VISUAL IMPACT ASSESSMENT REPORT:

KIMBERLEY STRENGTHENING PHASE 3 SCHEME: FERRUM – MOOKODI 400KV POWERLINE

PREPARED FOR:

DIGES GROUP

Suit No.2, 546, 16th Road, Midrand, 1685

P.O Box 7068, Midrand, 1685

Email: info@diges.co.za

ON BEHALF OF:

NATIONAL TRANSMISSION COMPANY SOUTH AFRICA (NTCSA)

PREPARED BY:

ZARA CAPITAL (PTY) LTD

110 Langeveldt Road

Johannesburg, Gauteng 1686

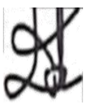
South Africa

Report name	Visual Impact Assessment Report: Kimberley Strengthening Phase 3 Scheme: Ferrum – Mookodi 400kv Powerline	
Reference code	DIG/VIA/001	
Submitted to	DIGES Group	
Report writer	Leon Katsidzira	
Reported reviewer	Tendai Dupwa	

DECLARATION OF CONSULTANTS INDEPENDENCE

I consider myself bound to the rules and ethics of the South African Council for the Architectural Profession (SACAP);

- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse any proposed developments, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;
- I do not have any influence over decisions made by the governing authorities;
- I undertake to disclose all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant;
- I have the necessary qualifications and guidance from professional experts in conducting specialist reports relevant to this application, including knowledge of the relevant Act, regulations and any guidelines that have relevance to the proposed activity;
- This document and all information contained herein is and will remain the intellectual property of Confluent Environmental. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigators.
- All the particulars furnished by me in this document are true and correct.



Leon Katsidzira

Contents

DECLARATION OF CONSULTANTS INDEPENDENCE 3

1 Introduction 7

1.1 Background 7

1.2 Terms of Reference 7

2 Project Backgroud 8

2.1 Locality 8

2.1.1 Topography 8

2.1.2 Land Use 8

2.1.3 General Characteristics 8

2.2 Main Project Components 8

2.2.1 Ferrum – Mookodi 400kV Powerline 8

2.2.2 Substation Upgrades 10

3 Visual Impact Assessment Methodology 10

3.1 Existing Environmental Values 10

3.2 GIS and Aerial Mapping 10

3.3 Identification of Viewpoints 11

3.4 Site Verification and Photographic Records 11

3.5 Review of Landscape Characteristics 11

3.6 Impact Assessment 11

3.7 Impact Criteria and Rating Scale 11

3.7.1 Significance of the Impact 13

3.8 Legislation and Guidelines considered 14

4 Assumptions and Limitations 14

5 Description of the Afferected Environment 16

5.1 Description of the Natural Physical Elements 16

5.1.1 Implications for the Project Site 18

6 The Visual Assessment 20

6.1 The Visual Analysis 20

6.1.1 The Viewshed 20

6.1.2 The Viewing Distance 21

6.1.3 Critical Views 22

6.1.4 The Visual Absorption Capacity 26
6.1.5 Cumulative Impacts 29
7 Impact Assessment for Ferrum – Mookodi 400kv Powerlineline 31
7.1 Impact assessment and rating 31
8 Impact Assessment for substation upgrades of the Ferrum substation 32
8.1 Ferrum Substation Upgrades 32
9 Impact Assessment for substation upgrades of the Mookodi Substation 34
9.1 Mookodi Substation Upgrades 34
10 Impact statement 35
10.1 The Visual Impact 35
10.1.1 The View Distance 35
10.1.2 Critical Viewpoints 36
10.1.3 Extent 36
10.1.4 Duration 36
10.1.5 Intensity or Severity 36
10.1.6 Frequency of Occurrence 36
10.1.7 Probability of Occurrence 36
10.1.8 Reversibility 36
10.1.9 Irreplaceable Loss of Resources 36
10.1.10 Consequence 37
10.1.11 Significance 37
10.1.12 Nature of the Impact 37
10.1.13 Degree of Confidence in Predictions 37
11 Recommendations and Conclusion 37
11.1 Recommendations 37
12 References 40

List of Tables

Table 3-1: Impact Assessment Methodology 12
Table 3-2: Legend for Impact Significance 13
Table 6-1: Visual Absorption Capacity Factors 26
Table 6-2: Visual Assessment Criteria -Intensity Rating 27

Table 6-3: Visual Assessment Criteria - Significance Rating 27
Table 6-4: Visual Assessment Criteria - Intensity Rating 28
Table 7-1: Impact assessment and rating for the Ferrum - Hotazel-Mookodi 400kV Powerline 31
Table 8-1: impact assessment and rating of the upgrades of the Ferrum substation..... 32
Table 9-1: Impact assessment and rating of the Mookodi substation upgrades. 34

List of Figures

Figure 2-1: Locality Map 9
Figure 5-1: Landscape Types 16
Figure 5-2: Topographic Map of the areas transverse Ferrum – Hotazel – Mookodi 400kV Powerline 18
Figure 6-1: Diagram Illustrating Diminishing Visual Exposure over Distance 21
Figure 6-2: This map illustrates the visibility of the powerline across the landscape, highlighting areas within various viewing distances (1 km to15 km) 23
Figure 6-3: Viewshed Analysis of Ferrum Substation 24
Figure 6-4: Viewshed Analysis of Mookodi Substation 25

1 INTRODUCTION

1.1 Background

Zara Capital has been appointed by Diges Group on behalf of the applicant, National Transmission Company South Africa (NTCSA) a subsidiary of Eskom Holdings SOC Ltd, to undertake the Visual Impact Assessment (VIA). This assessment is a component of the Environmental Impact Assessment (EIA) required for the Kimberley Strengthening Phase 3 Scheme: Ferrum – Mookodi 400kV Powerline project. The VIA evaluates potential visual impacts arising from the project, aiming to ensure compliance with environmental regulations and guidelines while recommending mitigation measures.

The Kimberley Strengthening Phase 3 Scheme is a strategic project aimed at enhancing the reliability and capacity of South Africa's electricity transmission network. The proposed powerline spans approximately ±260 kilometers, originating from the Ferrum Transmission Substation, located within the Gamagara Local Municipality in the Northern Cape Province. The line terminates at the Mookodi Substation, situated within the Naledi Local Municipality in the North West Province.

1.2 Terms of Reference

The scope of work for this Visual Impact Assessment (VIA) focuses on evaluating and addressing the potential visual impacts of the Kimberley Strengthening Phase 3 Scheme. This involves:

- Assessing Visual Character by examining the environmental components along the proposed ±260 km route, including topography, vegetation, and existing land uses.
- Identifying Visual Sensitivity by highlighting elements with high visual quality or cultural significance that could be affected by the project.
- Analysing Visual Impacts and evaluating how the transmission line and upgrading the substations might alter the sense of place and visual integrity of the area.
- Determining Visibility and establishing the extent to which the infrastructure will be visible from surrounding areas and critical viewpoints.
- Proposing Mitigation Measures and Recommending strategies to minimize adverse visual impacts and enhance integration with the surrounding environment.

2 PROJECT BACKGROUD

2.1 Locality

The proposed 400kV transmission powerline traverses two provinces: the Northern Cape and the North West Province. It spans a total distance of approximately 262 kilometers, originating from the Eskom Ferrum Substation located in the Gamagara Local Municipality within the Northern Cape Province. From there, the powerline meanders through the John Taolo Gaetsewe District Municipality and extends into the Dr Ruth Segomotsi Mompati District Municipality in the North West Province. See Figure 2-1.

2.1.1 Topography

The route is characterized by gently undulating terrain in the Northern Cape, transitioning to slightly flatter plains as it moves into the North West Province. The landscape features scattered hills, drainage lines, and occasional rocky outcrops, adding visual interest to the otherwise open expanses.

2.1.2 Land Use

In the Northern Cape, the dominant land use is mining and agriculture, with significant operations focused on mineral extraction. As the line moves into the North West Province, agricultural activities become more prominent, including crop farming and grazing lands. Settlements are sparsely distributed, with larger urban centers located outside the immediate project footprint.

2.1.3 General Characteristics

The area has a semi-arid climate, with vegetation primarily consisting of grasslands and low shrubs adapted to the dry conditions. The rural and open nature of the landscape contributes to a strong sense of place, characterized by expansive horizons and limited vertical intrusions, making any new infrastructure, such as the powerline, highly visible (See Figure 2-1).

2.2 Main Project Components

The Kimberley Strengthening Phase 3 Scheme involves the construction and upgrade of essential infrastructure to enhance electricity transmission reliability. The main project components are as follows:

2.2.1 Ferrum – Mookodi 400kV Powerline

- Construction of a 400kV transmission powerline spanning approximately 260 kilometers from the Ferrum Transmission Substation to the Mookodi Substation.

