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Gumeni Bosloop 132kV powerline visual impact study

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None

GLOSSARY

Aesthetics	Relates to the pleasurable characteristics of a physical environment as perceived through the five senses of sight, sound, smell, taste, and touch.
Adverse visual impact	Any modification in land forms, water bodies, vegetation or any introduction of structures which negatively impacts the visual character of the landscape and disrupts the harmony of the basic elements (i.e. form, line, colour and texture).
Basic elements	The four design elements (form, line, colour and texture) which determine how the character of a landscape is perceived.
Contrast	Opposition or unlikeness of different forms, lines, colours or textures in a landscape and therefore the degree to which project components visually differs from its landscape setting.
Form	The mass or shape of an object(s) which appears unified, such as a vegetative opening in a forest, a cliff formation or a water tank.
Integration	The degree to which a development component can be blended into the existing landscape without necessarily being screened from view.
Key viewing locations	One or more points on a travel route, use area or a potential use area, where the view of a management activity would be most revealing.
Landscape character	The arrangement of a particular landscape as formed by the variety and intensity of the landscape features and the four basic elements of form, line, colour and texture. These factors give the area a distinctive quality which distinguishes it from its immediate surroundings.
Landscape features	The land and water form, vegetation and structures which compose the characteristic landscape.
Line	The path (real or imagined) that the eye follows when perceiving abrupt differences in form, colour or texture. Within landscapes, lines may be found as ridges, skylines, structures, changes in vegetative types or individual trees and branches.
Mitigation measures	Methods or procedures designed to reduce or lessen the adverse impacts caused by management activities.
Rehabilitation	A management alternative and/or practice which restores landscapes to a desired scenic quality.
Scale	The proportionate size relationship between an object and the surroundings in which the object is placed.
Texture	The visual manifestations of the interplay of light and shadow created by the variations in the surface of an object or landscape.
Visual modification	A measure of the visual interaction between a development and the landscape setting within which it is located.
View-shed	The creation of a computer generated probable view-shed to define the extent to which the planned infrastructure is visible from key viewing locations.
Visual Sensitivity	The degree to which a change to the landscape will be perceived in an adverse way.
Visual Impact	A measure of joint consideration of both visual sensitivity and visual modification.
Anthropometric data:	Refers to data related to the systematic study of the measurement of humans.
Photomontage	The process and result of making a composite photograph by cutting and joining a number of other photographs. The composite picture was sometimes photographed so that the final image is converted back into a seamless photographic print.

1 INTRODUCTION

1.1 Background

Visual, scenic and cultural components of the environment can be seen as a resource and, similar to any other resource (which has a value to individuals), can add significant value to both the society and economy of a region. In addition, this resource may have a scarcity value, be easily degraded and is often irreplaceable.

The manner in which the built environment is developed has an immense impact on the intrinsic and systemic value of that environment. Thus developmental integrity is determined by the level of sensitivity practiced in integrating development into the environment in which it is to be located.

An iterative design approach enables the site planning and detailed design of a development project to be informed by and respond to the ongoing environmental impact assessment, as the environmental constraints and opportunities are taken into consideration at each stage of decision making. Visual impact assessments are an important part of an iterative design process, because it can help to avoid or minimise potential negative effects of a development and, where appropriate, can also help in seeking opportunities for landscape enhancement.

The study area is located in the Mpumalanga Province, approximately 12km south from Machadodorp, in a area located between the R36 and R541 roads (Figure 1).

The following components are included as part of this visual assessment:

- The creation of a computer generated view-shed to define the extent to which the planned infrastructure is visible from key viewing locations.
- A site inspection to identify the view-shed for the planned activities and potentially sensitive viewing locations within the vicinity.
- Characterisation of the existing visual landscape in terms of topography, existing land use and vegetation.
- Assessment of the potential visual impacts of the planned activities on sensitive receptors.
- Development of mitigation and management measures.

1.2 Existing operations

Eskom Distribution infrastructure already exists in the area.

1.3 The Project

This visual impact assessment (VIA) evaluates the potential visual impact of the following planned infrastructure:

- The establishment of a new 132Kv line between the Gumeni and Bosloop substations. Three alignments are being considered by Eskom and will be evaluated during the VIA process to determine the best environmentally practicable site (Figure 1).

1.4 Description of the Project surrounds

The project area is located in Mpumalanga Province, approximately 12km south from Machadodorp. Two main roads (R36 & R541) provide general access to the project area and access to the proposed sites are by secondary roads and minor dirt roads (Figure 1). The three alignments being considered fall predominantly within a rural area characterised by large open grassland areas and bush clumps (Figure 4 & 5).

1.5 Objectives of the Visual Assessment

This technical report is a visual assessment of the potential impacts of the planned infrastructure on the existing landscape and values of the area. The report identifies the visual character of the existing landscape, as well as the planned infrastructure.

