Visual Impact Assessment Report for the proposed Hekpoort – Cashan 132kV Powerline and Cashan Substation

Report Prepared for

Eskom Holdings SOC Limited

Report Number 465044/48V

Report Prepared by

srk consulting

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Visual Impact Assessment Report for the proposed Hekpoort – Cashan 132kV Powerline and Cashan Substation

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Disclaimer

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1 Introduction and Scope of Report

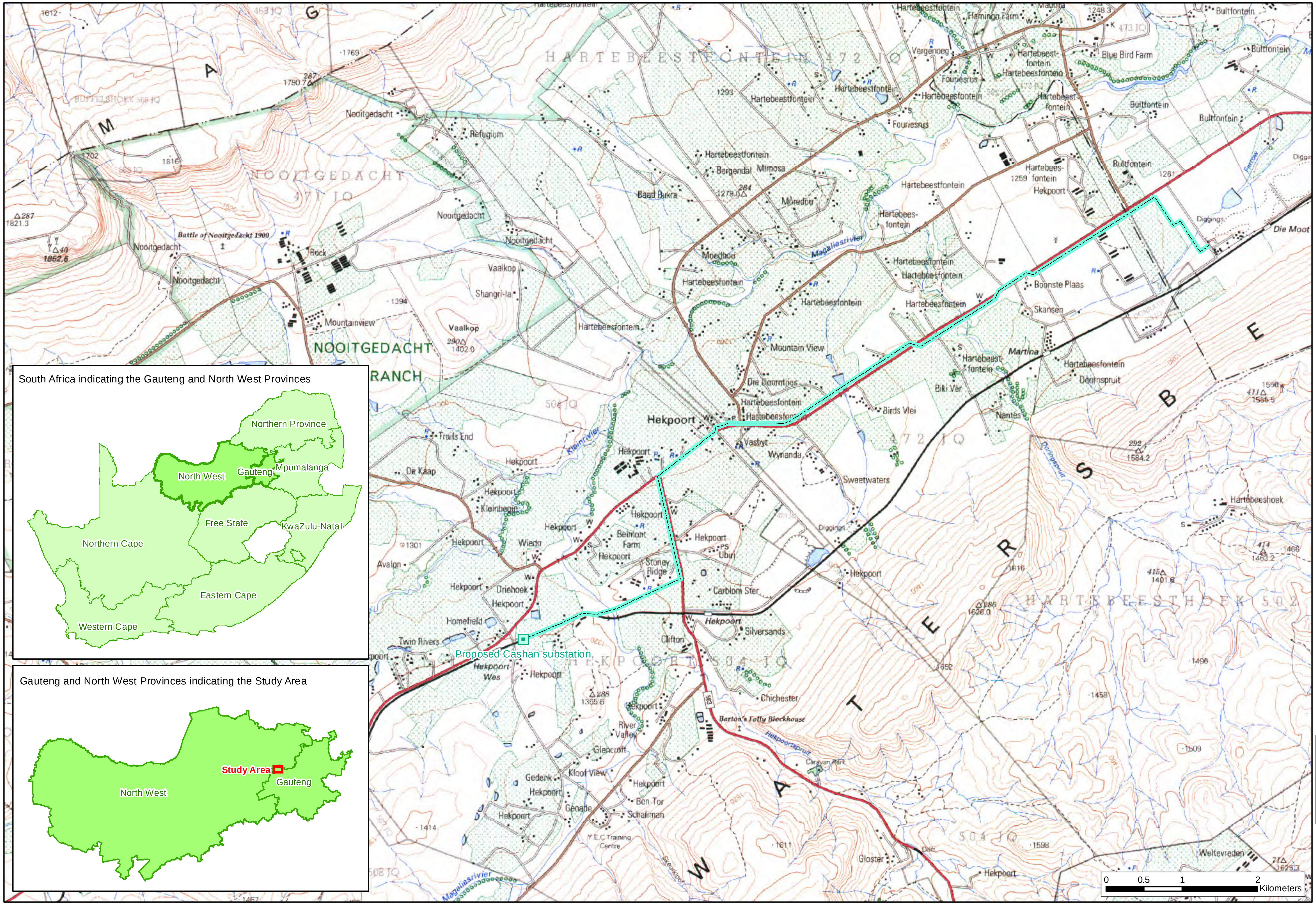
Eskom Holdings SOC Limited (Eskom) appointed SRK Consulting (South Africa) Pty Ltd. (SRK) to undertake an Environmental Assessment process for the proposed Cashan substation and 132 kilovolt (kV) powerline linking the existing Hekpoort substation to the proposed Cashan substation, in the Gauteng and North West Provinces in South Africa (Figure 1-1).

In terms of the National Environmental Management Act (NEMA, Act No. 107 of 1998), the proposed development requires a Basic Assessment (BA) process to be undertaken. As part of this process, a number of specialist studies have been identified, one of which is a Visual Impact Assessment (VIA). This report constitutes the VIA for the proposed powerline and substation.

The proposed project will entail upgrading the existing electrical infrastructure in the Hekpoort area (Figure 1-2) on the borders between the Gauteng and North West Provinces of South Africa, by establishing:

- A new substation; and
- A 132kV powerline linking the proposed substation to the existing Hekpoort substation.

This study considers both the magnitude of the visual impact (rated according to VIA criteria) and the significance of the visual impact (rated according to prescribed methodology). In addition to the existing mitigation measures built into the facility design, additional measures are proposed and are summarised as recommendations at the end of the report.



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Legend

- Proposed Cashan substation
- Proposed Powerline

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VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

LOCALITY MAP INDICATING THE STUDY AREA

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Project No: 465044	Fig No: 1-2

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VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

AERIAL IMAGE SHOWING THE ORIENTATION OF THE PROPOSED DEVELOPMENT

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1.1 Objectives of the study

The objectives of the investigation are to:

- Gain a detailed understanding of the baseline environment;
- Determine and assess the visual impacts (including cumulative impacts) to receptors and resources in the vicinity of the proposed powerline and substation;
- Determine and assess any issues that may have been raised by Interested and Affected Parties (IAPs) during the Environmental Assessment Process;
- Identify potential environmental management measures, where possible, in order that negative visual impacts may be mitigated against and positive benefits enhanced; and
- Assist in the provision of feedback to stakeholders, where necessary.

1.2 Terms of Reference

The purpose of this VIA is to assess the potential visual impacts that the proposed development may have on the surrounding landscape and to ensure that potential impacts are adequately addressed in the Environmental Management Programme (EMPr) and associated documentation for the project. This VIA also aims to identify adequate measures that should be implemented in order to mitigate against any potentially adverse visual impacts, associated with the proposed project, on the surrounding visual environment.

For this study, the terms of reference are to:

- Determine areas that will be visually exposed to the proposed powerline and substation;
- Determine the landscape character and the sense of place of the study area;
- Investigate the potential visual impacts of the proposed project;
- Describe and assess the potential visual impacts that the proposed powerline and substation may pose from selected identified critical areas and view fields; and
- Provide recommendations for mitigation of and identify potential adverse visual effects that the proposed project may have on the surrounding landscape.

1.3 Methodology and Approach to the Assessment

Due to the absence of guidelines regarding VIA's in the Gauteng and North West Provinces, this VIA is based upon the "*Guidelines for Involving Visual and Aesthetic Specialist in EIA Processes*" authored by the Provincial Government of the Western Cape (WC Guidelines) (Oberholzer, 2005).

The following methodology was applied to meet the terms of reference in the most objective way:

- Identification of data requirements and collation of data. This included acquiring spatial data on topography (contours), existing visual character and quality, details and plans of the proposed powerline and substation and other background information;
- A site visit conducted on 05 September 2013 to:
    - Become familiar with the site and its surroundings;
    - Verify the desktop spatial analysis undertaken;
    - Identify possible visual receptors; and
    - Identify and assess viewing points (affected communities) and visibility.

- A geo-spatial raster analysis[1] of all the processed data was conducted to determine the **magnitude** of the visual impacts of the following attributes:
  - Visual exposure (viewshed) and viewing distance;
  - Visibility;
  - Visual absorption capacity;
  - Landscape / townscape integrity;
  - Sensitivity of viewing receptors; and
  - Mitigation measures to reduce the overall visual impact to acceptable levels.

1.4 Approach to the assessment

Due to the subjective nature of the VIA process, emphasis has been placed on an environmentally accepted methodology and rating criteria in order that the results are clearly stated and transparent. Furthermore, all ratings are motivated and, where possible, judged against explicitly stated and objective criteria. The assessment has to be accurate and a number of techniques were used in the analysis to ensure reliability and credibility.

In order for a visual impact to occur there needs to be a viewer and an object that invokes a response from the viewer. The response can be either negative or positive. As such, the potential areas of influence[2] were delineated and compared against the viewshed (area of visual influence) in this VIA. Based on this model, areas that would not be visually influenced by the development were not assessed further. The areas identified as being potentially influenced were investigated in further detail by means of a site visit, a baseline comparison and further computer simulations and impact modelling using a Geographic Information System (GIS)[3].

The study focuses mainly on the operational impacts that the proposed development may have on the landscape and to a lesser extent on the impacts during construction and decommissioning. These impacts however, cannot be ignored and recommendations in terms of mitigation measures for the construction and decommissioning phases are provided and should be taken into consideration during the drafting of the EMPr for the construction, operation, closure and rehabilitation phases of the project.

This report is intended to be contextualised with the main environmental assessment report and other specialist studies undertaken for the project.

1 Using raster (data with cell based information) in conjunction with spatial information an analysis of the potential visual impacts can be undertaken

2 Areas of influence include suburbs / residential areas, roads, office blocks, recreational areas and tourist attractions.

3 The GIS package that was used is an ESRI ArcGIS 10.1 Spatial Analyst and 3-D Analyst Package.

1.5 Assumptions and limitations

The following assumptions and limitations are relevant to the study:

- The drawings (including the designs of the structures, site layout and height of the structures) supplied via electronic mail on 12 February 2014 from Mr. R Sobey and Mr. M Stols are assumed to be up to date and accurate and will remain unchanged for the duration of the VIA. These layouts were used to undertake the VIA analysis;
- The contour interval used in the analysis was 20 metres (m);
- The viewshed illustrates areas from which the proposed infrastructure is likely to be visible. It does not take local undulations, existing vegetation and man-made structures into account. Due to the interval of the contours, many of the undulations or natural landscape features smaller than 20 m tall could be lost. This means that the proposed infrastructure associated with the development may not be visible from everywhere indicated within the viewshed; as the proposed development may be obscured by existing infrastructure in the area, or vegetation or small/localised variations in the topography. It therefore indicates a “worst case” scenario;
- Visual impact assessments, by nature, are not a purely objective, quantitative process but are dependent to some extent on subjective judgments. Where subjective judgments are required, appropriate criteria and motivations have been clearly stated; and
- The significance of the impact has been calculated using a combination of the Hassell Matrix[4] and SRK’s impact rating methodology.

4 The Hassel Matrix has been developed from “The Visual Management System (VMS)” produced by Litton(1968) primarily used for the U.S. Forest Service (1973) and the US Bureau of Land Management (1980).

2 Description of the Proposed Development

Eskom is currently in the process of decreasing the pressure exerted on power stations by introducing additional substations to the various areas in need, with the aim of supplying electricity to areas with increasing electricity demand in the Gauteng and North West Provinces. Eskom therefore proposes to construct a new substation and powerline, approximately 12 kilometres (km) in length, adjoining the new substation to the existing Hekpoort substation.

The proposed upgrades include:

- The development of the new Cashan substation site approximately 12 km from the existing Hekpoort substation; and
- The development of a 132kV powerline linking the existing Hekpoort substation to the proposed new Cashan substation.

2.1 Study Area

The proposed project will consist of an approximately 12 km powerline corridor and the site of the proposed new substation. The overall study area crosses two local municipalities (namely Mogale City (GT411) and Madibeng (NW372) Local Municipalities). Due to the linear extent of the proposed powerline corridor, the overall study area has been divided into 4 smaller study areas in order to simplify the visual assessment (Figure 2-1). These smaller study areas include:

- The proposed Cashan substation site and
- Three (3) stretches of the proposed powerline linking the proposed Cashan substation, each approximately 4km long and selected in such a way that each could be assessed individually, to the existing Hekpoort substation. These stretches are referred to as:
    - o A – B,
    - o B – C, and
    - o C – D.

