after mitigation. In terms of mitigation, avoidance of the identified sensitive features is considered the most important measure to reduce the impact of the power line to a low level.	species takes place and before construction commences. ▪ Alien species especially large woody species such as *Propsopis glandulosa* should be cleared from the power line servitude, but indigenous species such as *Boscia albitunca* and *Boscia foetida*, should not be cleared ▪ Where the power line runs adjacent to existing power lines or access roads, the existing roads should be used and no additional permanent roads should be constructed for the power line where possible.

	Overall and with the suggested mitigation measures applied, the impact of the proposed 132 kV power line would be of local extent and low significance. There are no impacts associated with the development of the power line that are considered to be high and which cannot be mitigated to a low level. As such, there are no significant ecological reasons to oppose the construction of the Kalkaar grid connections to Kimberly or to Jacobsdal.	
Avi-fauna	An estimated 313 bird species could potentially occur in the study area of which 28 are classified as Red Data species. Three Important Bird Areas (IBAs) in the vicinity including Dronfield Nature Reserve (approx. 5km north Kimberley – SA031), Kamfer's Dam (approx. 6km north of Kimberley – SA032) and Benfontein Nature Reserve (approx. 14km south east of Kimberley – SA033). There is also a vulture breeding area for White-backed Vultures (Susanna Vulture Breeding Area) that can be found covering both Corridor 2 Alternatives 1 and 2, as well as another breeding area approx. 10km outside Jacobsdal. Potential impacts during the construction and decommissioning phase include the displacement of priority species and habitat transformation. Impacts are mainly negative but low. With mitigation, these impacts can be reduced further. For the operation phase, electrocutions and collisions of red data species is the primary potential impact. Potential impacts for collisions of red data species are rated as medium for Corridor 1 Jacobsdal Link and high for Corridor 2 Alternatives 1 and 2. This can be mitigated to a low level for Corridor 1 Jacobsdal Link and a medium level for Corridor 2 Alternatives 1 and 2. Potential impacts for electrocutions of red data species are rated as medium for Corridor 1 Jacobsdal Link and high for Corridor 2 Alternatives 1 and 2. All Corridors can be mitigated to a low level after mitigation. Finally, for the decommissioning phase, displacement of red data species as a result of disturbance is rated as low for Corridor 1 Jacobsdal Link and medium for Corridor 2 Alternatives 1 and 2. All Corridors can be mitigated to a low level after mitigation.	▪ Construction and de-commissioning activities should be restricted to the immediate footprint of the infrastructure. ▪ Access to the remainder of the study area should be strictly controlled to prevent unnecessary disturbance of Red Data species. ▪ Measures to control noise and dust should be applied according to current best practice in the industry. ▪ Existing access roads should be used optimally where possible and the construction of new roads should be kept to a minimum. ▪ Prior to the construction of the line, a walk-through must be conducted to ascertain of any White-backed Vulture breeding pairs will be impacted by the construction activities. If any breeding pairs are potentially at risk, the construction will have to be timed to fall outside the breeding season. ▪ The 132kV grid connection should be inspected at least once a quarter for a minimum of three years by the avifaunal specialist to establish if there is any significant collision mortality in