Figure 1: Locality Map

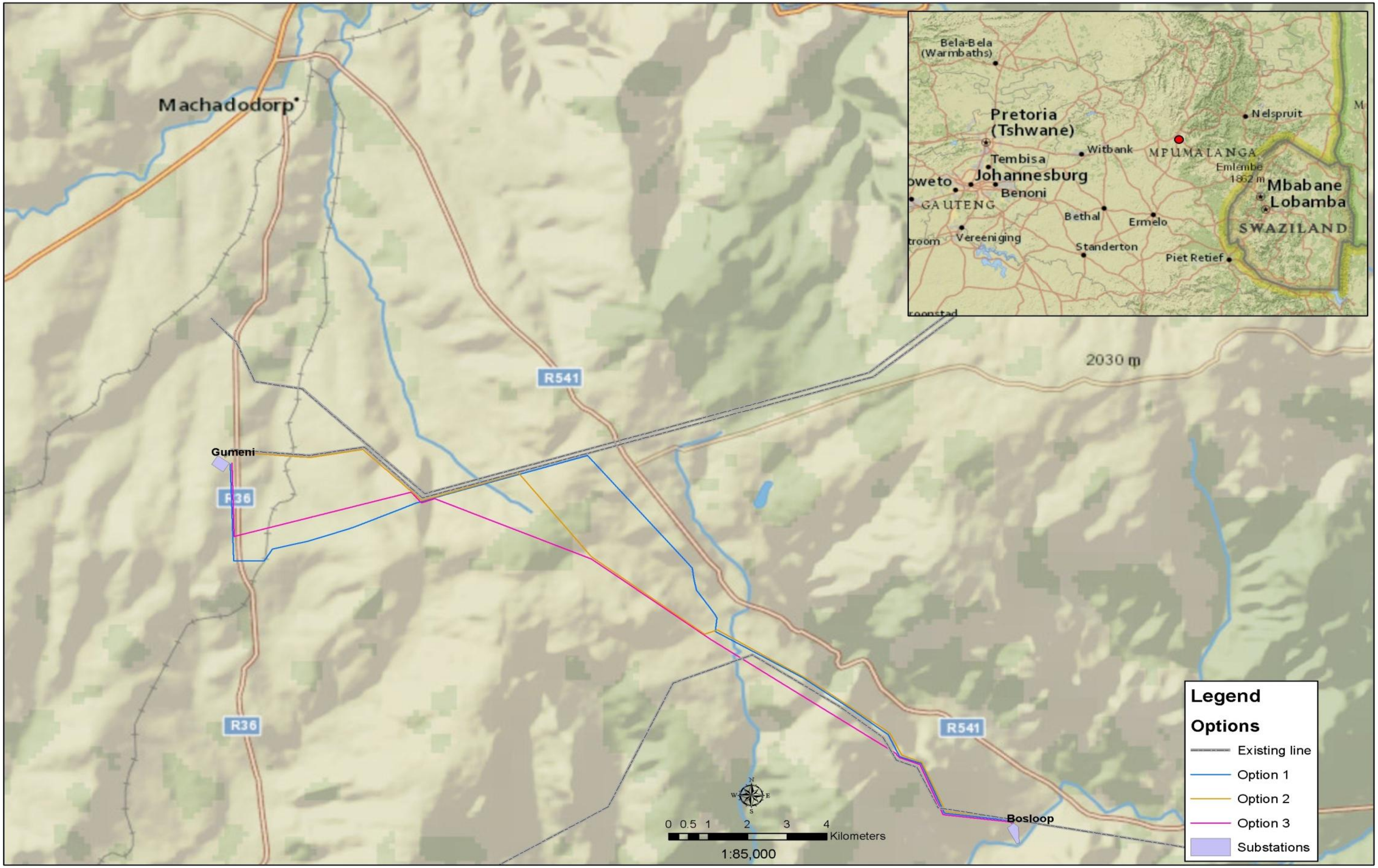


Figure 2: Aerial Map

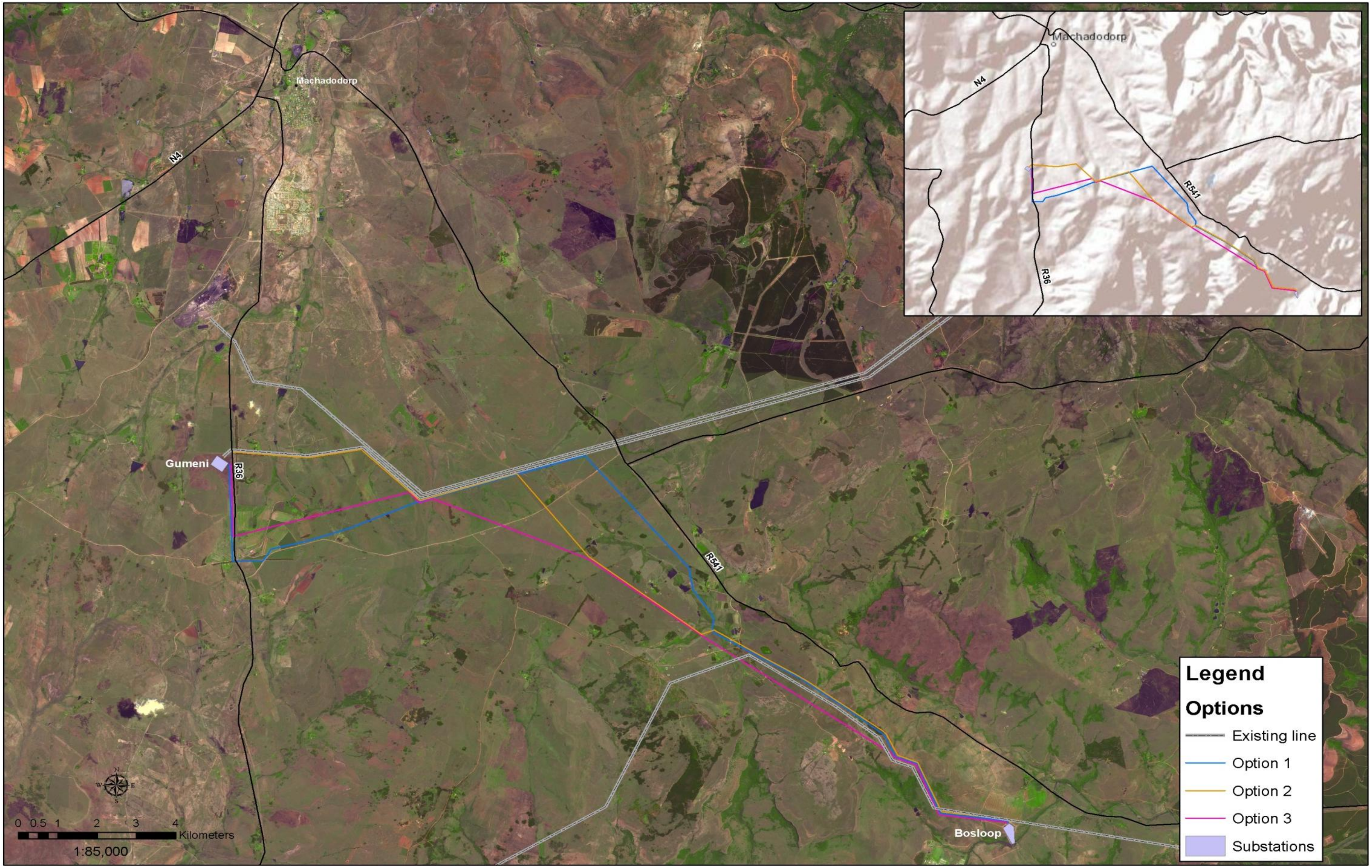


Figure 3: Topography

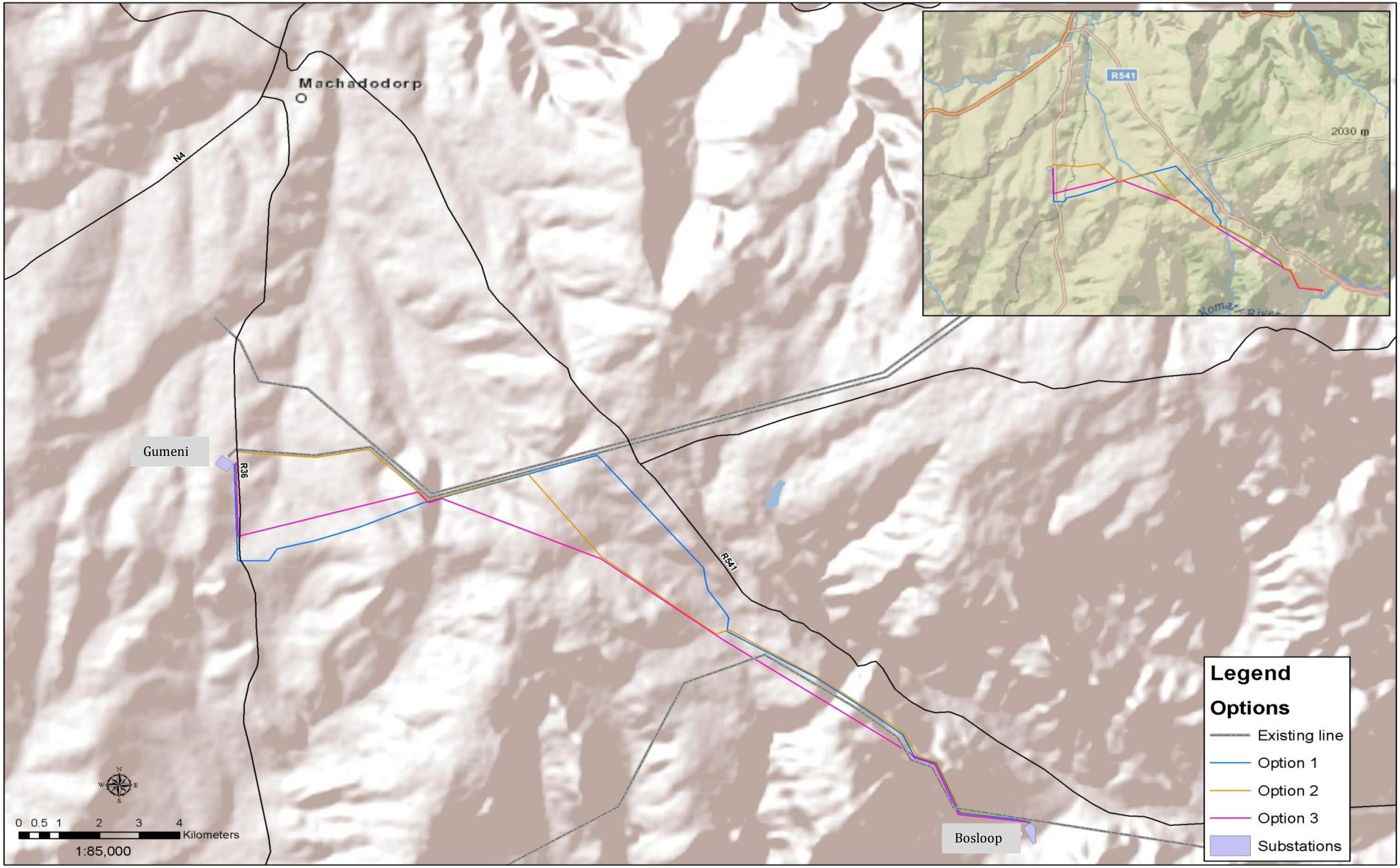
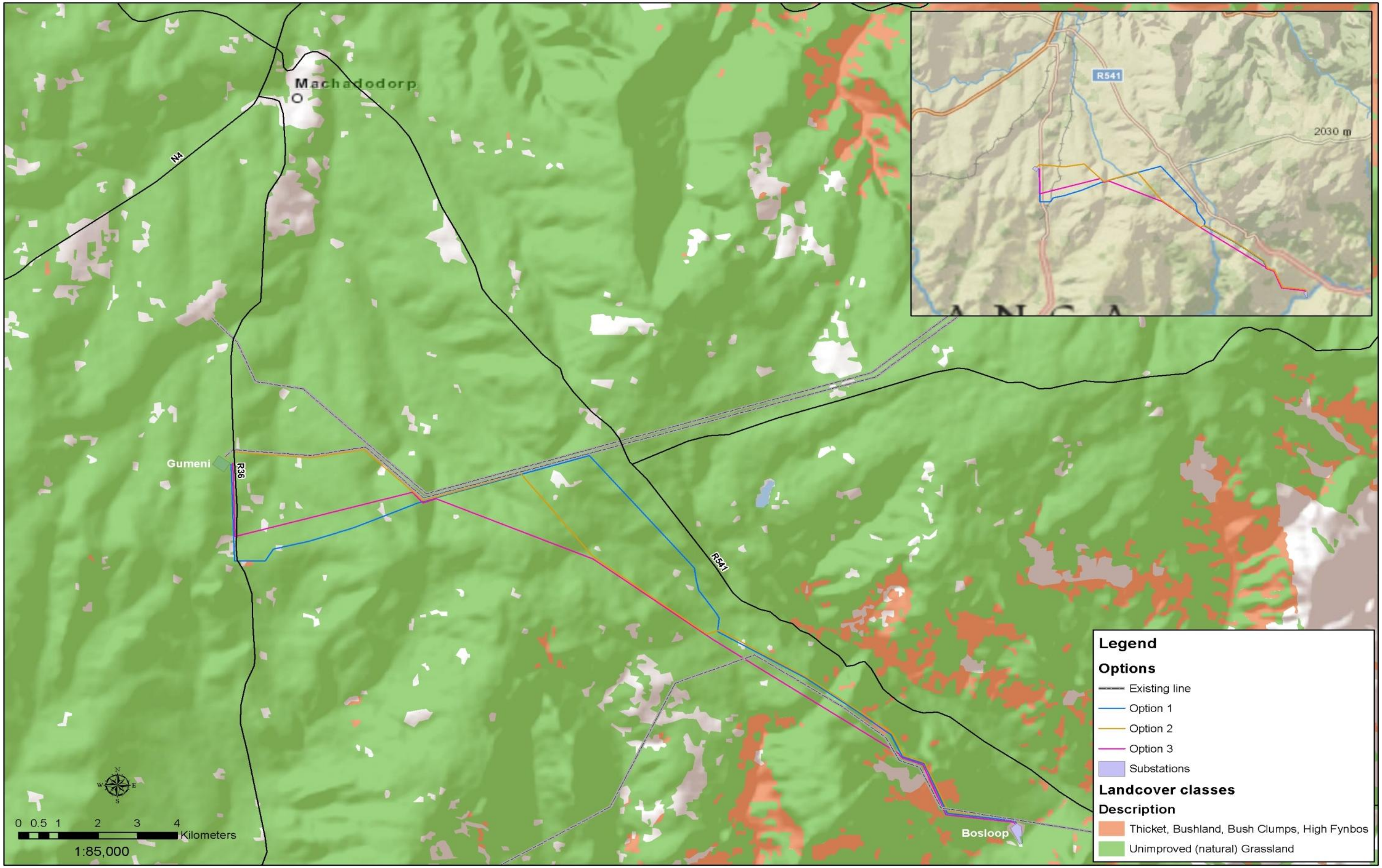