2.1.1 Cashan Substation Site

The site of the proposed Cashan substation site is approximately 27 km north-west of Krugerdorp, and approximately 35 km south-west of Brits, alongside the R563. The footprint area of the substation site is expected to be 100 m^2. The highest structure at the substation will be the communication mast, which is expected to be approximately 45 metres above ground level (magl).

2.1.2 Powerline

The proposed 132 kV powerline will be approximately 12 km long, running from the existing Hekpoort substation to the proposed Cashan substation. The servitude width required by Eskom for the overhead distribution line is 31 metres (15.5 metres from the centre of the powerline). It is anticipated that an 8 m wide strip will be required to be cleared of all vegetation for stringing purposes.

Powerline Stretch A – B

Powerline Stretch A – B commences at the existing Hekpoort Substation, follows the unpaved access road in a north-westerly direction towards the R560, where after it will continue in a south-westerly direction alongside the R560.

Powerline Stretch B – C

Powerline Stretch B – C continues alongside the R560 in a north-westerly direction, crossing the R560 twice.

Powerline Stretch C – D

Powerline Stretch C – D is the final stretch of the proposed powerline to the proposed Cashan substation. The powerline will head in a south-south-easterly direction from the R560 onto the R563, where it continues straight for approximately 1.3 km before heading south-westerly to the Cashan substation.

2.2 Summary of the main structural components

The section that follows outlines some of the parameters and assumptions made during the assessment of the visual impacts that the proposed development may have on the surrounding landscape.

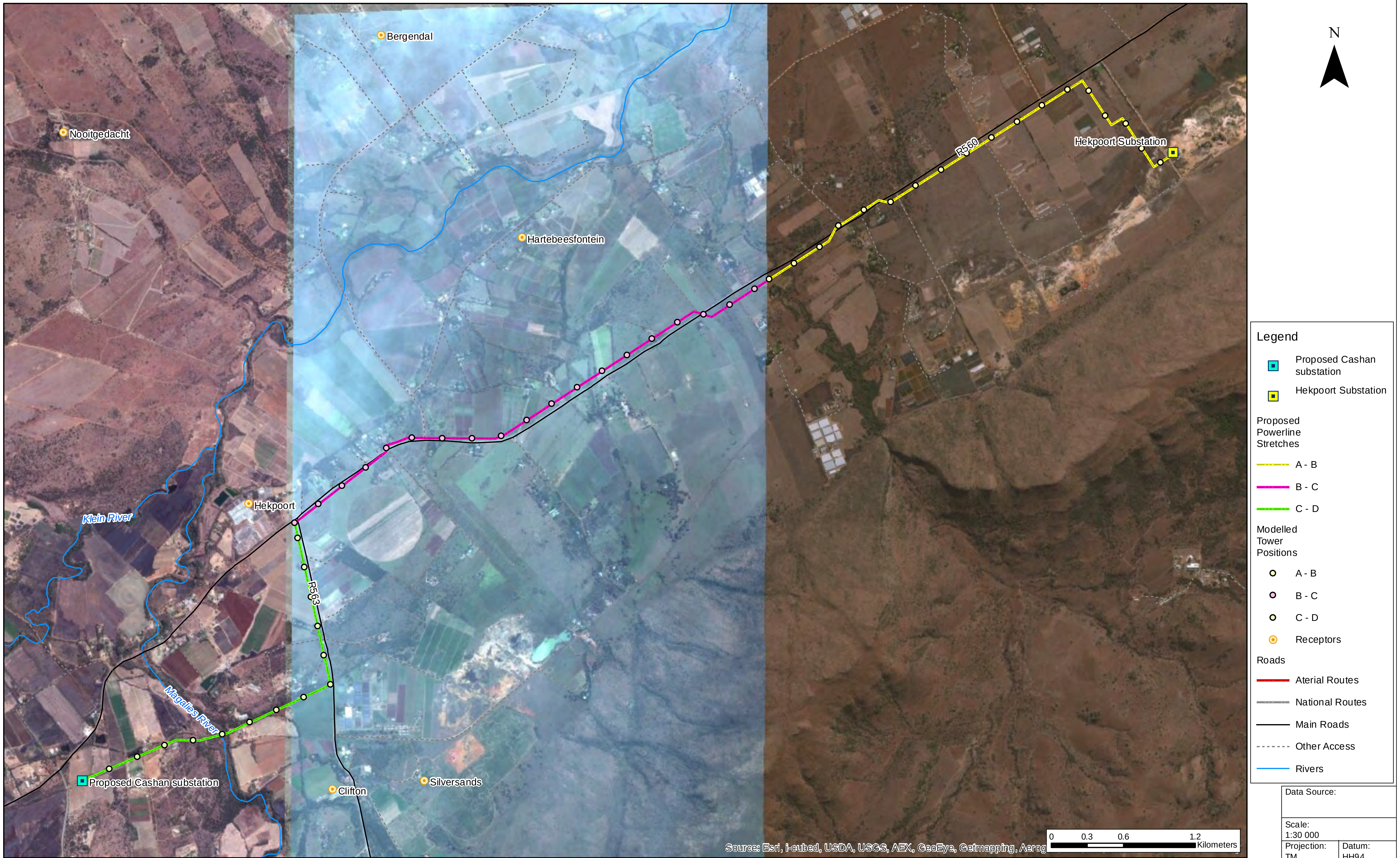
In order to understand the impact a structure may have on a receptor (viewer) it is important to understand what the structure will look like. The following key considerations are taken into account when assessing the probable visual impact on a receptor:

- **Height:** The higher the structure or facility is, the wider the visual envelope (viewshed) will be. The height of a structure may be mitigated / shielded by the topography of the surrounding area, man-made features or by natural features. The opposite is also true as the lack of the abovementioned “mitigation” or “shielding” may increase the visibility of the structure. Visually the perception of the height of a building or structure is partially a function of the spatial interaction between the topography, height of existing infrastructure and the height of natural features, such as trees and shrubs in the vicinity of the infrastructure.
- **Surface area:** The combination of the total surface area and the degree of visibility of the site has an impact on receptors. A smaller surface / face-area / cross-sectional area may reduce visibility from areas further away from the infrastructure and, hence could reduce the potential visual impact that the development may evoke. A larger surface / face / cross-sectional area will obstruct views which would previously have been visible and may lead to a more significant visual impact.
- **Arrangement of construction:** A staggered configuration, such as a powerline structure (as an example), ensures that the infrastructure may “blend” into the surrounding environment. Solid structures (retaining walls / buildings) are more obstructive and visible over a larger area.
- **Arrangement of colours:** The colour of infrastructure has an important function as it could either add emphasis on the structure, or it could assist in hiding / camouflaging it. It is therefore important that structures or buildings be painted with neutral colours which should be consistent with the colours of similar structures in the wider area.
- **Boundary with the environment:** The site earmarked for development may significantly change the appearance of the natural area in which it is located. It is therefore important to retain as many natural features as possible, such as the landscape and vegetation surrounding the site, where it does not pose a health or safety risk from an operational perspective.

Table 2-1 summarises how the main infrastructural components of the proposed development were modelled in GIS for the assessment of their visual impacts in terms of their heights, surface area and arrangement.

Table 2-1: Brief Description of the main components considered in the Visual Impact Assessment

Component	Height used in modelling (magl)	Arrangement used in modelling
Cashan substation site	45	The highest and potentially most visible structure of a substation is a 45 magl communication mast. This was used in the modelling of the Cashan substation.
Powerline Stretch A - B	30	Due to the powerline tower positions being undefined at the time of the study, it was assumed that the powerline span would be an average of 250 m. During the modelling of the corridor, a tower was assumed to be located every 250 m. Using information supplied by Eskom, a tower for a 132kV conductor is approximately 30 magl.
Powerline Stretch B - C		
Powerline Stretch C - D		



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VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

SITE LAYOUT OF THE PROPOSED DEVELOPMENT

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3 Description of the Project Environment

3.1 Criteria

Due to the subjective nature of VIAs, a number of criteria have been used to describe the visual aspects of the environment. The criteria evaluate the current visual landscape and the potential changes to the landscape the proposed development may have.

The following criteria can be used to describe the visual landscape of an area:

- **Visual Character:** Visual character is descriptive and non-evaluative, which implies that it is based on defined attributes that are neutral. A change in visual character cannot be described as having positive or negative attributes until it is compared with the viewer's response to that change. The probable change caused by the development is assessed against the existing degree of change caused through development.
- **Visual Quality:** Visual quality is evaluated by identifying the vividness, intactness and unity present in the viewshed. This approach to evaluating visual quality can also assist in identifying specific methods for mitigating specific adverse impacts that may occur as a result of the project.
- **Sense of Place:** Our sense of a place depends not only on spatial form and quality but also on culture, temperament, status, experience and the current purpose of the observer (Lynch, 1992). Central to the idea of 'sense of place' or *Genus Loci* is identity. An area will have a stronger sense of place if it can easily be identified, that is to say if it is unique and distinct from other places within the area.
- **Viewshed:** The viewshed indicates areas where the development components will potentially be visible from. This is established through spatial modelling.
- **Viewing Distance and Visibility:** The distance of a viewer from the proposed development is an important determinant of the magnitude of the visual impact. This is due to the visual impact of an object diminishing / attenuating as the distance between the viewer and the object increases. This is a measurement of how visual impacts are modified by distance. The effect of scale, topography, vegetation, weather, and distance, in turn alters the degree of a visual effect.
- **Visual Absorption Capacity (VAC):** The Visual Absorption Capacity (VAC) is the potential for the area to conceal an object.
- **Landscape Compatibility:** Landscape or townscape compatibility refers to the compatibility of the proposed structure with the existing landscape and townscape.
- **Viewer Sensitivity:** The sensitivity of viewers is determined by the number of viewers and by how likely they are to be impacted upon. Sensitivity is also dependent on the viewer's perception of the area and their ability to adapt to changes in the environment. This can also include how frequently they are exposed to the view, i.e. static views from houses would have a higher sensitivity than transient views experienced by motorists.

In the following sections of the report, the magnitude of the visual impact of the proposed development will be discussed, in terms of the criteria listed above.

3.2 Visual Character of the proposed development

The proposed development is approximately 27 km north-west of Krugerdorp, and approximately 35 km south-west of Brits, crossing between the Gauteng and North West Provinces. The closest neighbouring communities and villages include Hekpoort, Hartebeesfontein, Bultfontein, and Clifton.

The proposed development is at an altitude of between 1260 metres above mean sea level (mamsl) and 1280 mamsl. The topography of the study area is generally flat (refer to Figure 3-1), falling within the base of a valley. The landuse surrounding the site can be characterised as farmlands, small scale sand mining operations and residential communities. The study area can be divided into distinct 'land types' each with a dominant landscape character. These land types are:

- Small scale sand mining activities;
- Rural / grazing;
- Semi-natural areas;
- Tourism; and
- Agriculture.

Section 4 of this report assigns a numerical value for each of the components of the proposed development, based on the landuse character in which they are located, calculated on the rating Hassell matrix tabulated in Table 3-1 below.

Table 3-1: Land Use Character Rating System

Description	Value	Typical Character / Use
Unmodified landscape/natural	5	No / minimal impact associated with the actions of man. National parks, coastlines, pristine forest areas.
Natural transition landscape	4	A changing landscape character associated with the interface between natural areas and modified rural / pastoral or agricultural zones.
Modified rural landscape	3	Typical character is rural landscape, defined by field patterns, forestry plantations and agricultural areas and associated small-scale roads and buildings.
Transition landscape	2	Transitional landscape associated with the interface between rural, agricultural area and more developed suburban or urban zones.
Highly modified landscape, urban/industrial.	1	Substantially developed landscape. High levels of visual impact associated with buildings, factories, roads and other related infrastructure.

