VISUAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED ESTABLISHMENT OF THE ANDERSON 400kV SUBSTATION IN BROEDERSTROOM, NORTH WEST PROVINCE.

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DECLARATION OF INDEPENDENCE - VISUAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED ESTABLISHMENT OF THE ANDERSON 400kV SUBSTATION IN FLORA PARK A.H., GAUTENG PROVINCE.

Declaration of independence of the sub-consultant as required by NEMA Regulation 33(2) of GN 385:

Details of the person who prepared the report;

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The expertise of that person to carry out the specialist study or specialised process;
Masters in Landscape Architecture – ML(Prof) at University of Pretoria (2005)

The declaration of independence:

I-Dot Design Studio CC trading as *i*-scape, declare that the closed corporation:

- Act as the independent visual specialist in this application;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the National Environmental Management Act, Regulations, 2006;
- Have and will not have no vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the Authorities, any material information that have or may have the potential to influence its decision or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, Regulations, 2006.

Signature of the specialist:

Date: 13 September 2012

EXECUTIVE SUMMARY

I-scape was appointed by Nemai Consulting to compile a Visual Impact Assessment (VIA) report for the proposed establishment of the Anderson 400kV Substation near Flora Park A.H. in the City of Tshwane Municipality, Gauteng (Figure 1). The client, Eskom Holdings Ltd, has proposed the construction of a 400 kV transmission line between the existing Dinaledi Main Transmission Substation (MTS) and the proposed Anderson Substation as part of the Tshwane Strengthening project. The Environmental Impact Assessment for the 400 kV transmission line is not part of the substation application.

A VIA is a specialist study which assesses the potential visual changes to an existing baseline setting resulting from the implementation of a proposed project. The associated visual changes could potentially impact on the character and value of the landscape and affect the views and perceptions of observers in the study area. The purpose is to determine the significance of the changes and to recommend mitigation measures where the impacts are considered unacceptably negative.

The objectives will be to:

- Address the concerns that are raised during public participation events which relates to aesthetic or any visual aspects;
- Determine the impacts on the observers in the study area and the landscape character due to the change in the visual characteristics of the environment; and
- Recommend mitigation measures to alleviate or reduce the anticipated impacts.

STUDY AREA

The study area can shortly be described as the area affected by visual impact and usually extends beyond the boundaries of the site. For the purpose of this assessment the study area is limited to a radius of 10 km from the centre of the proposed Anderson Substation site. Within the study area one can define a Zone of Visual Influence (ZVI) or viewshed, which delineates the areas of anticipated visual impact as calculated by computer software.

The factors that most significantly influence the ZVI are topographic variation and land use/cover which could potentially screen the proposed project from critical viewpoints. These factors also contribute to the prevailing landscape character which establishes the context in which the project is proposed.

The study area is located in a moderately mountainous region and occupies most of a wide and open valley. The two parallel ridges of the Witwatersberg and Skurweberg provide a visual unit and contain views within the valley. Although the topographic elevation is not very dramatic it is considered aesthetically pleasing and contributes positively towards the value of the landscape character.

The study area accommodates a variety of land uses of which a rural, agricultural land use is the most prominent. One residential cluster, Flora Park A.H. occurs around the Broederstroom Primary School but for the remainder of the study area the population density is very low and

spread out. Three major transport routes traverse the study area and are considered important tourist routes connecting important tourist destinations such as Hartebeespoort Dam and the Cradle of Humankind World Heritage site.

PROJECT DESCRIPTION

In short the project entails the construction of a 400kV substation with a footprint of 300x300 m and a maximum height of 30 m. During construction earthmoving equipment and workforce will be present on site, preparing the substation platform and foundations. Transport vehicles will deliver construction material during the course of the construction phase. The footprint of disturbance is expected to be larger than the 300x300 m substation site, but rehabilitation should occur after completion. The result is that vegetation is damaged and the underlying soil is exposed which cause unsightly scarring in the landscape. During this stage dust clouds may occur on windy days but can be effectively mitigated.

Many of a substation's components are housed in buildings which are typically brick structures with corrugated iron roofs. Other components such as the transformers, circuit breakers, busbars etc. are located outside and form the bulk of the substation. A substation has a very industrial character with steel structures and cables connecting the different components. A telecommunication tower is usually also part of a substation which connects the control rooms of various substations. This is often the highest structure of a substation. The perimeter fence can either be a diamond mesh wire fence or a concrete palisade fence. As part of the security of a substation perimeter lighting is installed.

VISUAL IMPACT ASSESSMENT

Within the study area observers experience and interact differently with their environment and therefore value it differently. They may be affected by the proposed project due to additions or alterations in the landscape character which may influence their experience and views of the visual resource. In this assessment a distinction is made between impacts on the **observers** and impacts on the **landscape character**. The observers represent all people that may be affected visually while the impacts on the landscape character exclusively assess the changes to the landscape character and the impact on its visual value. A highly significant impact on the observers will not necessarily be a highly significant impact on the landscape character and vice versa and that's why the distinction is made.

The following typical impacts may be expected as a result of the construction and operation of the proposed project:

- The project activities or components noticeably change the existing features and the qualities of the landscape;
- The project introduces new features which are uncharacteristic or in contrast with the existing character of the landscape; and/or
- The project removes or blocks aesthetic features in the landscape which subsequently affects the visual value and aesthetic appeal of the visual resource.

The significance of this change/impact is a function of:

- The intensity of the impact;

- The sensitivity of the observers which are impacted or the sensitivity of the landscape character; and
- The exposure of the observer to the impact.

VISUAL IMPACTS DURING CONSTRUCTION PHASE

Visual impacts will result from the temporary presence of a construction camp and material stockyard as well as activities and disturbances on the substation site. Typical visual impacts often relate to the unsightly character of such a construction site brought about by the untidy and disorderly placement of ancillary elements and the associated surface disturbances. Construction equipment such as graders, front-end loaders etc. will be active on site. During the preparation of the base major earthworks will be required to level the site. The physical damage to the existing vegetation cover impacts on the landscape character and causes intrusive views.

Nature of Impact	Extent of Impact	Duration of Impact	Intensity of Impact	Probability of Impact	Significance of Impact	Level of Confidence
Construction phase – Travelling Tourists						
Without mitigation	Local	Short term	Low	Highly probable	Low	High
With mitigation	Local	Short term	Low	Highly probable	Low	High
Construction phase – Residents						
Without mitigation	Local	Short term	High	Highly probable	High	High
With mitigation	Local	Short term	Medium	Highly probable	Medium	High
Construction phase – Landscape Character						
Without mitigation	Local	Long term	Medium	Definite	Medium	High
With mitigation	Local	Long term	Medium	Highly probable	Medium	High

VISUAL IMPACTS DURING OPERATIONAL PHASE

The addition of a new substation will alter the baseline condition and impact on the character of the landscape due to a change in land use. The new substation will cause an intrusion on observers' views especially to those living or passing within 1 km of the site.

Nature of Impact	Extent of Impact	Duration of Impact	Intensity of Impact	Probability of Impact	Significance of Impact	Level of Confidence
Operational phase – Travelling Tourists						
Without mitigation	Local	Long term	Medium	Highly probable	Medium	High
With mitigation	Local	Medium term	Low	Highly probable	Low	High
Operational phase – Residents						
Without mitigation	Local	Long term	Medium	Highly probable	Medium	High
With mitigation	Local	Medium term	Low	Highly probable	Low	High
Operational phase – Landscape Character						
Without mitigation	Local	Long term	High	Highly probable	High	High
With mitigation	Local	Medium term	Medium	Highly probable	Medium	High

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. The mitigation measures address impacts during the design, construction and operational phase of the substation and are mainly focussed on mitigating intrusive views from sensitive viewpoints. A section on obtrusive lighting mitigation provides practical guidelines for the installation of security lighting.

CONCLUSION

The findings of this visual impact assessment have provided arguments and evidence that there will be negative impacts during both the construction and operational phase of the substation. During construction the impacts revolve around the extensive clearing of vegetation and the unsightly and intrusiveness nature of the construction site. The impacts will be most significant on the local residents within 1 km of the site as they will experience a high degree of sustained exposure for the duration of the construction phase. Mitigation can be implemented to reduce the significance of the visual impact and is mostly orientated towards screening of the construction site.

During the operational phase it can be expected that the same residents will be negatively affected due a fairly large addition to the landscape and the change in land use that will alter the prevailing landscape character. The change in landscape character is regarded highly significant but on a local scale. Mitigation measures can be introduced in the form of screen planting which will block the substation from sensitive viewpoints.