Figure 4: Land Cover



2 ASSESSMENT METHODOLOGY

2.1 Background

Visual impact assessments should not be seen as an obstacle in the approval process. Visual input, especially at the early concept stage of the project, can play an important role in helping to formulate design alternatives, as well as minimising impacts, and possibly even costs, of the project.

It is in the nature of visual and scenic resources to include abstract qualities and connotations that are by their nature difficult to assess or quantify as they often have cultural or symbolic meaning. It is necessary therefore to include both quantitative criteria (such as viewing distances), and qualitative criteria (such as sense of place), in visual impact assessments. An implication of this is that the impact ratings cannot simply be added together. Instead the assessment relies on the evaluation of a wide range of considerations, both objective and subjective, including the context of the proposed project within the surrounding area. The phrase "beauty is in the eye of the beholder" is often quoted to emphasize the subjectivity in undertaking a visual impact assessment.

The use of the basic elements of form, line, colour and textures has become the standard in describing and evaluating landscapes. Modifications in a landscape which repeat the landscape's basic design elements are said to be in harmony with their surroundings. Modifications which do not harmonize, often look out of place and are said to contrast or stand out in unpleasing ways. These basic design elements and concepts have been incorporated into the methodology to lend objectivity, integrity and consistency to the VIA process. By adjusting planned infrastructure designs so that the elements are repeated, visual impacts can be minimised.

The methodology is designed to separate the existing landscape and the planned infrastructure into their features and elements and to compare each part against the other in order to identify those parts which are not in harmony. Then, ways are sought to bring them back into harmony. An understanding of basic design principles and how they relate to the appearance of planned infrastructure s is essential in order to minimize visual impacts.

The methodology is therefore a systematic process to measure contrast in order to analyse potential visual impact of proposed planned infrastructure s and activities. It is not intended to be the only means of resolving these impacts and should be used as a guide, tempered by common sense, to ensure that every attempt is made to minimize potential visual impacts. The basic philosophy underlying the methodology can be easily described as the degree to which a management activity affects the visual quality of a landscape depends on the visual contrast created between a planned infrastructure and the existing landscape.

2.2 Key issues

In order to focus specialist input, key issues requiring specialist input must be identified. Key issues that tend to determine the need for the involvement of visual specialist relate to the type of environment, as well as type and scale of development.

Table 1 (Oberholzer 2005) shows a possible range of environments, from the most visually sensitive to the least sensitive on the one axis, and a range of development types from the least intensive to the most intensive on the other axis. The correlation of environment types with development types leads to varying levels of expected visual impact, on a scale from none to very high (see Table 1)

It must be noted and that the tables below should not be regarded as a comprehensive list of landscape/land use types and development categories, and do not replace the need for a comprehensive, systematic scoping process to identify the range of issues arising from a particular development.

Table 1: Key categories of development

Type of environment	Level of intensity				
	Category 1 development	**Category 2 development**	**Category 3 development**	**Category 4 development**	**Category 5 development**
Protected/wild areas of international, national, or regional significance	Moderate visual impact expected	High visual impact expected	High visual impact expected	Very high visual impact expected	Very high visual impact expected
Areas or routes of high scenic, cultural, historical significance	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected	Very high visual impact expected
Areas or routes of medium scenic, cultural or historical significance	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected
Areas or routes of low scenic, cultural, historical significance / disturbed	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected
Disturbed or degraded sites / run-down urban areas / wasteland	Little or no visual impact expected. Possible benefits	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected

Categorisation of issues to be addressed by a visual impact assessment:

Category 1 development:

e.g. nature reserves, nature-related recreation, camping, picnicking, trails and minimal visitor facilities.

Category 2 development:

e.g. low-key recreation / resort / residential type development, small-scale agriculture / nurseries, narrow roads and small-scale infrastructure.

Category 3 development:

e.g. low density resort / residential type development, golf or polo estates, low to medium-scale infrastructure.

Category 4 development:

e.g. medium density residential development, sports facilities, small-scale commercial facilities / office parks, one-stop petrol stations, light industry, medium-scale infrastructure.

Category 5 development:

e.g. high density township / residential development, retail and office complexes, industrial facilities, refineries, treatment plants, power stations, wind energy farms, power lines, freeways, toll roads, large scale infrastructure generally. Large-scale development of agricultural land and commercial tree plantations. Quarrying and mining activities with related processing plants.

2.3 General Method

This section outlines the methodology used to assess the visual impact of the planned infrastructure. The methodology to determine the level of visual impact of the planned infrastructure involves, in the first instance, a consideration of the existing visual environment. This includes a consideration of existing landscape setting and how the planned infrastructure is seen from various viewing locations. In this way the visual character of the landscape, as well as visual sensitivity of the various viewing locations can be determined.

Secondly, the visual modification of the planned infrastructure is determined by considering the visual characteristics of the planned infrastructure in the context of the landscape within which it is seen.

A combined consideration of both visual sensitivity and visual modification determines impact and gives some direction on mitigation strategies.

The key factors considered during the assessment included:

- Sensitive land uses (e.g. residential areas, public roads and natural/recreation areas); and
- The visual form, scale and colour of the development.