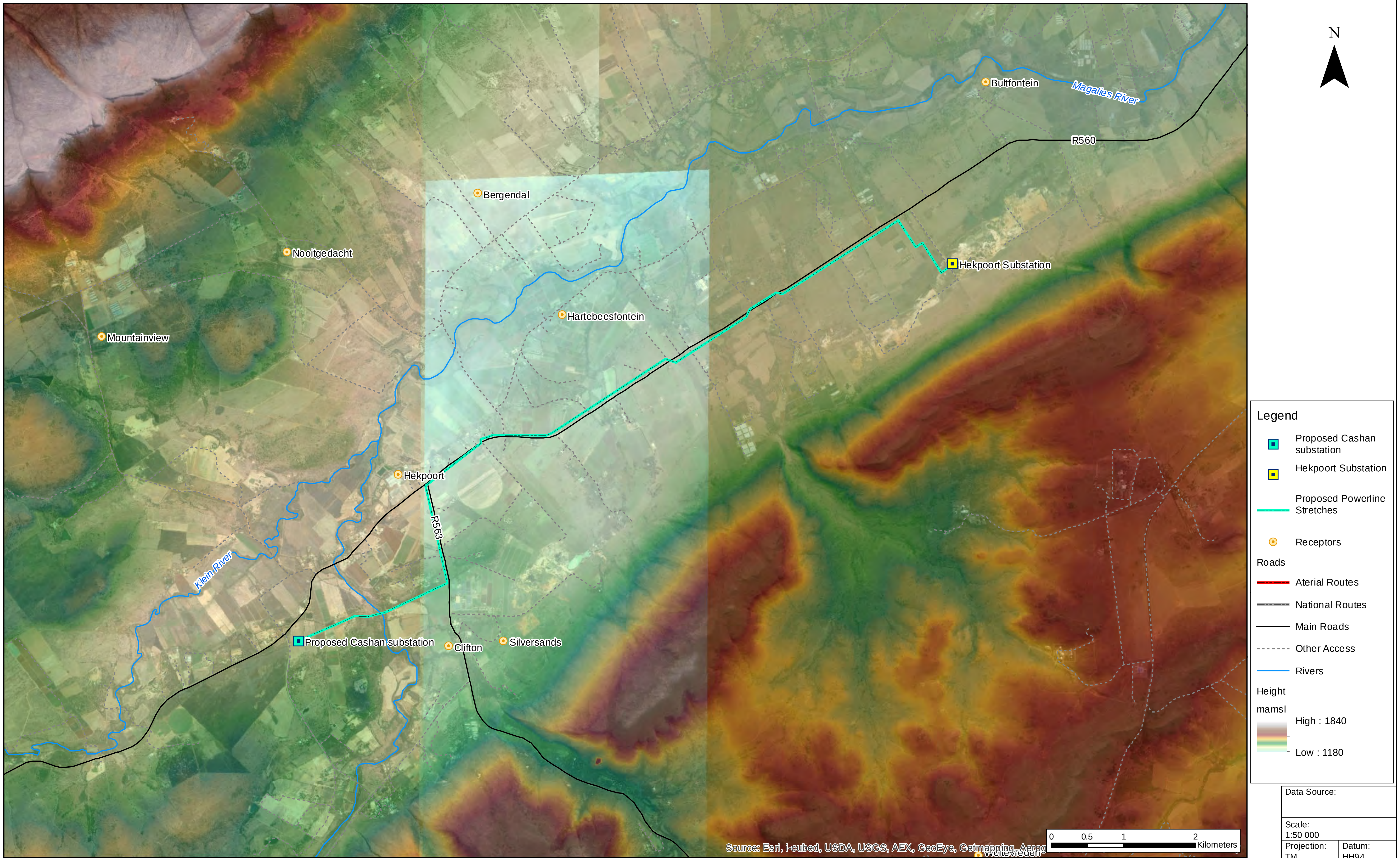
Generally the proposed powerline falls within close proximity to an existing powerline and road servitude. The area surrounding the development can be described as being a modified rural landscape characterised by the open grassveld interspaced agricultural fields (Plates 3-1 and 3-2). The proposed Cashan substation, however is proposed within a more rural / untouched landscape than that of the powerline (Plate 3-3). The area in which the proposed powerline falls can be described as being a changing landscape, placing it into the Natural transitional landscape category.

Plate 3-1: View towards the proposed powerline span from the existing Hekpoort substation

Plate 3-2: View towards the proposed powerline span, along the R560 towards the proposed Cashan substation

Extracted from Goggle Earth Street View, 2010

Plate 3-3: View towards the proposed Cashan substation from the R563



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VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

TOPOGRAPHY AROUND THE STUDY AREA

3.3 Visual Quality

Visual quality is evaluated by identifying the vividness, intactness and unity present in the viewshed. This approach to evaluating visual quality also assists in identifying specific methods for mitigating specific adverse impacts that may occur as a result of the project.

Aesthetic value is an emotional response derived from our experience and perceptions. As such, it is subjective and difficult to quantify in absolute terms. Studies in perceptual psychology have shown that humans prefer landscapes with higher complexity (Crawford, 1994). Landscape quality can be said to increase when:

- Topographic ruggedness and relative relief increases;
- Water forms are present;
- Diverse patterns of grassland and trees occur;
- Natural landscape increases and man-made landscape decreases; and
- Where landuse compatibility (coherence) increases.

Thus visual quality decreases when elements deter from the natural environment and, hence, influence the wider area of influence in a negative way.

Elements that decrease the visual quality of an area includes "visual clutter" and man-made features including, but not limited to:

- Roads and bridges;
- Dense developments and high buildings;
- Commercial facilities; and
- Mines, factories, stacks, etc.

Although the area surrounding the proposed development is considered to be natural, existing man-made features, such as existing powerlines, substations, small scale sand mining and agricultural activities, in the area detract from the natural environment and hence drop the visual quality to MEDIUM.

3.4 Sense of Place

Our sense of a place depends not only on spatial form and quality but also on culture, temperament, status, experience and the current purpose of the observer (Lynch, 1992). Central to the idea of 'sense of place' or *Genus Loci* is identity.

An area will have a stronger sense of place if it can easily be identified, that is to say that if it is unique and distinct from other places. Lynch defines 'sense of place' as "the extent to which a person can recognise or recall a place as being distinct from other places – as having a vivid or unique, or at least a particular, character of its own" (Lynch, 1992:131).

The sense of place in the villages surrounding the proposed development is that of farming, including scatter commercial and subsistence farms in the surrounding areas. As mentioned, small scale sand mining is also evident within the areas in close proximity to the existing Hekpoort substation.

4 Analysis of the Magnitude of the Visual Impact

4.1 Introduction

The following section outlines the assessment that was undertaken to determine the **magnitude** of the visual impact for the proposed development. Visual impacts associated with the proposed development and the cumulative impacts of these were assessed.

Various factors were considered in the assessment, as indicated in Section 3, including:

- Visual exposure of the development in terms of the viewshed;
- Visibility and viewing distance;
- Visual absorption capacity (VAC);
- Integrity with existing landscape / townscape; and
- The viewer's sensitivity to change.

These criteria are explained further in the following sections and are used to calculate the magnitude of visual impact, presented in Table 4-5 and Table 4-6.

4.2 Visual Exposure

Visual exposure is determined by the zone of visual influence or "the viewshed". A viewshed is a subset of a landscape unit (envelope) and is the topographically defined area that includes all the major observation sites from which the proposed development is expected to be visible. The boundary of the viewshed demarcates the zone of visual influence.

Verification of the viewsheds is required due to the fact that the viewshed does not take into account the existing features such as man-made obstacles and vegetation. Figure 4-1 indicates the locations of the various viewpoints or observer points used to verify the viewsheds. The viewpoints were chosen by selecting areas where a combined viewshed for proposed development (Appendix 1 indicates the viewsheds carried out for each stretch of the proposed powerline and Cashan substation).

Table 4-1 below outlines a set of Visibility Criteria that were used to rank how visible the proposed development may be from the selected viewpoints. Each of the viewpoints identified in Figure 4-1 have been rated according to visual exposure criteria, which is a combination of ratings in Table 4-1 and verification through a site visit. Each of the viewpoints has been rated according to the Visibility Criteria ranking.

Table 4-1: Visibility criteria (Exposure)

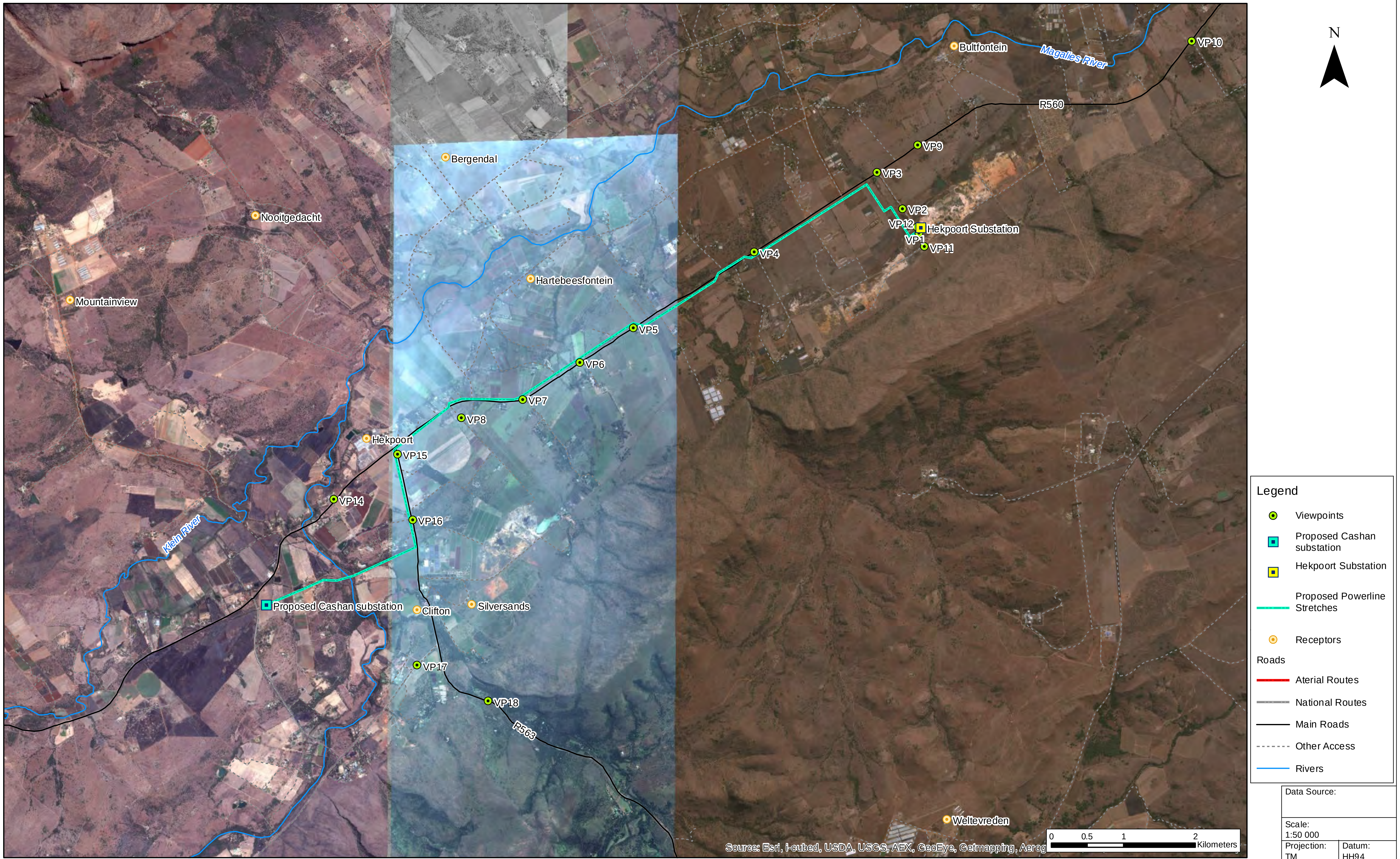
Visibility Ranking – after Site Visit Verification			
Not Visible	Marginally Visible	Visible	Highly visible
Final Visibility Criteria (Exposure Rating)			
1	2	4	5

The visibility rankings were then applied to assess the visual exposure of each of the chosen viewpoints to assess what measure of screening any vegetation and man-made features may have on the visibility of the proposed development. These viewpoints were chosen based upon their position in both the landscape and inside the visible areas of the viewshed. Attempts were made to choose viewpoints from various angles and distances from the proposed development. The findings from the Visibility Criteria are summarised in Table 4-2 below as a combination of the rankings identified in Table 4-1, Figure 4-1 and the site visit.