	Corridor 1 Jacobsdal Link is the shortest power line route and does not transect any vulture breeding areas. All potential impacts can be mitigated to a low level. There is not much difference in preference between Corridor 2 Alternative 1 and 2 as both are relatively the same length and traverse the Susanna White-backed Vulture breeding area. There is no preference between the two alternatives.	line with Eskom's Avifaunal procedures. Thereafter the frequency of inspections will be informed by the results of the first three years. ▪ The detailed protocol to be followed for the inspections will be compiled by the avifaunal specialist prior to the first inspection. ▪ The power line should be marked with Bird Flight Diverters (BFDs) for its entire length on the earth wire of the line, alternating black and white or as per agreement with independent Avifaunal specialist and Eskom. ▪ All the steel monopoles should be fitted with bird perches.
Wetlands	Two (2) main hydrogeomorphic types were identified including well developed riparian systems (namely the Modder River) and several depressions that differ in size (small pans – 0.9ha to 20ha; large pans – larger than 58ha to 401ha). Summary of assessments undertaken applied to riparian resources include the following: ▪ Modder River: PES-C; EI & ES-C; REC-C; Moderately Low Ecological Function and Service Provision; ▪ Large Pans: PES-C; EI & ES-C; REC-C; Moderately Low Ecological Function and Service Provision; and ▪ Small Pans: PES-C; EI & ES-C; REC-C; Moderately Low Ecological Function and Service Provision. Types of impacts to the riparian systems included: ▪ Loss of riparian habitat and ecological structure; and ▪ Changes to riparian ecological and sociocultural service provision; ▪ Impacts on riparian hydrology and sediment balance.	▪ Ensuring that during the design phase, cognisance is taken of the locality of identified freshwater resources and their associated buffers, and as far as is practicable, to avoid the placement of infrastructure within those zones unnecessarily. It is preferable that no infrastructure is placed within the river nor in the pans; ▪ Should it be absolutely essential at certain crossings to place infrastructure within the freshwater resources habitat, access to these areas must be limited to essential personnel (and construction vehicles) and the boundaries thereof are to be clearly demarcated on site. No contract laydown areas are to be

	Overall significance after mitigation is a low negative impact after management and mitigation measure implementation. Based on the findings of this study, it is the opinion of the ecologists that the proposed linear development is regarded as having low levels of impact on the surrounding freshwater resources identified, even if less than desirable mitigation of impacts occurs. With careful planning of the final layout of the powerlines and strict implementation of mitigation measures throughout all phases of the proposed project, impacts can be reduced to very low significance levels and the proposed project should, from a freshwater resource point of view, be considered favourably for development. Following the assessment of perceived impacts, consideration was given as to the preferred corridor option from a freshwater ecology perspective. As Corridor 1 was the only option provided for the routing of the powerline between the Kalkaar CSP to Jacobsdal Substation, this potion is considered to be "favourable". Depending on the final layout of the powerline within the corridor, with avoidance of most of the freshwater resources, this layout could have minimal impacts on the freshwater resources. Corridor 2, Alternative 2 is considered to be the best routing option for the powerline between Kalkaar CSP and the Kimberley Distribution Substation to Boundary Substation, as it traverses over the least amount of freshwater resources identified by this study.	permitted within the freshwater resources habitat or associated buffer zone; ▪ Due to the degraded state of the vegetation, especially within the pans, care must be taken to ensure that as little vegetation as possible is removed, and that all exposed soils as a consequence of construction activities must be suitably protected with a geotextile to prevent erosion and sedimentation of the river, and loss of functionality of the pans; and ▪ Any freshwater resource directly impacted upon during construction activities must be immediately rehabilitated in accordance with the EMPr following the completion of such activities at that specific site.
Soils and Agricultural Potential	The proposed project is can be found on land zoned as and used for agriculture. Soils on the site are predominantly shallow to moderately deep, loamy sands on underlying rock or hard-pan carbonate (Hutton, Mispah and Coega soil forms). The major limitation to agriculture in the study area is the climatic restrictions i.e. moisture/precipitation availability. The limited depth of the soils is a further limitation.	▪ Implementation of an effective system of storm water run-off control to mitigate erosion; and topsoil stripping and re-spreading to mitigate loss of topsoil.

	As a result, the study area is predominantly unsuitable for cultivation and agricultural land use is limited to grazing, except for some small irrigation areas along the Modder River. The land capability of the site varies according to land type from class 5 to class 7, which is from non-arable, moderate potential grazing land to non-arable, low potential grazing land. The limitations to agriculture are aridity and lack of access to water plus shallow soil depth. Because of these constraints, agricultural land use is mostly restricted to grazing. The natural grazing capacity is predominantly 14-17 hectares per animal unit. The centre pivot lands along the Modder River are considered to be of high agricultural sensitivity. The overhead power lines as well as any infrastructure on the ground must avoid these lands. There are three (3) factors that limit the significance of all potential agricultural impacts. The first is that the actual footprint of disturbance of the proposed power line is very small in relation to available, surrounding properties. The second is that the impact of a power line on the kind of agricultural activity (predominantly grazing) along the proposed project is very minimal, as this can continue in the presence of a power line with negligible disturbance. The third factor is that the site has very low agricultural potential, limited by severe climatic restrictions and soils with a low carrying capacity i.e. shallow soils. Four (4) potential negative impacts of the proposed project on agricultural resources and productivity were identified as: ▪ Loss of agriculturally zoned land due to the footprint of the power line infrastructure. ▪ Soil erosion caused by alteration of the surface characteristics. ▪ Loss of topsoil in disturbed areas, causing a decline in soil fertility. ▪ Degradation of veld vegetation beyond the direct footprint due to constructional disturbance, dust and vehicle compaction. All impacts were assessed as having low significance.	