The methodology employed during the preparation of this visual assessment was as follows:

- Characterisation of the existing landscape and visual setting;

  Undertaking a computerised view-shed analysis to determine a probable view-shed for the project. *Fischer (1995)* has analysed the effects of data errors on view-sheds calculated by Geographic Information Systems and has shown that the calculations are extremely sensitive to small errors in the data, and to the resolution of the data and the errors in viewer location and elevation. Other studies have also shown that a view-shed calculated using the same data but with eight different Geographic Information Systems can produce eight different results. *Hankinson (1999)* also states that view-shed are never accurate and they contain several sources of error and may not always be feasible to separate these errors or to estimate their size and potential effects. It is therefore better to describe a view-shed analysis as a probable view-shed that must be subjected to subsequent field testing and verification

  A probable view-shed can be based on topography only and shows areas that will be screened by intervening hills, mountains etc. A probable topographic view-shed does not take into account heterogeneous and complex natural and man-made elements in the surrounding landscape. Intervening vegetation, buildings or small variations in topography, such as road cuttings are therefore not considered. Therefore it is a conservative assessment of those areas that may be visually impacted by the planned infrastructure. Increasing sophistication/accuracy of the probable view-shed by the addition of data on complex natural and man-made elements in the landscape is desirable but it will introduce further errors of detail and interpretation in the view-shed analysis.
- Identification of points with potential views of the planned infrastructure;
- The illustration of potential landscape or visual impacts using photographs (photomontage). It must be kept in mind that the human eye sees differently than a camera lens both optically and figuratively. The focusing mechanisms of human eyes and camera lenses are different; human eyes move, and the brain integrates a complex mental image; human vision is binocular and dynamic, compared to a camera that tends to flatten an image. A 50mm standard lens (35mm camera) was used that most closely approximates to the human eye.
- Examination of the main components and activities of the planned infrastructure;
- Qualitative assessment of impacts, including:
  - Visual modification at key viewpoints – *How does the proposed development contrast with the landscape character of the surrounding setting?*
  - Visual sensitivity at key viewpoints – *How sensitive will viewers be to the proposed development?*
- Development of mitigation and management measures.

The methodology employed by this visual assessment is based on the following methodologies:

- The United States Department of Agriculture: Forestry Service - *Landscape Aesthetics* and

- The United States Bureau of Land Management *Visual Resources Management*,
- The Landscape Institute and the Institute of Environmental Management & Assessment - *Guidelines for Landscape and Visual Impact Assessment*
- *The Provincial Government of the Western Cape's Guideline for involving visual and aesthetic specialists in EIA processes* and the Guidelines for Landscape used.

2.4 Data

A visual impact assessment entails a process of data sourcing (collection of data during field work and various data custodians, such as the Chief Land Surveyor General and the Department of Environmental Affairs), spatial analysis, visualisation and interpretation. Geo-information technology is utilised which includes operations relating to GIS, GPS and remote sensing technology. This report makes extensive use of maps created in a Geographic Information System and photographs taken during a field survey of the site. It is imperative that these should be read and interpreted together with the text.

The best currently available datasets was utilized for the visual impact assessment. It is important to note that variations in the quality, format and scale of available datasets could limit the scientific confidence levels of the visual impact assessment outcomes.

The following data sets were used for this report:

- Contours and colour aerial photography from the Department of Rural Development & Land Reform, Chief Directorate: National Geospatial Information
- 2000 National Land cover data

2.5 Existing Visual Environment

The evaluation of the existing visual environment consists of the assessment of both the landscape setting, and key viewing locations within it, as described below.

2.5.1 Landscape Setting

The landscape setting can be defined in terms topography, vegetation, hydrology and land use features. These elements define the existing visual character of the landscape with which the planned infrastructure interacts.

2.5.2 Key Viewing Locations

Viewing locations are those areas where people are likely to obtain a view of the planned infrastructure. These viewing locations have different significance based on numerous factors, collectively evaluated though land use and viewing distance to the planned infrastructure.

The selection of the key viewing locations is their location within the defined view-shed where they would have a clear view of the planned infrastructure. Factors that should be considered in selecting the key viewing locations are:

(i) **Angle of observation** - The apparent size of a project is directly related to the angle between the viewer's line-of-sight and the slope upon which the planned infrastructure is to take place. As this angle nears 90 degrees (vertical and horizontal), the maximum area is viewable.

(ii) **Numbers of viewers** - Areas seen and used by large numbers of people are potentially more sensitive. Protection of visual values usually becomes more important as the number of viewers increase.

(iii) **Length of time** the project is in view - If the viewer has only a brief glimpse of the planned infrastructure, the contrast may not be of great concern. If, however, the planned infrastructure is subject to view for a long period, as from an overlook, the contrast may be very significant.

(iv) **Distance** from the project **-** The greater the viewing distances, the lower the visual sensitivity. The visual modification of a development is assumed to be the highest when the observer is very close to it and has a direct line of site. The visual modification then decreases with distance and is also known as distance decay (Hull & Bishop 1988).

(v) **Relative planned infrastructure size -** The contrast created by the project is directly related to its size and scale as compared to the surroundings in which it is placed.

(vi) **Season of use -** Contrast ratings should consider the physical conditions that exist during the heaviest or most critical visitor use season, such as tree defoliation during the winter, leaf colour in the fall and lush vegetation and flowering in the spring.

(vii) **Critical viewpoints**, e.g. views from communities, major roads, etc.

(viii)**Field of vision -** The visual impact of a development can be quantified to the degree of influence on a person's field of vision both horizontally and vertically. The horizontal central field of vision for most people covers an angle of between 50˚ and 60˚. The vertical central field of vision covers and angle of between 25˚ and 30˚. These typical parameters of human vision area based on anthropometric data. Within this angle, both eyes observe and object simultaneously. Within this field of central vision images are sharp, depth perception occurs and colour discrimination is possible. Developments, which take up less than 5% of the central field of vision, are usually insignificant in most landscapes (Human Dimension and Design, 1979).

(ix) **Visibility -** Viewed by the human eye 1.8 m from the ground across a "flat" surface such as the sea, the horizon will be of the order of 6 km distant, due to the curvature of the earth. Viewed at an elevation of 60 m, the horizon will be of the order of 32 km distant and from the top of a 1000 m mountain the horizon will be at a distance of approximately 113 km. A tall structure standing above the horizon would of course increase these distances significantly; for example, for an observer at 1.8 m who is viewing a man-made structure 50 m tall, the effective distance to the horizon is 34 km and for a 100 m structure the distance is 46 km (Miller & Morrice, no date).

(x) **Human perception -** Human perception is affected by the acuity of the human eye. In good visibility (visibility is meteorologically defined as the greatest distance at which an object in daylight can be seen and recognised), a pole of 100 mm diameter will become difficult to see at 1 km and a pole of 200 mm diameter will be difficult to see at 2 km. In addition, mist, haze or other atmospheric conditions may significantly affect visibility (Hill et al, 2001). Assuming this relationship is linear, and assuming absolute clarity of view, this suggests that the outer limit of human visibility in clear conditions of a pole 5000 mm (5 m) in diameter (a representative figure for a 60+ m high tower) will be of the order of 50 km; and the absolute limit of visibility imposed by the limit of the horizon viewed across a flat plane is similar at approximately 46 km.

(xi) **Perception -** Human perception is important in considerations of if and how planned infrastructure will be seen. People perceive size, shape, depth and distance by using many cues, so that context is critically important. When people see partial or incomplete objects, they may mentally "fill in" the missing information, so that partial views of infrastructure may have less effect than imagined. Although people may be able to physically "see" an object, unintentional "blindness" caused by sensory overload, or a lack of contrast or conspicuousness, can mean they fail to "perceive" the object. In a contrary way, large size, movement, brightness and contrast, as well as new, unusual or unexpected features, can draw attention to an object. In all these effects, issues such as experience, familiarity and memory may have an important role to play. Therefore, perception depends on experience, the visual field, attention, background, contrast and expectation, and may be enhanced or suppressed.

2.6 The Project

The planned infrastructure will have certain visual characteristics associated with it. These elements will express themselves in terms of form, shape, line, colour, and to a lesser extent, texture. An understanding of this visual character will provide an appreciation of how various mine elements will be seen in the landscape.

2.7 The impact analysis

The analysis of the interaction between the existing visual environment and the planned infrastructure provides the basis for determining visual impacts and mitigation strategies. This is completed by defining the visual effect of the planned infrastructure and visual sensitivity of viewing locations to determine impact.

2.7.1 Visual Modification

Visual modification is a measure of the level of visual contrast and integration of the planned infrastructure with the existing landscape.

An existing landscape has certain visual characteristics expressed through the visual elements of form, shape, line colour and texture. A development such as electricity distribution infrastructure has different visual characteristics that will create contrast with the existing landscape. As existing electricity distribution infrastructure already form part of the existing landscape, the visual effects of the planned infrastructure will borrow visual character from these operations, reducing visual modification.