Appendix 2 contains the full examination of the viewpoints. In total 18 viewpoints were used in the visual assessment for a true reflection of the potential visibility of the activities in the area. The viewpoints chosen represent a summary of the proposed development on the surrounding viewers. Appendix 3 presents the photographs taken from each of the viewpoints, highlighting the potential views towards the proposed development.

Table 4-2: Summarising the Visibility Rating (Exposure Rating) for the proposed development

<table>
<tr><th>Study Site</th><th>Exposure</th><th>Rating</th></tr>
<tr><td>Cashan substation site</td><td>Summarising the table in Appendix 2, based on the proposed positioning and height of the proposed Cashan substation, the exposure rating can be described as being highly visible from the north west and marginally visible from the south east.
The topography and existing vegetation appear to assist in the screening of views toward this area.</td><td>1.8</td></tr>
<tr><td>Powerline Stretch A - B</td><td rowspan="3">Summarising the table in Appendix 2, based on the proposed positioning of the powerline stretches; the exposure rating can be described as being highly visible from the eastern areas and marginally visible from the western areas.
Topography appears to assist in screening views towards this area. There are, however, some areas which are more exposed than others, i.e. viewers who travel along the R560 within the vicinity of the proposed development, are expected to be more exposed to views of the proposed powerline.</td><td>1.9</td></tr>
<tr><td>Powerline Stretch B - C</td><td>2.2</td></tr>
<tr><td>Powerline Stretch C - D</td><td>2</td></tr>
</table>



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VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

LOCATION OF VIEWPOINTS IN THE STUDY AREA

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Revision: A Date: 24 03 2014

4.2.1 Viewing distance and visibility

The distance of a viewer from the proposed project area is an important determinant of the magnitude of the visual impact on the viewer. This is due to the visual impact of an object diminishing / attenuating as the distance between the viewer and the object increases. This is a measurement of how visual impacts are modified by distance. The effect of scale, topography, vegetation and weather, change with distance, and in turn changes the degree of the visual effect.

Hull and Bishop, 1988 identify the inverse relationship between viewing distance and visual impacts, this relationship can be described as an exponential decrease in impact as the distance from the site increased. Figure 4-2 shows this relationship.

Viewsheds do not take into account the distance from the site a viewer may be in determining the visibility of the proposed feature. A method, known as the Fuzzy Viewshed, attempts to take into account the distance a viewer is from the proposed site. Equation 4-1 (Ogburn, 2006) defines the equation used to determine the possible impact of a feature in the landscape. Figure 4-3 indicates the Fuzzy Viewshed for the overall proposed development.

$$1 \; for \; d_{vp\rightarrow ij} \leq b_1$$

$$and$$

$$\mu(x_{ij}) = \frac{1}{\left(1+2\left(\frac{d_{vp\rightarrow ij}-b_1}{b_2}\right)^2\right)} \; for \; d_{vp\rightarrow ij} > b_1$$

.... Equation 4-1

Where:

μ = fuzzy membership

$d_{vp->ij}$= distance of object from the viewpoint

$b1$ = maximum distance from viewpoint of clear visibility

$b2$ = distance from viewpoint at which visibility drops to 50%

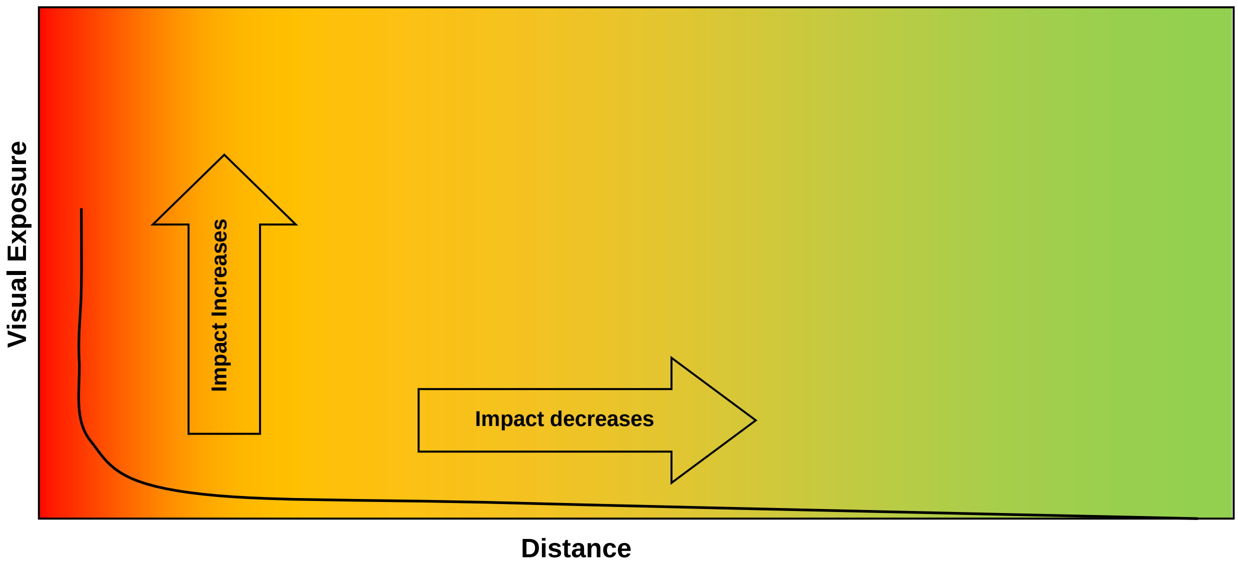


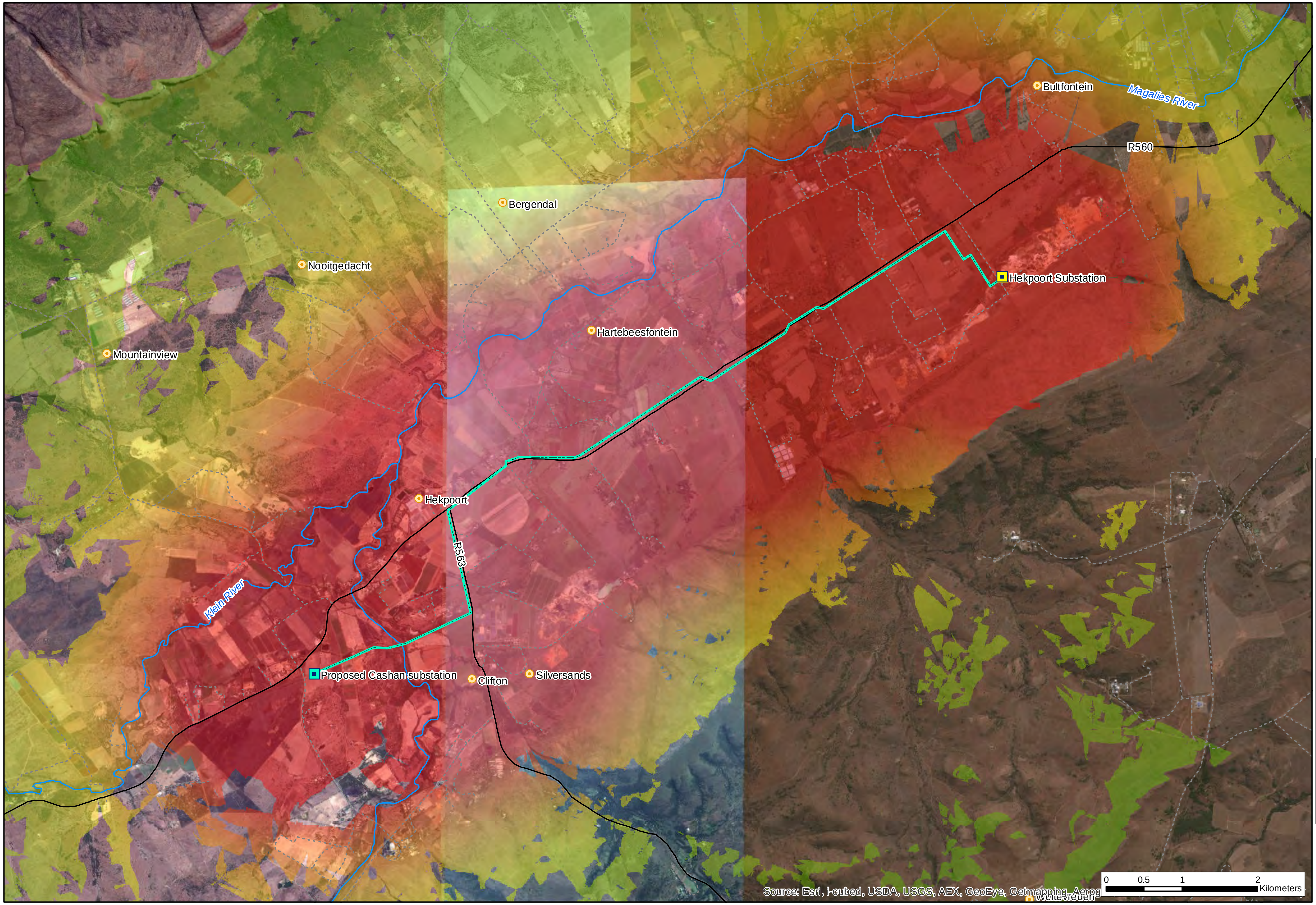
Figure 4-2 Depiction of how impact decreases with an increase in distance from a site (after Hull and Bishop, 1988)

The following rating system (Table 4-3) has been incorporated spatially with the viewshed to address the factor of distance between a viewer and an object. This rating system does not however, take into account the existing features (such as vegetation and man-made structures). Using the chosen viewpoints, it is possible to create a representative ranking for viewing distance and visibility for the proposed development (Figure 4-3).

Table 4-3: Distance Rating System

Location of development (From Viewpoint)	Category	Value	Description
0 to 0.5 km	Adjacent	5	Adjacent – The development can clearly be seen. Usually on the property boundary or property grounds.
0.5 km to 1 km	Foreground	4	This is the zone in which details such as colour, texture and form can be appreciated. Objects in this zone are highly visible unless obscured by other landscape features, existing structures or vegetation.
1 km to 3 km	Middle ground	3	The zone which occupies the area "between" detail and indistinct colour and line discernment. Objects in this zone can be classified as visible to moderately visible unless obscured by other elements within the landscape.
3 km to 5 km	Distant middle ground	2	This zone is discerned by means of line and colour. Texture and form are generally not seen. Objects in this zone can be classified as marginally visible to not visible. Areas beyond 3 km are usually not investigated as the impact would be negligible on these areas.
5 km and greater	Background	1	Background – Not Visible (Proposed development can hardly / not be seen).

Due to the topography around the proposed powerline, the distance rating can be described as falling into the distant middle ground (Table 4-3). This is due to the powerline becoming highly visible when a viewer may be adjacent to the development. The proposed substation falls within an area which is surrounded by various vegetation types, of varying heights. The proposed substation could, therefore, be described in terms of the Middle ground category of the distance rating system. This is provided that the surrounding vegetation is maintained as a barrier shielding viewers from the proposed Cashan substation.



Legend

- Proposed Cashan substation
- Hekpoort Substation
- Proposed Powerline Stretches
- Receptors

Roads

- Aterial Routes
- National Routes
- Main Roads
- Other Access
- Rivers

Fuzzy Viewshed

- High Visibility
- Low Visibility

Data Source:	
Scale: 1:50 000	
Projection: TM	Datum: HH94
Central Meridian/Zone: Lo27	
Date: 24/03/2014	Compiled by: MURA
Project No: 465044	Fig No: 4-3

srk consulting

VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

FUZZY VIEWSHED OF THE PROPOSED DEVELOPMENT

Path: G:\465044_48V_ESKOM_CASHAN_VIA_PTA\8GIS\GISPROJ\MXD\Figures\465044_48V_F4_3_Eskom_Cashan_VIA_Fuzzy_Viewshed_A3L_C_24032014.mxd

Revision: A Date: 24 03 2014

4.2.2 Visual Absorption capacity (VAC)

The Visual Absorption Capacity (VAC) is the potential for the area to conceal / mitigate the impact of the proposed development through natural or man-made features in the landscape. Factors contributing to the VAC include:

- Topography and vegetation that is able to provide screening and increase the visual absorption capacity of a landscape;
- The degree of urbanisation compared to open space. A highly urbanised landscape is better able to absorb the visual impacts of similar developments;
- An interrelated landscape comprising a unified environment; and
- The scale and density of surrounding developments.