This powerline is designed to support significant electricity transmission capacity, enabling the delivery of reliable electricity to approximately 1.2 million households within

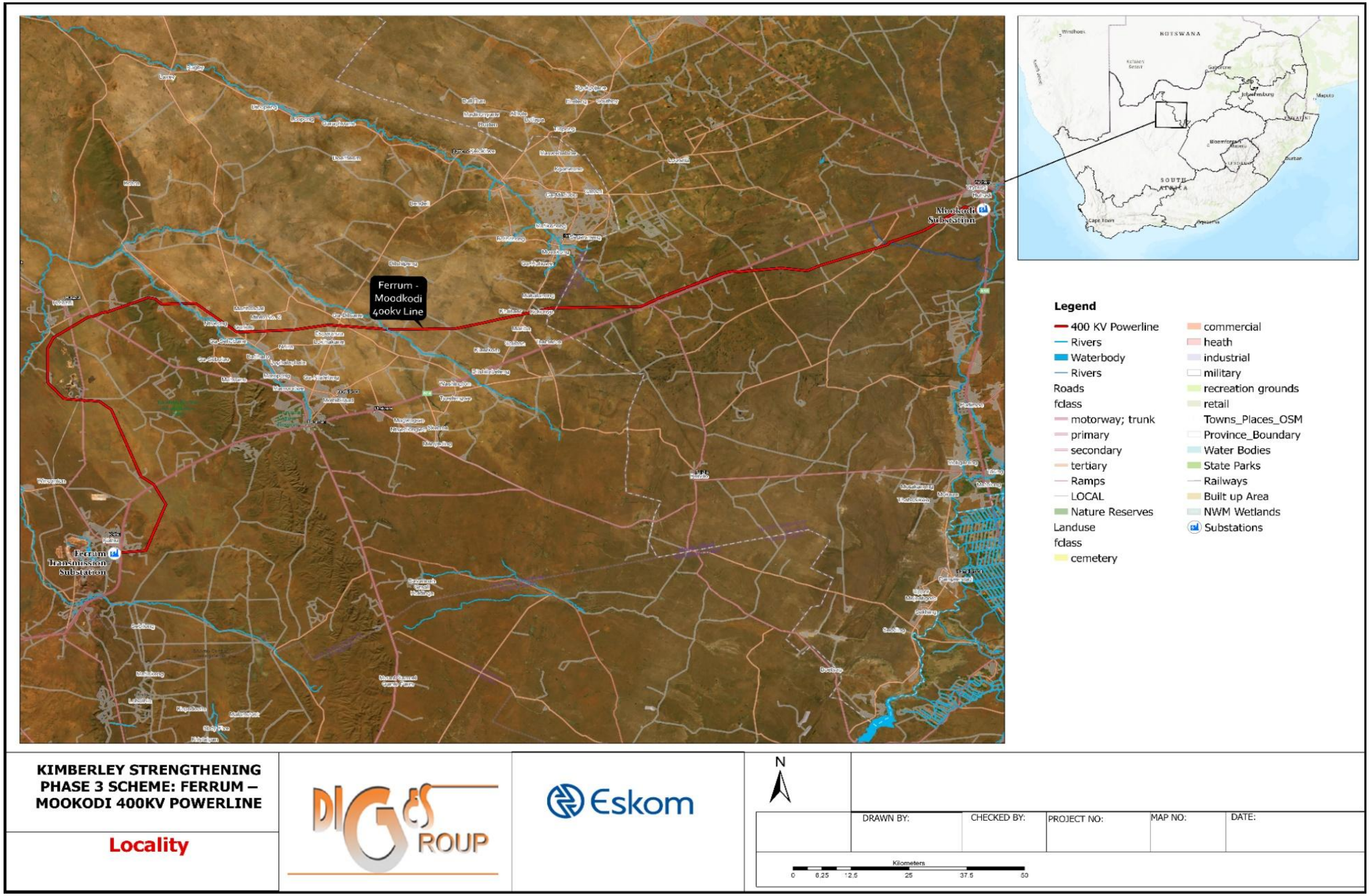


Figure 1: Locality Map

the Northern Cape and North West provinces. The improved network aims to address current load limitations and support future demand growth across residential, commercial, and industrial sectors.

2.2.2 Substation Upgrades

- **Mookodi Substation**
    - Installation of a 100MVAr busbar reactor at the Mookodi 400kV busbar.
    - Construction of a 400kV feeder bay.
    - Installation of a 400kV line reactor at the Mookodi 400kV.
- **Ferrum Substation**
    - Installation of a 100MVAr busbar reactor at the Ferrum 400kV busbar.
    - Construction of a 400kV feeder bay.
    - Installation of a 400kV line reactor at the Ferrum 400kV.

These enhancements are critical for reducing transmission losses, ensuring stability in the electrical grid, and accommodating increased power generation from renewable energy projects in the region.

3 VISUAL IMPACT ASSESSMENT METHODOLOGY

The Visual Impact Assessment (VIA) methodology adheres to the guidance provided in the Gazetted General Requirement Assessment Protocol (Government Gazette No. 43110, 20 March 2020) and Appendix 6 of the EIA Regulations, 2014). It also follows best practices outlined in the "Guideline for involving visual & aesthetic specialists in EIA processes: Edition 1".

3.1 Existing Environmental Values

The methodology to identify and evaluate the existing environmental values of the project area involves the following steps:

3.2 GIS and Aerial Mapping

Geographical Information Systems (GIS) datasets and aerial photography are used to create a visual catchment map. This map defines the areas from which the project can potentially be seen.

3.3 Identification of Viewpoints

Viewpoints accessible to the public or in residential areas are identified using aerial imagery. Key receptors include residents, recreational users, and workers in areas where significant changes may occur.

3.4 Site Verification and Photographic Records

Publicly accessible viewpoints are visited for verification. Photographs are taken to illustrate current views and assess potential visual changes.

3.5 Review of Landscape Characteristics

Planning, land use, and regional landscape characteristics are reviewed to establish a baseline understanding of the area's visual and ecological integrity.

3.6 Impact Assessment

The assessment of visual impacts includes the following components:

- **Landscape Impact-** This assesses the capacity of the landscape to accommodate changes to its physical features due to the introduction of new elements or modification of existing ones.
- **Visual Impact-** Evaluates changes in the view for sensitive receptors, including residents, recreational users, and workers.
- **Cumulative Impacts-** Considers combined impacts of the project alongside existing or foreseeable infrastructure developments.

3.7 Impact Criteria and Rating Scale

The visual impacts are rated in accordance with the Environmental Impact Assessment Regulations, 2014 and the criteria drawn from the IEM Guidelines Series, Guideline 5: Assessment of Alternatives and Impacts, published by the (DEAT, 2006) as well as the Guideline Document on Impact Significance (DEAT, 2002) as listed below.

The key issues identified during the Pre-Feasibility Phase inform the terms of reference of this specialist study. Each issue consists of components that on their own or in combination with each other give rise to potential impacts, either positive or negative, from the project onto the environment or from the environment onto the project. The significance of the potential impacts is considered before and after identified mitigation is implemented, for direct, indirect, and cumulative impacts, in the short and long term.

A description of the nature of the impact, any specific legal requirements and the stage (construction/decommissioning or operation) is given. Impacts are considered to be the same during construction and decommissioning.

The following criteria has been used to evaluate significance:

- **Nature:** This is an appraisal of the type of effect the activity is likely to have on the affected environment. The description includes what is being affected and how. The nature of the impact will be classified as positive or negative, and direct or indirect.
- **Extent and location:** This indicates the spatial area that may be affected

Table 3-1: Impact Assessment Methodology

The impacts are assessed as either having a: negative effect (i.e., at a `cost' to the environment), positive effect (i.e., a `benefit' to the environment), or Neutral effect on the environment.
Extent of the Impact (1) Site (site only), (2) Local (site boundary and immediate surrounds), (3) Regional (within the three local municipalities), (4) National, or (5) International.
Duration of the Impact The length that the impact will last for is described as either: (1) Immediate (<1 year) (2) Short term (1-5 years), (3) Medium term (5-15 years), (4) Long term (ceases after the operational life span of the project), (5) Permanent.
Magnitude of the Impact The intensity or severity of the impacts is indicated as either: (0) None, (2) Minor, (4) Low, (6) Moderate (environmental functions altered but continue), (8) High (environmental functions temporarily cease), or (10) Very high / Unsure (environmental functions permanently cease).
Probability of Occurrence The likelihood of the impact actually occurring is indicated as either: (0) None (the impact will not occur), (1) Improbable (probability very low due to design or experience) (2) Low probability (unlikely to occur), (3) Medium probability (distinct probability that the impact will occur), (4) High probability (most likely to occur), or

(5)	Definite.

Reversibility The degree to which an impact is reversible: (1) Completely reversible (2) Partly reversible (3) Barely reversible (4) Irreversible

3.7.1 Significance of the Impact

This rating is formulated by adding the sum of the numbers assigned to extent (E), duration (D) and magnitude (M) and multiplying this sum by the probability (P) of the impact. S=(E+D+M) P

The significance ratings are given below.

Table 3-2: Legend for Impact Significance

	Significance	Description of Significance
(<30)	Low	The activity will have a low impact in the environment. This impact would not have a direct influence on the decision to develop in the area.
(30-60)	Medium	Medium Impact – the activity will have a medium impact on the environment. The impact could influence the decision to develop in the area unless it is effectively mitigated.
(>60)	High	The activity will have a high impact on the environment. The impact must have an influence on the decision process to develop in the area.

The visual impact will, however, vary when evaluated against the criteria of intensity of visual impact and the significance of the impact.

An example is the situation where a project component such as the sections of the powerline located within a narrow undisturbed valley between two rising landforms. The visual impact's intensity is low since it cannot be seen from surrounding areas. The component has the hillsides as a backdrop and therefore blends into the valley texture. The significance, however, is high within the context of the scenic value of the pristine valley because the sense of place and the character of the valley are severely compromised.