The degree to which the visual characteristics of the planned infrastructure contrast with the existing landscape will determine the level of visual modification. For example a newly created mine will have a high visual modification due to strong contrast. An extension of operations in an existing mine will have a lesser visual modification. A successfully rehabilitated mine area will also have a lower visual modification due to limited contrast with the existing landscape.

In a similar way, a project is said to be integrated with the existing landscape based on issues of scale, position in the landscape and contrast. High visual integration is achieved if a development is dominated by the existing landscape, is of small scale and/or limited contrast.

The level of visual modification generally decreases with distance and is categorised as follows:

- **Negligible (or very low) level of visual modification** – where the development is distant and/or relates to a small proportion of the overall view shed.
- **Low level of visual modification -** where there is minimal visual contrast and a high level of integration of form, line, shape, pattern, colour or texture values between the development and the landscape. In this situation the development may be noticeable, but does not markedly contrast with the landscape.
- **Moderate level of visual modification -** where a component of the development is visible and contrasts with the landscape, while at the same time achieving a level of integration. This occurs where surrounding topography, vegetation or existing modified landscape provide some measure of visual integration or screening.
- **High level of visual modification -** where the major components of the development contrast strongly with the existing landscape and demand attention.

The following factors must be considered when applying visual modification categories:

(i) **Distance -** The contrast created by a planned project is less as viewing distance increases. The greater the viewing distances, the lower the visual sensitivity. The visual modification of a development is assumed to be the highest when the observer is very close to it and has a direct line of site. The visual modification then decreases with distance and is also known as distance decay.

(ii) **Angle of Observation -** The apparent size of a project is directly related to the angle between the viewer's line-of-sight and the slope upon which the project is to take place. As this angle nears 90 degrees (vertical and horizontal), the maximum area is viewable.

(iii) **Length of Time the project Is In View -** If the viewer has only a brief glimpse of the project, the contrast may not be of great concern. If, however, the project is subject to view for a long period, as from an overlook, the contrast may be very significant.

(iv) **Relative Size or Scale -** The contrast created by the project is directly related to its size and scale as compared to the surroundings in which it is placed.

(v) **Season of Use -** Contrast ratings should consider the physical conditions that exist during the heaviest or most critical visitor use season, such as tree defoliation during the winter, leaf colour in the fall and lush vegetation and flowering in the spring.

(vi) **Light Conditions -** The amount of contrast can be substantially affected by the light conditions. The direction and angle of lighting can affect colour intensity, reflection, shadow, form, texture and many other visual aspects of the landscape. Light conditions during heavy use periods must be a consideration in contrast ratings.

(vii) **Recovery Time -** The amount of time required for successful re-vegetation should be considered. Recovery usually takes several years and goes through several phrases (e.g. bare ground to grasses, to shrubs, to trees, etc.). It may be necessary to conduct contrast ratings for each of the phases that extend over long time periods. Those conducting contrast ratings should verify the probability and timing of vegetative recovery.

(viii) **Spatial Relationships -** The spatial relationship within a landscape is a major factor in determining the degree of contrast.

(ix) **Atmospheric Conditions -** The visibility of planned infrastructure s due to atmospheric conditions, such as air pollution or natural haze, should be considered.

(x) **Motion -** Movement such as waterfalls, vehicles or plumes draw attention to a project.

(xi) **Form -** Contrast in form results from changes in the shape and mass of landforms or structures. The degree of change depends on how dissimilar the introduced forms are to those continuing to exist in the landscape.

(xii) **Line -** Contrasts in line results from changes in edge types and interruption or introduction of edges, bands, and silhouette lines. New lines may differ in their sub-elements (boldness, complexity, and orientation) from existing lines.

(xiii) **Colour -** Changes in value and hue tend to create the greatest contrast. Other factors such as chroma, reflectivity and colour temperature, also increase the contrast.

(xiv) **Texture -** Noticeable contrast in texture usually stems from differences in the grain, density and internal contrast. Other factors such as irregularity and directional patterns of texture may affect the rating.

2.7.2 Visual Sensitivity

Visual sensitivity is a measure of how critically a change to the existing landscape is viewed by people from different land use areas in the vicinity of a development.

In this regard, residential, tourist and/or recreation areas generally have a higher visual sensitivity than other land use areas (e.g. industrial, agricultural or transport corridors), because land uses such as residential, use the scenic amenity values of the surrounding landscape and may be used as part of a leisure experience and often over extended viewing periods.

Landscapes are subdivided into three (3) distanced zones based on relative visibility from travel routes or observation points. The three zones are:

- **Foreground-Middleground Zone -** This is the area that can be seen from each travel route for a distance of 5 to 8 kilometres where management activities might be viewed in detail. The outer boundary of this distance zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape. In some areas, atmospheric conditions can reduce visibility and shorten the distance normally covered by each zone.
- **Background Zone -** This is the remaining area which can be seen from each travel route to approximately 24 kilometres, but does not include areas in the background which are so far distant

that the only thing discernible is the form or outline. In order to be included within this distance zone, vegetation should be visible at least as patterns of light and dark.

- **Seldom-Seen Zone -** These are areas that are not visible within the foreground-middleground and background zones and areas beyond the background zones.

Land-use areas are generally characterised in terms of low, moderate or high visual sensitivity, as follows:

- **Low visual sensitivity -** industrial areas, local roads, mining and degraded areas.
- **Moderate visual sensitivity -** tourist roads, major roads, sporting or recreational areas and places of work.
- **High visual sensitivity** - rural residences, recreation areas, conservation areas, scenic routes or trails.

Visual sensitivity may range from high to low, depending on the following additional factors:

(i) **The visual absorption capacity (VAC) -** The potential of the landscape to conceal the proposed project.

(ii) **Viewing distance** – The greater the viewing distances, the lower the visual sensitivity. The visual modification of a development is assumed to be the highest when the observer is very close to it and has a direct line of site. The visual modification then decreases with distance and is also known as distance decay.

(iii) **General orientation -** General orientation of residences to landscape areas affected by a project. Residential, tourist and/or recreation areas with strong visual orientation towards the planned infrastructure (i.e. those with areas such as living rooms and/or verandas orientated towards it), will have a higher visual sensitivity than those not orientated towards the planned infrastructure.

(iv) **Type of Users -** Visual sensitivity will vary with the type of users. Recreational sightseers may be highly sensitive to any changes in visual quality, whereas workers who pass through the area on a regular basis may not be as sensitive to change.

(v) **Amount of Use -** Areas seen and used by large numbers of people are potentially more sensitive. Protection of visual values usually becomes more important as the number of viewers increase.

(vi) **Public Interest -** The visual quality of an area may be of concern to local or national groups. Indicators of this concern are usually expressed in public meetings, letters, newspaper or magazine articles, newsletters, land-use plans, etc. Public controversy created in response to proposed activities that would change the landscape character should also be considered.

(vii) **Adjacent Land Uses -** The inter-relationship with land uses in adjacent lands can affect the visual sensitivity of an area. For example, an area within the view-shed of a residential area may be very sensitive, whereas an area surrounded by commercially developed lands may not be visually sensitive.

(viii) **Special Areas -** Management objectives for special areas such as natural areas, wilderness areas, conservation areas, scenic areas, scenic roads or trails frequently require special consideration for the protection of the visual values. This does not necessarily mean that these areas are scenic, but rather that one of the management objectives may be to preserve the natural landscape setting. The management objectives for these areas may be used as a basis for assigning sensitivity levels.

2.7.3 Visual Impact

The visual impact of the planned infrastructure has been determined by considering both visual modification and visual sensitivity which, when considered together, determine impact levels. The way in which the visual parameters of visual sensitivity and visual modification are cross referenced are illustrated in Table 2.

Table 2: Visual Impact Matrix

Visual Modification	Level of Visual Impact	Visual Sensitivity: **H** High	**M** Moderate	**L** Low
	H High	H	H	M
	M Moderate	H	M	L
	L Low	M	L	L
	VL Very Low	L	VL	VL

2.8 Application of Methodology

There are numerous locations in the vicinity of the planned infrastructure that will be visually impacted to various levels. For the purposes of the VIA, a number of sites within key sectors of the planned infrastructure boundaries were selected as representative key viewing locations.

These sites were selected with reference to field assessment, aerial photograph and view-shed analysis to determine the visibility of the planned infrastructure.