Visual absorption within the wider area of influence will further be provided by:

- Residential suburbs which may reduce the visibility of the site to people residing in the centre or towards the back of the residential area;
- The existing road infrastructure between viewpoints further than 2 km away, and
- Power lines, railway lines, etc.

The VAC is rated from high (1) to low (5) based on the capacity of the environment to absorb the visual impact of the facility. The VAC will be high when the environment can hide the development and as such, the colour of a facility can also determine its VAC. The VAC will be low in areas where the topography is flat and natural features such as trees, koppies and mountains are absent.

The immediate area surrounding the proposed development is generally flat, beyond which are undulating hills. Existing powerlines and substations are evident within the study area. Subsistence and commercial agriculture and scattered small scale sand mining activities are also apparent within close proximity to the proposed development. Due to the existing vegetation surrounding the proposed Cashan substation site, the VAC is rated as medium. The proposed powerline is rated as medium-low due to the proposed powerline being very exposed to travellers along the R560, yet vires of the powerline are expected to be impeded by powerline structures within the area.

4.2.3 Landscape / townscape compatibility

Landscape or townscape compatibility refers to the compatibility of the proposed development with the existing landscape and townscape. The landscape / townscape compatibility of the proposed powerline and substation were rated based on the following criteria specified in Table 4-4.

Table 4-4: Landscape / townscape compatibility rating criteria

High (1)	Moderate (3)	Low (5)
The development: • Is consistent with the existing land use of the area; • Is highly sensitive to the natural environment; • Is consistent with the urban texture and layout; • The buildings and structures are congruent / sensitive to the existing architecture / buildings; and • The scale and size of the development is similar to what exists.	The development: • Is moderately consistent with the existing land use of the area; • Is moderately sensitive to the natural environment; • Is moderately consistent with the urban texture and layout; • The buildings and structures are moderately congruent / sensitive to the existing architecture / buildings; and • The scale and size of the development is moderately similar to what exists.	The development: • Is not consistent with the existing land use of the area; • Is not sensitive to the natural environment; • Is very different to the urban texture and layout; • The buildings and structures are not congruent / sensitive to the existing architecture / buildings; and • The scale and size of the development is different to what exists.

According to the rating methodology outlined in Table 4-4 the consistency of the proposed development with the existing land use of the area can be determined. Table 4-5 presents the findings of the landscape compatibility of the proposed development.

Currently the area surrounding the proposed development comprises mainly of degraded grasslands, scattered small scale sand mining and agricultural activities. Due to this, and the positioning of the proposed development, the powerline and proposed substation site are considered to be moderately compatible with the surrounding landuse.

4.2.4 Sensitivity of viewers

The sensitivity of viewers is determined by the number of viewers and by how likely they are to be impacted upon. Sensitivity is also dependent on the viewer's perception of the area and their ability to adapt to changes in the environment. This can also include how frequently they are exposed to the view i.e. static views from houses would have a higher sensitivity than transient views experienced by motorists.

The following potentially sensitive areas exist in the study area:

- Residents of the adjacent villages; and
- Motorists travelling between Bultfontein and Doornspruit, along the R560.

Based on the analysis undertaken the following individuals could be potentially more sensitive to the development:

- Residents living in dwellings on residential edges facing the proposed development i.e. Hartebeesfontein, Clifton, Silversands, and Hekpoort; and
- Travellers along the R560, however these motorists would have been exposed to views of various other powerlines in the area, during travelling to their destinations.

Viewer sensitivity is ranked from high (5) to low (1) based on the probable perceptions of the viewers and their willingness to change.

4.3 Calculation of the Magnitude of the Visual Impacts

The following table (Table 4-5) combines the various factors influencing the visual impacts that the proposed development may have, thereby providing input towards calculating the magnitude of the visual impacts for each element.

Table 4-5: Summary of the criteria to determine the magnitude of the visual impact

Criteria	Cashan substation	Powerline Stretch A - B	Powerline Stretch B - C	Powerline Stretch C – D
*Visibility and Distance	3	2	2	2
**Visual Absorption Capacity	4	3	3	3
***Landscape Compatibility	3	3	3	3
****Viewer Sensitivity	4	2	2	2
Comment	***Distance:** Due to the topography and vegetation within the study area, the powerline is not expected to be visible beyond 3 km, however due to the proposed height and footprint of the proposed substation; it is expected to be visible up to 5km from its proposed location. ****Visual Absorption Capacity:** Existing powerline structures and the topography surrounding the proposed development may provide shielding to portions of the proposed structures from viewers, from various directions. *****Landscape Compatibility:** Due to existing powerlines and substations within the area, the proposed development is expected to be moderately compatible with the surrounding landuses. ******Viewer Sensitivity:** Due to the proposed powerline being situated within an area which has existing powerline structures, as well as the proposed powerline falling within an existing road servitude, the viewer sensitivity is expected to be decreased. However viewer sensitivity remains higher for the proposed substation, due to the lack of substations within close proximity.			

Table 4-6: Summary of the magnitude of the Visual Impact of the proposed development

Criteria	Cashan substation site	Powerline Stretch A - B	Powerline Stretch B - C	Powerline Stretch C – D
Visual Character	4	3	3	3
Visual Quality of the Environment	3	3	3	3
Visual Exposure	1.8	1.9	2.2	2
Visibility and Distance	3	2	2	2
Visual Absorption Capacity	4	3	3	3
Landscape Compatibility	3	3	3	3
Viewer Sensitivity	4	2	2	2
Magnitude	**3.26**	**2.56**	**2.60**	**2.57**

The **magnitude** of the visual impact, which is a subjective measure, is used in the next section to determine the visual impact, by means of a quantitative ranking approach on viewers in the surrounding area.

5 Visual Impact Assessment

The following section incorporates the findings of Section 5 and compiles them into a visual impact rating system.

5.1 Introduction to the Impact Assessment

The following section will outline some of the key factors used in the final assessment of the visual impacts of a structure. This assessment is an adaptation of the environmental impact assessment criteria used, however it has been adapted to fit the requirements of visual impact assessment criteria.

The criteria used include:

- Spatial Scope;
- Duration;
- Severity (obtained through Section 5);
- Frequency of Activity; and
- Frequency of Impact.
- The following sections will expand on each of the criteria used.

5.1.1 Spatial scope

The spatial scope for each structure is defined as - the geographical coverage (spatial scope) that the proposed structure may influence visually, taking into account the extent of the structure and the nature of the baseline environment is taken into account.

The spatial scope of the impact will be rated on the Spatial Scope Rating System, as indicated in Table 5-1 below.

Table 5-1: Spatial Scope Rating System

Criteria	Value
Activity specific	1
Area specific (within the mine lease area)	2
Local Area (within 3km)	3
Regional	4
National	5

5.1.2 Duration

Duration refers to the length of time that the aspect may cause a change either positively or negatively on the environment.

The visual assessment will distinguish between different time periods by assigning a rating to duration based on the Duration Rating System, as indicated in Table 5-2 below.

Table 5-2: Duration Rating System

Criteria	Value
One day to one month	1
One month to one year	2
One year to ten years	3
Life of operation	4
Post closure	5

5.1.3 Severity / Magnitude of the visual impact

The severity of the visual impact is derived from the modified Hassell Matrix (Table 4-6), taking into account:

- Visual Character;
- Visual Quality;
- Visual Exposure;
- Visibility;
- VAC;
- Landscape Compatibility; and
- Viewer Sensitivity.

5.1.4 Frequency of the activity

The frequency of the activity occurring refers to how often the activity would occur.

After describing the frequency the findings will be indicated on the Frequency of the activity Rating System scale, as indicated in Table 5-3 below.

Table 5-3: Frequency of the activity Rating System

Criteria	Value
Almost never/almost impossible	1
Very seldom/highly unlikely	2
Infrequent/unlikely/seldom	3
Often/regularly/likely/possible	4
Daily/highly likely/definitely	5

5.1.5 Frequency of the impact

The frequency of the impact refers to how often a structure impacts or may impact visually, either positively or negatively on the environment.

After describing the frequency the findings will be indicated on the Frequency of the impact Rating System scale, as indicated in Table 5-4 below.

Table 5-4: Frequency of the impact Rating System

Criteria	Value
Almost never/almost impossible	1
Very seldom/highly unlikely	2
Infrequent/unlikely/seldom	3
Often/regularly/likely/possible	4
Daily/highly likely/definitely	5

5.1.6 Significance determination

The environmental significance rating is an attempt to evaluate the importance of a particular impact, the consequence and likelihood of which has already been assessed by the relevant specialist. The description and assessment of the aspects and impacts undertaken are presented in a consolidated table (Table 5-5) with the significance of the impact assigned using the process and matrix detailed below. The sum of the first three criteria (spatial scope, duration and severity) provides a collective score for the CONSEQUENCE of each impact. The sum of the last two criteria (frequency of activity and frequency of impact) determines the LIKELIHOOD of the impact occurring. The product of CONSEQUENCE and LIKELIHOOD leads to the assessment of the SIGNIFICANCE of the impact, shown in the significance matrix overleaf.

5.2 Method of Assessing the Significance of Visual Impacts

In the following assessment of the significance of the visual impact, the magnitude (or severity) of the impact is qualified with spatial, temporal and probability criteria. These criteria are explained in Table 5-5 below.

Table 5-5: Framework for assessing environmental impacts

SPATIAL SCOPE	RATING	DURATION	RATING	SEVERITY	RATING
Activity specific	1	One day to one month	1	Insignificant	1
Area specific	2	One month to one year	2	Small	2
Whole site / plant	3	One year to ten years	3	Significant	3
Regional (neighbouring areas)	4	Life of operation	4	Great	4
National	5	Permanent	5	Disastrous	5
FREQUENCY OF ACTIVITY	**RATING**	**FREQUENCY OF IMPACT**	**RATING**		
Annually or less	1	Almost never / almost impossible	1		
6 monthly	2	Very seldom / highly unlikely	2		
Monthly	3	Infrequent / unlikely / seldom	3		
Weekly	4	Often / regularly / likely / possible	4		
Daily	5	Daily / highly likely / definitely	5		
SIGNIFICANCE RATING OF IMPACT			**TIMING**		
Very Low (1-25) Low (26-50) Medium -Low (51-75) Medium-High (76-100) High (101-125) Very High (126-150)			Pre-construction Construction Operation		
MITIGATION					
ADJUSTED SIGNIFICANCE RATING					

Once the rating criterion as described above is determined, the consequence of the impact is calculated by adding the scores for the first three criteria. The likelihood of the impact occurring is calculated by adding the scores of the last two criteria. The significance is then determined using Tables 5-6 and 5-7 overleaf. It must be noted that the ratings are not always completely applicable and requires modification to provide a result in the visual context.

Table 5-6: Significance Assessment Matrix

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

Table 5-7: Positive and Negative Mitigation Ratings

Colour Code	Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
	Very High	126-150	Improve current management	Maintain current management
	High	101-125	Improve current management	Maintain current management
	Medium-high	76-100	Improve current management	Maintain current management
	Low-medium	51-75	Improve current management	Improve current management
	Low	26-50	Improve current management	Improve current management
	Very low	1-25	**Maintain current management**	Improve current management

5.2.1 Impact Assessment

Based on the above methodology the visual impacts for **the proposed development** are rated as follows:

Scale / Spatial Scope – the proposed development is rated as having a **Local Area** impact due to the nature of a linear development, as well as the existing powerline infrastructure within the area.

Duration –the duration of the impact will be for the **life of the project**, provided the related infrastructure is removed and the area rehabilitated upon completion. Should the infrastructure not be removed, and the site not rehabilitated, the impact will be **permanent**.