	Recommended mitigation measures include implementation of an effective system of storm water run-off control to mitigate erosion; and topsoil stripping and re-spreading to mitigate loss of topsoil. Because of the low agricultural potential of the site and resultant low agricultural impacts, the development should, from an agricultural impact perspective, be authorised. Because of the low impacts and the uniformly low potential of the site, there is no preference between the different corridor options. There are no conditions resulting from this assessment that need to be included in the environmental authorisation.	
Heritage and Palaeontology	Heritage Findings: An archival and historical desktop study was undertaken which was used to compile a historical layering of the study area within its regional context. This component indicated that the landscape within which the project area is located has a rich and diverse history. These desktop studies were followed by a fieldwork component that comprised driving and walking through the study area. A total of twenty seven (27) occurrences of heritage resources were identified within Corridor 2 Alternative 1. Fourteen (14) of these would require mitigation before exhumation (graves) or destruction (historical structures) if development were to come within 20 m. Site Kal1 and Kal2 must be avoided with a 50 meter buffer. Thirteen (13) occurrences of heritage resources have high significance and should not be disturbed by development within 20 m. It is likely that further survey work in the study area will uncover additional heritage resources, especially graves, ruins and rock art sites on hilltops.	Heritage recommendations ▪ It is likely that further survey work in the study area will uncover additional heritage resources, especially graves, ruins and rock art sites on hilltops. Therefore a final walk-down must be undertaken.

	Palaeontological Findings: The Power line Project footprint is completely underlain by lower Permian sediments of the Ecca Group of the Karoo Basin (White Hill and Prince Albert Formations), Late Permian Volksrust Formation, and the Karoo Dolerite Suite and Quaternary deposits. The Power line Project footprint as a whole is a fairly flat lying terrain with grassy vegetation cover in places as well as a few thorn trees. The Karoo dolerite Suite is unfossiliferous and the sensitivity in the Quaternary sediments is low. Overall Impact Statement: Heritage – The overall impact evaluation has shown that the pre-mitigation impact on heritage resources is rated as High negative. However, with the implementation of the recommended mitigation measures, this will reduce the potential impact to a low negative impact. Corridor 1 and Corridor 2 Alternative 2 are viewed as favourable options due to the low potential impact on heritage resources which can be mitigated to address envisaged impacts. Corridor 2 Alternative 1 however, is viewed as not preferred as there is a large amount of heritage resources along this route. Palaeontology – From a palaeontological perspective, although the palaeontological sensitivity of the Whitehill, Prince Albert and Volksrust Formations is rated as high to very high, scarcity of fossil-bearing sediments and lack of exposure at the proposed sites indicate that the impact on palaeontological material is low. The fossil heritage in the development area is low/ negligible. As such, there is no preference between any of the proposed alternative corridors.	Palaeontology recommendations ▪ Should fossil material exist within the CSP Project area any negative impact upon it could be mitigated by surveying, recording, describing and sampling of well-preserved fossils by a professional palaeontologist. This should take place after initial vegetation clearance has taken place but before the ground is levelled for construction. Excavation of fossil heritage will require a permit from SAHRA and the material must be housed in a permitted institution. In the event that an excavation is impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction and infrastructure moved..
Visual	The Visual Impact Assessment (VIA) conducted for the proposed 132kV power line and associated infrastructure has demonstrated that most of the study area has a rural, partially scenic visual character which is transformed in part. The northern and south-western parts of the study area, near Kimberley and Jacobsdal respectively, are characterised by a more visually degraded landscape, which is mostly attributed to the presence of large-scale mining	▪ It must also be noted that SiVEST believe that the impacts associated with the construction and operation phases can be mitigated to acceptable levels provided the recommended mitigation measures are implemented.