Whilst there will be some variation in the impacts on specific viewing locations, an overall assessment of the visual impact on the selected locations will be representative for the majority of views experienced.

2.8.1 Visibility

For a visual impact to be experienced, landscape alterations resulting from the project need to be visible. Visibility of the planned infrastructure from adjoining view locations was determined by viewing into the planned infrastructure boundaries from a range of potential viewpoints. This was further assisted through the production of computer generated visible area maps (i.e. view-shed maps). The view-shed defines the extent to which the property is visible to the surrounding areas. A Digital Elevation Model (DEM) was generated making use of 5 meter contours for the planned infrastructure area. Existing structures and vegetation was not considered during the view-shed analysis.

2.8.2 Visual Sensitivity

The visual sensitivity of various viewing areas was determined by review of aerial photography, plans of the planned infrastructure, view-shed maps and topographic plans of the surrounding areas. This included the consideration of land use, viewing distances and the general level of screening available from topography, buildings and vegetation. The assigned sensitivities within each sector were also evaluated based on field study and other study data

2.8.3 Visual modification

The visual modification of the planned infrastructure on external viewpoints is illustrated in a number of photos taken from various key viewpoints within key sectors of the view-shed around the planned infrastructure boundary.

2.9 Mitigation measures

Visual impact mitigation strategies are developed for both on site and off site situations to ensure that visual modifications and/or visibility/visual sensitivity factors are decreased to achieve impact mitigation.

3 EXISTING ENVIRONMENT

3.1 Introduction

This section of the report establishes the visual character of the existing environment. This is needed to establish the change created by the planned infrastructure and provides a base line against which visual modification is measured.

3.2 Landscape Character

The landscape setting can be defined in terms topography, vegetation, hydrology and land use features. These elements define the existing visual character of the landscape with which the planned infrastructure interacts. The planned infrastructure and surrounding areas comprise the following topographical features and landscape units with varying levels landscape quality (Figure 3,

Figure 5):

- Flat areas
- Low hills
- Low and deep valleys

The vegetation communities are not very pronounced within the project area and the vegetation is dominated by large natural grassland areas. It includes bush land, thicket, bush clumps, high fynbos and grassland (Figure 2, Figure 5).

Figure 5: Topography and Vegetation

4 PROJECT DESCRIPTION

4.1 Introduction

The visual effect of the planned infrastructure is determined by considering the visual characteristics of the planned infrastructure in the context of the landscape within which it is seen. The visual assessment evaluates the potential visual impact of the following planned infrastructure:

- The establishment of a 132KV overhead power line linking the Gumeni and Bosloop substations.

4.2 Planned infrastructure

The planned infrastructure includes the following components (Figure 6):

(i) The construction of a 132KV overhead power line linking the Gumeni and Bosloop substation. Three alignment alternatives are being considered by Eskom Distribution and will be evaluated during the visual impact assessment process to determine the best environmentally practicable alignment (Figure 2).

(ii) Distribution line conductors are strung on in-line (suspension) towers and bend (strain) towers. The structures proposed to be used for the 132KV distribution line for the project are 132KV steel monopole structures (Figure 6).

(iii) The servitude width for a 132 kV distribution line is 22 meter (11 meter on either side of the centre line of the power line). The minimum vertical clearance to buildings, poles and structures not forming part of the power line must be 3.8 meter, while the minimum vertical clearance between the conductors and the ground is 6.7 meter. A minimum 8m (4 meter either side of the centre line of the power line) wide strip is to be cleared of all trees and for stringing purposes only. If any tree or shrub in other areas will interfere with the operation and/or reliability of the distribution line it will be trimmed or completely cleared. The minimum working area required around a structure position is 20 meter × 20 meter

(iv) Foundations will be mechanically excavated where access to the pole position is readily available. The same applies to the pouring of concrete required for the setting of the foundations. Prior to erecting the poles and filling of the foundations, the excavated foundations will be covered in order to safeguard unsuspecting animals and people from injury. All foundations are back-filled, stabilised through compaction, and capped with concrete at ground level. Composite insulators are used to connect the conductors to the towers.

(v) Composite insulators with a glass-fibre core with silicon sheds for insulation will be used.

(vi) Composite (Long rod type) insulators with silicone based weather shed material will be used for strain assemblies. Composite horizontal line post insulators will be used for the intermediate structures and on the jumper supports.

(vii) Access is required during both the construction and operation/maintenance phases of the distribution lines life.