Severity –the severity of the impact is rated from the **magnitude** without mitigation and is adjusted with mitigation.

Frequency of the activity - the frequency of the activity is not entirely appropriate for a visual impact but since the "activity" that causes the impact is the presence of the infrastructure; this is rated as "**often**" or being present all day.

The frequency of the impact – the impact in terms of substation is considered to be "**daily**" and the powerline frequency of the impact is considered to be "**often**".

The overall **Significance Ratings** for the different components of this visual impact study are provided in Table 5-8.

Table 5-8: Visual Impact Assessment Significance Ratings

Criteria	Cashan substation	Powerline Stretch A - B	Powerline Stretch B - C	Powerline Stretch C - D
Visual Character	4	3	3	3
Visual Quality of the Environment	3	3	3	3
Visual Exposure	1.8	1.9	2.2	2
Visibility and Distance	3	2	2	2
Visual Absorption Capacity	4	3	3	3
Landscape Compatibility	3	3	3	3
Viewer Sensitivity	4	2	2	2
Magnitude	**3.26**	**2.56**	**2.60**	**2.57**
Spatial Scope	**3**	**3**	**3**	**3**
Duration	**4**	**4**	**4**	**4**
Overall Consequence	**10.26**	**9.56**	**9.6**	**9.57**
Frequency of Activity	**5**	**5**	**5**	**5**
Frequency of Impact	**5**	**4**	**4**	**4**
Overall Likelihood	**10**	**9**	**9**	**9**
Significance Rating	**102.6**	**86.04**	**86.4**	**86.13**
	HIGH	**MEDIUM-HIGH**	**MEDIUM-HIGH**	**MEDIUM-HIGH**

The significance rating outlined in Table 5-8 is calculated through the combination of the **Magnitude / Severity** rating calculated in Section 4 and the **Spatial Scope** and **Duration** of the visual impact. The product of the **Overall Consequence** and the **Overall Likelihood** represents the Significance Rating of the visual impact, which in turn allows for the determination of corrective measures.

5.3 Summary of findings

The following section summarises the findings of the visual impact assessment, and explains the results calculated in Table 5-8. Some examples of mitigation are provided and show how the visual impact ratings could be improved.

The following section discusses the potential visual impacts of the proposed powerline stretches and substation site on the surrounding landscape, and how through mitigation, the Significance Rating of the findings may be reduced.

5.3.1 Cashan Substation

Using the prescribed environmental impact assessment criteria, the final significance rating for the Cashan Substation has been calculated as 102.6 (HIGH).

In terms of mitigation, the proposed mitigation measures will need to attempt to reduce the frequency of the ACTIVITY, VISIBILITY and IMPACT. Table 5-9 outlines how mitigation could reduce the overall visual impact of the proposed substation.

Table 5-9: Comparison of the visual significance rating with and without mitigation – Cashan Substation

Criteria	Cashan substation – without mitigation	Cashan substation – with mitigation
Visual Character*	4	4
Visual Quality of the Environment*	3	3
Visual Exposure*	1.8	1.8
Visibility and Distance**	3	2
Visual Absorption Capacity*	4	4
Landscape Compatibility**	3	3
Viewer Sensitivity*	4	4
Magnitude	**3.26**	**3.11**
Spatial Scope**	**3**	**2**
Duration	**4**	**4**
Overall Consequence	**10.26**	**9.11**
Frequency of Activity	**5**	**5**
Frequency of Impact	**5**	**4**
Overall Likelihood	**10**	**9**
Significance Rating	**102.6**	**81.99**
	HIGH	**MEDIUM-HIGH**

* - These are fixed as they are based upon data derived during the analysis (viewsheds, etc.) as well as the existing landscape

** - By reducing the visibility of the Substation through screening viewers from it, the overall visibly of the project could be reduced, thereby reducing the spatial scope of the impact

As noted in Table 5-9, the significance rating for the proposed Cashan substation can be reduced to MEDIUM-HIGH, by reducing the visibility and spatial scope of the proposed Cashan substation. This can be achieved through shielding local residents and travellers along the R560 from views of the proposed Cashan substation by means of maintaining existing vegetation along the boundary of the site.

5.3.2 Powerline Stretch A – B

Using the prescribed environmental impact assessment criteria, the final significance rating for the Powerline Stretch A – B has been calculated as 86.04 (MEDIUM-HIGH).

In terms of mitigation, the proposed mitigation measures will need to attempt to reduce the frequency of the ACTIVITY, VISIBILITY and IMPACT. Table 5-10 outlines how mitigation could reduce the overall visual impact of the Powerline Stretch A – B.

Table 5-10: Comparison of the visual significance rating with and without mitigation – Powerline Stretch A – B

Criteria	Powerline Stretch A – B – without mitigation	Powerline Stretch A – B – with mitigation
Visual Character*	3	3
Visual Quality of the Environment*	3	3
Visual Exposure*	1.9	1.9
Visibility and Distance**	2	1
Visual Absorption Capacity*	3	3
Landscape Compatibility**	3	3
Viewer Sensitivity*	2	2
Magnitude	**2.56**	**2.41**
Spatial Scope**	**3**	**2**
Duration	**4**	**4**
Overall Consequence	**9.56**	**8.41**
Frequency of Activity	**5**	**5**
Frequency of Impact	**4**	**3**
Overall Likelihood	**9**	**8**
Significance Rating	**86.04**	**67.28**
	MEDIUM-HIGH	**LOW-MEDIUM**

* - These are fixed as they are based upon data derived during the analysis (viewsheds, etc.) as well as the existing landscape

** - By reducing the visibility of the powerline through screening viewers from it, the overall visibly of the project could be reduced, thereby reducing the spatial scope of the impact and the frequency of the impact

As noted in Table 5-10, the significance rating for the Powerline Stretch A – B can be reduced by reducing the visibility of pylons from the viewers, whereby reducing the spatial scope as well as the frequency of the impact. Therefore through mitigation the significance rating for the Powerline Stretch A – B, can be considered to the LOW-MEDIUM.

5.3.3 Powerline Stretch B – C

Using the prescribed environmental impact assessment criteria, the final significance rating for the Powerline Stretch B – C has been calculated as 86. 4 (MEDIUM-HIGH).

In terms of mitigation, the proposed mitigation measures will need to attempt to reduce the frequency of the ACTIVITY, VISIBILITY and IMPACT. Table 5-11 outlines how mitigation could reduce the overall visual impact of the Powerline Stretch B – C.

Table 5-11: Comparison of the visual significance rating with and without mitigation – Powerline Stretch B – C

Criteria	Powerline Stretch B – C – without mitigation	Powerline Stretch B – C – without mitigation
Visual Character*	3	3
Visual Quality of the Environment*	3	3
Visual Exposure*	2.2	2.2
Visibility and Distance**	2	1
Visual Absorption Capacity*	3	3
Landscape Compatibility**	3	3
Viewer Sensitivity*	2	2
Magnitude	**2.60**	**2.45**
Spatial Scope**	**3**	**2**
Duration	**4**	**4**
Overall Consequence	**9.6**	**8.45**
Frequency of Activity	**5**	**5**
Frequency of Impact	**4**	**4**
Overall Likelihood	**9**	**9**
Significance Rating	**86.4**	**76.05**
	MEDIUM-HIGH	**MEDIUM-HIGH**

* - These are fixed as they are based upon data derived during the analysis (viewsheds, etc.) as well as the existing landscape

** - By reducing the visibility of the powerline through screening viewers from it, the overall visibly of the project could be reduced, thereby reducing the spatial scope of the impact and the frequency of the impact

As noted in Table 5-11, the significance rating for the Powerline Stretch B – C can be reduced by reducing the visibility and hence the spatial scope, through shielding viewers from the proposed powerline structures, the significance rating is still considered to be MEDIUM-HIGH. This is due to the proposed powerline stretch falling directly adjacent to the R560, whereby the frequency of the impact on motorists is not expected to be reduced through mitigation measures.

5.3.4 Powerline Stretch C – D

Using the prescribed environmental impact assessment criteria, the final significance rating for the Powerline Stretch C – D has been calculated as 86.13 (MEDIUM-HIGH).

In terms of mitigation, the proposed mitigation measures will need to attempt to reduce the frequency of the ACTIVITY, VISIBILITY and IMPACT. Table 5-12 outlines how mitigation could reduce the overall visual impact of the Powerline Stretch C – D.

Table 5-12: Comparison of the visual significance rating with and without mitigation – Powerline Stretch C – D

Criteria	Powerline Stretch C – D – without mitigation	Powerline Stretch C – D – with mitigation
Visual Character*	3	3
Visual Quality of the Environment*	3	3
Visual Exposure*	2	2
Visibility and Distance**	2	1
Visual Absorption Capacity*	3	3
Landscape Compatibility**	3	3
Viewer Sensitivity*	2	2
Magnitude	**2.57**	**2.43**
Spatial Scope**	**3**	**2**
Duration	**4**	**4**
Overall Consequence	**9.57**	**8.43**
Frequency of Activity	**5**	**5**
Frequency of Impact	**4**	**3**
Overall Likelihood	**9**	**8**
Significance Rating	**86.13**	**67.44**
	MEDIUM-HIGH	**LOW-MEDIUM**

* - These are fixed as they are based upon data derived during the analysis (viewsheds, etc.) as well as the existing landscape

** - By reducing the visibility of the powerline through screening viewers from it, the overall visibly of the project could be reduced, thereby reducing the spatial scope of the impact and the frequency of the impact

As noted in Table 5-12, the significance rating for the Powerline Stretch C – D can be reduced by reducing the visibility of pylons from the viewers, whereby reducing the spatial scope. Through the reduction of the spatial scope of the powerline stretch, and the visibility, the frequency of the impact will also be reduced. Therefore through mitigation the significance rating for the Powerline Stretch C – D, can be considered to the LOW-MEDIUM.

6 Mitigation Recommendations

The role of mitigation is critical in finding a design / rehabilitation solution that will be visually acceptable. Potential mitigation measures have been taken into consideration during the design phase, as discussed above and is also provided by natural features in the area. Only effective, economically feasible, appropriate and visually acceptable mitigation measures are recommended and these should form part of an EMPr to be implemented should the project be approved. Some mitigation recommendations include:

- Natural vegetation, wherever possible, must be retained on and around the site. The re-vegetation of the site during the operational phase should be considered only if it does not interfere with operations or pose a risk to the health and safety of people and animals. Vegetation around a structure breaks the outline of the structure against the landscape and will therefore allow for the structure to be less pronounced. Vegetation can be used to reduce the visual scarring of the landscape and potentially reduce the visual impacts of the proposed development;
- Should the visual impact of the proposed development be raised as a concern during the BA process, and vegetation is not a viable solution due to timeframes and spatial extent of the proposed development, another possibility could be the construction of manmade barriers between the most sensitive viewers and the proposed development, specifically the proposed Cashan substation.
- If feasibly possible, or raised as a concern during the BA process, a lane of low canopy trees / shrubs should be planted along the perimeters of the villages where sensitive viewers may reside. This can be done at the onset of construction, to aid in shielding viewers from the construction and operational activities;
- During construction, litter and dust management measures should be in place at all times;
- During construction, the entire site should be kept neat and tidy at all times;
- With regards to lighting, if construction or operation is to occur during the night, all lights used for illumination of the construction area should be faced inwards towards the construction site as not to disturb surrounding residents;
- External signage should be kept to a minimum and where possible attached existing buildings to avoid free-standing signs in the landscape;
- Upon seizing use of the powerline and substation, all equipment and infrastructure on site and rehabilitate the impacted areas by ripping the soil, cover the area with a suitable growth medium and vegetate the area with an indigenous grass; and
- In terms of post-closure rehabilitation it is important to restore the environment to a condition that is consistent with the surrounding area.

6.1 Management Guidelines

In order to allow for ease of understanding of the proposed mitigation measures during the varying phases at the proposed development, the following section will present some guidelines to aid in managing the visual impacts as a result of the proposed PPM. Table 6-1 will present these guidelines.

