VISUAL IMPACT ASSESSMENT FOR THE PROPOSED WESTGATE, TARLTON AND KROMDRAAI POWER LINE AND SUBSTATION, GAUTENG

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EXECUTIVE SUMMARY

Eskom Holdings Ltd Central Distribution Division (Eskom) has proposed the construction of a 132 kilovolt (kV) sub-transmission power line and a new substation in the Randfontein Local Municipality, Gauteng. The additional 132kV power line will attempt to answer the increasing electricity demand in the area that is caused by the rapid development.

As part of the Environmental Impact Assessment (EIA) requirements, a Visual Impact Assessment should be completed for the proposed construction and operation of the 132kV power line and substation. The Visual Impact Assessment is structured around the following main tasks:

1) **Determination of study area:** The determination of the extent and composing features of the study area;
2) **Project Description:** A description of the type, scale and extent of the proposed project;
3) **Visual Resource Assessment:** An assessment of the value of the visual resource based on its ecological, cultural and historic importance, scenic quality and sense of place;
4) **Visual Impact Assessment:** This section determines the sensitivity of the receptors and assesses the significance of the potential visual impacts;
5) **Comparative Analysis:** Comparing the different alternative alignments and arriving at a most preferred option; and
6) **Mitigation Measures:** Mitigation measures are proposed to alleviate or completely eliminate the potential impacts that are identified.

DETERMINATION OF STUDY AREA

The study area is located west of Krugersdorp in Randfontein. It includes the area between the existing Westgate and Tarlton Substations. From Tarlton Substation the study area includes the region north of the N14 to where the new Kromdraai Substation is proposed. The study area overlaps with the Krugersdorp Game Reserve and the Cradle of Humankind (COH) World Heritage Site near the Sterkfontein Caves.

Large parts of the study area are severely transformed by human activities and varies considerably in its use. The following five dominant land use categories have been identified:

- Mining and quarrying resulting in derelict and highly disturbed landscapes;
- High and moderately dense residential resulting in urban environments;
- Agricultural Holdings resulting in a less urbanised, yet residential environments;
- Agricultural, varying between cultivated fields and livestock farming; and
- Conservation and Nature Reserves featuring qualities of the historical landscape.

DESCRIPTION OF PROJECT

The proposed project consists of the construction of a 132kV power line between the existing Westgate Substation and Tarlton Substation and from here to the proposed Kromdraai Substation. The power line is expected to be a single steel pole structure embedded in a sub-surface concrete foundation.

The project comprises of 8 alternative corridors between the existing Westgate and Tarlton Substations and from Tarlton Substation to the proposed Kromdraai Substation. The proposed

Kromdraai Substation will be located in an open site adjacent the Bloubank Stream that flows through the Oaktree AH. Its footprint will be 0.64 ha (80 x 80 metres)

VISUAL RESOURCE ASSESSMENT

The character of the landscape is considered as a visual resource and is regarded as a limited resource under increasing pressure from development world wide. Similar to any natural resource, a visual resource has a specific value to a group of people/observers. The Visual Resource Assessment described the value of the landscape based on its inherent importance, scenic quality and sense of place. It provides insight on the qualities of the landscape and its importance to observers.

From the assessment it became evident that the Southern Region of the study has a low scenic quality and a very low concentration of important features. The disturbance due to mining has altered and destroyed the original scenic qualities of the landscape and left derelict mine dumps and open spaces. This part of the study area is considered to have a low value.

The Central and Northern Regions of the study area are relatively rich in elements of importance. The varied topography creates ridges and valleys, valued for their ecological and aesthetic importance. The Krugersdorp Game Reserve conserves an area along a drainage line with waterfalls and wetlands. The COH brings another dimension to the cultural and tourism value of the area. Despite the relatively moderate scenic quality of the region, the low impact of human interventions ensures that the landscape is generally dominated by its natural features. The Central and Northern Region is moderately valued on a regional and provincial level for its aesthetic qualities and the Northern Region is also highly valued on a national and international scale for its historic significance.

VISUAL IMPACT ASSESSMENT

Within the study area, specific observers experience different views of the visual resource and therefore value it differently. They will be affected because of alterations to the visual resource and therefore their views due to the proposed project. The following typical visual impacts may occur as a result of the construction and operation of the proposed project:

- The project activities or components will noticeably change existing features or qualities of the visual resource;
- A project introduces new features which are uncharacteristic or in contrast with the existing character of the environment; and/or
- A project removes or blocks aesthetic features of the landscape which successively affects the scenic quality of a study area.

The following two tables summarise the potential visual impacts during the construction and operational phases of the power line and substation.

CONSTRUCTION PHASE

Nature of Impact	Extent of Impact	Duration of Impact	Intensity of Impact	Probability of Impact	Significance of Impact	Level of Confidence
Construction phase – 132kV Power line						
Without mitigation – Activities and project components will cause a perceivable negative change in the existing qualities of the visual resource.	Regional	Short term	Medium	Highly probable	Medium to High	High
With mitigation – Duration of impact can be limited through proper rehabilitation and the intensity of the negative impact can be reduced.	Regional	Short term	Low	Highly probable	Low	High
Construction phase – Kromdraai Substation						
Without mitigation – Activities and project components will cause a perceivable negative change in the existing qualities of the visual resource.	Regional	Short term	High	Highly probable	High	High
With mitigation – With additional screening the extent of impact will be reduced, duration of impact can be limited through proper rehabilitation and the intensity of the impact will be reduced.	Local	Short term	Medium	Highly probable	Medium	High

Generally the magnitude of the visual impact is considered low to medium during the construction of the power line. The screening capacity of the vegetation in the Southern Region considerably mitigates the magnitude to a level where the impact is regarded minimal. The Central and Northern Regions are more exposed due to the agricultural land use. Consequently the VAC is regarded moderate to low.

The areas where a high visual impact is expected is where the alignments pass through the residential areas of Eldorado, Eljeesee, Helderblom, Marabeth and Beckedan AH as well as alterative 7 that traverse the western part of the Krugersdorp Game Reserve. The observers that are present in these areas are highly sensitive receptors. The magnitude of the impact is regarded as medium due to the relative low intensity of the construction activity and the temporary nature of the impact.

The alignments that are proposed between Tarlton and Kromdraai Substations, traverse an area of low receptor concentration. A limited number of viewers will be affected by the construction activity, but the receptors are regarded as moderately and highly sensitive. The study area intersects with the COH which is a tourist destination. The magnitude of the impact is regarded as medium due to the relative low intensity of the construction activity and the temporary nature of the impact.

The construction of the Kromdraai Substation will change the visual environment of the residents in Oaktree AH. The intensity of the impact is considered high due to the clearing and grading of the

80 x 80 m footprint of the substation. The magnitude of the impact is high considering the low VAC and the moderate scenic quality of the study area. An impact of a large magnitude occurs in an area where highly and exceptionally high sensitive visual receptors reside or pass through. The construction of the substation will cause a highly significant impact on the scenic qualities of the visual resource.

OPERATIONAL PHASE

Nature of Impact	Extent of Impact	Duration of Impact	Intensity of Impact	Probability of Impact	Significance of Impact	Level of Confidence
Operational phase – 132kV Power line						
Without mitigation – Activities and project components will cause a perceivable negative change in the existing qualities of the visual resource. Project could result in the reduction of the VAC in certain sections of the corridor exposing unsightly elements	Regional	Long term to permanent	Medium	Highly probable	Medium to High	High
With mitigation – Upgrading of an existing power line instead of constructing an additional power line will be the most preferred mitigation measure with the highest affect. Alignment along existing power lines is more accepted than following a new alignment. This will cause the least visual change based on the baseline setting.	Regional	Long term to permanent	Low	Highly probable	Low	High
Operational phase – Kromdraai Substation						
Without mitigation – Activities and project components will cause a perceivable negative change in the existing qualities of the visual resource. Project introduces elements that are uncharacteristic and in contrast with the visual environment.	Regional	Long term to permanent	High	Definite	High	High
With mitigation – Relocation of substation will have greatest mitigating affect, but additional screen planting can reduce the extent as well as the intensity of the impact	Local	Medium term	Medium	Highly probable	Medium	High

The completed power line will result in a visual change that will be greater than the baseline setting. The power line will generally result in a weak visual contrast and will not substantially increase the visual dominance of the project over the existing conditions. A great mitigating factor is the presence of an existing network of power- and transmission lines in the Southern and Central Region of the study area, which renders the additional 132kV power line as fairly compatible with the region's character.

According to a study done by Hull & Bishop (1988) the impact is most severe within 1 km of the proposed power line. The areas of concern are those residential and conservation areas that are located within this impact zone. Generally the magnitude of the impact varies between medium and high depending on the VAC of the site and whether the proposed 132kV will be in parallel with an existing power line. The Northern Region is fairly free of power infrastructure and the additional power line will impact on the current scenic quality of the visual resource. The significance of the visual impact will be medium to high as the project will be exposed to highly and exceptionally high sensitive viewers.

The presence of the Kromdraai Substation will cause a great alternation to the visual resource. The uncharacteristic features of the substation will contrast severely with the existing land uses. The intensity of the impact is considered high due to the scale of the substation and the exposed location of the site. The magnitude of the impact is also high considering the low VAC and the moderate scenic quality of the study area. An impact of a high magnitude occurs in an area where highly and exceptionally high sensitive visual receptors reside or pass through. The substation will cause a highly significant impact on the scenic qualities of the visual resource and the views that are experienced of the visual resource.