Figure 6: 132KV steel monopole structure

Figure 7: Option 1 view shed analysis

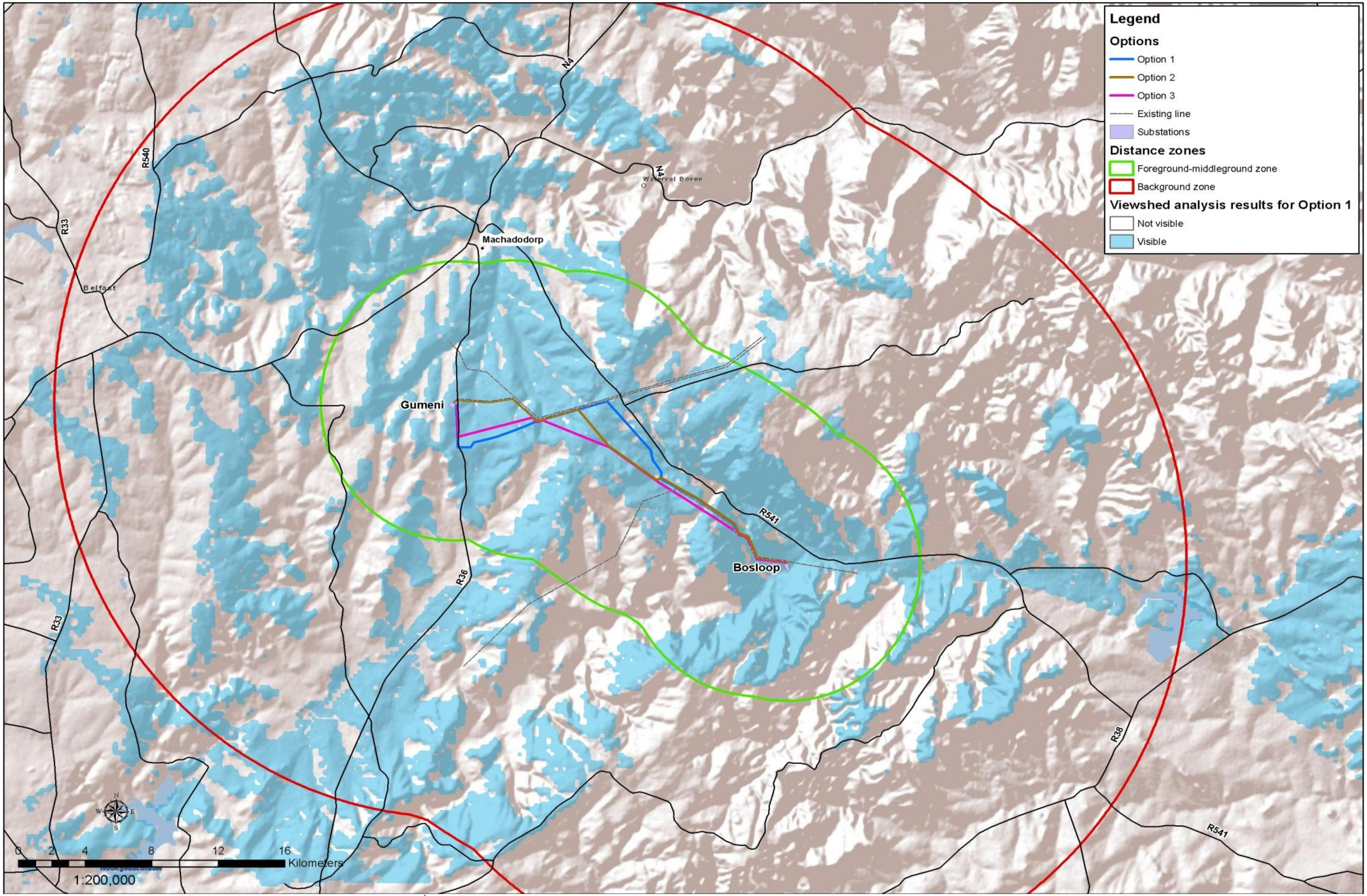


Figure 8: Option 2 view shed analysis

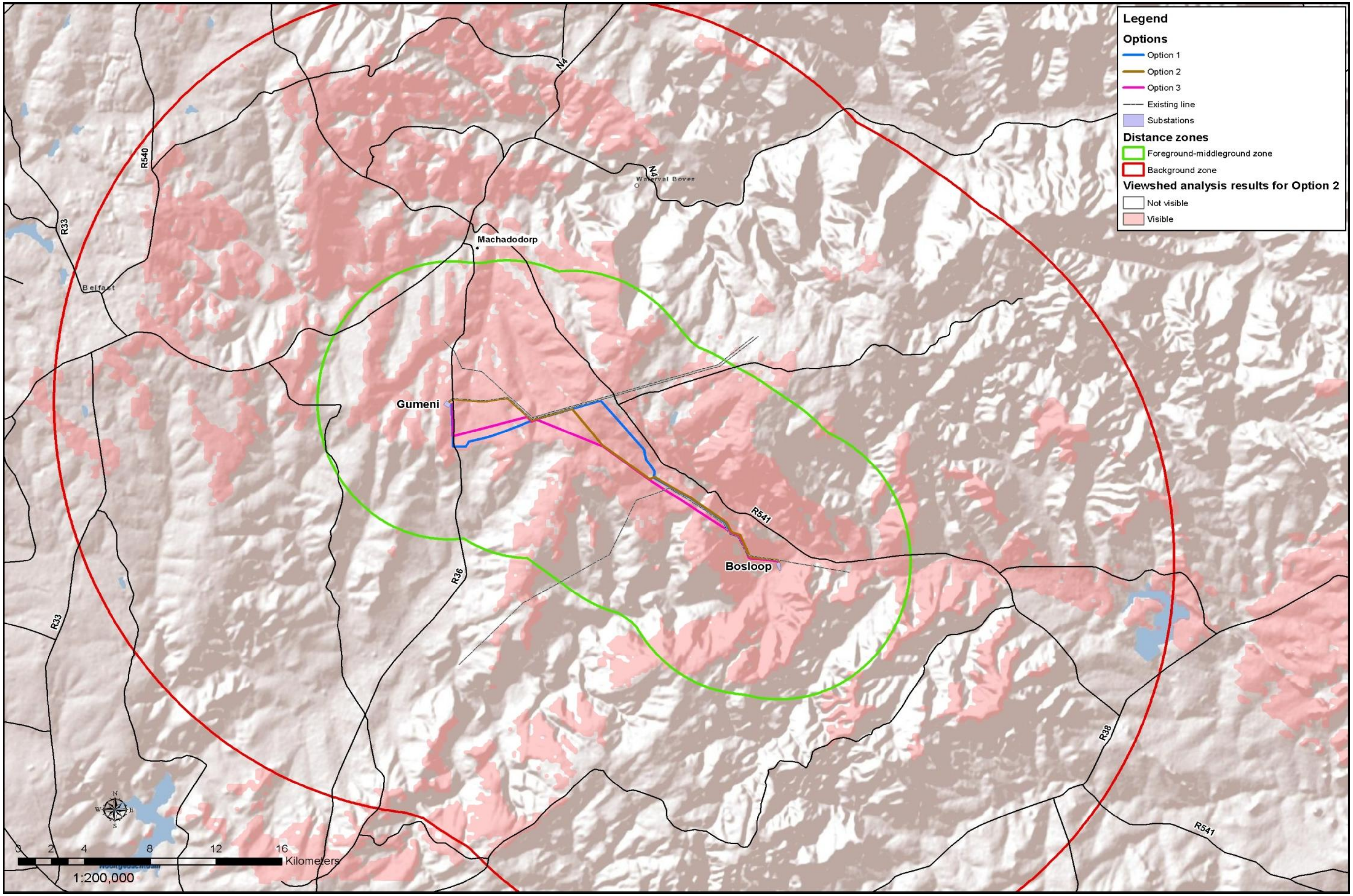
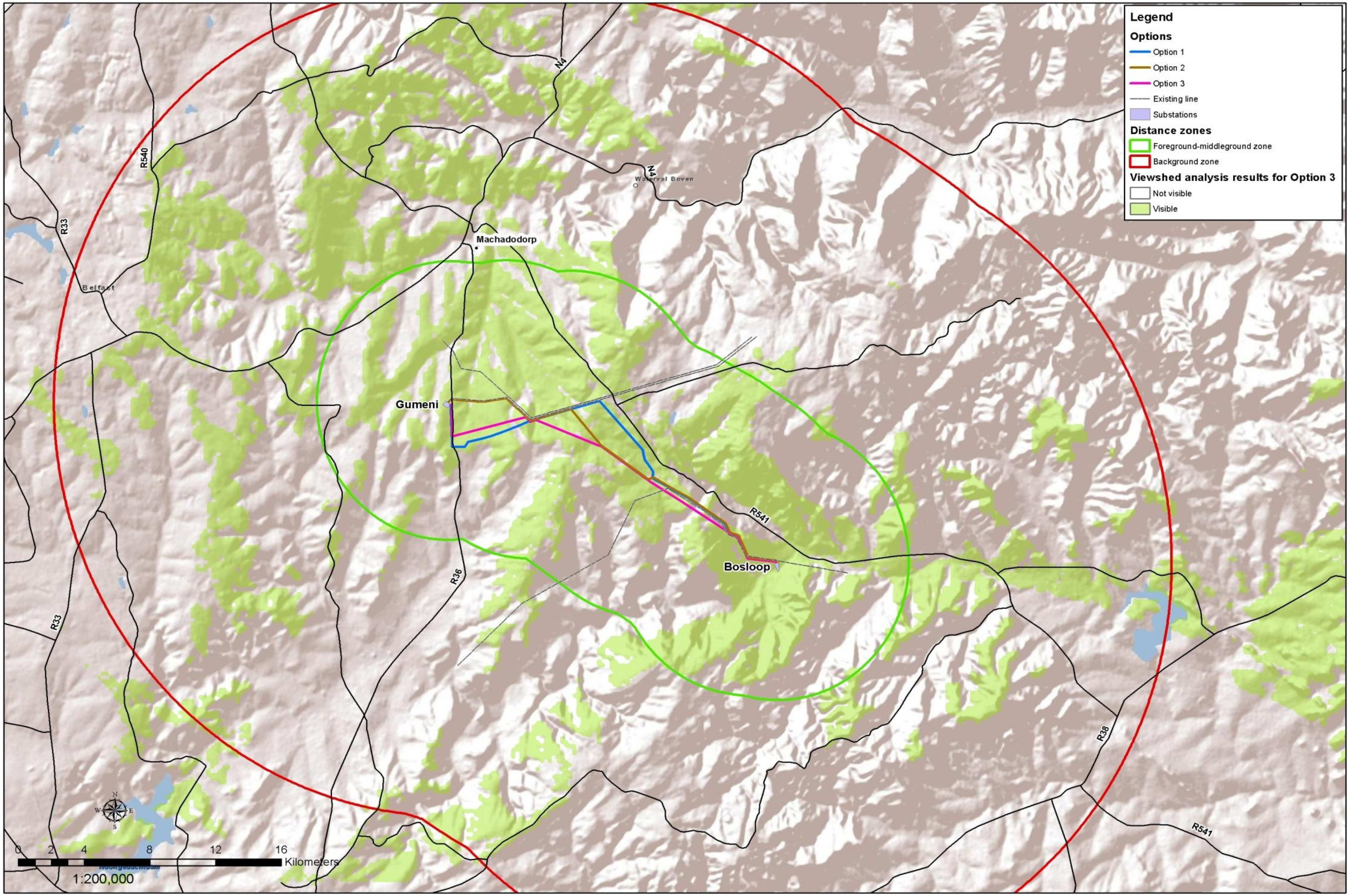


Figure 9: Option 3 view shed analysis



5 IMPACT ASSESSMENT

5.1 Introduction

This section defines the visual impact that is experienced from various view locations around the project areas. The visual impact levels are a final determinant for mitigation strategies outlined in Section 6. The visual impact will vary according to the visual modification of the planned infrastructure, its visibility and the visual sensitivity of areas from which it is seen. The potential sensitive viewing locations around the planned activities include rural residences, roads and protected areas (nature reserves, national parks and private nature reserves).

The main issues to consider in the assessment of visual impacts are:

- The number of sensitive viewing locations; and
- The level to which the planned infrastructure is visible – if not seen, then there is no impact.
- **Extent – 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 - 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);
  - long term, (e.g. lifespan of the project);
  - permanent, where time will not mitigate the visual impact.
- **Intensity – the magnitude of the impact on views, scenic or cultural resources.**
  - low, where visual and scenic resources are not affected;
  - medium, where visual and scenic resources are affected to a limited extent;
  - high, where scenic and cultural resources are significantly affected.