	activities, existing electrical infrastructure as well as informal/semi-formal settlements and residential areas/communities. As such, the visual character in these parts of the study area is visually degraded, typical of a peri-urban environment. In addition, the southern and central parts of the study area are characterised by a more natural / scenic visual character due to the prevalence of the natural intact vegetation, limited human habitation and limited transformation and/or development. The visual character in these areas is thus typical of a natural rural environment. Commercial cultivation is concentrated along the Modder River in the southern parts of the study area. These areas are dominated by various agricultural activities and other elements typical of a pastoral environment. The study area is not typically valued or utilised for its natural scenic value and therefore relatively few tourism, historically or culturally significant sensitive receptors were identified during the fieldwork. A desktop investigation revealed that several farmsteads are also present within the study area which may perceive the power line to be an unwelcome intrusion, depending on the perception of the viewer. The impact assessment revealed that the significance of the visual impacts resulting from the proposed power line and associated infrastructure would be low during the construction phase and medium during the operational phase. These potential impacts can be mitigated to acceptable levels provided the recommended mitigation measures are implemented. All the proposed power line corridor alternatives were assessed to determine which alternative would result in the lowest overall visual impact. Based on the assessment, Corridor 1 (Green) is considered to be a favourable alignment for the proposed power line while Corridor 2 Alternative 1 (Purple) is not considered to be a preferred alignment. Corridor 2 Alternative 2 (Turquoise) was considered to be the preferred alignment, due to the presence of existing power lines and lack of visually sensitive and potentially sensitive receptor locations within close proximity.	
Socio-Economic	The review of the relevant policy documents concluded that the proposed project falls in line with the national and local government developmental objectives. It may also form part of the SIP10 and SIP8. Furthermore, the proposed project is not expected to compromise the spatial visions of the three	▪ Due to nature of the businesses of surrounding landowners, consultation was identified as important with regards to the final powerline routing for the project.

	municipalities and two provinces; however, care needs to be taken when the route is chosen as to avoid green areas earmarked by the Sol Plaatje LM. The project will improve the reliability of electricity supply in the region as the SolarReserve Kalkaar CSP Project will augment the national electricity supply, which could lead to establishment of more electricity connections in the region or country as a whole. The proposed project will also have a positive albeit small impact on the national economy and local employment, as expenditure on construction activities to the value of between approximately R60 million and R144 million, depending on the corridor approved, is likely to stimulate between approximately R180 million and R432 million of production revenue in the country and create up to fourteen temporary direct employment opportunities for the local communities. All three corridors have been considered. It appears that commercial livestock and game farming is the dominant land use that may be impacted by any of these corridor options and alternatives. The agricultural sector is a significant contributor to the economies of Letsemeng and Tokologo and creates approximately 33% and 22% of all job opportunities in the respective municipalities. This emphasises the need to minimise the project's potential negative impact on the dominant activities observed in the zone of influence of the project. Corridor Alternatives received the same average scores for positive and negative impacts for both before and after mitigations measures. Considering the preferences allocated to these two alternatives for each impact, no clear differentiation can be made between the alternatives and all could be equally considered.	

The impact rating of the proposed development according to each environmental aspect are provided in the **Table 75** below.

Key

Low negative	Low positive
Medium negative	Medium positive
High negative	High positive

Table 75: Impact rating summary for the proposed 132kV power line and associated infrastructure during the construction phase