The converse is also true in that a high visual intensity impact can have a low significance. The visual impact assessment will therefore be based on the criteria of intensity and significance relative to land use and the nearness to important viewpoints.

3.8 Legislation and Guidelines considered

In South Africa, there are specific legal requirements for visual impact assessments and, relevant legislative frameworks provide overarching guidance:

- **National Environmental Management Act (NEMA) (Act No. 107 of 1998)**
  - Section 2(4)(ii) emphasizes avoiding pollution and environmental degradation or minimizing and remedying them where unavoidable.
  - Section 2(4)(iii) highlights minimizing the disturbance of landscapes and culturally significant sites.
- **National Heritage Resources Act (NHRA) (Act No. 25 of 1999)**
  - Recognizes landscapes and natural features of cultural significance as part of the National Estate (Section 3(2)(d)).
- **Protected Areas Act (NEMA) (Act 57 of 2003):**
  - Aims to preserve natural landscapes for ecological and cultural heritage protection.
- **Advertising on Roads and Ribbons Act (Act No. 21 of 1940)**
  - Provides limited control over visual pollution related to signage along public roads.
- **Guidelines for Visual and Aesthetic Specialists**
  - The Western Cape DEA&DP's guideline outlines best practices for incorporating visual and aesthetic considerations into EIAs.

These legal and procedural frameworks ensure that visual impacts are assessed with due consideration of sustainable development principles, balancing environmental, social, and cultural factors.

4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are considered in this study:

- **Core Focus on Scenic Areas-** The assessment assumes that scenic wilderness areas and landscapes hold intrinsic eco-tourism and aesthetic value, influencing community perceptions and potential impacts.
- **Demographic Assumptions-** Viewer demographic data is assumed based on general observations. Detailed viewer-specific studies were not conducted; these can be undertaken during the design phase if necessary.

- **Subjectivity in Landscape Evaluation-** Evaluating visual resources involves qualitative standards. Individual perceptions vary due to experiences, cultural background, and social contexts, making absolute determination challenging.
- **Localized Perceptions-** Communities in economically depressed areas may prioritize economic opportunities over visual considerations, potentially influencing responses to visual changes.
- **Viewshed Mapping Limitations-** The viewshed map is computer-generated and may overstate visibility by not accounting for minor landscape interruptions like trees, small buildings, and landforms.
- **Exclusion of Ancillary Infrastructure-** Ancillary components like borrow pits, spoil dumps, and construction camp sites are excluded from this assessment. These should be assessed during detailed design phases.
- **Detailed Mitigation Design-** Site-specific mitigation measures for cut-and-fill slopes are not included; these will be addressed by landscape architects in subsequent project stages.
- **Do-Nothing Alternative-** The 'Do-Nothing' alternative has not been explicitly addressed, as it assumes the continuation of the existing landscape without project influence.

These considerations reflect the inherent complexities in evaluating visual impacts and ensure a balanced approach to the assessment within the study's scope and limitations.

5 DESCRIPTION OF THE AFFERECTED ENVIRONMENT

5.1 Description of the Natural Physical Elements

The natural physical elements within the project area are categorized according to distinct topographical regions (refer to Figure 5-1: Landscape Types). These regions align closely with the vegetation types identified by Low and Rebelo (1996), as these vegetation classifications inherently consider the area's topographical characteristics. The proposed project traverses a single major landscape type and the Savannah biome, showcasing a diverse range of environmental features.

These landscape categorizations are employed solely to delineate the components of the landscape for the purpose of this assessment. They are not intended to substitute for or overlap with findings from flora-specific studies conducted for this project.

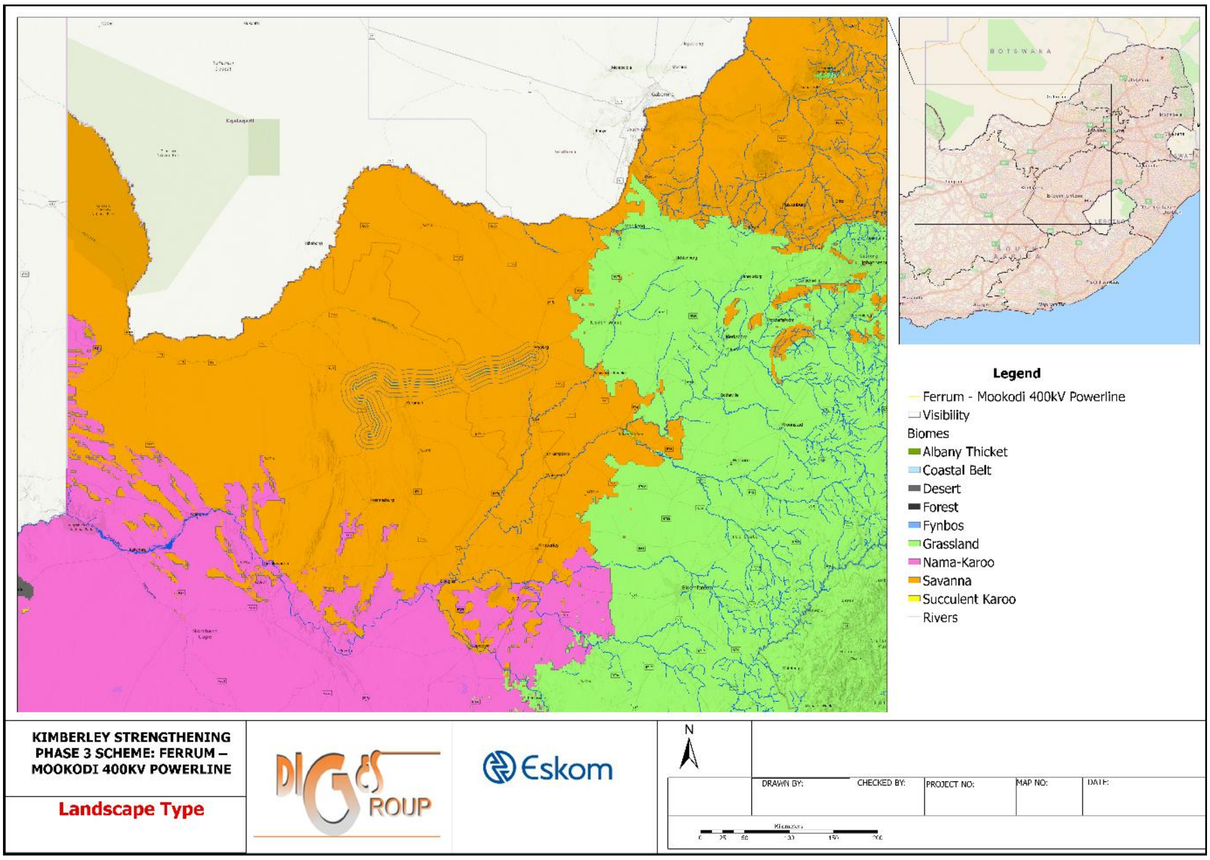


Figure 2: Landscape Types

The natural physical elements of the project site are described in terms of the following categories:

Topology

Refers to the physical form and relief of the land, including variations in elevation, slopes, and terrain features.

Vegetation Cover

Describes the type and density of plant life across the landscape, which contributes to ecological value and aesthetic appeal.

Land Use

Encompasses human activities and modifications to the natural landscape, reflecting the region's socio-economic patterns.

Visibility

Relates to the extent to which features in the landscape can be seen from various viewpoints, influenced by terrain and vegetation.

Landscape Diversity

Highlights the variety of physical and visual elements within the area, contributing to its aesthetic and ecological value.

Landscape Characteristics:

The spirit, or sense of place, is that quality imparted by the aspects of scale, colour, texture, landform, enclosure, and particularly the land use. According to K. Lynch (1992) 'it is 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'.

The quality of Genius Loci is a function of attributes such as the scenic beauty or uniqueness and distinctive character of the built and cultural landscape. The visual quality is the visual significance given to a landscape determined by cultural values and the landscape's intrinsic physical properties (Smardon, et al, 1986). While many factors contribute to a landscape's visual quality, they can ultimately be grouped under three headings: vividness, intactness and unity.

The visual quality can be categorised under relative headings such as high, medium and low visual quality for the study area. High refers to those areas that have a high aesthetic appeal such as mountains, river valleys, unspoilt coastal zones and wilderness areas. The medium areas are those that have high visual diversity, but which have already been modified by human activity comprising the aesthetic appeal such as roads, minor infrastructure and settlements. The low visual quality areas are those that are relatively highly populated and which have been heavily impacted on by human activity such as industrial and mining areas or which have a low aesthetic appeal due to a lack of landscape diversity or interest.

The study area focuses on a 15 km radius around each of the project components.

5.1.1 Implications for the Project Site

Topology

The predominantly flat to gently undulating terrain increases the visibility of the powerline infrastructure across much of the project area. Slight elevation changes, including occasional hills and drainage lines, may create focal points where the infrastructure stands out visually.

The simplicity of the terrain means that there are few natural barriers to obscure the project components, making topographical variations critical in shaping local visual impacts.