COMPARATIVE ANALYSIS AND CONCLUSION

A number of variations exist between the alignments connecting Westgate and Tarlton Substations. All of them share the same corridor between point A & B at which point four different routes split off. Alternative 8 is the most preferred option for the route between Westgate and Tarlton Substations to a large degree. The particular variation of Alternative 8 is between point A, B, M & E. Alternative 8 will impact on the least sensitive visual receptors and will align with the general direction of a railway for approximately 7 km before it turns north towards Tarlton Substation. The route also avoids crossing through the agricultural holdings of the Central Region where a concentration of highly sensitive visual receptors reside. The potential increase in the cumulative visual impact that will occur between the sections E, D, K & J will also be avoided.

Alternative 1 & 3 are marginally more preferred than Alternative 2, mostly due to fact that it aligns with an existing power line for the section between X and C. The existing power line is regarded as a mitigating factor that renders an additional power line more compatible in the visual resource. The author is of the opinion that consolidating a new power line in an already existing corridor of another power line is visually more acceptable than constructing an additional power line approximately a kilometre away from an existing power line. The cumulative visual impact is regarded as acceptable only two power lines will run in parallel.

The least preferred option is Alternative 7. The fact that it crosses the Krugersdorp Game Reserve is regarded as a fatal flaw. A highly significant visual impact is expected as highly sensitive visual receptors will be affected. The visual resource will be affected negatively as the power line will contrast with the naturalistic character of the game reserve.

ALIGNMENTS BETWEEN WESTGATE AND TARLTON SUBSTATIONS		
Ranking from most to least preferred	**Alternative alignment**	**Route description**
1	Alternative 8	A, B, M & E
2	Alternative 1&3	A, B, (Y)X, C, D & E
3	Alternative 2	A, B, Y, C, D & E
4	Alternative 7	A, B, L, J & E

The alternatives between Tarlton and the proposed Kromdraai Substations will have very similar visual impacts. The same argument applies as in the above section that the visual impact of consolidating an additional power line in an existing corridor is generally more accepted than introducing a power line into a baseline setting absent of these types of infrastructure.

Alternative 4 & 5 follow the same alignment up to Portion 77 of the Farm Sterkfontein 173-IQ (Point F). Alternative 4 branches off to the east while Alternative 5 continues along the existing transmission tower up to Portion 35 of the farm Sterkfontein 173-IQ (Point FG). Of the two alternatives, Alternative 5 is the most preferred by a small margin. Alternative 5 continuous for a longer length along the existing transmission line, causing a fairly small visual change to the baseline condition. From here it branches off to the proposed Kromdraai Substation. Much fewer visual receptors are present within 1 km of the alignment than if compared to Alternative 4. This means that fewer visual receptors will be exposed to the new power line.

Alternative 6 and the section of Alternative 7 between J & I are considered as the least preferred options. The cumulative visual impacts for the section between point E and K are considered unacceptable. Also, a greater number of viewers will be affected along points H & I.

ALIGNMENTS BETWEEN TARLTON AND KROMDRAAI SUBSTATIONS		
Ranking from most to least preferred	**Alternative alignment**	**Route description**
1	Alternative 5	E, F, FG & G
2	Alternative 4	E, F & G
3	Alternative 6	E, D, K, H, I & G
4	Alternative 7	I & J

NO-GO OPTION

The no-go option is defined as the option where the project will not be implemented. In terms of the visual impact, this option will not cause any changes to the baseline condition and therefore no visual change will occur. The visual impact will therefore be neutral as no observers will be affected and no changes to the character of the visual resource will occur. The no-go option is the most preferred option above all the alternatives that have been proposed based on the fact that no negative visual impacts will occur.

MITIGATION MEASURES

The aim of mitigation is to reduce or alleviate the anticipated impacts that are a consequence of the proposed project's components and activities.

Mitigation measures are provided for three phases of the project namely, the design, construction and operational phases. "Mitigation is a design skill that should start at the very inception of a project with the analysis of environmental opportunities and constraints." (Institute of Environmental Assessment and Landscape Institute, 1995) This approach generates preventative measures that will influence design decisions instead of relying on cosmetic landscape remediation of a completed project.

It is believed that with the implementation of the mitigation measures the potential visual impacts will be reduced to less significant levels.

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LIST OF ABBREVIATIONS

AH	Agricultural Holdings
COH	Cradle of Humankind
EIA	Environmental Impact Assessment
FHWA	Federal Highway Administration of the United States Department of Transportation
GIS	Geographical Information System
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment
ZVI	Zone of Visual Influence

1 INTRODUCTION

Eskom Holdings Ltd Central Distribution Division (Eskom) has proposed the construction of a 132 kilovolt (kV) sub-transmission power line and a new substation in the region of the Randfontein Local Municipality, Gauteng. The existing 11kV and 44kV network is rendered incapable for future demand and thus requires upgrading. The additional 132kV power line will attempt to answer the increasing electricity demand in the area that is caused by rapid development.

Arcus GIBB (Pty) Ltd approached I-scape to complete a Visual Impact Assessment (VIA) as part of the Environmental Impact Assessment (EIA) process. A VIA is a specialist study assessing the potential visual changes in an existing setting which could be brought about by a proposed project. The associated impacts of a proposed project could potentially affect the character of the landscape and affect the views and perceptions of observers in the study area. The purpose is to determine the significance of the affects and to recommend mitigation measures where the impacts are considered unacceptable.

1.1 METHODOLOGY

The following methodology for the assessment of visual impacts is used:

1) **Determination of study area:** The determination of the extent and composing features of the study area;
2) **Project Description:** A description of the type, scale and extent of the proposed project;
3) **Visual Resource Assessment:** An assessment of the value of the visual resource based on its ecological, cultural and historic importance, scenic quality and sense of place;
4) **Visual Impact Assessment:** This section determines the sensitivity of the receptors and assesses the significance of the potential visual impacts;
5) **Comparative Analysis:** Comparing and ranking the different alternative alignments from most to least preferred; and
6) **Mitigation Measures:** Mitigation measures are proposed to alleviate or completely eliminate the potential impacts that are identified.

1.2 LIMITATIONS AND ASSUMPTIONS

This section provides a clear understanding of the limitations and assumptions that negatively affect the accuracy of the assessment and influences the confidence of the visual specialist in his professional judgement.

- A Visual Impact Assessment is not a purely objective science and relies on qualitative evaluations which integrate human perceptions. It is the objective of the visual specialist to utilise as much quantitative data as possible to substantiate professional judgement and motivate subjective opinions;
- It is unclear at this stage what the construction duration would be for the proposed 132kV power line and Kromdraai Substation respectively. It is assumed that the entire construction period will not exceed 18 months;
- The location and size of a construction camp/s and material stockyard/s had not been determined at the time of the assessment. It is assumed that the construction camp and

material stockyards will be located adjacent to each other on a site that is fairly central and accessible;

- The frequency visibility mapping discussed in Appendix 1 only calculates the primary screening ability of the study area's topography. The data set that is utilised by the GIS (Geographical Information System) does not support the screening ability of trees and/or structures and assumes that the study area is void of any such elements. The secondary screening capability of the landscape will be discussed in the main report;
- The land use data set that was used for the viewer sensitivity analysis in Appendix 2 is from the year 2000. The data does not completely represent the current day scenario but differences are considered omissible at the regional scale on which the assessment is done; and
- The scenic quality evaluation technique that is adopted in Section 4.3 was developed for the evaluation of scenic areas in the jurisdiction area of the U.S. Bureau of Land Management (BLM). No such evaluation technique has been developed for South African landscapes and therefore the evaluation technique has been adapted to suite local conditions.

2 STUDY AREA

The study area can be described as the area in the landscape that will be affected by visual impact. This area is also referred to as the Zone of Visual Influence (ZVI) and includes the areas in the landscape from where the proposed project will be visible. The factors that mostly influence the ZVI are topographic variation and land cover which could potentially screen the proposed project from critical viewpoints. The ZVI can be determined through a method called *visibility mapping*. Visibility mapping is a GIS procedure which incorporates topographical features and the screening it provides from a particular point in the landscape. The study area is limited to a distance of 5 km beyond which the sources of visual impact are considered negligible and thus omissible.

The study area is located west of Krugersdorp in Randfontein. It includes the area between the existing Westgate and Tarlton Substations. From Tarlton Substation the study area includes the region north of the N14 to where the new Kromdraai Substation is proposed. The study area overlaps with the Krugersdorp Game Reserve and the Cradle of Humankind (COH) World Heritage Site near the Sterkfontein Caves (Figure 2).

The greatest part of the study area is significantly transformed by human activities. A variety of land uses occur in the study area which causes a change in character as one moves through the landscape (Figure 2). Five dominant land use categories are identified. Evidently, four of the five land uses have changed the original character of the landscape to a great extent. They are:

- Mining and quarrying resulting in derelict and highly disturbed landscapes;
- High and moderately dense residential development resulting in urban environments;
- Agricultural Holdings resulting in a less urbanised, yet residential environment;
- Agricultural, varying between cultivated fields and livestock farming; and
- Conservation and Nature Reserves featuring qualities of the historical landscape character.

The Southern Region of the study area is dominated by mining activities, urbanisation and derelict open spaces, mostly associated with mining activities. The most dominating features are the mine dumps/slimes dams. The left over open spaces between the dumps are highly degraded and is mostly infested by Eucalyptus stands which in their own right partially screen the mine dumps. The suburb of Robin Park, West of the Westgate Substation, is predominantly residential with the exception of Randfontein Golf Course and country club at Robinson Lake, Greenhills Cemetery on Northway road and a few small commercial buildings. The gardens are well established and large trees are abundant. The dense vegetation cover reduces the dominance of the buildings and creates an urban forest.