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Biodiversity	Loss of Vegetation during construction	-48 (medium negative)	-24 (low negative)
	Faunal Impacts during construction	-24 (low negative)	-10 (low negative)
Avifauna	Displacement of priority species due to disturbance and habitat transformation during the construction and de-commissioning of the 132kV sub-transmission line	-34 (medium negative)	-18 (low negative)
Wetlands	Loss of riparian habitat and ecological structure (Modder River)	- 26 (low negative)	- 7 (low negative)
	Changes to riparian ecological and sociocultural service provision (Modder River)	- 26 (low negative)	- 7 (low negative)
	Impacts on riparian hydrology and sediment balance (Modder River)	- 26 (low negative)	- 7 (low negative)
	Loss of riparian habitat and ecological structure (Large Pans)	-30 (medium negative)	- 7 (low negative)
	Changes to riparian ecological and sociocultural service provision (Large Pans)	-30 (medium negative)	- 7 (low negative)
	Impacts on riparian hydrology and sediment balance (Large Pans)	-30 (medium negative)	- 7 (low negative)
	Loss of riparian habitat and ecological structure (Small Pans)	- 26 (low negative)	- 7 (low negative)
	Changes to riparian ecological and sociocultural service provision (Small Pans)	- 26 (low negative)	- 7 (low negative)
	Impacts on riparian hydrology and sediment balance (Small Pans)	- 26 (low negative)	- 7 (low negative)
Agricultural Potential & Soil	Loss of agricultural land use	-11 (low negative)	-11 (low negative)
	Soil erosion	-22 (low negative)	-10 (low negative)
	Loss of topsoil	-22 (low negative)	-10 (low negative)
	Degradation of grazing	-10 (low negative)	-9 (low negative)

Heritage & Palaeontology	Chance finds	-68 (high negative)	-8 (low negative)
	Rock engravings	-68 (high negative)	-8 (low negative)
	Cemeteries and graves	-68 (high negative)	-8 (low negative)
	Palaeontology	-20 (low negative)	-8 (low negative)
Visual	Rating of visual impacts for the proposed 132kV power line and associated infrastructure	-24 (low negative)	-20 (low negative)
Social-economic	Impact on economy	+30 (medium positive)	+30 (medium positive)
	Impact on employment and income	+12 (low positive)	+12 (low positive)
	Impact on strengthening national grid capacity	+16 (low positive)	+16 (low positive)

Table 76. Impact rating summary for the proposed 132kV power line and associated infrastructure during the operational phase

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Biodiversity	Ecological degradation during operation	-30 (medium negative)	-11 (low negative)
Avifauna	Collisions of Red Data species with the proposed 132kV line	-57 (high negative)	-32 (medium negative)
	Electrocutions of Red Data species on the proposed 132kV line.	-54 (high negative)	-26 (low negative)
Wetlands	None		
Agricultural Potential & Soil	Loss of agricultural land use	-11 (low negative)	-11 (low negative)
Heritage & Palaeonotology	None		
Visual	Rating of visual impacts for the proposed 132kV power line and associated infrastructure	-34 (medium negative)	-34 (medium negative)
Social-economic	Impact on current business activity	-22 (low negative)	-8 (low negative)
	Impact on future business	-21 (low negative)	-6 (low negative)
	Impact on property	-22 (low negative)	-9 (low negative)

Table 77. Impact rating summary for the proposed 132kV power line and associated infrastructure during the decommissioning phase

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Biodiversity	Decommissioning Impacts on Fauna	-24 (low negative)	-10 (low negative)
	Ecological Degradation due to Decommissioning	-28 (low negative)	-11 (low negative)

Avifauna	Displacement of priority species due to disturbance and habitat transformation during the construction and de-commissioning of the 132kV sub-transmission line	-34 (medium negative)	-18 (low negative)
Wetlands	None		
Agricultural Potential & Soil	None		
Heritage & Palaeonotology	None		
Visual	Rating of visual impacts for the proposed 132kV power line and associated infrastructure	-24 (low negative)	-20 (low negative)
Socio-economic	None		

5 COMPARATIVE ASSESSMENT OF ALTERNATIVES

As indicated in **Figure 89**, two power line corridor alternatives for the interconnection point from Kalkaar CSP via Kimberley DS to Boundary Substation will be assessed.

Importantly, Corridor 1 – Jacobsdal link is not an alternative to the above mentioned alternative corridors and therefore did not undergo comparative assessment. It is a mandatory link which requires environmental authorization for the completion of the interconnection circuit from Jacobsdal Substation to the SolarReserve Kalkaar CSP Project site which will then route via Kimberly Distribution Substation to Boundary Substation. All sensitivities, potential impacts and required mitigation measures were however determined and included in this report.