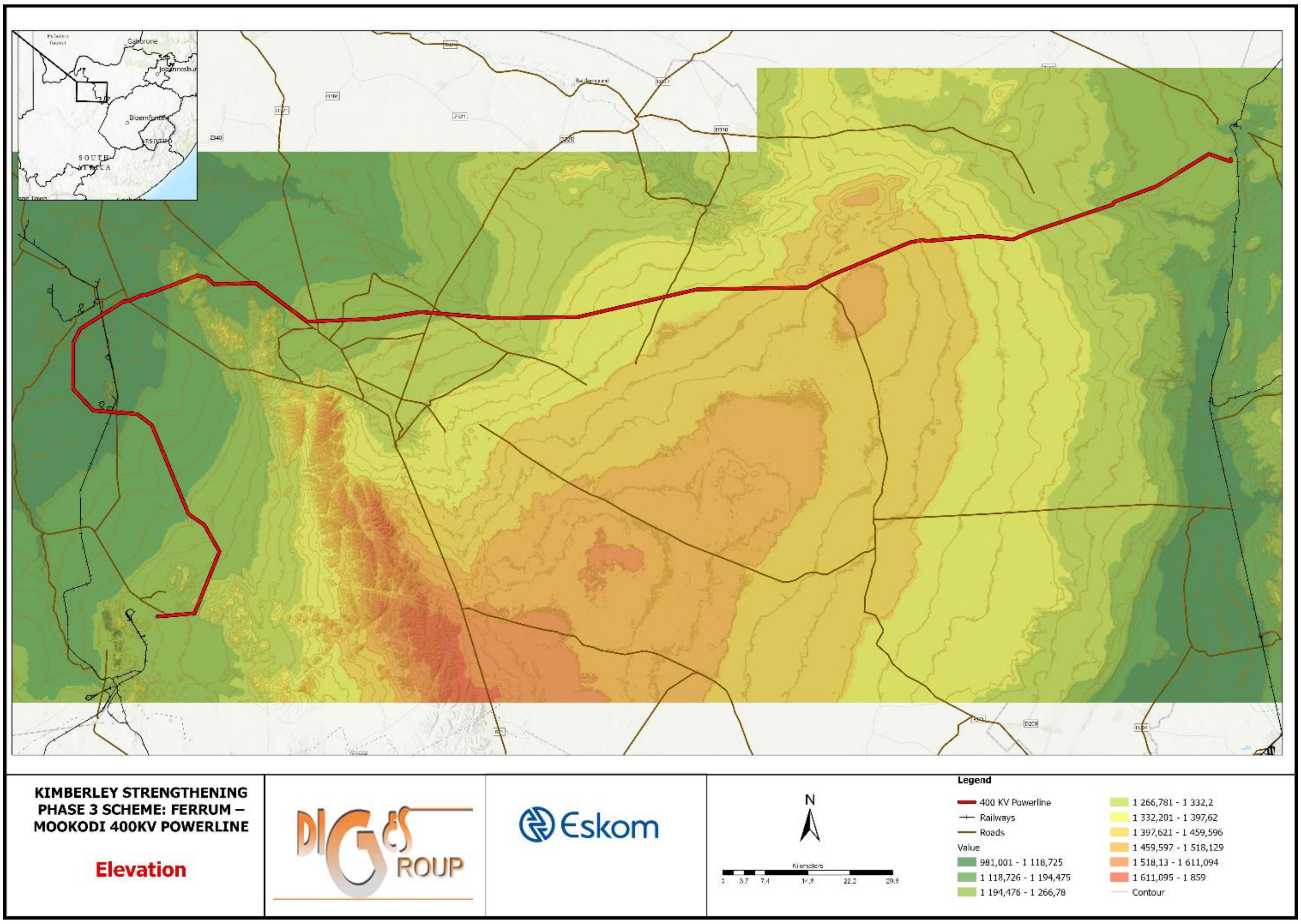


Figure 3: Topographic Map of the areas transverse Ferrum –Mookodi 400kV Powerline

Vegetation Cover

Sparse vegetation in the Northern Cape reduces natural screening, allowing the infrastructure to be highly visible over long distances. In contrast, the slightly denser vegetation in the North West provides limited visual buffering in localized areas.

Vegetation cover influences the integration of the powerline into the landscape. The scattered trees and shrubs characteristic of the savannah biome may soften the visual impact but are insufficient to conceal large-scale infrastructure fully.

Land Use

The rural and agricultural nature of the region means that local residents are accustomed to open landscapes, where changes to the visual environment are more immediately noticeable.

Mining activities in the Northern Cape introduce an industrial character to certain areas, potentially reducing sensitivity to additional infrastructure. However, this does not negate the visual prominence of the powerline in less industrialized zones.

Visibility

The expansive, flat terrain maximizes the visual catchment of the powerline, ensuring that it is visible from numerous vantage points, including roads and settlements.

Key visual receptors include local residents, travellers along regional roads, and workers in agricultural and mining sectors. The infrastructure may alter their perception of the landscape's openness and natural character.

Landscape Diversity

The moderate diversity of the landscape, including grassy plains interspersed with rocky outcrops and drainage features, creates visual interest and a sense of natural balance. The introduction of large-scale infrastructure may disrupt this balance, altering the visual harmony of the area.

The presence of varied landforms amplifies the contrast between natural features and man-made elements, increasing the visual prominence of the powerline in some sections.

Landscape Characteristics

The savannah biome's expansive horizons and tranquil rural character define the visual identity of the area. The introduction of tall, linear infrastructure may fragment this sense of openness and alter the perception of the region as an unspoiled landscape.

The rural character of the site may make the visual changes more pronounced for local communities, who associate the landscape with cultural and natural heritage.

Despite these challenges, careful design and mitigation measures, such as aligning infrastructure with existing features and using non-reflective materials, can help reduce the visual impact.

This analysis underscores the significance of the physical elements in shaping the visual impacts of the project. Their interplay with the proposed infrastructure highlights the need for targeted mitigation strategies to preserve the area's aesthetic and cultural value.

6 THE VISUAL ASSESSMENT

6.1 The Visual Analysis

This section describes the aspects which have been considered in order to determine the intensity of the visual impact on the area. The criteria includes the area from which the project can be seen (the viewshed), the viewing distance, the capacity of the landscape to visually absorb structures and forms placed upon it (the visual absorption capacity), and the appearance of the project from important or critical viewpoints.

6.1.1 The Viewshed

The viewshed is a topographically defined area which includes all possible observation sites from which the project will be visible. The boundary of the viewshed, which connects high points in the landscape, is the boundary of possible visual impact (Alonso, et al, 1986). Local variations in topography and man-made structures would cause local obstruction of views. The viewshed, based on the GIS assessment and fieldwork, extends for the main part from 1 km to greater than 20 km (see figure 6-2).

6.1.1.1 Viewshed Analysis of Ferrum Substation

Figure 6-3 depicts the viewshed of the Ferrum Substation, illustrating the extent of visibility across the surrounding landscape (Figure 6-3). Key viewing distances are highlighted, showcasing areas where the substation's infrastructure is most likely to be visible, considering topography and other visual barriers.

6.1.1.2 Viewshed Analysis of Mookodi Substation

Figure 6-4 illustrates the viewshed of the Mookodi Substation, highlighting the visibility of the substation's infrastructure within key distances. The analysis considers the generally flat terrain and an observer offset of 55 m vertically, indicating that the construction and operation of the substation will be visually prominent across much of the surrounding landscape.

6.1.1.3 Impact Review

The flat terrain of the project area minimizes natural barriers like hills or dense vegetation that could otherwise shield views of the substation. As a result, the infrastructure, including busbar reactors, line reactors, and feeder bays, will stand out against the horizon. This is particularly true when viewed from close distances within 1 km, where the substation infrastructure will dominate the field of vision.

6.1.2 The Viewing Distance

The visual impact of an object in the landscape diminishes at an exponential rate as the distance between the observer and the object increases (Hull and Bishop, 1988). Thus, the visual impact at 1000 metres would be approximately a quarter of the impact as viewed from 500 metres. Consequently, at 2000 metres, it would be one sixteenth of the impact at 500 metres. The view of the project components would appear so small from a distance of 5000 metres or more that the visual impact at this distance is insignificant. On the other hand, the visual impact of the project components from a distance of 500 metres or less would be at its maximum (figure 6-2).

Viewing distance categorizes the proximity of observers to the project components:

- Foreground (0-1 km): The infrastructure will be highly prominent and dominate the visual field.
- Middle ground (1-6 km): The powerline remains visible but integrates moderately with the landscape.
- Background (6+ km): The infrastructure becomes less distinct, blending into the horizon.