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LIST OF ABBREVIATIONS

DEM	Digital Elevation Model
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
GIS	Geographical Information System
MTS	Main Transmission Substation
NECSA	Nuclear Energy Corporation of South Africa
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment
ZMVE	Zone of Maximum Visual Exposure
ZVI	Zone of Visual Influence

1 INTRODUCTION

I-scape was appointed by Nemai Consulting to compile a Visual Impact Assessment (VIA) report for the proposed establishment of the Anderson 400kV Substation near Flora Park A.H. in the City of Tshwane Municipality, Gauteng (Figure 1). The client, Eskom Holdings Ltd, has proposed the construction of a 400 kV transmission line between the existing Dinaledi Main Transmission Substation (MTS) and the proposed Anderson Substation as part of the Tshwane Strengthening project. The Environmental Impact Assessment for the 400 kV transmission line is not part of the substation application.

A VIA is a specialist study which assesses the potential visual changes to an existing baseline setting resulting from the implementation of a proposed project. The associated visual changes could potentially impact on the character and value of the landscape and affect the views and perceptions of observers in the study area. The purpose is to determine the significance of the changes and to recommend mitigation measures where the impacts are considered unacceptably negative.

2 OBJECTIVES AND METHODOLOGY

2.1 VIA OBJECTIVES

The objectives will be to:

- Address the concerns that are raised during public participation events which relates to aesthetic or any visual aspects;
- Determine the impacts on the observers in the study area and the landscape character due to the change in the visual characteristics of the environment; and
- Recommend mitigation measures to alleviate or reduce the anticipated impacts.

2.2 VIA METHODOLOGY

The above objectives will be met by applying the following methodology:

1) **Delineation of study area:** The determination of the extent of the study area and its comprising features by doing a site survey and through the use of computer software;
2) **Project Description:** A description of the type, scale and extent of the proposed project, with a particular focus on the visible elements. Information is provided by the client;
3) **Visual Impact Assessment:** This section determines the sensitivity of the receptors and assesses the significance of the potential visual impacts;
4) **Mitigation Measures:** Mitigation measures are proposed to alleviate or completely eliminate the potential impacts that are identified.

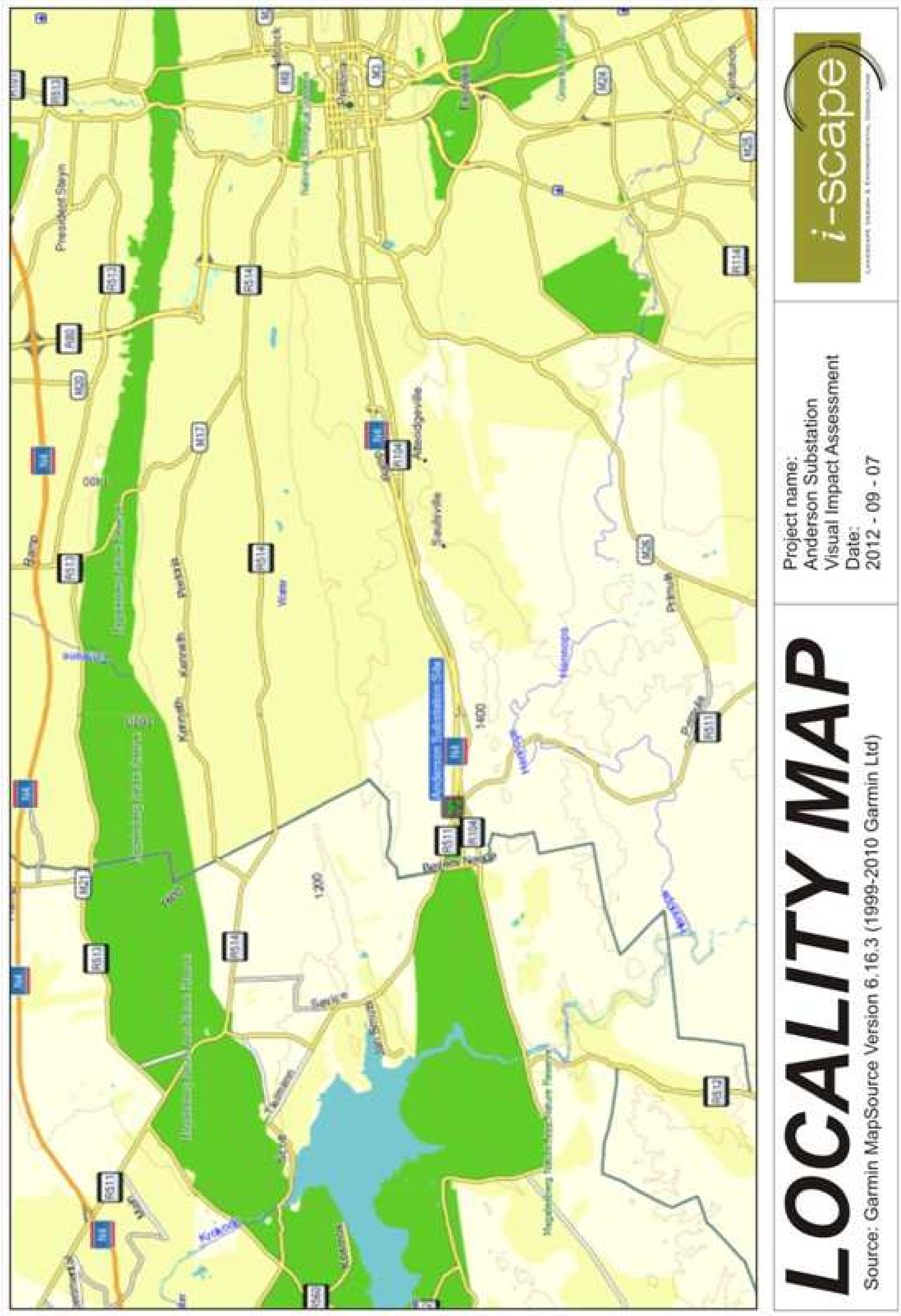


Figure 1: Locality Map

3 LIMITATIONS AND ASSUMPTIONS

This section provides a clear understanding of the limitations and assumptions that negatively affects the accuracy of the assessment and influences the confidence of the visual specialist in his professional judgement. In general the specialist's confidence is influenced by the inherent knowledge of the specific project and study area as well as by the level of detail provided pertaining to the project.

- A Visual Impact Assessment is not a purely objective science and often integrates qualitative evaluations based on human perceptions. It is the visual specialist's aim to utilise as much quantitative data as possible to substantiate professional judgement and to motivate subjective opinions;
- The study area was visited at the beginning of September 2012 and the environment was still in its typical winter condition. Time and budget constraints prevented the visual specialist to return to the site to document the character of the study area during other seasons. The visual specialist is however confident that the information acquired during the site investigation was sufficient to do an assessment;
- No comments or complaints were received during the public participation events prior to the writing of this report that has specific reference to aesthetic or visual impact issues. The sensitivity of the viewers can therefore not be confirmed firsthand and a generic rating system will be used to determine viewer sensitivity; and
- The visibility map in Appendix 1 calculates the screening ability of the landscape based on the natural topography alone. Contour data with a 20 m interval is used to determine the visibility of the substation. The screening affect of trees, structures and man-made landforms is not represented in the maps, but are further discussed under the relevant section.

4 STUDY AREA

The study area can shortly be described as the area affected by visual impact and usually extends beyond the boundaries of the site. For the purpose of this assessment the study area is limited to a radius of 10 km from the centre of the proposed Anderson Substation site. Within the study area one can define a Zone of Visual Influence (ZVI) or viewshed, which delineates the areas of anticipated visual impact as calculated by computer software (Refer to Appendix 1).

The factors that most significantly influence the ZVI are topographic variation and land use/cover which could potentially screen the proposed project from critical viewpoints. These factors also contribute to the prevailing landscape character which establishes the context in which the project is proposed. These landscape attributes are briefly discussed in the following sections.

Topography: The study area is located in, what can be described as a wide open valley between two parallel mountain ridges. These ridges form part of the Magalies Mountain Range and are locally referred to as the Witwatersberg and Skurweberg on the northern and southern side of the site respectively. In the valley approximately 400 m north of the site is the inconspicuous Moganwe stream which is a tributary of the Crocodile River. The elevated topography is considered aesthetically pleasing with a relatively high scenic value due to its natural character.

Land Use/Cover: The study area is considered fairly rural but features a variety of land uses. The predominant land use appears to be agricultural with small scale farming visible on the foothills and plains near the Moganwe stream. A great percentage of the study area is covered in natural vegetation especially on the mountain ridges. Natural vegetation is typically dense thorn bushes and trees but in some areas a savannah-like vegetation type occurs with mostly grassland and isolated tree stands. These areas are presumed to be previously cultivated farmland that has rehabilitated to a grassland savannah.

Agricultural Holdings (A.H.) such as the small and isolated Flora Park A.H. near the Broederstroom Primary School is one of the most densely populated residential clusters in the study area. It is also located near the Tydstroom Abattoir which is the most prominent business development in the study area but has an agricultural association. Farmsteads are scattered across the study area and are generally located higher up the mountain.