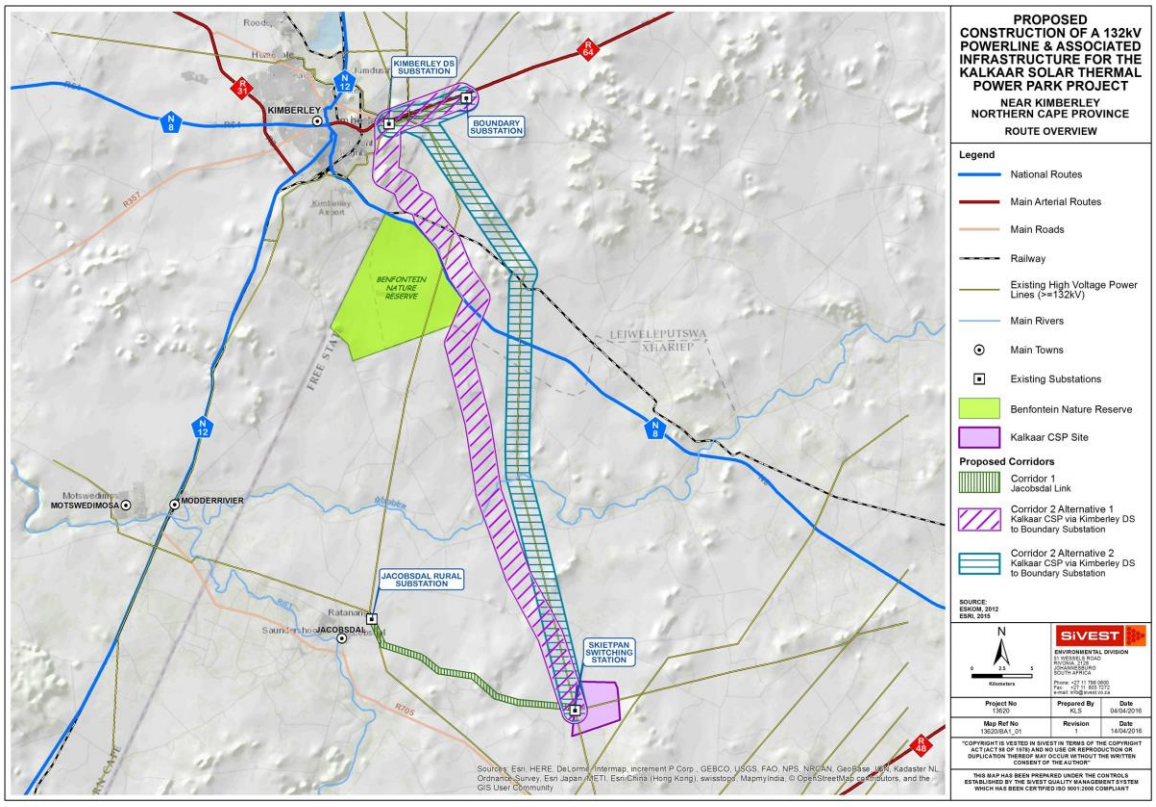


Figure 89: Route Overview Map

Each of these alternatives are comparatively evaluated below (Table 78) in terms of the findings from the specialist studies conducted during the BA.

Key

PREFERRED
FAVOURABLE
NOT PREFERRED

Table 78. Preferred Power Line Alternative Corridor Summary

	Preferred Kalkaar Powerline Corridor Alternative		
Environmental Aspect	**Corridor 2 Alternative 1 – Kalkaar CSP via Kimberley DS to Boundary Substation (Purple)**	**Corridor 2 Alternative 2 – Kalkaar CSP via Kimberley DS to Boundary Substation (Turquoise – Preferred)**	**Corridor 1 – Jacobsdal Link (Green – Preferred)**
Biodiversity	Favourable	Preferred	Favourable
Avi-fauna	No preference	No preference	Preferred
Wetlands	Favourable	Preferred	Favourable
Agricultural Potential and Soils	No preference	No preference	No preference
Heritage and	Not preferred	Favourable	Favourable
Palaeontology	No preference	No preference	No preference
Socio-economic	No preference	No preference	No preference
Visual	Not preferred	Favourable	Favourable

As per the summary of the preferred power line corridors shown above, the following reasons substantiate the final selection of the following preferred alternative:

Corridor 2 Alternative 2 – Kalkaar CSP via Kimberley DS to Boundary Substation (Turquoise – Preferred)