The Central Region of the study area is less intensively developed and agriculture is the main land use. Irrigated vegetable plots are a common sight along the Rietspruit and North Way road. The agricultural holdings of Helderblom, Eldorado, Eljeesee, Marabeth and Beckedan are situated along Rustenburg Road (R24) and are characterised by modest to large houses and tree rich gardens. Small scale farming, nurseries and horse stables enhance a country character that is often associated with agricultural holdings. The Krugersdorp Game Reserve is located between the R24 and the N14, east of Helderblom AH. The game reserve is approximately 1300ha and is representative of the natural vegetation cover which comprises mostly of open grasslands on the exposed plains and bush thickets in the valleys and along rocky outcrops. The game reserve also houses a number of wild animals and provides camping and conference facilities.

The Northern Region, north of the N14, is even more sparsely developed than the Southern and Central Region of the study area. This is mainly due to the World Heritage Site's management policies restricting certain types of development in this area. The topography is varied and becomes more dramatic to the north. The area is mostly zoned for agriculture, and livestock farming takes preference over crop production. The vegetation cover consists predominantly of grassland, and shrubs and trees occur mostly along drainage corridors. Since the declaration of the COH as a World Heritage Site, DACEL[1] prepared a master plan for the development of the COH into a world-class tourism and educational facility. In response, many guest houses, wedding venues, conference and team buildings facilities emerged to accommodate the growing tourist market.

[1] DACEL – Department of Agriculture, Conservation, Environment and Land Affairs

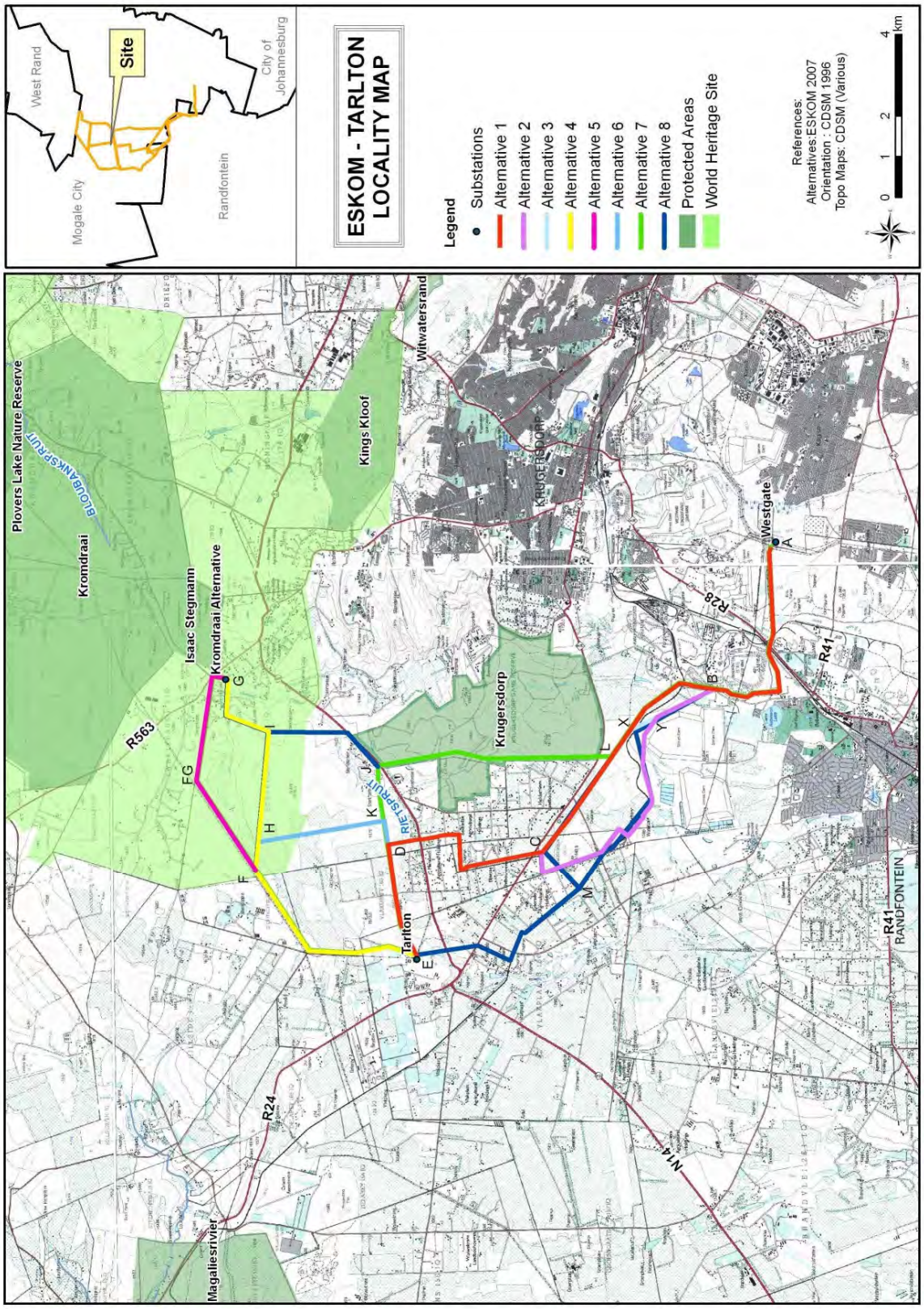


Figure 1: Locality Map

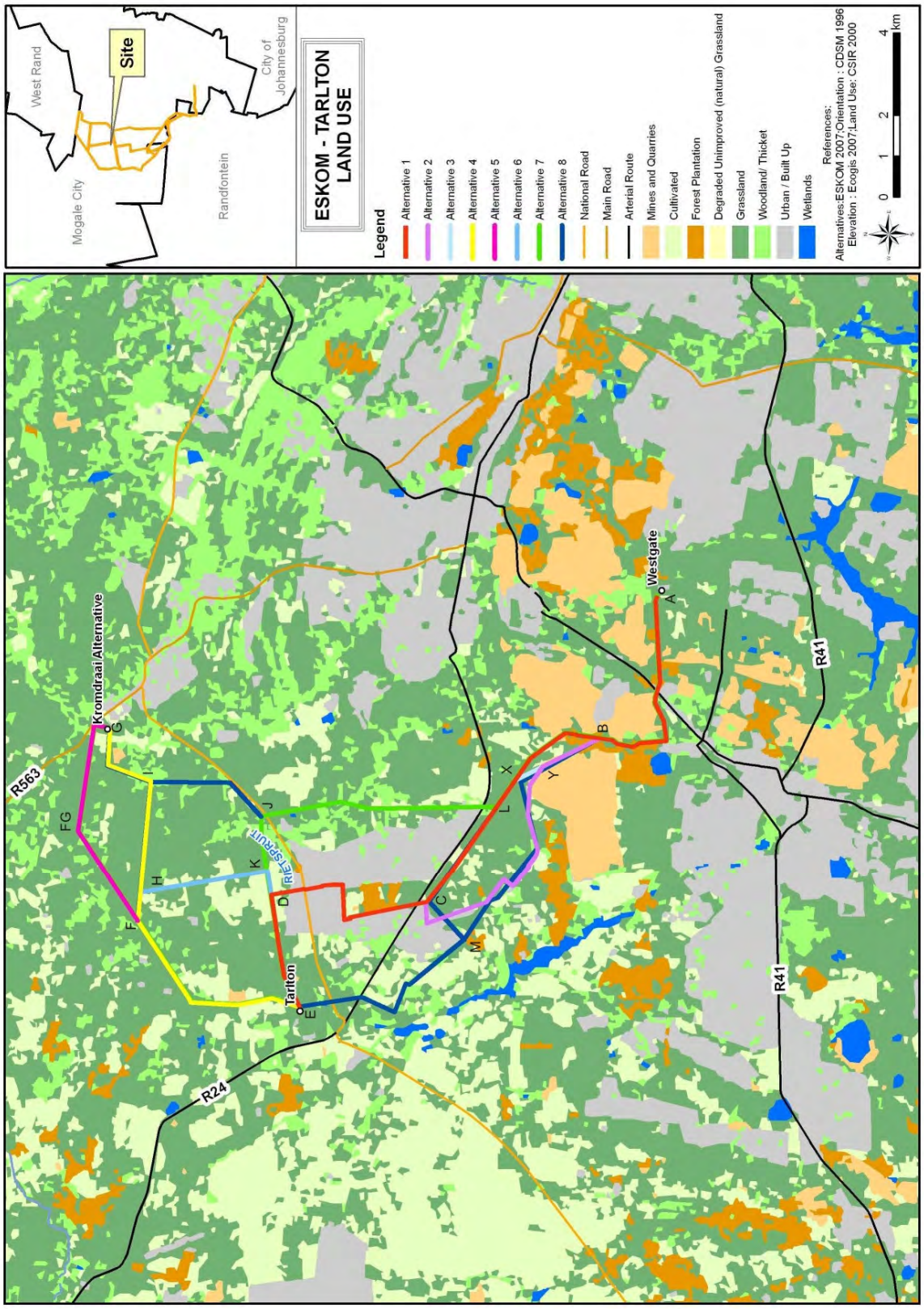
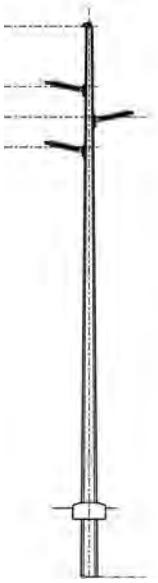


Figure 2: Land use map of study area

3 PROJECT DESCRIPTION

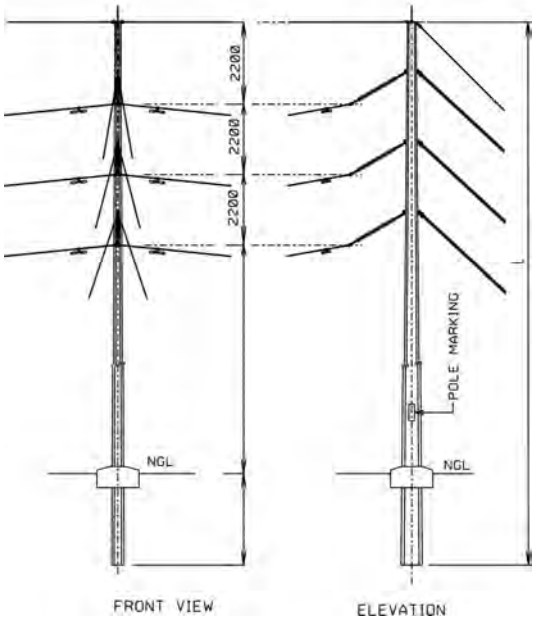
The proposed project consists of the construction of a 132kV power line between the existing Westgate Substation and Tarlton Substation and from here to the proposed Kromdraai Substation. The power line is expected to be a single steel pole structure of type 259 A, B, C and D embedded in a sub-surface concrete foundation. The four pole types are fairly similar in appearance but are used in different applications namely intermediately or on the angels. The maximum pole length is expected to be 22 m above natural ground level.