The NECSA Power Plant is approximately 4 km south west of the site and although most of the infrastructure is hidden behind some hills, the massive cooling towers and stacks are visible from the surrounding landscape. This has impacted on the character of the landscape to some degree and brings an industrial undertone to the study area.

Major transport routes traverse the study area of which the N4 Highway, R104 and R511 is the most prominent. In general the transport infrastructure is sparse but is considered important links between specific tourist attractions and carries relatively high traffic volumes.

Existing Electricity Infrastructure: The existing electricity network is surprisingly inconspicuous when considering the proximity of the NECSA Power Plant. The power plant generates an estimated 20MW power of which most is distributed to the south. A few distribution lines, presumably 88/132kV, traverse the study area but are mounted on low timber poles and are fairly unnoticeable. A small substation is located between the Tydstroom Abattoir and proposed Anderson Substation site, where a convergence of distribution lines occurs. The proposed Dinaledi – Anderson 400kV Transmission line will presumably increase the dominance of the electrical infrastructure due to the oversized transmission towers.

5 PROJECT DESCRIPTION

Construction phase

The construction of a substation is assumed to take 12-24 months to complete. During this phase the following basic steps is expected to occur in no particular order:

- Survey and pegging of substation site by a ground survey team;
- Construction of additional access roads and gates if required. Existing roads will be used as far as possible but it can be expected that a perimeter road will be created around the site which will typically be a two-tread dirt road;
- Establishment of construction camp and stockyard with basic administrative and ablution facilities;
- Construction of substation platform usually by means of earthmoving equipment such as graders and back actors;
- Substation assembly and construction;

- Perimeter fence construction and installation of security lights; and
- Site rehabilitation.

A construction camp is usually a cleared and fenced area adjacent to the substation site where temporary site offices and ablution facilities 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 may cause a visual impact.

During construction earthmoving equipment and workforce will be present on site, preparing the substation platform and foundations. Transport vehicles will deliver construction material during the course of the construction phase. The footprint of disturbance is expected to be larger than the 300x300 m substation site, but rehabilitation should occur after completion. The result is that vegetation is damaged and the underlying soil is exposed which cause unsightly scarring in the landscape. During this stage dust clouds may occur on windy days but can be effectively mitigated.

The exact location of the loop-in and loop-out lines which will connect the substation to the 400kV transmission line have not yet been determined. This is expected to be one of the last steps in the construction phase before testing and final handover occurs.

Operational phase

A substation is considered a high-voltage electrical system facility and typically consists of the following components:

- Transformers;
- Circuit breakers;
- Feeder bays;
- Reactor;
- Busbars;
- Oil containment dams for transformer oils;
- Loop-Out lines;
- Loop-In lines;
- Buildings; and
- Security fence and perimeter lighting.

Many of a substation's components are housed in buildings which are typically brick structures with corrugated iron roofs. Other components such as the transformers, circuit breakers, busbars etc. are located outside and form the bulk of the substation. A substation has a very industrial character with steel structures and cables connecting the different components. A telecommunication tower is usually also part of a substation which connects the control rooms of various substations. This is often the highest structure of a substation.

The perimeter fence can either be a diamond mesh wire fence or a concrete palisade fence. As part of the security of a substation perimeter lighting is installed.

6 VISUAL IMPACT ASSESSMENT

Within the study area observers experience and interact differently with their environment and therefore value it differently. They may be affected by the proposed project due to additions or alterations in the landscape character which may influence their experience and views of the visual resource. In this assessment a distinction is made between impacts on the **observers** and impacts on the **landscape character**. The observers represent all people that may be affected visually while the impacts on the landscape character exclusively assess the changes to the landscape character and the impact on its visual value. A highly significant impact on the observers will not necessarily be a highly significant impact on the landscape character and vice versa and that's why the distinction is made.

The following typical impacts may be expected as a result of the construction and operation of the proposed project:

- The project activities or components noticeably change the existing features and the qualities of the landscape;
- The project introduces new features which are uncharacteristic or in contrast with the existing character of the landscape; and/or
- The project removes or blocks aesthetic features in the landscape which subsequently affects the visual value and aesthetic appeal of the visual resource.

The significance of this change/impact is a function of:

- The intensity of the impact;
- The sensitivity of the observers which are impacted or the sensitivity of the landscape character; and
- The exposure of the observer to the impact.

Intensity of impact

The intensity of an impact is a measure of how severe a particular impact is considered to be. It can be described according to scale, extent and visual absorption capacity, but human perceptions also play a significant role although difficult to measure.

- **Scale** refers to the physical size of the project/development relative to the context it is situated in. For example, a four storey shopping centre in a typically residential suburb will be considered large and out of scale;
- **Extent** refers to the Zone of Visual Influence (ZVI) of the particular project/development and the coverage relative to the study area. This is determined through visibility analysis and is addressed in Appendix 1; and
- **Visual Absorption Capacity:** The intensity of an impact is often mitigated by the inherent Visual Absorption Capacity (VAC) of the landscape. The VAC of a landscape also 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 VAC may have one or more of the following attributes:
  - A high screening capacity which screens views from sensitive vantage points or contains the ZVI to a relatively localised area;
  - Is often intensely developed or transformed by exploitive human activities and therefore has a low value and scenic quality as a baseline condition to start with;

- Has characteristic land uses that are compatible with the proposed project; and/or
- 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 VAC may:

- Be an open or exposed landscape with few topographic or surface features that can act as visual screens from sensitive vantage points and has therefore a large ZVI relative to the study area;
- Comprises of land uses that are incompatible with the proposed project or the project will contrast severely with the landscape character; and/or
- Has a very high concentration of valued attributes or its attributes are of a high value.

- **Human perceptions** are for all practical reasons subjective, but are considered a valuable indication as to how people respond to a proposed project. Often the general acceptance or non-acceptance of a project/development will be reflected in public consultations. Up until the submission of the report no concerns were raised by any I&AP with particular reference to visual or aesthetic impacts. It is assumed that the general perception towards electrical infrastructure is negative but varies in the degree between different parties. Usually a correlation can be drawn between the level of negative sentiment and the distance from the proposed project. Although it is only the Anderson Substation that is assessed in this report, the 400 kV transmission line is associated with it and the cumulative impact potentially raises the negative perception of the projects.

Sensitivity of observers

The sensitivity of an observer is related to the value an observer has for the particular visual resource 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.

Table 1: Viewer Sensitivity

VIEWER SENSITIVITY	DEFINITION (BASED ON THE LANDSCAPE INSTITUTE, 2002 ED PP90-91)
High	Views from major tourist or recreational attractions or viewpoints promoted for or related to appreciation of the landscape, or from important landscape features. Users of all outdoor recreational facilities including public and local roads or tourist routes whose attention or interest may be focussed 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 activity; Views from urbanised areas, commercial buildings or industrial zones. Views from heavily industrialised or blighted areas

Tourists visiting the study area are usually considered highly sensitive towards impacts on the visual environment especially from dedicated viewpoints that are specifically located to enjoy a view. In the region outside the study area there are a number of tourist destinations in the form of reserves, conference venues, restaurants, etc. The most prominent attractions in the greater region are undoubtedly the Hartbeespoort Dam and the Cradle of Humankind World Heritage Site which attracts a great number of tourists annually. This has led to a significant development in other tourist related activities and people visit the area to experience and enjoy what is on offer. They will often take a scenic drive through the mountains on their way to a destination. The project is not expected to impact directly on any of these tourist attractions but it is on route and tourists will pass the substation site. They are regarded as motorists with a greater awareness and a **medium** sensitivity due to their brief exposure.

The residents in the study area are classified as visual receptors of **high** sensitivity owing to their sustained visual exposure to the proposed development as well as their attentive interest towards their living environment.

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 is often regarded as the factor that has the greatest impact on the exposure of an impact. A general assumption is that the further one is from the source of impact the less exposed and the less intrusive an impact will be. During the site investigation it was noticed that at distances of 3 – 4 km it will be reasonably difficult to distinguish the proposed substation from its surroundings. The empirical test is regarded fairly accurate as there is an existing, smaller substation directly adjacent to the proposed site. This was used as a reference and although the Anderson Substation will be larger in scale the distance factor will remain important in limiting the exposure of the impact (Appendix 2);
- True visibility of the project; keeping in mind visual contrast and the decrease in visibility over distance. Over great distances true visibility often diminishes as hazy or misty atmospheric conditions causes reduced contrast between the project and its surroundings and background. At nearer distances factors such as screening play a greater role in limiting the true visibility;
- Duration, i.e. sustained, temporary, intermittent exposure, etc; and
- Viewer incidence is a measure of determining the frequency and number of viewers viewing the proposed project. Due to a lack of quantitative data the rating is based on an arbitrary scale from high to low specifically designed for this project:
    - For a high viewer incidence to occur the site should be located within 1 km of a relatively densely populated area, adjacent to a major transport route and/or within 1 km from a recognised public gathering area such as a park;
    - A medium viewer incidence occurs if the site is within 2 km but further than 1 km of a densely populated area or major transport route, or nearby a sparsely populated area such as a farming community or agricultural holdings; and
    - A low viewer incidence occurs if the site is located in an area of vacant-/farmland with no or limited populated areas within 5 km and only a tertiary road network is present.