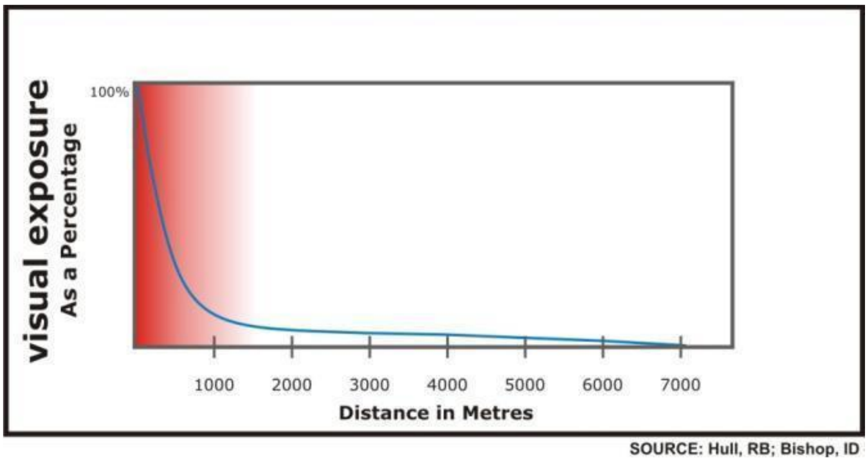


Figure 4: Diagram Illustrating Diminishing Visual Exposure over Distance

6.1.3 Critical Views

Views identified as being critical have been discussed under Section 5. These have been overlaid on the viewshed to determine the extent of these within the viewing zones radiating out from the project components.

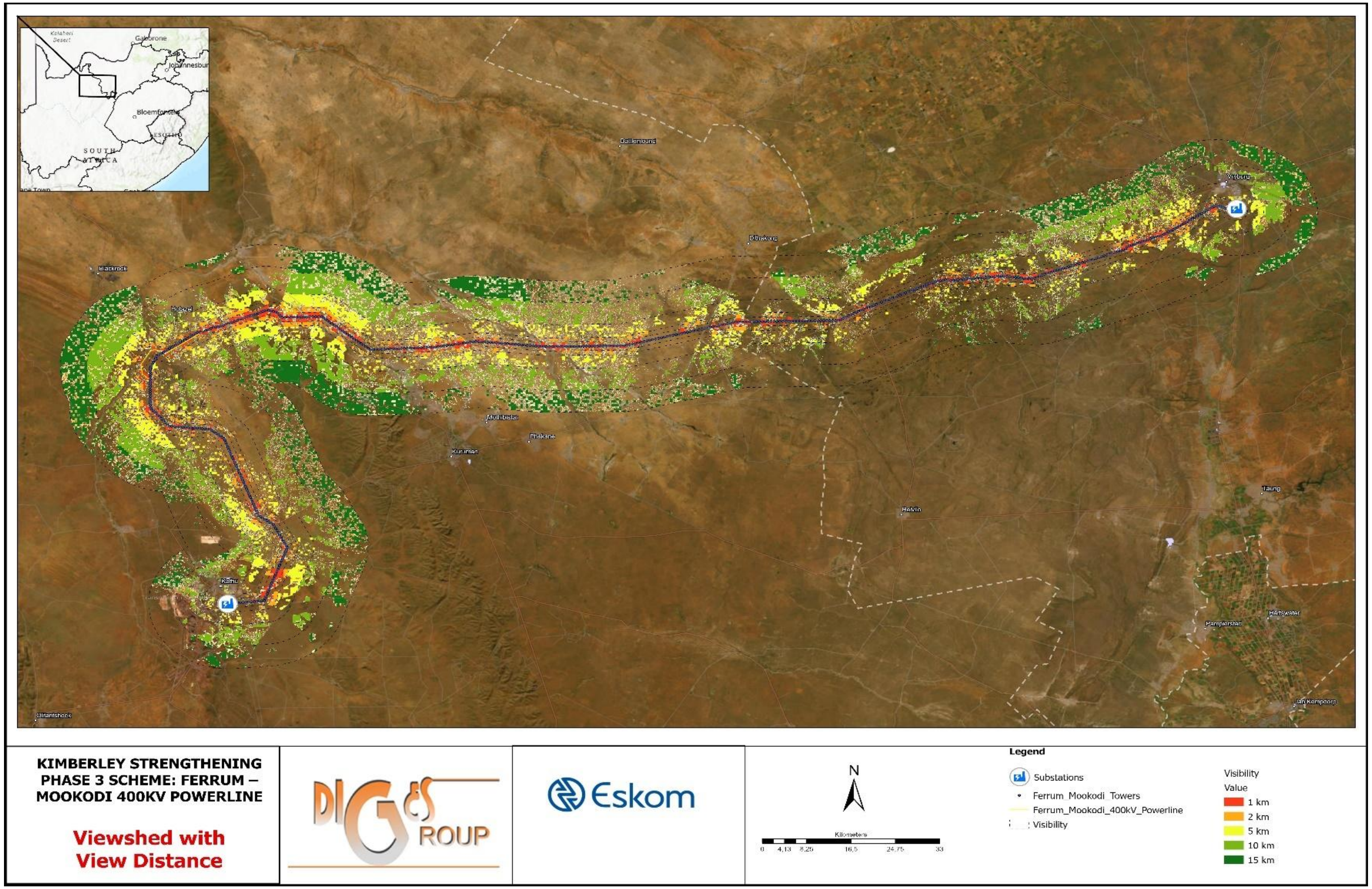


Figure 5: This map illustrates the visibility of the powerline across the landscape, highlighting areas within various viewing distances (1 km to15 km)