Type 259 A

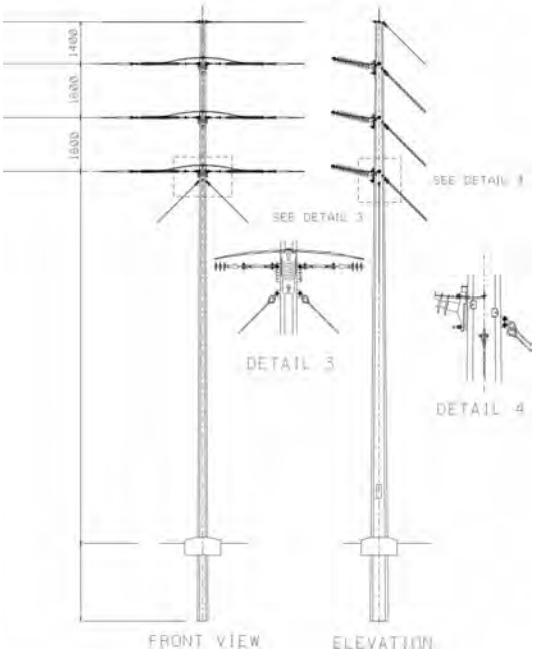


Type 259 B

Type 259 C



Type 259 D



The project comprises of a number of alternative corridors between the existing Westgate and Tarlton Substations and from Tarlton Substation to the proposed Kromdraai Substation. The alternative alignments are indicated on Figure 1. The routes correlate with the point numbering as follows:

Alternative 1 (Red): ABXCDE
Alternative 2 (Purple): ABYCDE (Variation on alternative 1)
Alternative 3 (Cyan): ABYXCDE (Cross-over between alternative 1&2)
Alternative 4 (Yellow): EFIG
Alternative 5 (Pink): EF FG G (Variation on alternative 4)
Alternative 6 (Light blue): EDKHIG (Variation on alternative 4)
Alternative 7 (Green): ABXLJKDEFG
Alternative 8 (Dark blue): BME; LCM; JI; FG

The proposed Kromdraai Substation will be located in an open site adjacent the Bloubank Stream that flows through the Oaktree AH. Its footprint will be 0.64 ha (80 x 80 metres) and it is assumed that the substation will be similar in appearance as the other two substations in the study area (Figure 3).

Figure 3: Existing Westgate Substation

CONSTRUCTION PROCESS

The construction process for the power line is expected to continue for approximately 18 months. It consists of the following basic phases:

- Establishment of construction camp;
- Survey and pegging of pole/tower positions;
- Construction of access roads if required;
- Clearing or trimming of vegetation along corridor;
- Pole/tower assembly and erection;
- Conductor stringing and tensioning; and
- Servitude rehabilitation.

The exact location of the construction camps and material stockyards has not yet been determined yet. A construction camp is usually a cleared and fenced area where temporary site offices are located and construction materials are stockpiled. Due to its temporary nature and practical function, aesthetic consideration is often less of a concern which could result in an unsightly terrain that will have a visual impact.

4 VISUAL RESOURCE ASSESSMENT

4.1 INTRODUCTION

The study area, which consists of the landscape and its comprising elements, is considered a visual resource. Similar to other natural resources, a visual resource has a value to a group of people/observers, in this case an aesthetic value. An aesthetic value can not be described in terms of monetary quantities, but it is a qualitative value with an underlying social, cultural and/or ecological connotation. Aesthetic value can be further described as an appreciation of the quality of a visual resource and refers to the sensory experience one has when exposed to the perceivable qualities of a visual resource.

The value of a visual resource is assessed on different scales, namely:

- International (e.g. World Heritage Sites);
- National (e.g. National Parks or designated wilderness areas, characterised by exceptional beauty); and
- Regional (e.g. Conservation areas or historic buildings bearing importance for towns or local communities).

The following question should also be asked; "What are the factors that generate the value of the particular visual resource?" This is a debatable issue due to the degree of subjectivity that relates to human's visual perceptions. Thorough research regarding this issue has concluded that the value of a visual resource to a nation, a community or a specific individual can be assessed in a rather clinical manner by discussing the following parameters:

- Ecological, social and/or cultural aspects of importance;
- Scenic quality; and
- Sense of place (Genius loci).

Although other evaluation models exist, these parameters are considered adequate in order to accurately assess the value of this visual resource. The following sections will discuss and evaluate each parameter on its merits.

4.2 ECOLOGICAL, SOCIAL AND/OR CULTURAL IMPORTANCE

An ecologically important landscape is not necessarily one that is highly aesthetic, but its importance depends on other aspects such as conservation value. In Gauteng, all ridges are protected by an environmental policy. The Ridge Policy (DACEL[2], 2001) stresses the importance of ridges in terms of their biodiversity value, recreational potential and aesthetics. Watercourses and wetlands are also managed and protected by the state Department of Water Affairs and Forestry (DWAF) indicating the national value of these resources.

It is outside the scope of this study to discuss the Ridge Policy or legislation around watercourses and wetlands in detail. What is important to note is that these are landscape features that are considered highly valuable on a regional, provincial and national level. The value of these features can also be attributed to their aesthetic appeal. A landscape of high topographic relief generally

[2] DACEL: Department of Agriculture, Conservation, Environment and Land Affairs

contributes to a higher scenic quality than a mundane landscape with no features of interest. Ridges are often the most visible points in a landscape and developments or disturbances on these ridges are coincidently also highly visible. This illustrates the sensitivity of these landforms from a visual perspective.

The uninterrupted view of flowing water or an open water body is also regarded as highly scenic. Although the watercourses in the study area are limited to small tributaries of the high lying catchments, their presence contribute to the quality of the landscape on a micro scale.

The aspects of social and cultural importance brings the forth dimension of *time* into the equation of value determination. A landscape develops into a social or cultural asset because of the history associated with that landscape. A single or a series of historic events imprinted on the landscape, either through perceivable elements, or intangible chronicles, generates a value that relates to the social or cultural importance of that landscape.

The most relevant example of a cultural important landscape is the Cradle of Humankind (COH), overlapping with the northern part of the study area. The COH is declared a World Heritage Site due to the significant archaeological findings that were made in the region. The most significant finding is probably the scull, know as Mrs Ples, found at the Sterkfontein Caves. The archaeological finding is anticipated to be representative of human origin and therefore has international archaeological value.

Human being's association with the archaeological artefacts and the apparent age of these findings are the very factors that intrigue people to visit the COH. The physical quality of the visual resource is not the primary attraction, but the significant history contained in the landscape and the artefacts bringing the distant past within tangible and observable reach. This has lead to the COH achieving an international status and placing a value on the landscape which extends to a world audience.

It can therefore be argued that the Northern region of the study area has exceptional value from an ecological, social and cultural point of view. The greater topographic elevation causes fairly interesting landforms and drainage patterns contributing to the ecological value of the landscape. The international social and cultural value that is brought about by the status of the World Heritage Site is a significant contributor to the value of the landscape.

The Central Region comprises mostly of small scale farming on the agricultural holdings. In exception to this, the Krugersdorp Game Reserve is situated along a drainage corridor with some exceptional natural features, such as wetlands, waterfalls and deeply fissured valleys. The wildlife in the game reserve is an added attraction and contributes to the ecological and conservation importance of the central study area.

The scenic value of the Southern Region is considerably less than the Northern or Central Regions. The Southern Region of the study area consists of an undulating landscape and is greatly modified by urbanisation and mining activities thus compromising ecological integrity. This region falls out of the COH and is therefore considered less important from a cultural perspective as well.

4.3 SCENIC QUALITY

Through sensory experience we attach a psychological value to a perceived landscape. The ability to perceive and mentally interpret a scene of a landscape can be understood in terms of analysing physiological and psychological processes. Otherwise stated, from the point where the eye is stimulated by the light that enters through the cornea, the mind interprets the scene, analyses the different stimuli and arrives at a point where it can cognitively formulate an opinion about the scene that is viewed.

It is important to note that each person's psychological value will differ due to the vast differences in cultural backgrounds, historic experiences and knowledge of a specific landscape, to mention but a few factors[3]. Despite the differences in human opinions, research has indicated commonalities in perceptions with regards to scenic quality. The model used here to determine scenic quality, is derived from the Bureau of Land Management (BLM), U.S Department of the Interior. The following seven fundamental factors are evaluated and rated for the three sub-regions in the study area:

- Landform;
- Vegetation;
- Water;
- Colour;
- Influence of adjacent scenery;
- Scarcity; and
- Cultural Modifications.