The following key viewpoints have been identified and are considered representative of the views that are typically experienced in the study area. These key viewpoints are further discussed in Appendix 2:

- Views from the major transport routes such as the N4, R511 and R104; and
- Views from the residential cluster at Flora Park A.H.

Sensitivity of the Landscape Character

The sensitivity of a landscape's character is a measure of the robustness of its character and the ability of the landscape to accommodate certain changes without detrimental impacts on its character. The sensitivity of a landscape's character has a close correlation with the VAC of the study area but is also influenced by the scale and type of the proposed project.

A landscape character with a high sensitivity will typically have one or a combination of the following attributes:

- Has a low VAC;
- Has a high degree of inter-visibility with adjacent landscapes;
- Has a well established identity and sense of place;
- Is often in a pristine natural condition with high ecological value that contributes to a valued aesthetic condition;

A visual resource with a low sensitivity will typically have one or a combination of the following attributes:

- Has a high VAC;
- Is often visually isolated and has a low degree of inter-visibility with adjacent landscapes;
- Has a poorly established identity and sense of place;
- Is often greatly developed to an extent where no or very little aesthetic features exist.

The landscape character of the study area is considered medium - low and it is expected that the proposed project will not cause major changes to the character. This can be attributed to the fact that a medium to high VAC limits the visibility of the site and that an existing substation provides a context that is orientated towards electricity infrastructure.

6.1 VISUAL IMPACTS DURING CONSTRUCTION PHASE

6.1.1 CRITERIA OF ASSESSMENT – CONSTRUCTION PHASE

CRITERIA OF ASSESSMENT	
NATURE OF IMPACT	
Visual impacts will result from the temporary presence of a construction camp and material stockyard as well as activities and disturbances on the substation site. Typical visual impacts often relate to the unsightly character of such a construction site brought about by the untidy and disorderly placement of ancillary elements and the associated surface disturbances. Construction equipment such as graders, front-end loaders etc. will be active on site. During the preparation of the base major earthworks will be required to level the site. The physical damage to the existing vegetation cover impacts on the landscape character and causes intrusive views.	
INTENSITY OF IMPACT	
Scale	The footprint of the substation is estimated at 300x300 m which is an area of 90 000 m². The maximum height will be limited to 30 m although most of the components of the substation will have a much lower height.
Extent	During construction the entire footprint area will be stripped of vegetation which will expose the underlying soil. The actual area of disturbance is expected to be larger than the substation footprint as the construction camp will probably be located adjacent the current site location. Dust clouds may occur during windy days which will increase the visibility and extent of the impact. Dust clouds can however be mitigated fairly effectively. As the substation gain height the extent of impact will increase gradually.
Human perceptions	Generally, humans have a negative perception when confronted with a construction site or -activity, especially close to their dwellings or near the vicinity of a protected area. It is often considered an eyesore due to the surface disturbance and the scarring of the landscape.
VAC	The VAC of the study area is considered medium to high. The mountain ranges north and south of the study area greatly contain the visibility of the site. In general, the vegetation cover consists of fairly dense bushes and trees that provide a medium to high degree of visual screening. In a radius of approximately 500m around the site the VAC is considered low as the vegetation consists only of open grassland. At greater distances vegetation and other developments provide a higher degree of screening thereby increasing the VAC. During the early stages of construction the site will be less visible due to the surface activity but as the substation gain height some of the structures will exceed the height of the surrounding vegetation.
VIEWER SENSITIVITY	
Residents are considered highly sensitive. Motorists travelling through the area on a scenic drive on their way to a destination are considered to have a medium sensitivity.	
EXPOSURE TO IMPACT	
Distance to source of impact	Throughout the study area observers will experience the visual impact relating to the construction phase in varying degrees depending on their exposure to the project and their sensitivities. The distance to the source of impact is considered the greatest factor aggravating or mitigating the exposure to the impact. Viewers within 1000m of the source of impact are expected to experience a high intrusion on their views due to their close proximity and level of perceivable detail. During the construction phase the intrusion is expected to increase over a larger area as the substation approaches completion. Viewers that are further away may become aware of the construction activity and will experience intrusion on their views but to a lesser degree. The distance factor will decrease the dominance of the construction activity. Within 1000m there are only a few farmsteads that may experience full views of the site. In most instances vegetation screening or other structures will partially or completely screen the site from these views. Motorists travelling on the N4, R511 and R104 will experience a full view of the site as they pass within a few hundred meters. At distances greater than 2km from the site there are more residents but the site investigation confirmed that the vegetation cover will provide partial to full screening from these views. From the local road network one may be able to experience glances of the construction site at distances greater than 2km.
True visibility	During construction a footprint of 90 000m² will be cleared leaving a relatively large area devoid of vegetation. At close distances (0-1000m) the true visibility is considered great due to the relatively large

	area of disturbance in an observer's visual field and the greater level of detailed that can be perceived. At greater distances (1000-4000m) the true visibility is expected to decrease drastically due to the smaller area of disturbance in the visual field and the lower level of perceivable detail.
Duraton	Construction duration is unknown but is expected to be 12-24 months. Residents will be exposed to the impact for the duration of the construction phase. Motorists and tourists will only have brief or occasional views as they travel through or visit the region.
Viewer incidence	Viewer incidence is regarded high due to the close proximity of the site to major transport routes.

Table 2: Visual Impact 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 – Travelling Tourists						
Without mitigation	Local	Short term	Low	Highly probable	Low	High
With mitigation	Local	Short term	Low	Highly probable	Low	High
Construction phase – Residents						
Without mitigation	Local	Short term	High	Highly probable	High	High
With mitigation	Local	Short term	Medium	Highly probable	Medium	High
Construction phase – Landscape Character						
Without mitigation	Local	Long term	Medium	Definite	Medium	High
With mitigation	Local	Long term	Medium	Highly probable	Medium	High

6.2 VISUAL IMPACTS DURING OPERATIONAL PHASE

6.2.1 CRITERIA OF ASSESSMENT – OPERATIONAL PHASE

CRITERIA OF ASSESSMENT	
NATURE OF IMPACT	
The addition of a new substation will alter the baseline condition and impact on the character of the landscape due to a change in land use. The new substation will cause an intrusion on observers' views especially to those living or passing within 1 km of the site.	
INTENSITY OF IMPACT	
Scale	The footprint of the substation is estimated at 300x300 m which is an area of 90 000 m². The maximum height will be limited to 30 m although most of the components of the substation will have a much lower height.
Extent	The ZVI covers a relatively small percentage of the study area due to topographic screening. Vegetation screening is expected to decrease the ZVI even more. The frequency visibility map in Appendix 1 shows that large areas will only experience partial views especially to the south, but full views may be experienced

	to the north. North of the site is a low population density and almost no public roads thus the impact will only affect a limited number of observers.
Human perceptions	Generally, humans have a negative perception towards power infrastructure such as substations although different reasons are given. The negative perception towards the Anderson Substation may be aggravated due to its association with the Dinaledi – Anderson 400kV transmission line.
VAC	The VAC of the study area is considered medium to high. The mountain ranges north and south of the study area greatly contain the visibility of the site. In general, the vegetation cover consists of fairly dense bushes and trees that provide a medium to high degree of visual screening. In a radius of approximately 500m around the site the VAC is considered low as the vegetation consists only of open grassland. At greater distances vegetation and other developments provide a higher degree of screening thereby increasing the VAC. The frequency visibility map indicates that the highest degree of visibility is concentrated within 1 km of the site and along the highest point of the ridges. To the south only partial views can be expected.
VIEWER SENSITIVITY	
Residents are considered highly sensitive. Motorists travelling through the area on a scenic drive on their way to a destination are considered to have a medium sensitivity.	
EXPOSURE TO IMPACT	
Distance to source of impact	Throughout the study area observers will experience the visual impact relating to the substation in varying degrees depending on their exposure to the project and their sensitivities. The distance to the source of impact is considered the greatest factor aggravating or mitigating the exposure to the impact. Viewers within 1000m of the source of impact are expected to experience a high intrusion on their views due to their close proximity and level of perceivable detail. Viewers that are further away may become aware of the substation and will experience intrusion on their views but to a lesser degree. The distance factor will decrease the dominance of the substation. Within 1000m there are only a few farmsteads that may experience full views of the substation. In most instances vegetation screening or other structures will partially or completely screen the substation from these views. Motorists travelling on the N4, R511 and R104 will experience a full view of the substation as they pass within a few hundred meters. At distances greater than 2km from the site there are more residents but the site investigation confirmed that the vegetation cover will provide partial or full screening from these views. From the local road network one may be able to experience glances of the substation at distances greater than 2km.
True visibility	At close distances (0-1000m) the true visibility is considered great due to the relatively large area the substation occupies in an observer's visual field and the greater level of detailed that can be perceived. At greater distances (1000-4000m) the true visibility is expected to decrease drastically due to the smaller area the substation occupies in the visual field and the lower level of perceivable detail.
Duration	Residents will be exposed to the impact for the lifespan of the project. Motorists will only have brief or occasional views as they travel through or visit the region.
Viewer incidence	Viewer incidence is regarded high due to the close proximity of the site to major transport routes.