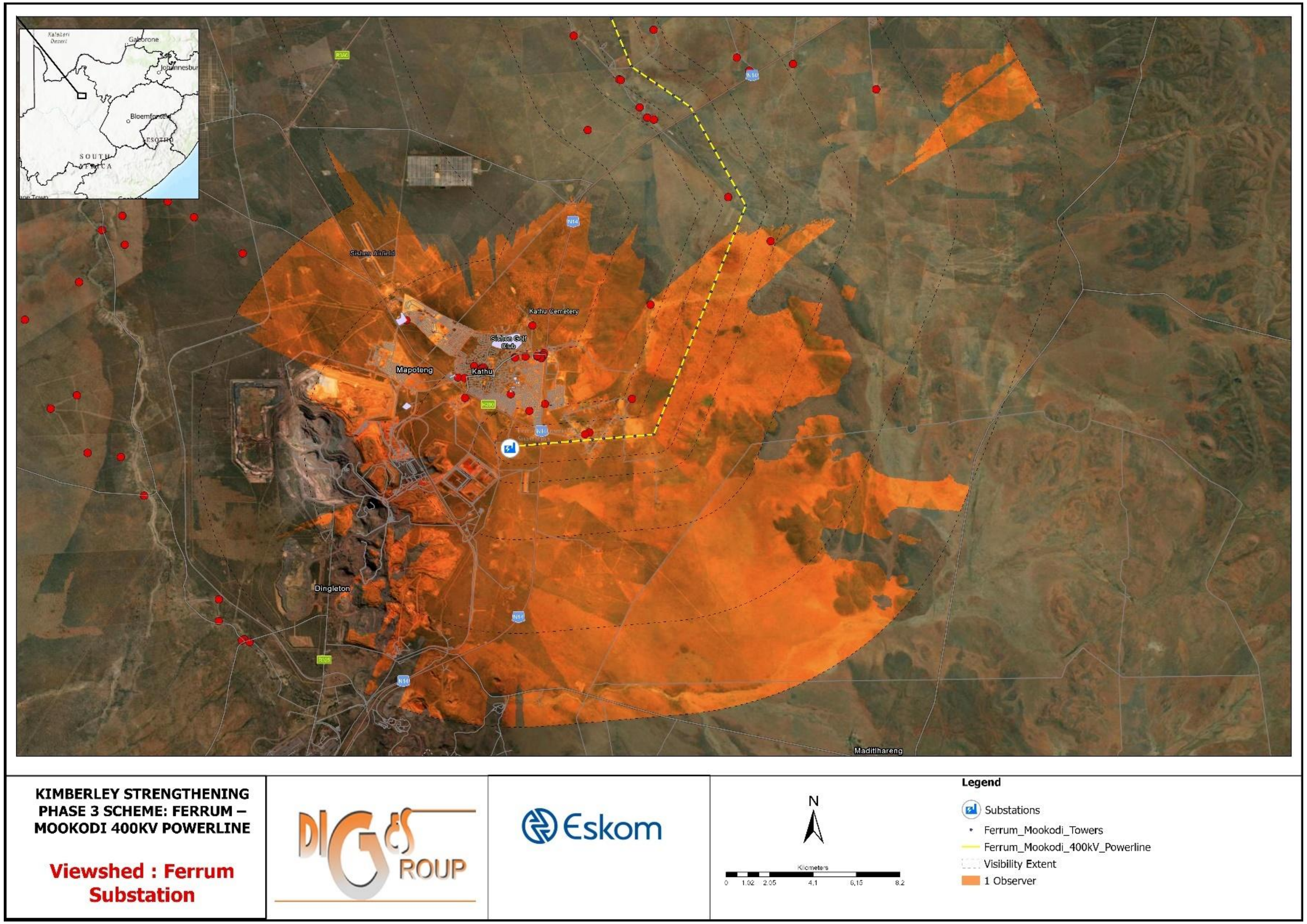


Figure 6: Viewshed Analysis of Ferrum Substation

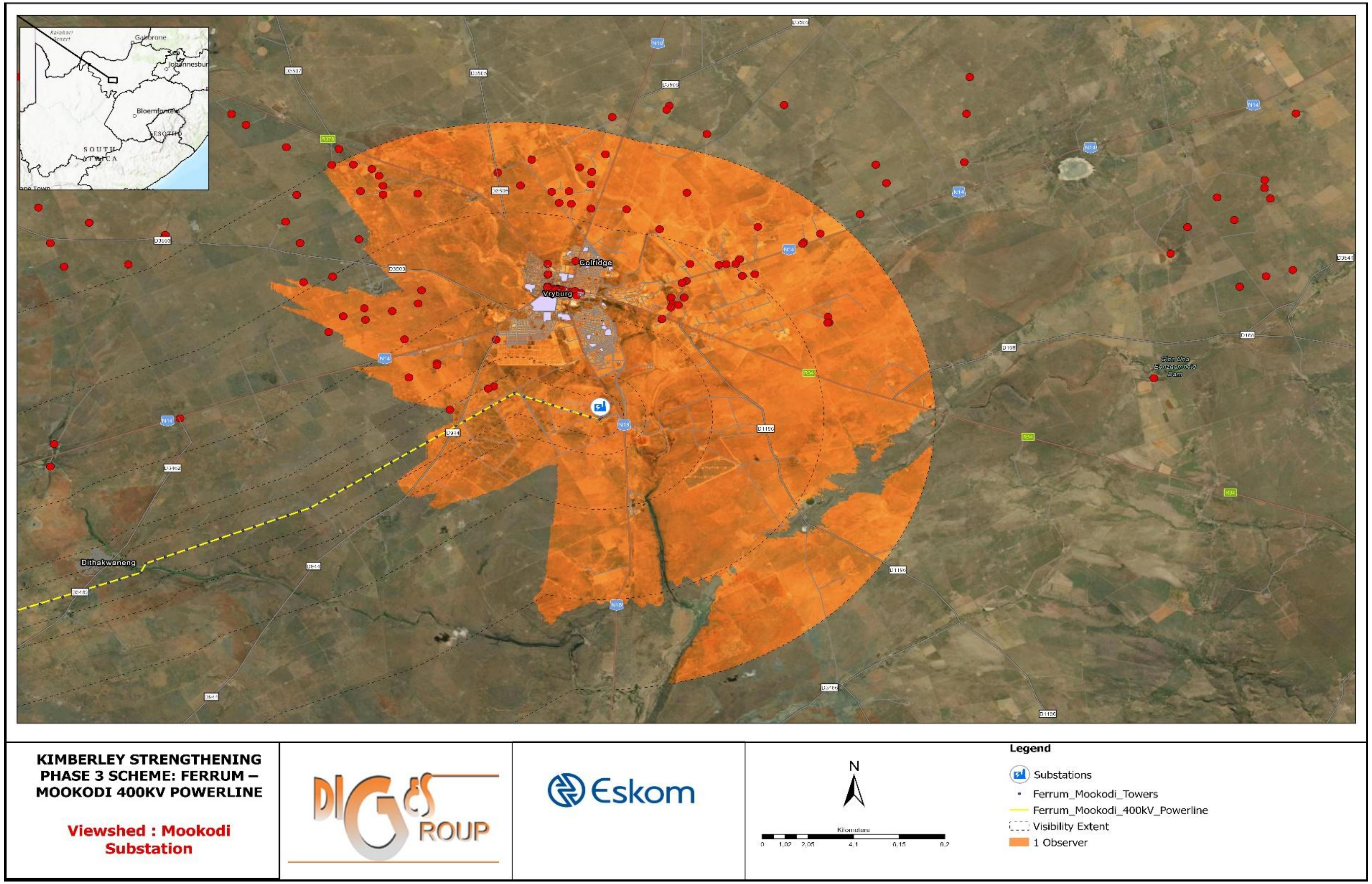


Figure 7: Viewshed Analysis of Mookodi Substation

6.1.4 The Visual Absorption Capacity

The Visual Absorption Capacity (VAC) is a measure of the landscape's ability to visually accept / accommodate or embrace a development. Areas which have a high visual absorption capacity are able to easily accept objects so that their visual impact is less noticeable. Conversely areas with low visual absorption capacity will suffer a higher visual impact from structures imposed on them. In this case the VAC has been defined as a function of three factors. The capacity of the landscape to visually absorb new structures depends on vegetation density, landform complexity, and existing infrastructure.

The VAC was determined based on field experience, taking into account the following:

- Slope
- Visual Pattern with regard to vegetation and structures
- Vegetation height

Table 6-1: Visual Absorption Capacity Factors

VAC Factor		Categories		
Slope	Range Numeric Value VAC	0-3 % 3 Low	3-6 % 2 Moderate	> 6 % 1 High
Vegetation Height	Range Numeric Value VAC	VAC < 1 m 3 Low	1-6 m 2 Moderate	>6 m 1 High
Visual Pattern	Description Numeric Value VAC	Uniform 3 Low	Moderate 2 Moderate	Diverse 1 High

It is therefore concluded that the VAC can be regarded as:

It has a combined rating of 9 which equates with a **Low VAC** due to the open landscape and grassland. Areas within the deeper valleys have a moderate VAC due the steep topography.

This implies that the areas with a **Low** VAC are inherently unable to visually accommodate or accept the visual change made by the proposed development.

The Visual Assessment Criteria (intensity, significance and intensity ratings) are specified in **Tables 6-2** to **6-4**.

Table 6-2: Visual Assessment Criteria -Intensity Rating

Visual Assessment Criteria	Intensity Rating		
	High	**Medium**	**Low**
Visibility from critical viewpoints	Highly visible within 1 km	Partially visible due to viewpoints approximately 2 km from the proposed development	Low visibility due to viewpoints approximately 3 km or more from the proposed development
Visibility from general surrounding landscape	Not obscured by natural landform	Partially obscured by landform	Mostly obscured by surrounding landform
Visual intrusion on landscape character and sense of place	Dominates sense of place	Partially influences sense of place	Has little effect on sense of place
Visual association with existing infrastructure development	Existing development is easily visible from proposed development (within 2 km)	Existing development is partially visible from proposed development (>2-<5 km)	Existing development is barely noticeable (>6 km) from the proposed development
Visibility from homesteads, conservation areas, local communities, villages and towns	Highly visible. dominates view within 500 - 1 000 m	Visible but does not dominate view within range 1 000 - 2 500 m	Visible but are not obviously noticeable in the view > 2 500 m

Table 6-3: Visual Assessment Criteria - Significance Rating

Visual Assessment Criteria	**Significance Rating**		
	High	**Medium**	**Low**
Visibility from existing viewpoints	Particularly interferes with scenic views from viewpoints	Partially interferes with scenic views from viewpoints	Components are too far from the viewpoints to interfere with scenic views
Visibility from general surrounding landscape	Compromises particularly scenic distant views of the landscapes	Particularly noticeable in scenic landscapes	Hardly noticeable in scenic landscapes
Visual intrusion on landscape character and sense of place	Compromises proclaimed conservation nature reserves and wilderness areas is within 500 - 1 000 m of a natural feature e.g. pans, mountains	Compromises particularly scenic landscape features e.g. coastal edge, undisturbed valleys; within 1 000 - 2 500 m	Compromises built up areas which exhibit an industrial character; is less visible, homestead greater than 2 500 m away

Visual association with existing infrastructure development	Where the development is within 200 m from existing Infrastructure development	Where the development is within 1 000 m from existing Infrastructure development	Where the development is further than 2 500 km from existing development. The visual intrusion is not associated with the other development
Visibility from homesteads, conservation areas, local communities, villages and towns	Where the visibility of the development interferes with the way of life such as a tourism enterprise and/or obstructs scenic distant views by being within 500 - 1000 m of the community	Where the visibility of the development interferes with the way of life such as a tourism enterprise and/or obstructs scenic distant views by being within 1 000 - 2500 m of the homestead	Where the visibility of the development interferes with the way of life such as a tourism enterprise and/or obstructs scenic distant views by being within 2 500m and greater of the homestead

Table 6-4: Visual Assessment Criteria - Intensity Rating

CRITERIA	HIGH	MEDIUM	LOW
Visibility	Very visible from many places beyond 5 000 m zone.	Visible from within the 5 000 m zone but partially obscured by intervening objects.	Only partly visible within the 5 000 m zone and beyond due to screening by intervening objects.
Genius Loci / Sense of Place	A particularly definite place with an almost tangible dominant ambience or theme.	A place which projects a loosely defined theme or ambience.	A place having little or no ambience with which it can be associated.
Visual Quality	A very attractive setting with great variation and interest but no clutter.	A setting which has some aesthetic and visual merit.	A setting which has little aesthetic value.
Visible Social Structures	Housing and/or other structures as a dominant visual element.	Housing and/or other structures as a partial visual element.	Housing and/or other structures as a minor visual element.
Surrounding Landscape Compatibility	Ideally suits or matches the proposed development.	Can accommodate the proposed development without appearing totally out of place.	Cannot accommodate proposed development without it appearing totally out of place visually.
Character	The site or surrounding area exhibits a definite character.	The site or surrounding area exhibits some character.	The site or surrounding area exhibits little or no character.
Scale	A landscape which has horizontal and vertical elements in	A landscape with some horizontal and vertical elements in	Where vertical variation is limited, and most elements

	high contrast to the human scale.	some contrast to the human scale.	are related to the human and horizontal scale.
Visual Absorption Capacity (VAC)	The ability of the landscape to easily accept visually a particular development because of its diverse landform, vegetation and texture.	The ability of the landscape to less easily accepts visually a particular development because of a less diverse landform, texture and vegetation.	The ability of the landscape not to visually accept a proposed development because of a uniform texture, flat slope and limited vegetation cover.
View Distance	If uninterrupted view distances to the site are > 5 km.	If uninterrupted view distances are < 5 km but > 2.5 km.	If uninterrupted view distances are > 500 m and < 2 500 m.
Critical Views	Views of the project are to be seen by many people passing on main roads and from prominent areas i.e. towns / urban areas / settlements, game farms, guest farms / lodges, hiking corridors, conservation areas, naturally scenic areas.	Some views of the project from surrounding towns / urban areas / settlements, main roads and game farms / lodges / conservation areas, naturally scenic areas.	Limited views to the project from towns / urban areas / settlements, main roads and game farms / lodges / conservation areas, naturally scenic areas.