Table 6-1: Visual Management Guidelines

Phase	Proposed Mitigation Measure
Pre-Construction	• All topsoil removed from the site, prior to construction activities, should be stored for rehabilitation purposes at the site.
Construction	• Ensure vegetation along the boundary of the proposed substation is maintained, to ensure views towards the substation are impeded. • If vegetation is to be cleared on site, erosion control measures should be kept in place to ensure that excessive scarring of the landscape is reduced. • During construction, dust control measures should be implemented to ensure that undue interest is not drawn to the site. • If construction is to occur during the night, all lighting should be kept facing inward. This is to ensure that excessive light does not escape from the construction area. • Investigation into the establishment of vegetation and/or the construction of man-made barriers between the sensitive viewers and the proposed development (i.e. the proposed Cashan substation) must be undertaken during the construction and operational phases. • During construction, litter control measures should be kept in place to ensure that the site is maintained in a neat and tidy condition. • External signage should be kept to a minimum, and where possible should be attached to existing buildings, to avoid free-standing signage.
Operation	• Low foot level lighting should be used where it is deemed safe. • Physical barriers could be used as shielding or cover to prevent excess light leaving the substation. • Where possible, lighting should be faced / shielded inward away from the viewers. • Areas of high reflective surfaces should be covered in an attempt to reduce the reflection from the development. This is important on nights of cloud or mist. • During operations, litter control measures should be kept in place to ensure that the site is maintained in a neat and tidy condition. • External signage should be kept to a minimum, and where possible should be attached to existing buildings, to avoid free-standing signage.
Decommissioning and Closure	• Re-establish vegetation within the substation footprint to allow for the VAC of the area to be increased. • All infrastructure used should be disassembled and removed from site to ensure the site resembles a natural state.

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Partner

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

7 References

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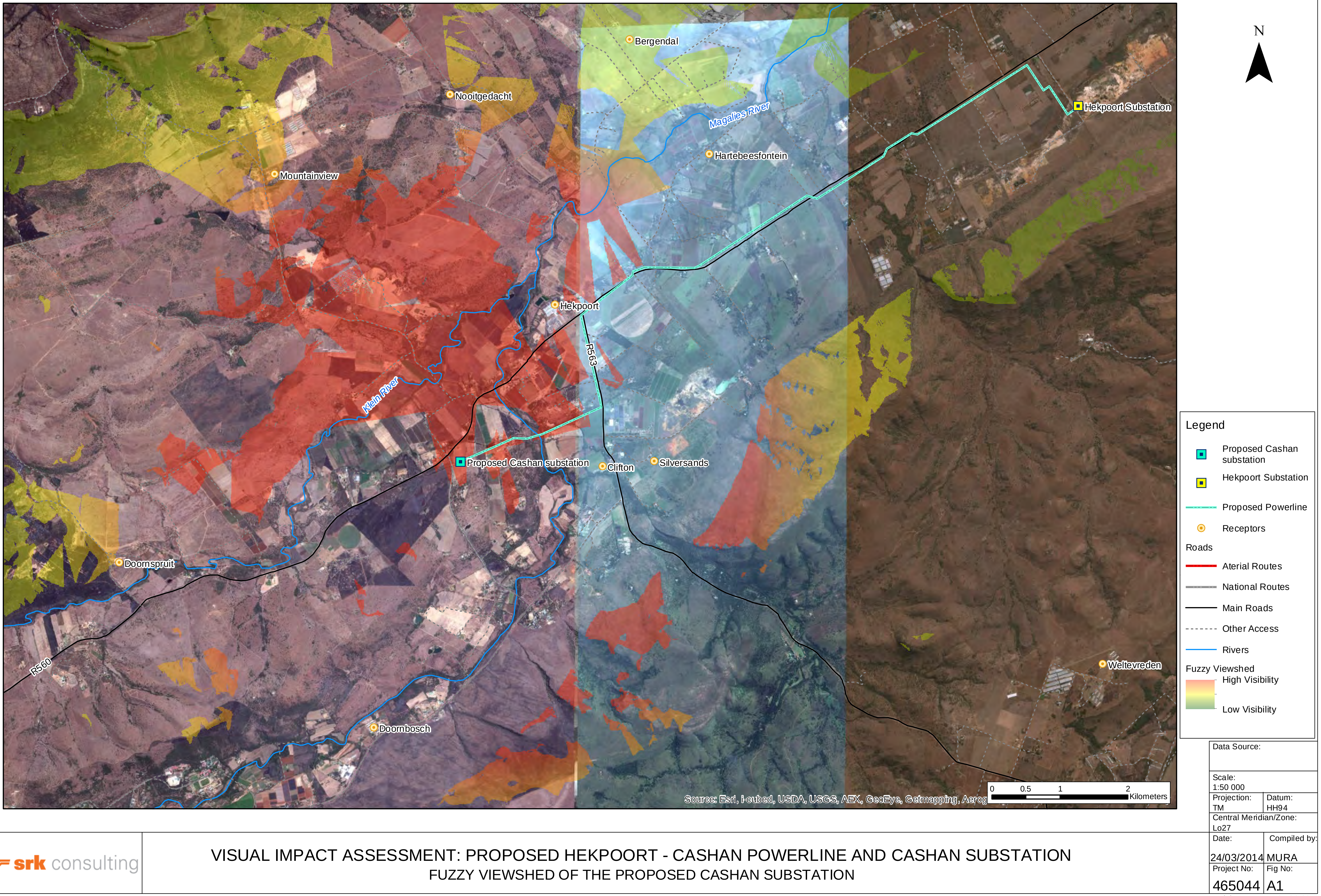
Appendices

Appendix 1: Viewsheds



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VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

FUZZY VIEWSHED OF THE PROPOSED CASHAN SUBSTATION

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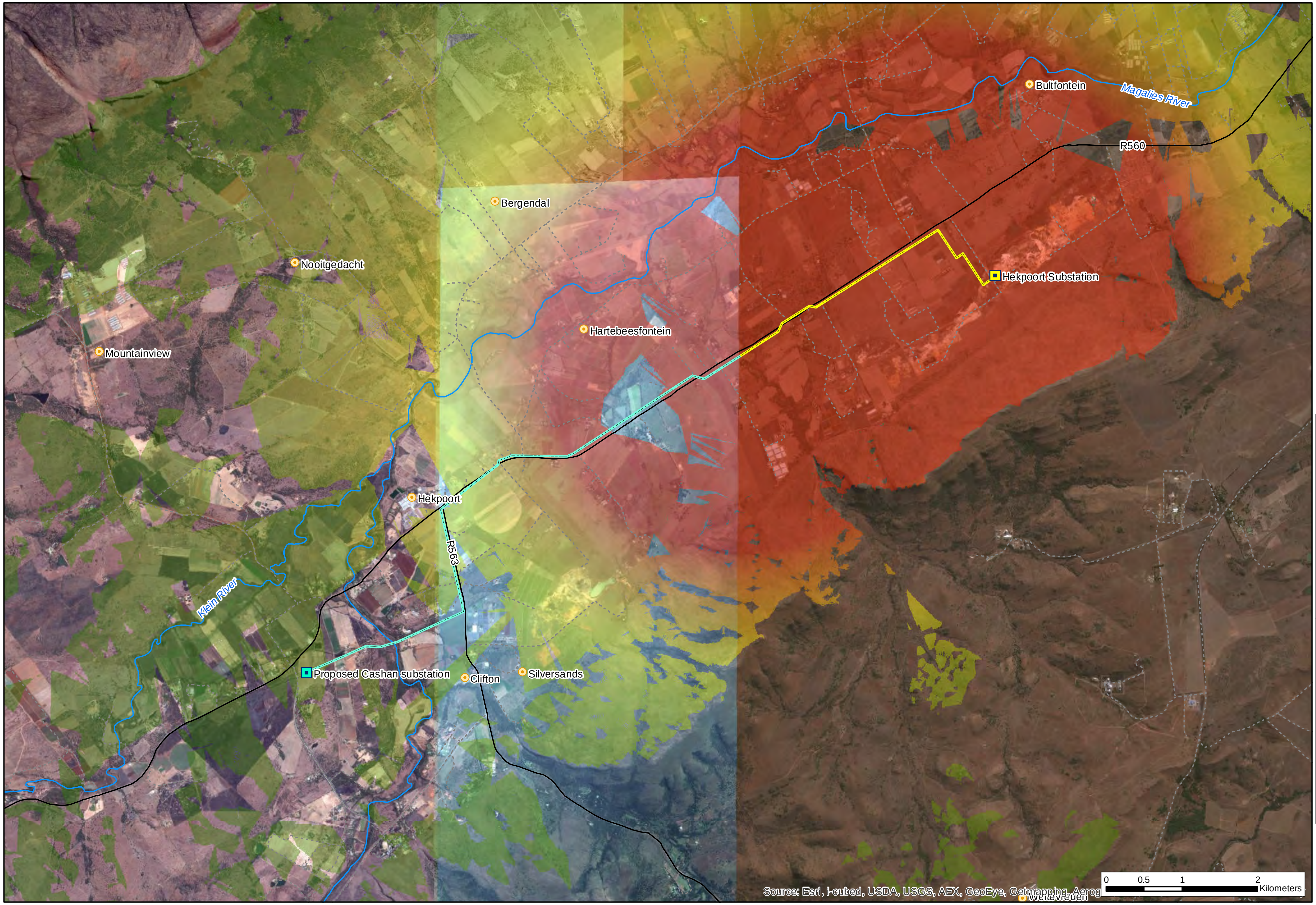
Revision: A Date: 24 03 2014



Legend

- Proposed Cashan substation
- Hekpoort Substation
- Receptors
- Proposed Powerline Stretch A - B
- Proposed Powerline

Roads

- Aterial Routes
- National Routes
- Main Roads
- Other Access
- Rivers

Fuzzy Viewshed

- High Visibility
- Low Visibility

Data Source:	
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Projection: TM	Datum: HH94
Central Meridian/Zone: Lo27	
Date: 24/03/2014	Compiled by: MURA
Project No: 465044	Fig No: A2

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VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

FUZZY VIEWSHED OF THE PROPOSED POWERLINE STRETCH A - B

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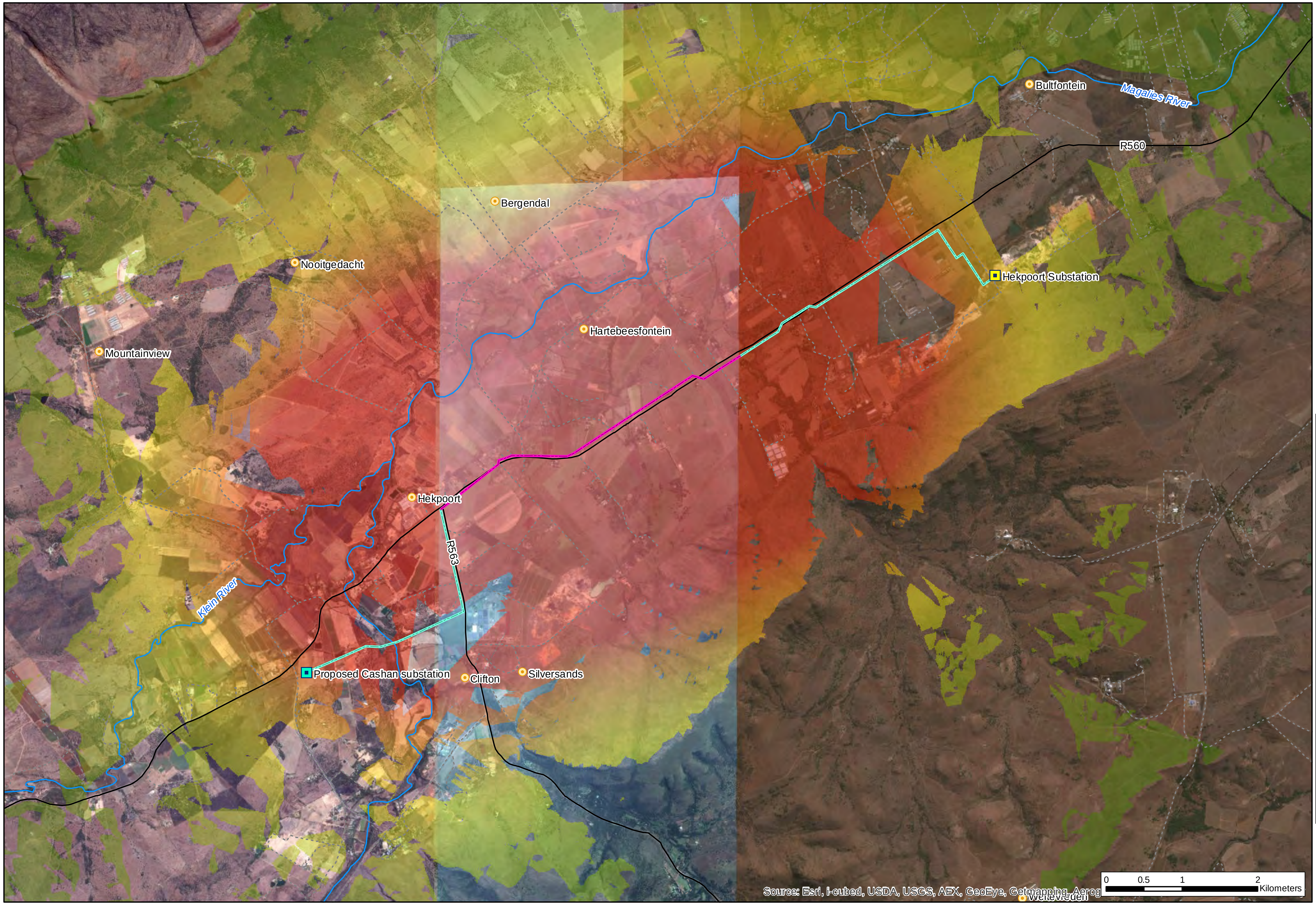