6.2.2 POTENTIAL OBTRUSIVE LIGHTING CONDITIONS

Obtrusive lighting, otherwise known as light pollution refers to excessive lighting conditions which can be harmful, wasteful and/or cause annoyance. It is often a result of poor lighting installation and creates conditions of light trespass, glare or sky glow. Obtrusive lighting as a visual impact is typically associated with relatively large developments, developments that require high intensity illumination of outdoor spaces such as recreational facilities, developments that require high intensity security lighting, or developments in wilderness areas where a low ambient light condition is part of the original context and character.

Obtrusive lighting is identified as a potential impact for two reasons:

- Security lighting will be installed inside and on the perimeter of the substation. No technical detail is available but it is assumed that flood lights will be installed on high masts and that the lights will be of a relatively high intensity to fulfil its purpose; and
- The site will be located on a vacant portion of land next to an existing substation that also features floodlighting on high masts. The closest residents are within 500 m of the site and it is expected that they will experience obtrusive lighting conditions due to their proximity.

It should be noted that to quantify obtrusive lighting levels is an extremely specialised field and requires the service of a specialist lighting engineer who can interpret detailed technical information. The aim of this study is not to quantify the impact but rather to discuss the potential problem areas and to provide practical mitigation measures which can be implemented during the detail design stages.

Sections 6.2.2.1 to 6.2.2.3 discuss the various types of obtrusive lighting that can be expected as a result of the establishment of a substation in the study area. The probability of the occurrence of such obtrusive lighting conditions is also discussed. Mitigation measures in Section 7.1 provide applicable solutions to minimise or completely contain possible negative obtrusive lighting levels.

6.2.2.1 Light trespass

Light trespass is a condition where emitted light from a source, enters neighbouring properties with annoying consequences. Light trespass typically occurs when light fixtures are mounted in such a way that it directs light onto adjacent properties. Light fixtures without covers allow light to disperse into all directions and can have a similar effect. The level of annoyance relates to the light intensity that is exerted by a specific light source and the proximity of the affected viewer. In this case the light intensity of the flood lights is expected to be relatively high and the nearest affected viewers will be residents within 300-500 m of the site. Floodlights that are directed above the horizontal will be clearly visible from these locations. It is a fact that light intensity decreases over distance but it greatly depends on the type of light, the reflectors in the light fittings, etc. No confident assessment can be made regarding the annoyance level due to a lack of technical data but the probability of obtrusive lighting is considered medium to high. It is proposed that consideration is given to mitigate potential light trespass.

6.2.2.2 Glare

Glare is a result of excessive contrast between light and dark areas in the visual field which causes visual discomfort or completely disables vision. This impact usually occurs at a very specific location and is typically a result of spot lights directed into the viewing plane of viewers. The impact is at its most severe near the source of the light and diminishes over distance.

Glare is possible if exceptionally strong floodlights are directed into the viewing plane of motorists passing the site. The probability of glare occurring is considered low, as there is no obvious need for such strong lights in this application.

6.2.2.3 Sky glow

Sky glow refers to the "glow" that is visible above extensively developed areas at night. This is a result of light reflecting off surfaces and/or poorly directed light sources being refracted into the atmosphere, illuminating the dust or moisture particles in the air. Sky glow is of particular annoyance to astronomers due to its affect on the visibility of the night sky. It impairs the vividness of stars which are so often an amenity of the wilderness landscape.

Sky glow usually occurs over large populated areas and is highly unlikely to be a result of this project unless excessively strong floodlights are installed in an upward direction. It is however important to take cognisance of the potential of poorly directed light sources and reflective materials.

Table 3: Visual Impact 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 – Travelling Tourists						
Without mitigation	Local	Long term	Medium	Highly probable	Medium	High
With mitigation	Local	Medium term	Low	Highly probable	Low	High
Operational phase – Residents						
Without mitigation	Local	Long term	Medium	Highly probable	Medium	High
With mitigation	Local	Medium term	Low	Highly probable	Low	High
Operational phase – Landscape Character						
Without mitigation	Local	Long term	High	Highly probable	High	High
With mitigation	Local	Medium term	Medium	Highly probable	Medium	High

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 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.

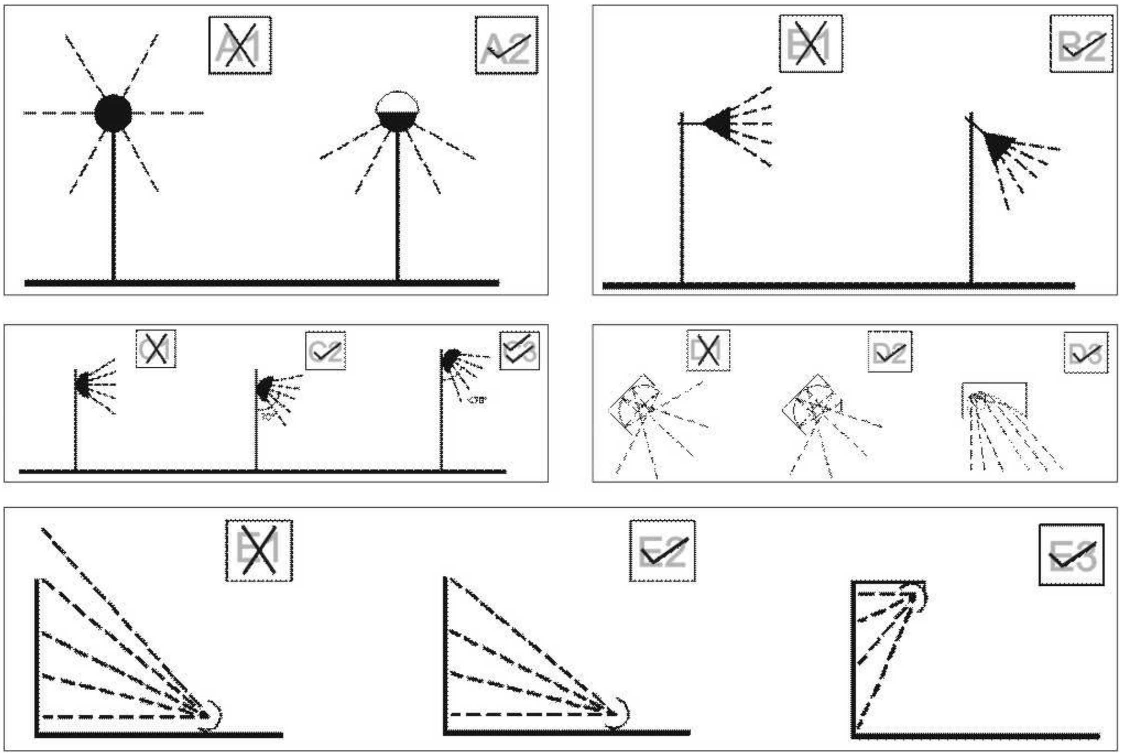
7.1 DESIGN PHASE

Obtrusive lighting is identified as a potential problem but due to a lack of technical detail no accurate assessment can be made. It is very difficult to predict obtrusive lighting conditions and requires the service of a lighting engineer in order to quantify potential obtrusive lighting impacts. The mitigation proposed here is preventative measures that should form part of the design phase of the development.

- Confine light output within property boundaries through using specifically designed luminaires such as full cut-off luminaires to minimise upward spread of light near to and above the horizontal (Figure 2 – A);
- Tilt spotlight luminaires to direct the light to the intended spot, instead of allowing it to light areas outside its purpose (Figure 2 – B);
- Mount outdoor spot lights on the appropriate pole height. Higher mounting heights allow lower main beam angles which can reduce glare (Figure 2 – C).
- Utilise control systems to reduce light levels during inactive periods or at predetermined times while maintaining sufficient lighting for safety and security (NEMA , 2000).
- Where vertical surfaces are illuminated, such as advertising signs or buildings façades, it is recommended that luminaires should light downwards. If up-lighting is the only alternative, the use of shields, baffles or louvers should be installed to reduce light spillage over or under the structure (Figure 2 – E).
- Do not over illuminate areas. Use the correct illuminance intensity for the purpose intended.