6.1.5 Cumulative Impacts

The visual impacts of the proposed development have been evaluated based on its effect on the visual environment. Visual assessment, as a component of human aesthetics, is one of several social impacts—such as noise and sense of place—that collectively contribute to cumulative impacts. However, this study focuses solely on visual impacts.

Since the proposed development is situated on rural agricultural land in a "greenfields" area, there are minimal cumulative impacts from adding to an existing development network within the site boundaries. On the other hand, one could argue for a 100% cumulative impact, as the project introduces an entirely new development in a previously undeveloped area.

Visually, the development connects to external elements such as Eskom transmission lines, existing villages, roads, and agricultural lands surrounding and intersecting the site. While this connection increases the cumulative impact, it cannot be quantified empirically. Nonetheless, it is generally understood that visual impacts diminish exponentially with distance, whereas doubling the size or scale of a development may amplify its impact disproportionately.

Despite this increase in cumulative impact, placing new structures alongside existing ones is often preferable. Such areas are already disturbed, and the overall impact is likely to be less significant than introducing similar structures into untouched landscapes.

7 IMPACT ASSESSMENT FOR FERRUM – MOOKODI 400KV POWERLINELINE

7.1 Impact assessment and rating

Table 7-1: Impact assessment and rating for the Ferrum -Mookodi 400kV Powerline

Nature: The construction and presence of the powerline and associated infrastructure directly alter the natural landscape's visual integrity. The powerline's prominence in the landscape, especially in areas of high scenic or cultural value, can erode the unique sense of place associated with the region.		
Activity: • Clearing vegetation along the route for access roads, tower sites, and workspaces. • Possible grading or excavation in rocky or uneven terrains. • Digging foundations for pylons. • Transporting and installing steel towers using cranes and heavy machinery • Setting up temporary staging areas for construction materials and equipment. • Constructing temporary or permanent access roads to remote sections of the route. • Installing conductor cables between towers, requiring extended work zones • Any activities within the delineated watercourse		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Highly Probability (4)	Medium Probability (3)
Duration	Medium term (2)	Short term (2)
Extent	Regional (3)	Regional (3)
Intensity	Moderate (6)	Moderate (4)
Significance	44 (Medium)	27 (Low)
Status (positive or Negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	High Probability (4)	Medium Probability (3)
Duration	Long term (4)	Long term (4)
Extent	Regional (3)	Local (2)
intensity	High (8)	Moderate (6)
Significance	60 (Medium)	36 (Medium)
Status (positive or Negative)	Negative	Negative
Reversibility	Partly Reversible	Partly Reversible
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation: • Restrict clearing to only essential areas. • Rehabilitate disturbed areas post-construction with native vegetation. • Consolidate storage areas and use natural topography to conceal machinery where feasible. • Use colour-coordinated materials to blend temporary structures with the environment. • Use directional or shielded lighting to minimize visual impact in dark-sky areas. • Ensure all temporary structures, camps, and equipment are removed promptly post-construction.
Cumulative impacts: The cumulative impacts of the Ferrum–Mookodi 400kV Powerline from construction and operations are **medium** in significance. Construction causes temporary disturbances, while operations result in permanent visual and ecological changes. In areas with existing infrastructure, these impacts may intensify landscape fragmentation. However, effective mitigation reduces the overall impact, ensuring it remains notable but manageable

8 IMPACT ASSESSMENT FOR SUBSTATION UPGRADES OF THE FERRUM SUBSTATION

8.1 Ferrum Substation Upgrades

Table 8-1: impact assessment and rating of the upgrades of the Ferrum substation

Nature: The construction and upgrades of the Ferrum Substation and associated infrastructure directly affect the visual integrity of the surrounding landscape. The substation's expanded footprint, with additional high-voltage equipment and supporting structures, introduces prominent vertical and industrial elements. In areas with high scenic or cultural value, this infrastructure can diminish the unique sense of place and alter the natural aesthetic character of the region.		
Activity: • Site preparation, including clearing vegetation and levelling land. • Transport of materials, machinery, and equipment to the site. • Installation of the 100MVAr busbar reactor, 400kV feeder bay, and 400kV line reactor. • Construction of support infrastructure, such as access roads and drainage systems. • Increased workforce presence and temporary facilities on-site. • Commissioning and testing of the new equipment. • Regular maintenance and inspection of installed equipment. • Periodic servicing and repair of infrastructure. • Monitoring of equipment performance. • Increased energy capacity transmission through the substation.		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	High Probability (4)	Medium Probability (3)

Duration	Short term (2)	Short term (2)
Extent	Local (2)	Local (2)
Intensity	Moderate (6)	Low (4)
Significance	40 (Medium)	24 (Low)
Status (positive or Negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Definite (5)	Medium Probability (3)
Duration	Long term (4)	Long term (4)
Extent	Regional (3)	Regional (3)
intensity	High (8)	Moderate (6)
Significance	75 (high)	39 (Medium)
Status (positive or Negative)	Negative	Negative
Reversibility	Partly Reversible	Partly Reversible
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

- Limit vegetation clearance to essential areas.
- Screen active construction sites using temporary barriers.
- Restore disturbed areas with indigenous vegetation post-construction.
- Design substation elements to blend with the surrounding landscape using neutral, non-reflective materials.
- Establish a buffer zone with indigenous vegetation to minimize visual intrusion.
- Implement lighting systems that minimize light pollution and glare.

Cumulative impacts: The cumulative impacts are **medium** in significance. During construction, temporary disturbances such as machinery movement, and dust generation contribute to noticeable changes. In contrast, operations result in permanent visual due to the substation's presence and the powerline's prominence in the landscape. In areas where existing infrastructure is already present, these impacts amplify landscape fragmentation and diminish the area's natural character. Nevertheless, effective mitigation measures, including vegetation restoration, site screening, and infrastructure design, help reduce the overall impact, ensuring it remains notable but manageable over time.

9 IMPACT ASSESSMENT FOR SUBSTATION UPGRADES OF THE MOOKODI SUBSTATION

9.1 Mookodi Substation Upgrades

Table 9-1: Impact assessment and rating of the Mookodi substation upgrades.

Nature: The construction and upgrades of the Mookodi Substation and associated infrastructure directly affect the visual integrity of the surrounding landscape. The substation's expanded footprint, with additional high-voltage equipment and supporting structures, introduces prominent vertical and industrial elements. In areas with high scenic or cultural value, this infrastructure can diminish the unique sense of place and alter the natural aesthetic character of the region. The construction phase involves site preparation, equipment delivery, installation, and commissioning. During operations, the infrastructure will remain functional and visible, contributing to the region's energy stability.		
Activity: • Site preparation, including clearing vegetation and levelling land. • Transport of materials, machinery, and equipment to the site. • Installation of the 100MVAr busbar reactor, 400kV feeder bay, and 400kV line reactor. • Construction of support infrastructure, such as access roads and drainage systems. • Increased workforce presence and temporary facilities on-site. • Commissioning and testing of the new equipment. • Regular maintenance and inspection of installed equipment. • Periodic servicing and repair of infrastructure. • Monitoring of equipment performance. • Increased energy capacity transmission through the substation.		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	High Probability (4)	Medium Probability (3)
Duration	Short term (2)	Short term (2)
Extent	Local (2)	Local (2)
Intensity	Moderate (6)	Low (4)
Significance	40 (Medium)	24 (Low)
Status (positive or Negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Definite (5)	Medium Probability (3)
Duration	Long term (4)	Long term (4)
Extent	Local (2)	Local (2)
intensity	Medium (6)	Moderate (6)
Significance	60 (Medium)	36 (Medium)

Status (positive or Negative)	Negative	Negative
Reversibility	Partly Reversible	Partly Reversible
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	
Mitigation: • Minimize vegetation clearing and rehabilitate disturbed areas. • Implement dust suppression and noise control measures. • Limit construction activities to working hours. • Use natural colours and finishes to reduce visual intrusion. • Screen the substation with indigenous vegetation. • Monitor and maintain the surrounding environment to prevent degradation		
Cumulative impacts: The cumulative impacts of the Mookodi Substation upgrades during construction and operations are **medium** in significance. Construction creates temporary disturbances, while operations result in long-term visual changes. These impacts can exacerbate landscape fragmentation in areas with existing infrastructure. However, effective mitigation ensures that the impacts remain notable but manageable, supporting the region's energy demands while preserving its visual integrity		

10 IMPACT STATEMENT

10.1 The Visual Impact

The construction and presence of the Ferrum–Mookodi 400kV Powerline, along with the Ferrum and Mookodi substation upgrades, significantly influence the landscape's visual integrity. The powerline's linear nature and the substation infrastructure introduce industrial elements to areas that may have scenic, rural, or cultural value. These alterations disrupt the visual harmony of the environment. The extent of this impact depends on factors such as viewing distance, the surrounding landscape's visual absorption capacity, and subjective perceptions of the local community. While some residents might perceive the development as a symbol of progress, others may view it as a negative transformation of the natural landscape.