Legend

- Proposed Cashan substation
- Hekpoort Substation
- Receptors
- Proposed Powerline Stretch B - C
- Proposed Powerline

Roads

- Aterial Routes
- National Routes
- Main Roads
- Other Access
- Rivers

Fuzzy Viewshed

- High Visibility
- Low Visibility

Data Source:

Scale: 1:50 000

Projection: TM | Datum: HH94

Central Meridian/Zone: Lo27

Date: 24/03/2014 | Compiled by: MURA

Project No: 465044 | Fig No: A3

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VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

FUZZY VIEWSHED OF THE PROPOSED POWERLINE STRETCH B - C

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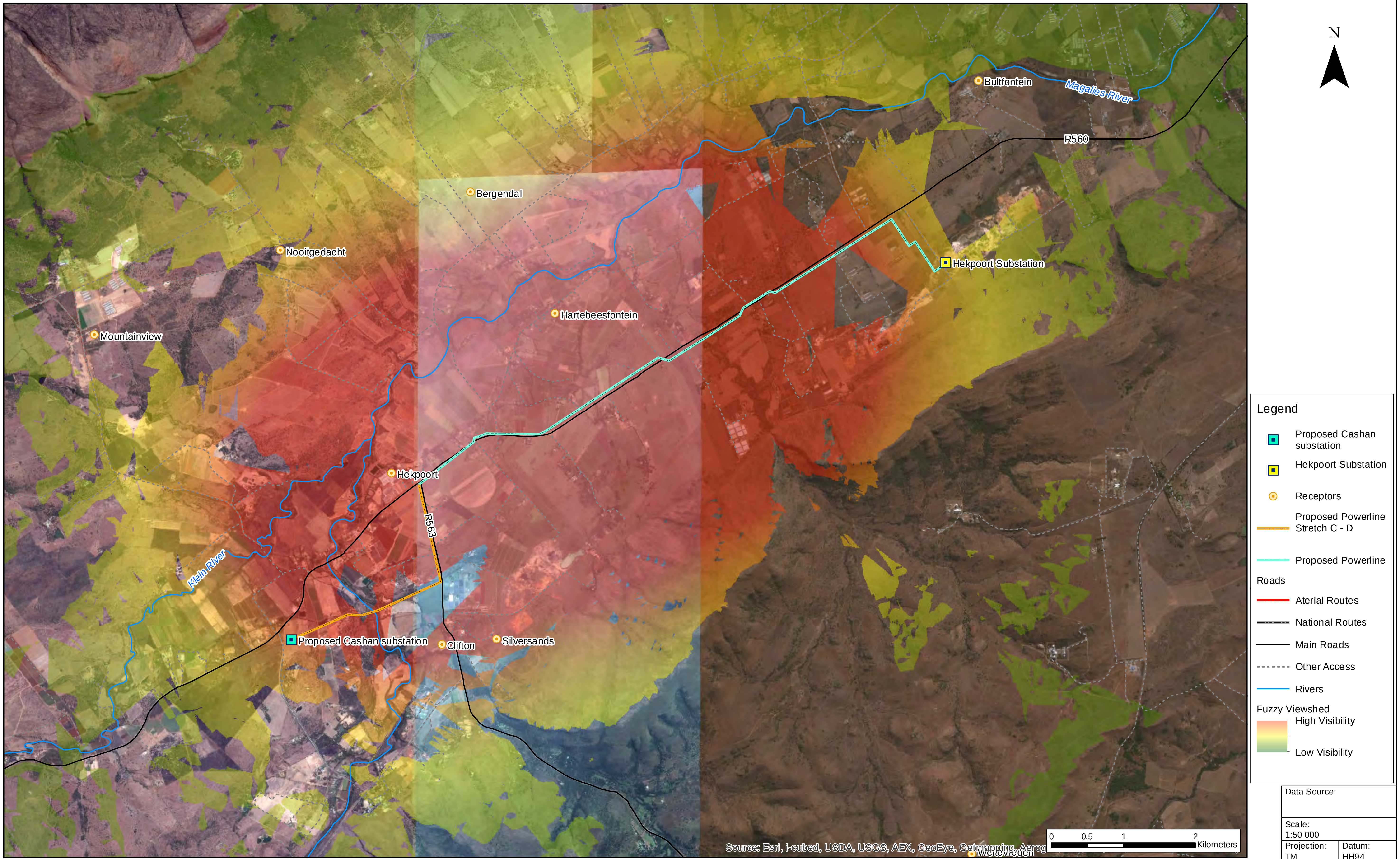
Revision: A Date: 24 03 2014



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Project No: 465044	Fig No: A4

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VISUAL IMPACT ASSESSMENT: PROPOSED HEKPOORT - CASHAN POWERLINE AND CASHAN SUBSTATION

FUZZY VIEWSHED OF THE PROPOSED POWERLINE STRETCH C - D

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Revision: A Date: 24 03 2014

Appendix 2: Description of the Viewpoint Analysis

Viewpoint	Description	Cashan Substation	Powerline Spans		
			A - B	B - C	C - D
VP1	Viewpoint 1 is located adjacent to the existing Hekpoort Substation.	Not Visible - 1	Marginally Visible - 2	Not Visible - 1	Marginally Visible - 2
VP2	Viewpoint 2 is located along the unpaved road, between the existing Hekpoort Substation and the R560.	Not Visible - 1	Marginally Visible - 2	Not Visible - 1	Marginally Visible - 2
VP3	Viewpoint 3 is located on the R560, adjacent to the "Farm House Complex" at the beginning of the access road to the existing Hekpoort Substation.	Not Visible - 1	Visible - 4	Not Visible - 1	Not Visible - 1
VP4	Viewpoint 4 is located along the R560, at the entrance to "Wicked Earth Food".	Not Visible - 1	Highly Visible - 5	Marginally Visible - 2	Not Visible - 1
VP5	Viewpoint 5 is located along the R560, outside of a farmhouse.	Not Visible - 1	Marginally Visible - 2	Highly Visible - 5	Not Visible - 1
VP6	Viewpoint 6 is lcoated along the R560, adjacent to cultivated agricultural land.	Not Visible - 1	Marginally Visible - 2	Highly Visible - 5	Not Visible - 1
VP7	Viewpoint 7 is located on the R560, at the entrance to the "Loch Ballymore Private Estate".	Not Visible - 1	Marginally Visible - 2	Highly Visible - 5	Not Visible - 1
VP8	Viewpoint 8 is located adjacent to the proposed Magalise Village.	Marginally Visible - 2	Not Visible - 1	Highly Visible - 5	Visible - 4
VP9	Viewpoint 9 is located adjacent to the R560, looking towards the Hekpoort Substation. Sand mining is evident in the area.	Not Visible - 1	Marginally Visible - 2	Not Visible - 1	Not Visible - 1
VP10	Viewpoint 10 is located adjacent to the R560, at the entrance to "P.H. Potgieter & Seuns" Farm.	Not Visible - 1	Marginally Visible - 2	Not Visible - 1	Not Visible - 1
VP11	Viewpoint 11 was taken behind the existing Hekpoort Substation, facing the proposed powerline.	Not Visible - 1	Marginally Visible - 2	Not Visible - 1	Marginally Visible - 2
VP12	Viewpoint 12 is located along the unpaved access road connecting the existing Hekpoort substation to the R560, indicating an example of the proposed powerline towers.	Not Visible - 1	Marginally Visible - 2	Not Visible - 1	Marginally Visible - 2
VP13	Viewpoint 13 is located at the border between the Gauteng and Free State Provinces, outside of the Mogale city.	Not Visible - 1	Not Visible - 1	Not Visible - 1	Not Visible - 1
VP14	Viewpoint 14 is located at the Hekpoort Village, adjacent to the R560.	Highly Visible - 5	Marginally Visible - 2	Marginally Visible - 2	Marginally Visible - 2
VP15	Viewpoint 15 is located along the R563, near the intersection with the R560, facing the proposed Kashan substation.	Highly Visible - 5	Not Visible - 1	Visible - 4	Highly Visible - 5
VP16	Viewpoint 16 is located along an unpaved road, facing the proposed Kashan substation site.	Highly Visible - 5	Not Visible - 1	Marginally Visible - 2	Highly Visible - 5
VP17	Viewpoint 17 is located along the T1, at the entrance to "The Nutbush (Boma Lodge)".	Marginally Visible - 2	Not Visible - 1	Not Visible - 1	Marginally Visible - 2
VP18	VP18 is located along the R563.	Marginally Visible - 2	Not Visible - 1	Not Visible - 1	Marginally Visible - 2
		1.9	**2.4**	**2.4**	**2.4**

Appendix 3: Photographs of the viewpoints taken

Viewpoint	Description	Photograph
VP1	Viewpoint 1 is located adjacent to the existing Hekpoort Substation.	
VP2	Viewpoint 2 is located along the unpaved road, between the existing Hekpoort Substation and the R560.	
VP3	Viewpoint 3 is located on the R560, adjacent to the "Farm House Complex" at the beginning of the access road to the existing Hekpoort Substation.	
VP4	Viewpoint 4 is located along the R560, at the entrance to "Wicked Earth Food".	
VP5	Viewpoint 5 is located along the R560, outside of a farmhouse.	

VP6	Viewpoint 6 is lcoated along the R560, adjacent to cultivated agricultural land.	
VP7	Viewpoint 7 is located on the R560, at the entrance to the "Loch Ballymore Private Estate".	
VP8	Viewpoint 8 is located adjacent to the proposed Magalise Village.	
VP9	Viewpoint 9 is located adjacent to the R560, looking towards the Hekpoort Substation. Sand mining is evident in the area.	
VP10	Viewpoint 10 is located adjacent to the R560, at the entrance to "P.H. Potgieter & Seuns" Farm.	

VP11	Viewpoint 11 was taken behind the existing Hekpoort Substation, facing the proposed powerline.	
VP12	Viewpoint 12 is located along the unpaved access road connecting the existing Hekpoort substation to the R560, indicating an example of the proposed powerline towers.	
VP13	Viewpoint 13 is located at the border between the Gauteng and Free State Provinces, outside of the Mogale city.	
VP14	Viewpoint 14 is located at the Hekpoort Village, adjacent to the R560.	
VP15	Viewpoint 15 is located along the R563, near the intersection with the R560, facing the proposed Kashan substation.	

VP16	Viewpoint 16 is located along an unpaved road, facing the proposed Kashan substation site.	
VP17	Viewpoint 17 is located along the T1, at the entrance to "The Nutbush (Boma Lodge)".	
VP18	VP18 is located along the R563.	

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