Figure 2: Guidelines for the Reduction of Obtrusive Lighting

(Source: ILE, 2005)



7.2 CONSTRUCTION PHASE

As a general rule of thumb one can significantly reduce the extent and intensity 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 environment. The following techniques can be implemented to reduce surface disturbances:

- Locate construction camps and stock yards in the least visible areas. If it can be located on an area that is already disturbed or within the boundaries of an existing development, it will eliminate the need to disturb additional areas;
- The screening capacity of the site can be temporarily enhanced through the erection of a 3 m high shade cloth fence around the construction camp and substation site during construction. The colour of the shade cloth should be similar to that of the adjacent vegetation, i.e. a light brown or khaki green;
- Keep the construction camp and construction area neat and tidy at all times. Remove any waste products from the site or contain it in an enclosed area out of sight from viewers;
- Keep to existing road infrastructure as far as possible to minimise the physical damage to vegetation;
- Implement rehabilitation of disturbed areas as soon as possible to limit the duration of exposed surfaces;
- Minimise unsightly cut- and fill areas by stepping 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 screening planting along the southern eastern and northern sides of the substation. These sides are fairly exposed and sensitive viewers may be impacted;
- Signage should be simple and unobtrusive and not protrude above the skyline when viewed from any direction; and
- A definite effort should be made to reduce the height and scale of the structures, if at all possible.

7.3 OPERATIONAL PHASE

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

8 CONCLUSION

The findings of this visual impact assessment have provided arguments and evidence that there will be negative impacts during both the construction and operational phase of the substation. During construction the impacts revolve around the extensive clearing of vegetation and the unsightly and intrusiveness nature of the construction site. The impacts will be most significant on the local residents within 1 km of the site as they will experience a high degree of sustained exposure for the duration of the construction phase. Mitigation can be implemented to reduce the significance of the visual impact and is mostly orientated towards screening of the construction site.

During the operational phase it can be expected that the same residents will be negatively affected due a fairly large addition to the landscape and the change in land use that will alter the prevailing landscape character. The change in landscape character is regarded highly significant but on a local scale. Mitigation measures can be introduced in the form of screen planting which will block the substation from sensitive viewpoints.

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APPENDIX 1

The true or actual visibility of an object in the landscape is influenced by a combination of factors. Apart from physical objects that occur in the line of sight between the observer and an object, empirical research indicates that the visibility of an object also decreases as the distance between the observer and the object increases. The ability to perceive detail is dependent on several aspects of which distance from an object and contrast between the object and its surroundings, is considered most influential. The condition of the atmosphere plays a role in the perceivable contrast between an object and its background. Even on the clearest of days, the sky is not entirely transparent and airborne particulates cause a reduction in the vividness of colours. The contrast between light and dark diminishes as the viewing distance increases and the object becomes less and less visible. The object eventually appears to merge with the background, making it imperceptible with the naked eye.

The Zone of Visual Influence (ZVI) can be determined through a method called visibility/viewshed mapping. This is utilised to establish a first order impression of a project's extent of visibility. Visibility/viewshed analysis assists the Visual Specialist in identifying sensitive observers that may be affected by a proposed project. It is a GIS procedure which incorporates topographical features and the screening it provides from a particular point in the landscape. It does not include the screening of vegetation, structures or other man-made landforms. The study area is limited to a distance of 10 km beyond which the sources of visual impact is considered negligible and thus omissible. The height of the substation is limited to 30 m.

A further development on this technique is referred to as a frequency visibility analysis. This allows for visibility mapping of a vertical element and reflects the degree of visibility of that element on a vertical plane. The result is a range of colours on a map grading from red to yellow and can be interpreted to determine the areas that will only have a partial view of the substation.

- Red is an indicator of maximum visibility, i.e. the entire 30 m substation will possibly be visible from these areas;
- Orange areas indicate that only the top 20 m will be visible thus the bottom 10 m will be screened behind a landform; and
- Yellow represent those areas where only the top 10 m may be visible and the majority of the substation is hidden behind a landform.

It can be expected that these zones will be reduced due to areas of dense vegetation cover in the study area, but this data set can not be incorporated in the viewshed analysis. During the site survey it became apparent that vegetation plays a significant role in screening of the substation site, especially from the western side.

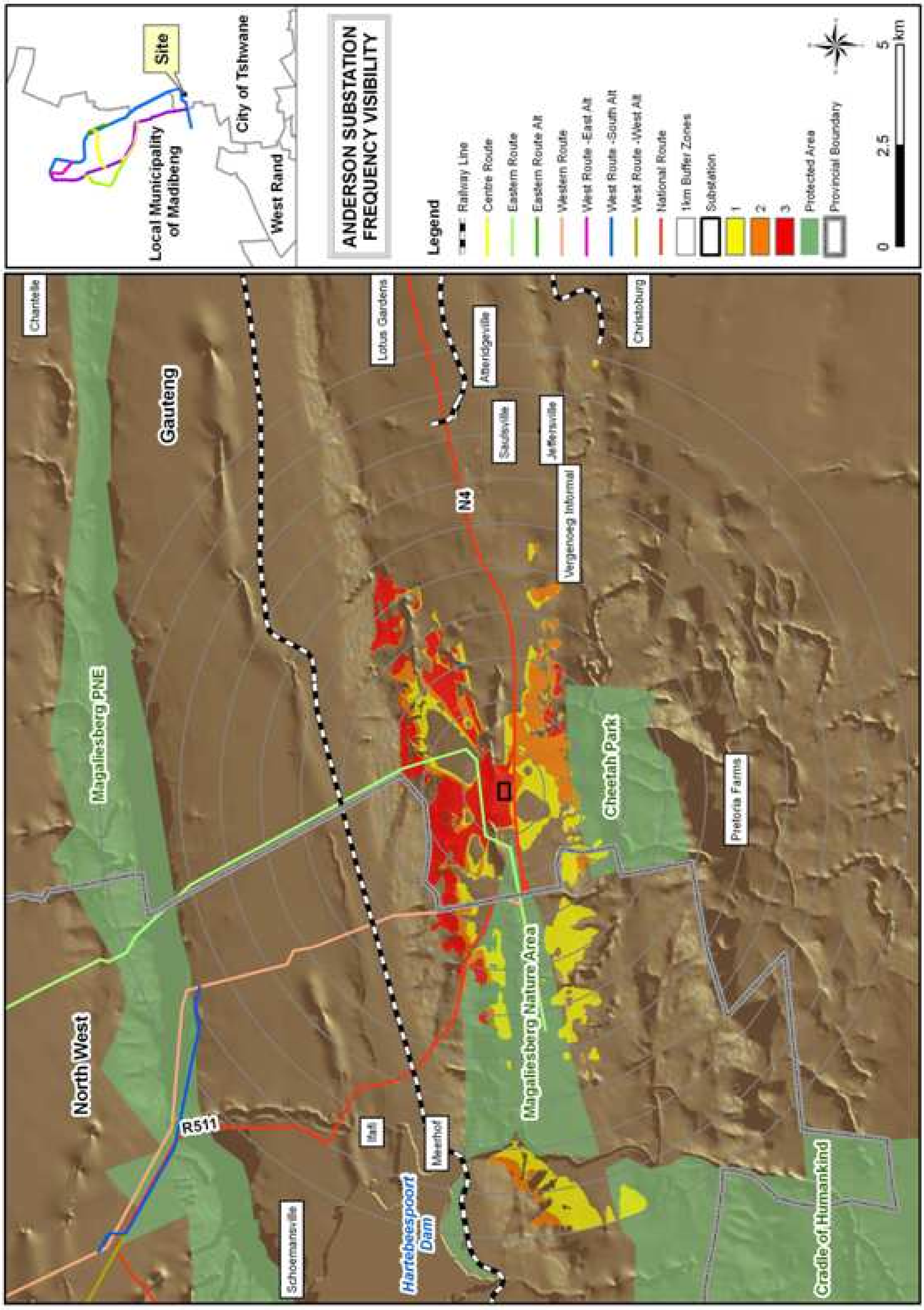

Figure 3: Frequency visibility analysis

APPENDIX 2

Five locations have been selected as representative of sensitive viewpoints in the study area. Although these are not the only sensitive viewpoints they are considered to represent the study area and the views that can be experienced in the study area. On each panoramic photograph certain dominant landscape features are indicated to provide the reader with some reference points. In the notes it also makes reference to the distance the viewpoints are from the proposed site. Figure 4 shows the locations of each viewpoint and can be revisited to confirm certain finding.