These seven factors are evaluated according to a scenic evaluation rating system adopted from the BLM. Table 1 provides a description of the seven factors in terms of a high, medium or low classification. Table 2 to Table 4 provide a score for each classification through which the relevant sub-region of the study area is evaluated (the highlighted cells reflect the evaluation of the region). The values of the cells are added and the assessment concludes with the comparison of the final value to the following scenic quality classification:

- High = 19 or more;
- Moderate = 12 – 18; and
- Low = 11 or less.

[3] Research has shown that age, gender, profession, etc. also play a role in the formulation of an opinion of a landscape.

Table 1: Description of scenic evaluation ratings

(Source: Bureau of Land Management)

Key Factors	High	Medium	Low
Landform	High vertical relief as expressed in prominent cliffs, spires or massive rock outcrops. Severe surface variation or highly eroded formations. Detail features which are dominant and exceptionally striking and intriguing.	Interesting erosion patterns or variety in size and shape of landforms. Detail features which are interesting though not dominant or exceptional.	Low rolling hills, foothills or flat valley bottoms. Few or no interesting landscape features.
Vegetation	A variety of vegetation types as expressed in interesting forms, textures and patterns.	Some variety of vegetation, but only few major types.	Little or no variety or contrast in vegetation.
Water	Clear and clean waterbodies, still or cascading white water, any of which are a dominant element in the landscape.	Flowing or still but not dominant in the landscape.	Absent, or present but not visible.
Colour	Rich colour combinations. Variety or vivid colours. Visually appealing contrasts in the soil, rock, vegetation or water.	Some intensity of variety in colours and contrast of the soil, rock and vegetation, but not dominant scenic elements.	Subtle colour variations, contrast or interest. Generally muted colour tones.
Influence of adjacent scenery	Adjacent scenery greatly enhances scenic quality.	Adjacent scenery moderately enhances overall scenic quality.	Adjacent scenery has little or no influence on overall scenic quality.
Scarcity	One of a kind, unusually memorable or very rare within the region. Consistent chance for exceptional wildlife or wildflower viewing, etc.	Distinctive, though somewhat similar to others within the region.	Interesting within its setting, but fairly common within the region.
Cultural modifications	Modifications add favourable to visual variety while promoting visual harmony.	Modifications add little or no visual variety to the area and introduce no discordant elements.	Modifications add variety but are very discordant and promote strong disharmony.

Table 2: Scenic evaluation chart of the Southern Region

Key Factors	High	Medium	Low
Landform	5	3	1
Vegetation	5	3	1
Water	5	3	0
Colour	5	3	1
Influence of adjacent scenery	5	3	0
Scarcity	5	3	1
Cultural modifications	2	0	-4
Total	**3**		

The scenic evaluation of the Southern Region is exceptionally low, mostly due to the mining activity and urbanisation that dominate the landscape. Derelict open spaces and unsightly mine dumps are a common feature detracting from the overall scenic quality of the southern sub-region.

Table 3: Scenic evaluation chart of the Central Region

Key Factors	High	Medium	Low
Landform	5	3	1
Vegetation	5	3	1
Water	5	3	0
Colour	5	3	1
Influence of adjacent scenery	5	3	0
Scarcity	5	3	1
Cultural modifications	2	0	-4
Total	**13**		

The scenic evaluation of the Central Region is regarded as moderate. This part of the study area falls out of the mining zone and is dominated by small scale agricultural land uses. Some major transport routes traverse the rural landscape, and low density residential development is present. The Krugersdorp Game Reserve is a natural asset of the Central Region. The interesting erosion patterns and associated wetlands and waterfalls are scenic features of the game reserve. These scenic features are rather out of sight and can only be experienced once in the game reserve, therefore only raising the aesthetic value on a local scale. Furthermore, no exceptional or distinct natural or man made features are present in the region and it is considered a fairly common landscape within the greater region.

Table 4: Scenic evaluation chart of the Northern Region

Key Factors	High	Medium	Low
Landform	5	3	1
Vegetation	5	3	1
Water	5	3	0
Colour	5	3	1
Influence of adjacent scenery	5	3	0
Scarcity	5	3	1
Cultural modifications	2	0	-4
Total	**15**		

The Northern Region is considered to have a moderate scenic quality. This is attributed to the greater topographical variation which brings more interest to the region. The low impact of human interference results in a landscape that is partially dominated by its natural features. It is however still a fairly common landscape in the region and no distinct features can be identified that significantly emphasis its scenic uniqueness.

4.4 SENSE OF PLACE

Sense of place can simply be described as the prevailing ambience brought about through the co-existence of the elements in the landscape. It is often an emotional experience that a place brings when one is exposed to its qualities. In this definition two essential requirements for an appreciation of sense of place are identified. Firstly, it must be a person experiencing the emotion or sensation and secondly, it must be a place being experienced. (Barnard et al, 2006)

Not all places have the same significance in its sense of place. Two characteristics are common in all areas that have a significant sense of place:

- A unique identity of a place/landscape – unique features, in some cases the rarity of a feature adds a deeper dimension to the value of the feature.
- The humanity of a place/landscape – The past and present interaction between a place and people. (Barnard et al, 2006)

The Sterkfontein Caves in the Isaac Stegmann conservation area is considered to have a significant sense of place. The caves are unique geological features and are considered fairly rare. The significance of the palaeontological and archaeological findings that are found in the deposits endows the landscape with a historical significance, which in affect also provides the landscape with an ancient quality, valued by an international group of enthusiasts.

The Krugersdorp Game Reserve is also regarded as an area with a distinct sense of place. In the present day, conservation areas such as this have great tourism value and people are generally in favour of conservation. The Krugersdorp Game Reserve is a small area of wilderness in an otherwise developed and cultivated landscape. The contrast with the surrounding land uses makes it a unique and memorable place.

4.5 CONCLUSION

The Visual Resource Assessment described the value of the landscape based on its inherent importance, scenic quality and sense of place. It provides insight on the qualities of the landscape and its importance to observers.

It becomes evident that the Southern Region of the study has a low scenic quality and a very low concentration of important features. The disturbance due to mining has altered and destroyed the original scenic qualities of the landscape and left derelict mine dumps and open spaces. This part of the study area is considered to have a low value.

The Central and Northern Regions of the study area is relatively rich in elements of importance. The varied topography creates ridges and valleys, valued for their ecological and aesthetic importance. The COH brings another dimension to the cultural and tourism value of the area. Despite the relatively moderate scenic quality of the region, the low impact of human interventions ensures that the landscape is generally dominated by its natural features. The Central and Northern Regions are moderately valued on a regional and provincial level for its aesthetic qualities and highly valued on a national and international scale for its historic significance.

5 VISUAL IMPACT ASSESSMENT

Within the study area, specific observers experience different views of the visual resource and therefore value it differently. They will be affected because of alterations to the visual resource which will impact on their views. The following typical visual impacts may occur as a result of the construction and operation of the proposed project:

- The project activities or components will noticeably change existing features or qualities of the visual resource;
- A project introduces new features which are uncharacteristic or in contrast with the existing character of the environment; and/or
- A project removes or blocks aesthetic features of the landscape which successively affects the scenic quality of a study area.

The study area includes a diverse group of observers which can be attributed to the diversity in land uses and the linear scale of the project. The following major viewer groups are identified in the study area:

- Tourists visiting the Krugersdorp Game Reserve and places of interest within the Cradle of Humankind such as the Sterkfontein Caves at Isaac Stegmann;
- Residents of the study area; and
- Commuters and farm workers that may experience frequent views of the proposed project.

These observers are regarded as receptors that will be affected by the proposed project. A dramatic change to the baseline conditions of a landscape could potentially lead to a dramatic change in the views of certain receptors. The significance of an impact is a function of:

- The magnitude of the impact;
- The sensitivity of the observer which is impacted on; and
- The exposure of the observer to the impact.

Magnitude of impact

The magnitude of an impact can be described according to the scale, extent and intensity of the project. The magnitude is often mitigated by the inherent capacity of the landscape to absorb change. The capacity of a landscape refers to the robustness of its character and its resulting ability to tolerate changes from a particular intervention without detrimental effects to its original qualities and/or values.

A landscape with a high capacity is one that:

- Has a high Visual Absorption Capacity (VAC) and consequently screens views from sensitive vantage points;
- Is often intensely developed or transformed by exploitive human activities and therefore the landscape has a low value and scenic quality as a baseline condition;
- Has characteristic land uses that are compatible with the proposed project; and
- Has a low concentration of valued attributes or its attributes are of a low value.

On the other end of the scale, a landscape with a low capacity is one that:

- Has a low VAC and is often an exposed landscape with few topographic or surface features to create visual screens from sensitive vantage points;
- Comprises of land uses that are incompatible with the proposed project; and
- Has a very high concentration of valued attributes or its attributes are of a high value.

Sensitivity of observers

The sensitivity of an observer is related to the purpose and the value they have for the scene being impacted on. To determine viewer sensitivity a commonly used rating system is utilised. This is a generic classification of observers and enables the visual impact specialist to establish a logical and consistent viewer sensitivity rating for viewers who are involved in different activities without engaging in extensive public surveys.

In addition, viewer sensitivity is combined with visibility mapping (Appendix 2). Viewer sensitivity mapping is based on the land use of the study area and provides an indication of the viewer groups that are found in the zone of visual influence and their spatial relationship to the proposed project and its components.