10.1.1 The View Distance

The visibility of the powerline and substations decreases exponentially with distance. The highest visual impact occurs within 1,000 meters of the infrastructure, particularly where the powerline crosses open or elevated landscapes. While some project components may theoretically be visible beyond 10 kilometers, most views are restricted to within 5 kilometers due to topographical barriers.

10.1.2 Critical Viewpoints

Key viewpoints include major roads, nearby towns, villages, and open landscapes with unobstructed sightlines to the powerline and substations. Public spaces that rely on aesthetic value will experience higher sensitivity to visual impacts, making them critical viewpoints.

10.1.3 Extent

The visual impact of construction activities is regional, affecting broad areas due to the movement of equipment, the clearing of vegetation, and temporary structures. During operations, the impact becomes localized, with the powerline and substations visible within a 10-kilometer radius under normal conditions.

10.1.4 Duration

The construction phase's visual impact is temporary, lasting only for the duration of the activities and subsequent rehabilitation efforts. However, the operational phase introduces a permanent visual impact as the powerline and substations will remain visible for the infrastructure’s lifespan.

10.1.5 Intensity or Severity

The intensity of the visual impact is highest within 500–1,000 meters of the powerline and substations, particularly in critical viewpoints. Despite its prominence in these zones, the impact is unlikely to disrupt major ecological or community systems.

10.1.6 Frequency of Occurrence

The visual impact is continuous during the operational phase due to the permanent presence of the powerline and substation infrastructure. During construction, the impact is temporary but occurs daily, coinciding with work activities.

10.1.7 Probability of Occurrence

The visual impact is certain during both construction and operation due to the scale and nature of the infrastructure.

10.1.8 Reversibility

The visual impact is partially reversible. Rehabilitation efforts, including vegetation restoration, can reduce the impact in construction zones. However, the permanent presence of the powerline and substations limits full reversibility.

10.1.9 Irreplaceable Loss of Resources

The construction and operation phases result in a medium level of irreplaceable resource loss, primarily affecting natural vegetation, topsoil, and the visual integrity of the landscape.

10.1.10 Consequence

The consequence of the visual impact is considered **medium**, given its prominence in the immediate vicinity and mitigation efforts to integrate infrastructure into the environment.

10.1.11 Significance

The overall significance of the visual impact is medium-low during construction, owing to its temporary nature, and medium during operations due to the powerline and substations' long-term visibility.

10.1.12 Nature of the Impact

The visual impact is predominantly negative during both construction and operation. The industrial infrastructure conflicts with the natural or rural landscape, particularly in areas of scenic or cultural value.

10.1.13 Degree of Confidence in Predictions

The degree of confidence in these visual impact predictions is **medium**, relying on established methodologies, field observations, and professional judgment.

11 RECOMMENDATIONS AND CONCLUSION

11.1 Recommendations

To mitigate the visual impacts associated with the Ferrum–Hotazel–Mookodi 400kV Powerline and the upgrades to the Ferrum and Mookodi substations, the following recommendations are aligned with the principles of visual impact management:

1. **Landscape Integration**

    - Design the substations and powerline structures to minimize contrast with the surrounding environment by using neutral, non-reflective colours and materials that blend with the natural landscape.

    - Position infrastructure to follow natural topographic lines and avoid prominent ridgelines or highly visible areas.

2. **Vegetative Screening**

    - Establish vegetative buffers with indigenous plant species around substations and along critical sections of the powerline to obscure structures and reduce visibility from key viewpoints.

- Maintain and restore natural vegetation in disturbed areas to enhance visual absorption capacity and reduce the visual footprint of the development.

3. **Viewshed Consideration**

- Avoid locating infrastructure in areas with high visual sensitivity, such as near cultural or scenic landmarks, where the visual integrity is critical.

- Perform site-specific analyses to identify less intrusive locations and adjust alignments accordingly.

4. **Construction Phase Mitigation**

- Ensure temporary structures, materials, and equipment are placed out of sight from public areas and removed immediately after use.
- Limit construction activities to defined areas and avoid unnecessary clearing of vegetation.

5. **Lighting Management**

- Install downward-directed and shielded lighting to reduce light pollution during operational phases, particularly at substations.

- Use motion-sensitive lighting to minimize nighttime visual intrusion.

6. **Stakeholder Collaboration**

- Engage with local stakeholders to incorporate their concerns into the visual mitigation strategies, especially in areas of high cultural or aesthetic value.

- Provide visual simulations and renderings to communicate the expected visual impact and proposed mitigation measures effectively.

7. **Monitoring and Adaptation**

- Implement regular visual impact monitoring during both construction and operation phases to ensure the effectiveness of mitigation measures.
- Adapt mitigation measures based on monitoring results and feedback from stakeholders.

8. 10.2 Conclusion

The Ferrum–Mookodi 400kV Powerline and associated substation upgrades will inevitably alter the visual character of the landscape, particularly in areas of high visual sensitivity. The visual impact is expected to be most pronounced within 1,000 meters of the infrastructure, with diminishing significance beyond 10 kilometers. Without mitigation, these impacts could detract from the natural landscape's aesthetic value and affect the local sense of place.

However, with the implementation of the recommended measures, the visual impact can be reduced to **medium-low significance** during operations and **low significance** after construction rehabilitation. These recommendations, coupled with ongoing stakeholder engagement and environmental monitoring, aim to balance infrastructure development with preserving the region's visual and cultural integrity.

12 REFERENCES

1. Bishop, I. D., & Hulse, D. W. (1994). Prediction of scenic beauty using mapped data and geographic information systems. Landscape and Urban Planning, 30(1-2), 59-70.
2. McCool, S. F., & Stankey, G. H. (1986). Visitor perceptions of wilderness: Implications for wilderness management. Journal of Forestry, 84(1), 30-33.
3. Hull, R. B., & Bishop, I. D. (1988). Scenic impacts of electricity transmission towers: The influence of landscape type and observer distance. Journal of Environmental Management, 27(1), 99-108.
4. Visual Resource Management (VRM) Guidelines. (2013). Bureau of Land Management (BLM), U.S. Department of the Interior.
5. Swanwick, C. (2002). Landscape Character Assessment: Guidance for England and Scotland. Countryside Agency and Scottish Natural Heritage.
6. Smardon, R. C. (1988). Visual impact assessment for transportation projects. Landscape and Urban Planning, 15(1-2), 141-157.
7. Sutherland, W. J., et al. (2006). The identification of priority research questions for the conservation of biological diversity. Journal of Applied Ecology, 43(3), 617-627.
8. Wind Energy Development: A Guide to Visual Impact Assessment (WEG). (2014). Renewable Energy Systems Ltd.
9. Landscape and Visual Impact Assessment (LVIA). (2013). Guidelines for Landscape and Visual Impact Assessment, 3rd Edition. Landscape Institute and Institute of Environmental Management and Assessment (IEMA).
10. Bell, S. (1999). Landscape: Pattern, Perception, and Process. Taylor & Francis.
11. Gobster, P. H., et al. (2007). The shared landscape: What does aesthetics have to do with ecology? Landscape Ecology, 22(7), 959-972.
12. Federal Highway Administration (FHWA). (1981). Visual Impact Assessment for Highway Projects. U.S. Department of Transportation.
13. Punter, J. V. (1991). Participation in the design of urban space. Landscape Design, 200, 24-27.
14. Otero, L., et al. (2014). Aesthetic and perceptual evaluation of wind energy infrastructure: An analysis of its visual impact on the landscape. Energy Policy, 65, 233-241.
15. National Environmental Management Act (NEMA). (1998). South African Government.
16. Scott, D., & Canter, L. W. (1997). Environmental Impact Assessment for the Transmission Line Industry. Environmental Impact Assessment Review, 17(1), 67-84.
17. Swanwick, C., & Land Use Consultants. (2004). Visual and sensory impact assessment guidance. Countryside Commission for Wales.

18. Tyrväinen, L., & Miettinen, A. (2000). Property prices and urban forest amenities. Journal of Environmental Economics and Management, 39(2), 205-223.
19. Viewpoint Management and Mitigation. (2009). Institute of Environmental Assessment (IEA) Guidelines.
20. Environmental Systems Research Institute (ESRI). (2020). Using GIS to Support Landscape and Visual Impact Assessment. ESRI White Papers.

APPENDIX 1 SITE PHOTOS

Figure 8: Mookodi Substation

Figure 9: Access tracks within the farms and distribution lines

Figure 10: Some sections are characterised by grassland with scattered trees

Figure 11: The N14

Figure 12: Sishen mine dumps viewed at a distance of approximately 5km from within the study area, just south of the town of Kathu (Smit, 2021)

Figure 13: The Kuruman Mountains, with a view of the road and associated infrastructure. Note shrubland vegetation and rocky red soil

Figure 14: Areas surrounding the Ferrum substation

APPENDIX 2 CV