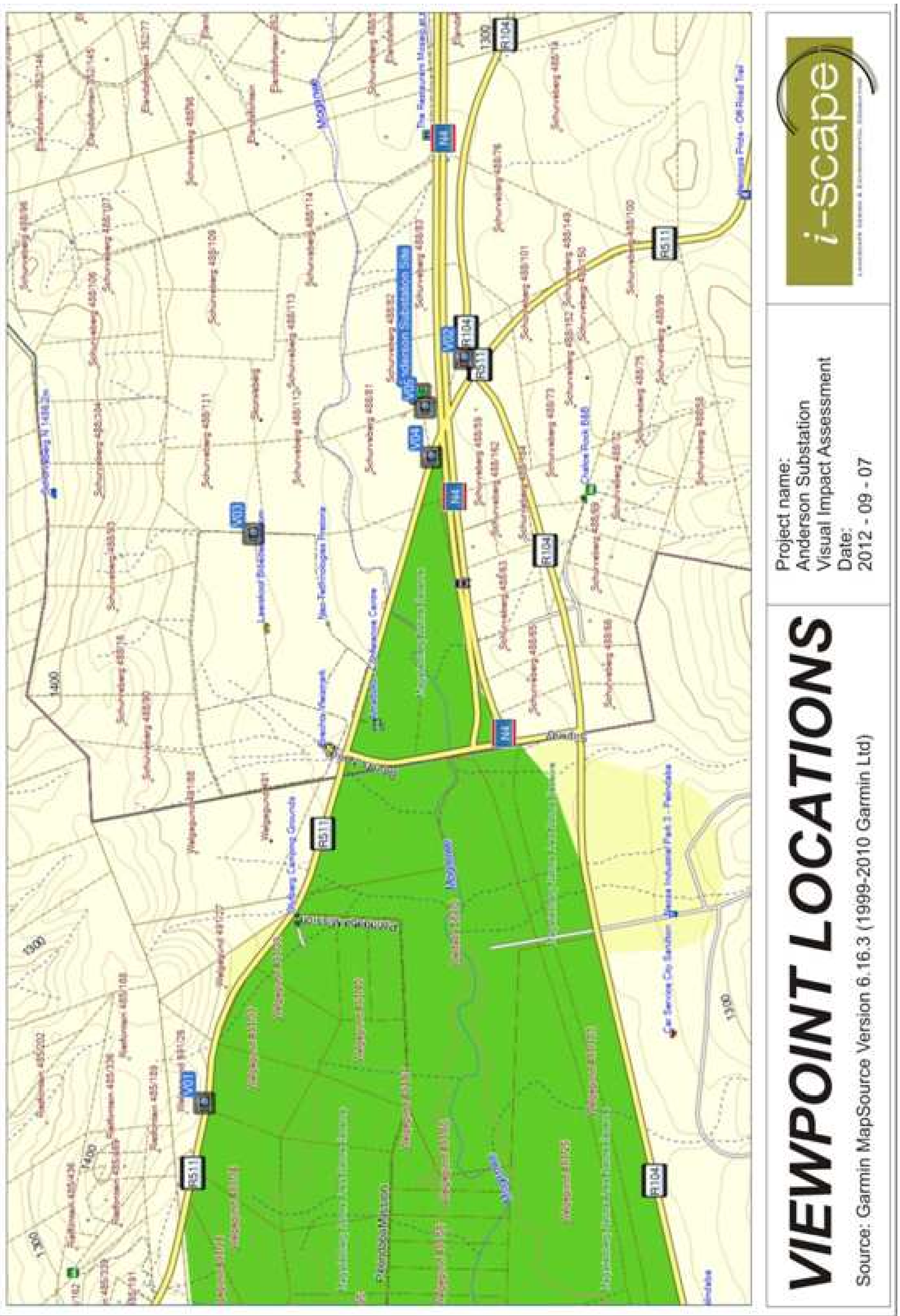

Figure 4: Location of Viewpoints

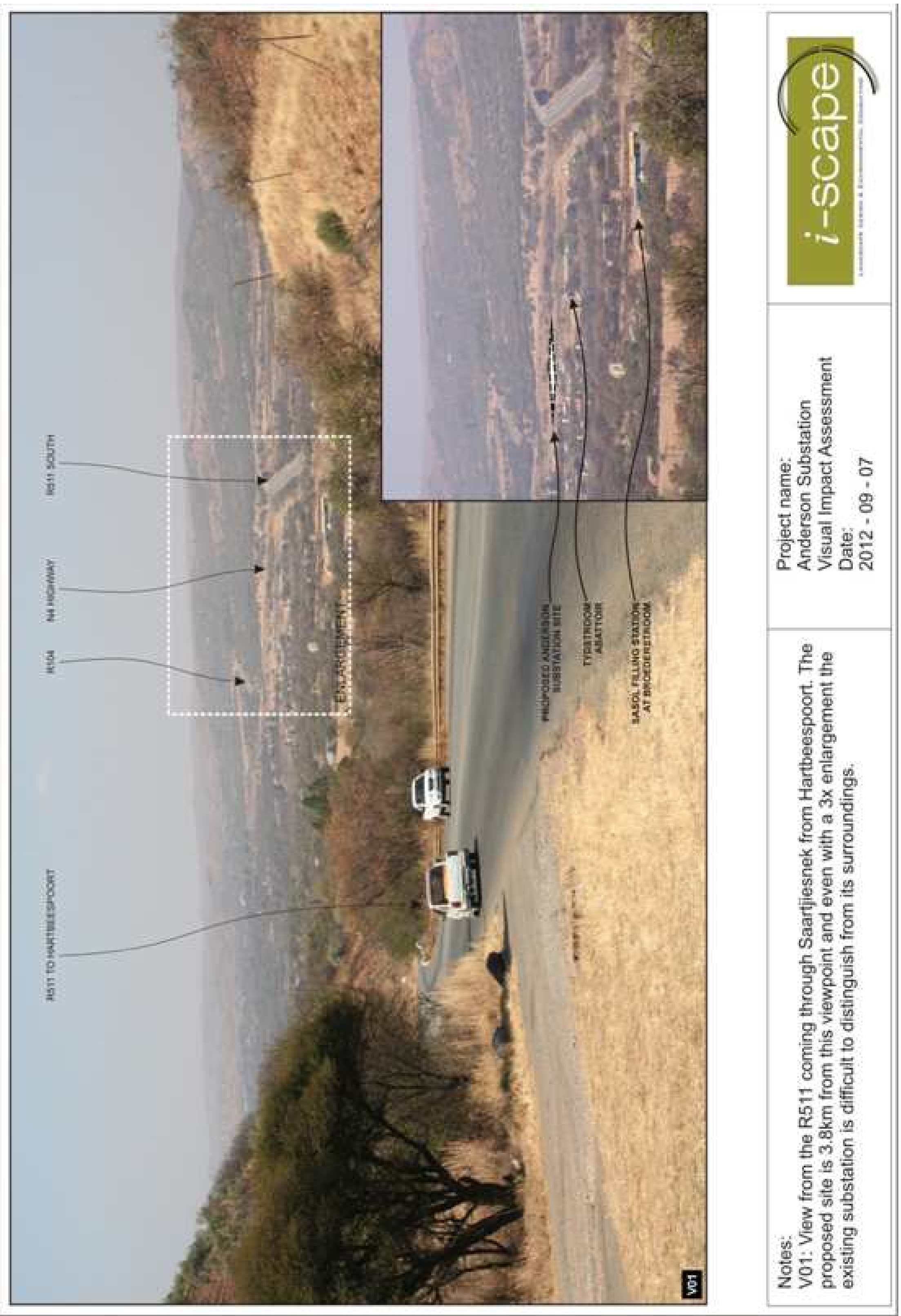

Figure 5: Viewpoints 1&2

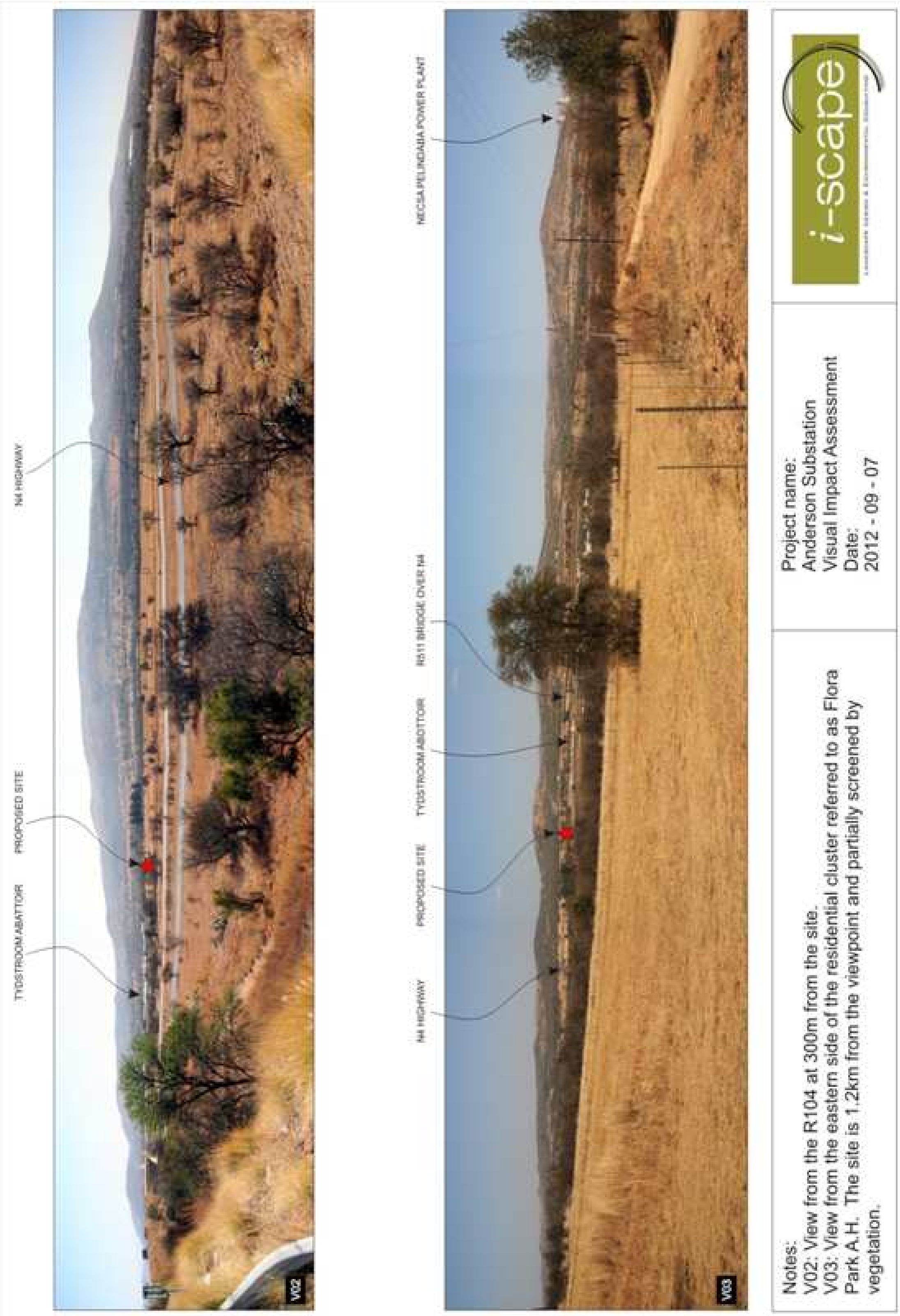

Figure 6: Viewpoints 3&4

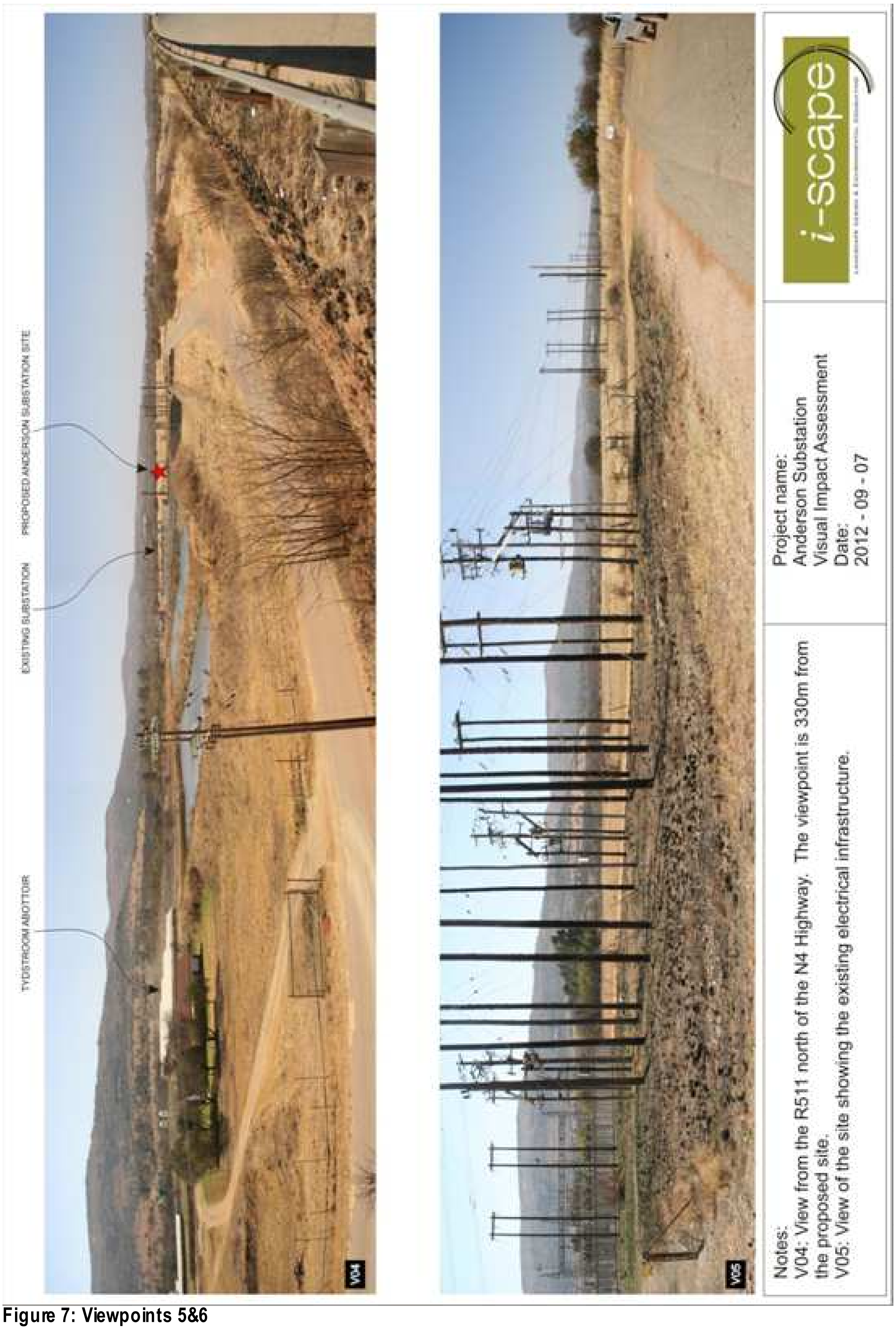

Figure 7: Viewpoints 5&6

APPENDIX 3

IMPACT ASSESSMENT CRITERIA

Various criteria are defined in the Environmental Impact Assessment Regulations (DEAT, 1998) which are adopted for the assessment of the visual impacts on the observers in the study area. The interpretation of these criteria is described as follows:

- **Nature of impacts:** An appraisal of the visual effect the activity would have on the receiving environment. This description should include the sensitivity of the receptors that are affected, and the manner in which they are affected, (both positive and negative effects).
- **Extent of impacts:** The spatial or geographic area of influence of the visual impact, i.e:
  - Site-related: extending only as far as the activity;
  - Local: limited to the immediate surroundings;
  - Regional: affecting a larger metropolitan or regional area;
  - National: affecting large parts of the country;
  - International: affecting areas across international boundaries.
- **Duration of impacts:** The predicted life-span of the visual impact:
  - Short term, (e.g. duration of the construction phase);
  - Medium term, (e.g. duration for screening vegetation to mature or rehabilitation to be successful);
  - Long term, (e.g. lifespan of the project);
  - Permanent, where time will not mitigate the visual impact.
- **Intensity of impacts:** The magnitude of the impact on views, and character of the visual resources.
  - Low, where the character of visual resources or views of the visual resource are not affected;
  - Medium, where the character of visual resources or views of the visual resource are affected to a limited extent;
  - High, where the character of visual resources or views of the visual resource are significantly affected.
- **Probability of impacts:** The degree of likelihood of the visual impact occurring:
  - Improbable, where the possibility of the impact occurring is very low;
  - Probable, where there is a distinct possibility that the impact will occur;
  - Highly probable, where it is most likely that the impact will occur; or
  - Definite, where the impact will occur regardless of any prevention measures.
- **Determination of significance of impacts:** The significance of impacts can be determined through a synthesis of the aspects produced in terms of their nature, duration, intensity, extent and probability, and are described as:
  - Low, where it will not have an influence on the decision;
  - Medium, where it should have an influence on the decision unless it is mitigated; or
  - High, where it would influence the decision regardless of any possible mitigation. (Oberholzer, 2005)