Table 5: Viewer Sensitivity

VIEWER SENSITIVITY	DEFINITION (BASED ON THE LANDSCAPE INSTITUTE, 2002 ED PP90-91)
Exceptional	Views from major tourist or recreational attractions or viewpoints promoted for or related to appreciation of the landscape, or from important landscape features.
High	Users of all outdoor recreational facilities including public and local roads or tourist routes whose attention or interest may be focused on the landscape; Communities where the development results in changes in the landscape setting or valued views enjoyed by the community; Residents with views affected by the development; People generating an income from the visual resource or pristine quality of the environment.
Moderate	People engaged in outdoor sport or recreation (other than appreciation of the landscape); People commuting between work place and home or other destinations.
Low	People at their place of work or focussed on other work or activities; Views from urbanised areas, commercial buildings or industrial zones. Views from heavily industrialised or blighted areas

Tourists are also classified as **exceptionally high** (red) sensitive observers owing to their inherent expectations and the visual interest they place on the environment. Their attention is focused towards the landscape which they essentially utilise for enjoyment purposes and appreciation of the quality of the landscape.

Residents of the affected environment are classified as visual receptors of **high** (orange) sensitivity owing to their sustained visual exposure to the proposed development as well as their attentive interest towards their living environment.

People travelling between their work place and home or those working on farms or at any outdoor facility are considered to be **moderately** (yellow) sensitive receptors. They have a particular interest in their living environment and are exposed to visual impacts adjacent to the road or near their working environment more frequently than for instance a once-off visitor to the region.

People experiencing views from industrial zones and blighted areas are also regarded as having **low** (grey) sensitivity as their inherent expectation is considerably lowered.

Exposure to impact

An observer's exposure to an impact is influenced by a combination of the following aspects:

- Distance from the source of impact;
- True visibility of the project keeping in mind visual contrast and the decrease in visibility over distance (Refer to Appendix 1);
- Duration, i.e. sustained, temporary, intermittent exposure, etc;

5.1 VISUAL IMPACTS DURING CONSTRUCTION PHASE

132 kV Power line

Visual impacts will result from the temporary presence of construction camps, material stockyards, and surface disturbances within the power line servitude. As mentioned earlier, the location and size of the construction camps and material stockyards has not been determined, which is problematic in assessing the true visual impacts associated with it. It is assumed that the construction camp and material stockyard will be located adjacent to each other on a site that is fairly central and accessible. The expected visual impacts often relate to the unsightly character of such a site brought about by the untidy and disorderly placement of elements in the site. The impact will however be temporary.

The construction of the power lines will also cause surface disturbances along the servitude during this period. Vegetation around the tower/pole base will be trampled on and tall trees and shrubs will be trimmed or removed in the servitude. This will cause physical damage to the vegetation cover and may cause a perceivable change to the qualities of the visual resource. This is also expected to be a temporary impact that will eventually return to the baseline condition or at least similar to the baseline condition.

Certain sections of the alternative routes pass through well established Eucalyptus plantations. In order to adhere to safety regulations, the corridor needs to be cleared of trees and high growing shrubs. The clearance of a corridor may lead to the removal of mature trees which in themselves screen views to existing power lines or unsightly objects, such as mine dumps. This may expose certain viewers to highly unsightly elements in the study area.

The intensity of the impact during construction of the power line is considered low to medium but will extend along the entire length of the corridor. It can be expected that foundations for each pole will be dug by a type of excavator and a relatively small surface disturbance will occur around each pole. An access road will be required between the poles for construction and later for routine maintenance activities. A concentration of construction vehicles and work force will be present

along sections of the corridor for the entire construction period, emphasising the construction activity.

The magnitude of the visual impact will be dramatically mitigated by the existing screening capacity of the landscape in the Southern Region and parts of the Central Region. These areas are considered to have a high VAC due to the presence of large Eucalyptus plantations and mine dumps along certain sections of Alternative 1, 2, 3, 7 & 8. Residents from the nearby Robin Park and Greenhills neighbourhoods are expected to have no significant change in their views during construction, assuming that the existing Eucalyptus plantation along Tweelopies Road, north east of Robinson Lake will remain intact. These residential areas are also quite established neighbourhoods and the gardens consist of mature trees and lush vegetation. Therefore, views in these neighbourhoods are internalised and very few residents have open viewing corridors in the direction of the proposed power line.

Taking into account that the plantation may be thinned out to such an extent that views of the construction are possible, the impact is only limited to those residents living on the fringe of the neighbourhoods, fronting the proposed power line. Their views are still considered partially blocked by their boundary fences and trees between them and the construction area, significantly reducing the magnitude of the impact.

The area north of the mine dumps up to Eldorado AH is rather exposed due to its agricultural land use and low concentration of structures and trees. Alternative 1, 2, 3, 7 & 8 will be visible from Helderblom and Eldorado AH as well as from the Krugersdorp Game Reserve. Alternative 1 (and the variations thereof sharing the same route for this section) passes within 1 km from Helderblom AH and it is expected that the construction activities will temporarily affect the quality of the visual resource from these vantage points. The intensity of the impact is considered to be low and duration of construction temporary. Helderblom AH is regarded as an established neighbourhood. The residents that do have open viewing corridors to the proposed alignment will only experience partial views of the construction activity if taking into account the screening of property fences and garden vegetation.

Alternative 2 (and the variations thereof sharing the same route for this section) passes approximately 1 – 2 km south and south west of Helderblom AH. The distance in itself is a mitigating factor and it can be expected that views will be affected minimally and that the construction activity will be in the middle to background of the view which significantly reduces the magnitude of the impact.

As Alternatives 1, 2 & 3 enters Eldorado AH, it follows the edge of the residential area through to Marabeth AH. The Eldorado, Eljeesee, Helderblom, Marabeth and Beckedan AH are established neighbourhoods and large trees often line the property boundaries. The trees are very effective visual barriers and views are mostly internalised in these neighbourhoods. Residents living on the edge of the neighbourhoods fronting the proposed Alternative 1, 2 & 3 alignments will be mostly affected due to their close proximity. These residents will experience partial views of the construction activity but will be highly exposed due to the activity occurring so close to their homes.

Alternative 7 passes east of Helderblom AH within the boundaries of the Krugersdorp Game Reserve. Residents on the fringe of the suburb closest to the game reserve will be affected most severely due to their fairly unobstructed views into the game reserve. One can assume that views into the game reserve are highly valued and that any changes to those views will be regarded as unacceptable. For tourists visiting the game reserve the construction activity and the associated surface disturbances will also be regarded as unacceptable. Tourists generally express a highly sensitive attitude towards a conservation area. Any type of construction which does not benefit the conservation area, will have a high magnitude and subsequently cause a highly significant visual impact.

Alternative 8 remains fairly west of the residential development in the Central Region of the study area. It wraps around the southern fringe of Eldorado AH but further stays in the agricultural areas. Residents living on the southern fringe of Eldorado AH will be mostly affected due to their close proximity. These residents will experience partial views of the construction activity but will be highly exposed due to the activity occurring so close to their homes.

The Northern Region of the study area between Tarlton and the proposed Kromdraai Substations has a greater degree of topographical variation and becomes even more varied further north. The landscape is very much rural, limited to farms and a few small concentrations of agricultural holdings. The natural vegetation is predominantly grassland with groupings of trees and shrubs along drainage lines, on ridges and around farmstead and agricultural holdings. The most northern part of the study area intersects with the Cradle of Humankind. Tourists often travel on the local road network between the different points of interests of which the Sterkfontein Caves are the nearest. Guest houses, conference facilities and wedding venues particularly occur in the vicinity of the Cradle of Humankind. The Northern Region of the study area is relatively rich in elements of importance. The varied topography creates ridges and valleys, valued for their ecological and aesthetical importance. A moderate scenic quality is attributed to these natural features and quaint rural character.

The VAC of the Northern Region is low to moderate. The topography causes some degree of visual screening but surface disturbances on the slopes of the hills will be highly exposed to surrounding views. Considering the limited screening provided by vegetation and the high visibility of surface disturbances, the magnitude of the visual impact caused by the construction activity is considered moderate to high and will cause perceivable changes to the existing qualities of the visual resource.

The visual receptors in the area are highly sensitive to changes to the visual resource. The visual impact will however be short term, i.e. during construction until the surface disturbances are rehabilitated.

Kromdraai Substation

Visual impacts will result from the temporary presence of construction equipment, material stockpiles, and work forces at the proposed Kromdraai Substation site. During construction, the grading of the 80 x 80 m footprint will damage and remove the existing vegetation cover, exposing the underlying soils. These surface disturbances will impact on the qualities of the visual resource and cause unsightly views towards the construction site.

The substation will be located on an open site in the Oaktree AH adjacent the Bloubank Stream. The impact during construction of the Kromdraai Substation will be of a high intensity but will remain within the boundaries of the site. Some cut and fill will presumably be required and heavy ground moving machinery will be utilised. Once the base is prepared and levelled, the steel lattice structures will be erected, probably through the use of a portable crane.

The site is very exposed and the VAC is considered low. The adjacent properties are large and trees typically surround the houses providing some degree of screening and therefore mitigating the magnitude of the impact slightly.

A low concentration of residents lives in a 2 km radius of the site. They will experience a high visual exposure to the construction activities due to their proximity and the exposed nature of the site. They will experience a great change in their visual environment that will impact on the original character and scenic quality of the area.

Tourists visiting or travelling through the Cradle of Humankind will be exposed to the surface disturbances on occasion. They are however considered as exceptionally sensitive due to their inherent expectation of the region. The short duration of their exposure reduces the magnitude of the impact to some degree but considering the intensity of the activity the significance of the visual impact is considered medium.