There is not much difference in terms of preference with regards to avifauna, soils and agricultural potential, palaeontology and socio-economic aspects. However, there are reasons against the selection of Corridor 2 Alternative 1 (heritage and visual) as well as reasons motivating for the selection of Corridor 2 Alternative 2 (with regards to wetlands and biodiversity). As such, the selection of the Corridor 2 Alternative 2 – CSP Project Site via Kimberley DS to Boundary Substation as the preferred option was made taking into account the following:

- Presence of an existing line along this route will decrease the footprint and negative impact of the new line;
- Lower number of freshwater resources to be affected;
- Lowest potential impact on heritage resources and with appropriate mitigation measures, could address envisaged impacts.
- Follows existing power lines; and
- Fewer potential sensitive receptors.

Again, it must be reiterated that Corridor 1 – Jacobsdal link is not an alternative to the above mentioned alternative corridors and therefore did not undergo comparative assessment. It is a mandatory link which requires environmental authorization for the completion of the interconnection circuit from Jacobsdal Substation to the SolarReserve Kalkaar CSP Project site which will then route via Kimberly Distribution Substation to Boundary Substation. All sensitivities, potential impacts and required mitigation measures were however determined and included in this report.

Corridor 1 – Jacobsdal Link (Green – Preferred)

Ultimately, the following must be taken into account for this proposed corridor as being preferred:

- The Jacobsdal link has not very high sensitivity sections along the route;
- Much lower risk of avi-fauna collision mortality and avoidance of vulture breeding areas;
- Least number of freshwater resources to be affected;
- Lowest potential impact on heritage resources and with appropriate mitigation measures, could address envisaged impacts.
- Shorter route and thus less physical impact (reduced footprint);
- Reduced potential negative socio-economic impacts;
- Lowest visual impact; and
- More economically viable being the shorter route.

From the above, **Corridor 2 Alterantive 2 (Turquoise) and Corridor 1 – Jacobsdal Link (Green) are both to be environmentally authorized with the implementation of mitigation measures**.

5.1 "No-go" Alternative

The "no-go" alternative assumes that the proposed activity does not go-ahead, implying a continuation of the current situation or the status quo. The "no-go" or "no-action" alternative is regarded as a type of alternative that provides the means to compare the impacts of project alternatives with the scenario of a project not going ahead. In evaluating the "no-go" alternative it is important to take into account the implications of foregoing the benefits of the proposed project.

In the case of this project, the no-go alternative would result in no power line and associated infrastructure being constructed, and it would therefore not be possible to export the electricity generated at the Kalkaar Concentrated Solar Power Project to the national grid. South Africa is under immense pressure to provide electricity generating capacity in order to reduce the current electricity demand in the country. With the global focus on climate change, the government is under severe pressure to explore alternative energy sources in addition to coal-fired power stations. Although solar power is not the only solution to solving the energy crisis in South Africa, it is the best solution for the study area in question and not establishing the proposed power line for the operation of the Kalkaar Concentrated Solar Power Project would be detrimental to the mandate that the government has set to promote the implementation of renewable energy.

Although the potential impacts identified (such as visual impacts) would not occur if the project did not go ahead, it must be noted that the socio economic benefit of the proposed project should equally not be overlooked. The No-Go alternative has thus been eliminated due to the fact that the identified environmental impacts can be suitably mitigated and that by not building the project, the socio-economic benefits would be lost.

6 CONCLUSION

The findings of the specialist studies undertaken within this BA provide an assessment of both the benefits and potential negative impacts anticipated as a result of the proposed 132kV power line from the proposed Kalkaar Concentrated Solar Power Project via Kimberley DS to Boundary Substation as the first interconnection point, and importantly also to the Jacobsdal Substation as a extension of the interconnection point.

The findings conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding. Areas of special concern have however been identified which will require site specific mitigation measures. These are included within the EMPr to ensure that these areas receive special attention.

From the assessments above, Corridor 2 Alterantive 2 (Turquoise) and Corridor 1 – Jacobsdal Link (Green) are both to be environmentally authorized with the implementation of mitigation measures. This is because each corridor is less environmentally and socially sensitive and would result in the least environmental and social impact.

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