Conclusion

Generally the magnitude of the visual impact is considered low to medium during the construction of the power line. The screening capacity of the vegetation in the Southern Region considerably mitigates the magnitude to a level where the impact is regarded minimal. The Central and Northern Regions are more exposed due to the agricultural land use. Consequently the VAC is regarded moderate to low.

The areas where a high visual impact is expected is where the alignments pass through the residential areas of Eldorado, Eljeesee, Helderblom, Marabeth and Beckedan AH as well as alterative 7 that traverses the western part of the Krugersdorp Game Reserve. The observers that are present in these areas are highly sensitive receptors. The magnitude of the impact is regarded as medium due to the relatively low intensity of the construction activity and the temporary nature of the impact.

The alignments that are proposed between Tarlton and Kromdraai Substations, traverse an area of low receptor concentration. A limited number of viewers will be affected by the construction activity, but the receptors are regarded as moderately and highly sensitive. The study area intersects with the COH which is a tourist destination. The magnitude of the impact is regarded as medium due to the relatively low intensity of the construction activity and the temporary nature of the impact.

The construction of the Kromdraai Substation will change the visual environment of the residents in Oaktree AH. The intensity of the impact is considered high due to the clearing and grading of the 80 x 80 m footprint of the substation. The magnitude of the impact is high considering the low VAC

and the moderate scenic quality of the study area. An impact of a large magnitude occurs in an area where highly and exceptionally high sensitive visual receptors reside or pass through. The construction of the substation will cause a highly significant impact on the scenic qualities of the visual resource.

Table 6: Prediction of impacts during construction phase

Nature of Impact	Extent of Impact	Duration of Impact	Intensity of Impact	Probability of Impact	Significance of Impact	Level of Confidence
Construction phase – 132kV Power line						
Without mitigation – Activities and project components will cause a perceivable negative change in the existing qualities of the visual resource.	Regional	Short term	Medium	Highly probable	Medium to High	High
With mitigation – Duration of impact can be limited through proper rehabilitation and the intensity of the negative impact can be reduced.	Regional	Short term	Low	Highly probable	Low	High
Construction phase – Kromdraai Substation						
Without mitigation – Activities and project components will cause a perceivable negative change in the existing qualities of the visual resource.	Local	Short term	High	Highly probable	High	High
With mitigation – With additional screening the extent of impact will be reduced, duration of impact can be limited through proper rehabilitation and the intensity of the impact will be reduced.	Local	Short term	Medium	Highly probable	Medium	High

5.2 VISUAL IMPACTS DURING OPERATIONAL PHASE

132kV Power line

One of the dilemmas that service providers are often confronted with in developed areas is the lack of sufficient space. This problem is especially evident in the case of linear infrastructure, such as power lines, which require a linear servitude with a substantial width. Often, the only available space to locate a power line is through public open space system such as parks and drainage corridors and across farms. These open space systems are often appreciated for their aesthetic value by the local community. Erecting a power line through an open space interferes with the aesthetic value of that space. It changes the character of the visual resource and alters the aesthetic value of that space.

A servitude is necessary to manage certain safety risks and for access during maintenance of a power line. By implication this means that servitudes are effectively “sterilised” for most types of development or use. Servitudes through a built up area are often a dumping ground because it is perceived as no-man’s land. This is especially evident in the open spaces around the mine dumps

and in the servitudes of the existing power infrastructure. Refuse dumping and littering are great negative impacts which directly affects the aesthetic value of a visual resource.

The completed power line will result in a visual change that will be similar to, although different from the baseline setting. A single power line with its tower/poles and cables will generally result in a weak visual element and no substantial increase in visual dominance is expected. An inherent mitigating factor is the presence of an existing network of power- and transmission lines in the Southern and Central Region of the study area, which renders the additional 132kV power line as fairly compatible with the region's character. On the other hand, an existing network of power lines increases the cumulative visual impact. Where more than three power lines run in parallel, the visual dominance is often greatly magnified by the width of the servitude and the visually strong corridor that is created through a particular landscape. In such cases, the cumulative visual impact is aggravated.

During the lifespan of the project, maintenance personnel will require periodic access to the power line corridor and substations in order to complete routine examinations. This may require the clearance of shrubs under and around the pole base and conductors. These routine activities may result in physical damage to vegetation due to the movement of equipment and vehicles along the corridor.

A study done by Hull & Bishop (1988) demonstrated that the impact of a power line on the scenic quality of a landscape is most significant when the viewing distance is within 500 m from the pole sites. Up to 1 km the impact is still regarded as significant but greatly reduced over the distance. Further than 1 km the impact on the scenic quality is significantly reduced and is therefore considered minimal or negligible.

The areas where highly sensitive visual receptors are within 1 km of the alignments are Robin Park, Helderblom, Eldorado, Eljeesee, Helderblom, Marabeth, Beckedan AH and Krugersdorp Game Reserve. The alignments between Tarlton and Kromdraai Substations traverse through an area that consists of a low concentration of residents on farms and agricultural holdings. Wolfelea and Oaktree AH are among the areas of concern including tourists visiting the Cradle of Humankind.

Their proximity to the proposed power line will influence the scenic quality of the visual resource. The residential areas in the Southern and Central Region of the study area are well established and vegetative screening will limit actual visibility of the power line. The derelict character of the mining zone and the physical screens that are provided by the mine dumps and Eucalyptus plantations in the open spaces significantly increases the VAC of the Southern Region. Residents of Robin Park are expected to experience no noticeable change in their visual environment assuming that the existing Eucalyptus plantation along Tweelopies Road, north east of Robinson Lake will remain intact. Taking into account that the plantation may be thinned out to widen the corridor, it may be possible that residents from Robin Park and Green Hills will be exposed to more unsightly elements such as existing power lines in the same corridor and mine dumps from the Randfontein Estate Gold Mines. This will have a significant increase in the magnitude of the visual impact and it is therefore strongly recommended that the trees must be retained.

A similar scenario exists at the agricultural holdings in the Central Region of the study area. Alternative 1 & 2 will be parallel to an existing transmission line that bisects an established Eucalyptus plantation between the residential areas. Large trees on the edges of these agricultural holdings and in the gardens add to the screening capacity. Removal of some of the trees to widen the corridor could decrease the screening capacity and cause the residents to be exposed to the existing and proposed power lines. A severely aggravated impact will occur unless the corridor maintains its original screening capacity.

Alternative 7 traverses the Krugersdorp Game Reserve. The area is free of such infrastructure and bearing in mind that it is a natural conservation area, a power line will cause a great visual contrast with the baseline condition. The observers visiting the game reserve are regarded as highly sensitive receptors and a power line will impact on the quality of the visual resource and the views that are experienced.

The alignments between Tarlton and Kromdraai Substations will be highly exposed to views from the surrounding landscape. The low to moderate VAC of the Northern Region and the fairly rural character signifies that the visual resource is sensitive for any type of additional infrastructure. The viewers in the Northern Region are mostly residents and tourists. Their high sensitivity makes them susceptible to changes in the visual resource. The magnitude of the impact is considered moderate to high, keeping in mind that the part of the study area that intersects with the Cradle of Humankind is fairly free of power line infrastructure and the proposed 132kV power line will be a foreign and uncharacteristic addition to the existing environment.

One of the major concerns is the cumulative visual impact that will be created by the additional power lines entering and existing Tarlton Substation. A high concentration of power lines already exists around the Tarlton Substation and additional power lines will cause an increase in the cumulative visual impact. The corridor between Tarlton Substation and Portion 67 of the farm Vlakdrift 163 IQ (point D on Figure 1) could potentially have three power lines in parallel. The visual change is considered quite severe and will exceed the threshold of acceptability.

Kromdraai Substation

The proposed Kromdraai Substation will cause a significant change to the baseline setting of the visual environment. It will introduce an uncharacteristic structure in the landscape and cause a strong visual contrast with the existing land use. The exposed site significantly increases the degree of visibility of the substation and it is expected that most residents within a 5 km radius will experience views to the substation. A high magnitude of visual impact will occur due to the scale of the substation, its uncharacteristic features and impact on the scenic quality of the landscape.

The visual receptors in the impact zone are highly to exceptionally sensitive. It can be expected that the substation will perceivably change the existing qualities of the visual resource and result in a highly significant visual impact.

Conclusion

The completed power line will result in a visual change that will be greater than the baseline setting. The power line will generally result in a weak visual contrast and will not substantially increase the visual dominance of the project over the existing conditions. A great mitigating factor

is the presence of an existing network of power- and transmission lines in the Southern and Central Region of the study area, which renders the additional 132kV power line as fairly compatible with the region's character.

According to a study done by Hull & Bishop (1988) the impact is most severe within 1 km of the proposed power line. The areas of concern are those residential and conservation areas that are located within this impact zone. Generally the magnitude of the impact varies between medium and high depending on the VAC of the site and whether the proposed 132kV will be in parallel with an existing power line. The Northern Region is fairly free of power infrastructure and the additional power line will impact on the current scenic quality of the visual resource. The significance of the visual impact will be medium to high as the project will be exposed to highly and exceptionally high sensitive viewers.

The presence of the Kromdraai Substation will cause a great alternation to the visual resource. The uncharacteristic features of the substation will contrast severely with the existing land uses. The intensity of the impact is considered high due to the scale of the substation and the exposed location of the site. The magnitude of the impact is also high considering the low VAC and the moderate scenic quality of the study area. An impact of a high magnitude occurs in an area where highly and exceptionally high sensitive visual receptors reside or pass through. The substation will cause a highly significant impact on the scenic qualities of the visual resource and the views that are experienced of the visual resource.

Table 7: Prediction of impacts during operational phase

Nature of Impact	Extent of Impact	Duration of Impact	Intensity of Impact	Probability of Impact	Significance of Impact	Level of Confidence
Operational phase – 132kV Power line						
Without mitigation – Activities and project components will cause a perceivable negative change in the existing qualities of the visual resource. Project could result in the reduction of the VAC in certain sections of the corridor exposing unsightly elements	Regional	Long term to permanent	Medium	Highly probable	Medium to High	High
With mitigation – Upgrading of an existing power line instead of constructing an additional power line will be the most preferred mitigation measure with the highest affect. Alignment along existing power lines is more accepted than following a new alignment. This will cause the least visual change based on the baseline setting.	Regional	Long term to permanent	Low	Highly probable	Low	High
Operational phase – Kromdraai Substation						
Without mitigation – Activities and project components will cause a perceivable negative change in the existing qualities of the visual resource. Project introduces elements that are uncharacteristic and in contrast with the visual environment.	Regional	Long term to permanent	High	Definite	High	High
With mitigation – Relocation of substation will have greatest mitigating affect, but additional screen planting can reduce the extent as well as the intensity of the impact	Local	Medium term	Medium	Highly probable	Medium	High

6 COMPARATIVE ANALYSIS AND CONCLUSION

A number of variations exist between the alignments connecting Westgate and Tarlton Substations. All of them share the same corridor between point A & B at which point four different routes split off. Alternative 8 is the most preferred option for the route between Westgate and Tarlton Substations to a large degree. The particular variation of Alternative 8 is between point A, B, M & E. Alternative 8 will impact on the least sensitive visual receptors and will align with the general direction of a railway for approximately 7 km before it turns north towards Tarlton Substation. The route also avoids crossing through the agricultural holdings of the Central Region where a concentration of highly sensitive visual receptors reside. The potential increase in the cumulative visual impact that will occur between the sections E, D, K & J will also be avoided.

Alternative 1 & 3 are marginally more preferred than Alternative 2, mostly due to the fact that it aligns with an existing power line for the section between X and C. The existing power line is regarded as a mitigating factor that renders an additional power line more compatible to the visual resource. The author is of the opinion that consolidating a new power line in an already existing corridor of another power line is visually more acceptable than constructing an additional power line approximately a kilometre away from an existing power line. The cumulative visual impact is regarded as acceptable as only two power lines will run in parallel.

The least preferred option is Alternative 7. The fact that it crosses the Krugersdorp Game Reserve is regarded as a fatal flaw. A highly significant visual impact is expected as highly sensitive visual receptors will be affected. The visual resource will be affected negatively as the power line will contrast with the wilderness character of the game reserve.

Table 8: Ranking of alternatives between Westgate and Tarlton Substations

Ranking from most to least preferred	Alternative alignment	Route description
1	Alternative 8	A, B, M & E
2	Alternative 1&3	A, B, (Y)X, C, D & E
3	Alternative 2	A, B, Y, C, D & E
4	Alternative 7	A, B, L, J & E

All the alternatives between Tarlton and the proposed Kromdraai Substations will have very similar visual impacts. The same argument applies as in the above section that the visual impact of consolidating an additional power line in an existing corridor is generally more accepted than introducing a power line into a baseline setting absent of these sort of infrastructure.

Alternative 4 & 5 follow the same alignment up to Portion 77 of the Farm Sterkfontein 173-IQ (Point F in Figure 1). Alternative 4 branches off to the east while Alternative 5 continues along the existing transmission tower up to Portion 35 of the farm Sterkfontein 173-IQ (Point FG in Figure 1). Of the two alternatives, Alternative 5 is the most preferred by a small margin. Alternative 5 continuous for a longer length along the existing transmission line, causing a fairly small visual change to the baseline condition. From here it branches off to the proposed Kromdraai Substation. Much fewer visual receptors are present within 1 km of the alignment than compared to Alternative 4. This means that fewer visual receptors will be exposed to the new power line.

Alternative 6 and the section of Alternative 7 between J & I are considered as the least preferred options. The cumulative visual impacts for the section between point E and K are considered unacceptable. Also, a greater number of viewers will be affected along points H & I.

Table 9: Ranking of alternatives between Tarlton and Kromdraai Substations

Ranking from most to least preferred	Alternative alignment	Route description
1	Alternative 5	E, F, FG & G
2	Alternative 4	E, F & G
3	Alternative 6	E, D, K, H, I & G
4	Alternative 7	I & J

6.1 NO-GO OPTION

As part of the EIA requirements, it is necessary to discuss the no-go option. The no-go option is defined as the option where the project will not be implemented. In terms of the visual impact, this option will not cause any changes to the baseline condition and therefore no visual change will occur. The visual impact will therefore be neutral as no observers will be affected and no changes to the character of the visual resource will occur. The no-go option is the most preferred option above all the alternatives that have been proposed based on the fact that no negative visual impacts will occur.

7 MITIGATION

The aim of mitigation is to reduce or alleviate the anticipated impacts that are a consequence of the proposed project's components and activities.

Mitigation measures are provided for three phase of the project namely, the design, construction and operational phases. "Mitigation is a design skill that should start at the very inception of a project with the analysis of environmental opportunities and constraints." (Institute of Environmental Assessment and Landscape Institute, 1995) This approach generates preventative measures that will influence design decisions instead of relying on cosmetic landscape remediation of a completed project.

7.1 DESIGN PHASE

The single most important mitigation measure that should be addressed in the design phase is the proper location of the proposed power line and substation. A thorough assessment of alternative locations for the proposed project can yield the greatest results in limiting visual impact. The following mitigatory considerations can assist in locating the project components:

- The human eye tends to follow dominant lines in a scene and is stimulated to explore their origin and termination. This is the study of visual force where an observer follows certain lines or edges in a scene in a particular direction. Usually the eye will move up in valleys and down ridges of a mountainous scene. These are the obvious locations where power lines and substations should be restricted in order to maintain visual coherence of the horizon line;
- Each study area has a natural screening capacity, either through topographical variation or vegetative screening, or a combination of both. The study area provides the opportunity to locate certain sections of the power line through the exotic woodlands which will in effect completely or partially conceal the power line from outside vantage points. This type of planning must go hand in hand with on site confirmation in order to establish the best route that will require the least clearing of trees and so retain the sites natural screening capacity;
- Due to the exposed location of the substation site, the substation will have a relatively large visual impact zone. Relocation of the substation to a less exposed site is preferred otherwise the screening capacity of the site can be enhanced through additional screen planting; and
- It is highly recommended that the existing power line network be upgraded. Where an existing power line can be dismantled and substituted by a single larger capacity power line, the option must be considered as this will have the least visual change. This will also prevent several power lines running in parallel in a corridor and increasing the cumulative visual impact to unacceptable levels.

7.2 CONSTRUCTION PHASE

As a general rule of thumb one can significantly reduce the extent and magnitude of visual impact by limiting the area of surface disturbance during construction. Exposed soil or damaged vegetation is expected to cause visual intrusion and impact on the scenic quality of the visual resource. The following techniques can be implemented to reduce surface disturbances:

- Locate construction camps and stock yards in the least visible areas. Make use of the natural screening capacity of the site by placing these facilities in the lower lying areas of the site or adjacent a dense vegetation patch with sufficient height to conceal these project components. Alternatively, the screening capacity of the site can be enhanced through the erection of a 2 m shade cloth fence around the construction camp and substation site while screen planting is being established. The colour of the shade cloth should be similar to that of the adjacent vegetation;
- Keep the construction camp neat and tidy at all times. Remove any waste products from the site or contain it in an enclosed area out of the sight from viewers;
- Establish limits of disturbances during construction through demarcating construction areas to the minimum area required for construction;
- Keep to existing road infrastructure as far as possible to minimise the physical damage to vegetation in the power line corridor;
- Retain as much of the existing vegetation as possible, specifically existing mature trees that contributes to the natural screening capacity of the site; and
- Implement rehabilitation of disturbed areas as soon as possible to limit the duration of exposed surfaces.

Further mitigation measures can be implemented to specifically reduce the visual impact during construction of the Kromdraai Substation:

- Minimise unsightly cut- and fill areas by stepping in the substation building platform and thereby lowering the structure by as much as possible;
- Shape the cut and fill embankments by rounding the edges and giving it a more natural appearance if space permits. Alternatively, embankments must be stabilised preferably through planting (unlikely to be an option inside the substation boundary fence due to safety consideration) to cover up any exposed soil and to restrict erosion;
- Establish tree lanes in strategic places namely on the property boundary of all the substations, adjacent properties or in passing road reserves. These tree lanes should be planted with specific views in mind and will act as screen planting fragmenting extensive views of the substation. This method of mitigation will require negotiations with the adjoining landowners but if views from their own properties could be mitigated in this way, it should not be difficult to demonstrate the validity of this technique;
- Avoid construction during weekends and holidays near residential areas and tourist attractions such as guest houses, nature or conservation areas;
- Signage should be simple and unobtrusive and not be seen anywhere against the skyline; and
- A definite effort should be made to reduce the height and scale of the structures, if at all possible.

7.3 OPERATIONAL PHASE

- Maintenance of the servitude in terms of clearing up littering and dumped refuse is highly recommended. This must be done on a routine basis in order to keep the servitude neat and maintain a visually pleasing condition;
- All lighting, especially perimeter security lighting at the Kromdraai Substation must be shielded to minimise light spillage and pollution. No direct light sources must be seen from outside the site;

- Previously rehabilitated areas must be monitored to prevent the infestation of alien vegetation species that may become an unsightly feature; and
- Screen planting that was specifically established to minimise the intrusiveness of the power line or substation must be maintained and dead or sick plants replaced for a determinate period after construction.

8 REFERENCES

As a matter of best practice, this assessment is based on internationally accepted guidelines and standards with regards to VIA. The following sources are frequently referred to:

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