Table 3: Location of sensitive viewing locations

Sensitive viewing locations	Figure
Regional roads: R36 & R541	2
Secondary roads and minor dirt roads	2
Towns: Machadodorp	2

Table 4: Summary of Visual Assessment

Planned infrastructure	Figure	Visual sensitivity	Visual modification level	Impact	Impact after rehabilitation	Preferred option
Option 1	7	H	H	H	H	×
Option 2	8	M	M	M	M	√
Option 3	9	H	H	H	H	×

5.2 Conclusion and recommendations

The view-shed analysis from the identified sensitive viewing locations indicates that all three alignment options and associated infrastructure will be visible in the foreground-middleground and background zones from main roads, secondary/minor roads and towns. Visibility will reduces in the seldom seen zones that in turn decreases the visual modification created by the infrastructure due to the increased viewing distance.

All three alignments and its associated structures will have a visual impact on the scenic resources of the region due to the limited capacity of the topography and environment to screen the infrastructure. Existing power lines and associated infrastructure are already present in the project area that is clearly visible from the regional roads.

Option 1 & 2 will follow a new alignment from Gumeni next to the R36 and then cross the road and continue until linking with an existing line deeper in the project area (Figure 2). These two options will therefore be clearly visible from the road and will create new infrastructure in areas where there was none before with a higher visual impact. Option 3 follows and existing line from Gumeni and then follows and alignment further away from the R36 & R541 and thereby creating a reduced the visual impact.

The predicted life span of the visual impact will be permanent, where time will not mitigate the visual impact. The magnitude of the impact on views and scenic resources will be medium.

There are several recommendations as to the mitigation of the visual impact of the proposed infrastructure (Section 6). The visual impact of power lines depends largely on where it is located and how it is moulded to the natural terrain. Proper location will contribute significantly to the reduction of line and colour impacts. Galvanized steel should be darkened to prevent glare and the use of earth-tone paint with a low reflective level will reduce the visual effect of the new infrastructure.

6 VISUAL MITIGATION AND MANAGEMENT

6.1 Introduction

This section of the report outlines visual mitigation strategies that will complement existing mitigation measures. The mitigation measures in relation to reducing visual impact can be categorised as:

- On site treatments to reduce visual effects; and
- Treatments at viewer locations to reduce visual sensitivity.

On site treatments involve rehabilitation of land forms and land cover, while viewer location treatments involve a range of treatments to screen views, filter views and/or re-orientate primary views.

On site treatments might include:

- Visual and ecological planting patterns of indigenous vegetation to achieve landscape patterns that emulate in part existing mixes of tree and grass cover in the surrounding landscape.
- Minimising exposure of work areas to sensitive receptors.
- Preparing an internal landscape plan for rehabilitation areas.

At viewer location treatments include:

- Landscape design and plantings for affected locations. This will require an appropriately qualified person to visit the affected locations and develop a landscape plan to screen or filter views to the project areas.

Design fundamentals are general design principles that can be used for all forms of activity or development, regardless of the resource value being addressed. Applying the following three fundamentals will assist with mitigation measures:

- Proper siting or location.
- Reducing unnecessary disturbance.
- Repeating the elements of form, line, colour and texture of the surrounding landscape.

Design strategies are more specific activities that can be applied to address visual design problems. The following strategies will not necessarily applicable to every proposed activity or project:

- Colour selection
- Earthwork
- Vegetative manipulation
- Structures
- Reclamation/restoration
- Linear alignment design considerations

The fundamentals and strategies mentioned above are all interconnected, and when used together, can help resolve visual impacts from proposed activities or developments.

6.2 Mitigation measures

The following mitigation should be considered when constructing the proposed infrastructure for this project to reduce the visual impact:

6.2.1 Linear alignments

The visual impact of linear projects such as the construction of power lines depends largely on where it is located and how it is moulded to the natural terrain. Proper location can often contribute significantly to the reduction of line and colour impacts, making other measures either unnecessary or less costly and easier to accomplish.

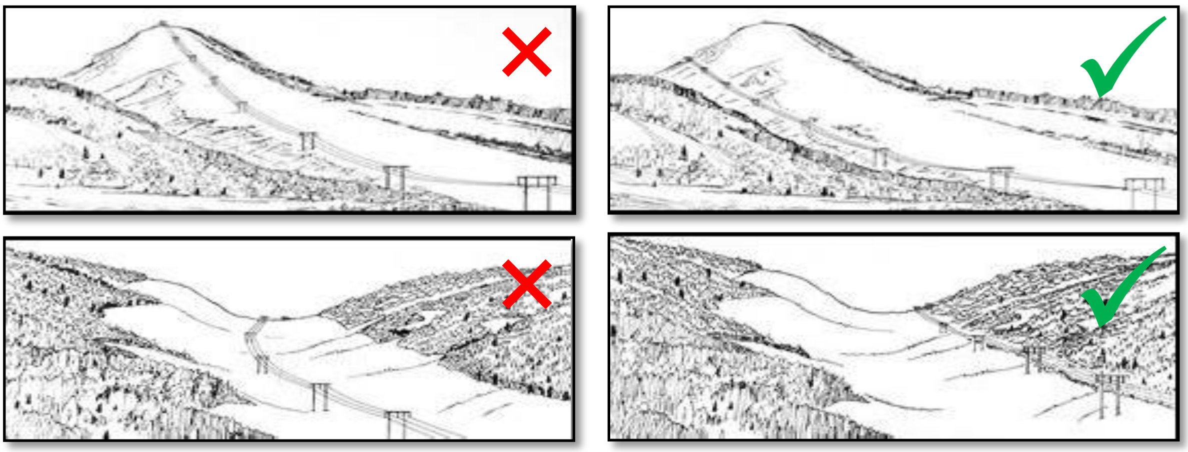
Finding the best route for linear alignments involves:

- Identifying and analyzing all possible corridor alignments and selecting the most feasible option for the proposed project.
- Locating the proposed project within the selected corridor after a thorough analysis of all environmental, socioeconomic and engineering factors.

The following should be considered during the determination of an alignment:

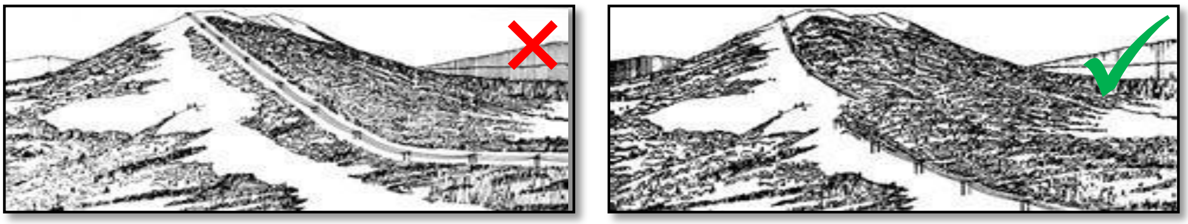
- **Topography** is a crucial element in alignment selection. Visually, it can be used to subordinate or hide man-made changes in the landscape. Projects located at breaks in topography or behind existing tree groupings are usually of much less visual impact than projects located on steep side slopes. By taking advantage of natural topographic features, cut and fill slopes can be greatly minimized.
- **Topographic breaks** frequently exhibit a natural line element that the proposed alignments can repeat or blend with to strengthen the design. This line element is partly established by a visual shadow zone, which will further aid in reducing the contrast of the project.
- **Hydrological conditions** can strongly affect the visual impact of buried and surface construction. The risks of surface and subsurface erosion within the corridor should be analyzed and evaluated.

Figure 10: Focal points



(Focal points in the landscape should be avoided where possible, as the human eye is attracted to these points first).

Figure 11: New disturbances



(New disturbance should be avoided and the natural lines in the landscape should be followed where possible).

6.2.2 Vegetation manipulation

(i) Partial clearing at the limits of construction rather than clearing the entire area – leaving islands of vegetation results in a more natural look.

(ii) Use irregular clearing shapes.

(iii) Feathering/thinning the edges of the cleared areas. Feathering edges reduces strong lines of contrast. To create a more natural look along an edge, a good mix of tree/shrub species and sizes should be retained.

(iv) Establishing limits of disturbance that reflect the minimum area required for construction.

(v) Locating construction staging and administrative areas in less visually sensitive areas.

The edges of this vegetation clearing have been thinned or "feathered" to create a natural-looking treatment.

The clearing of this hillside works well with the existing lines and vegetative patterns found in this landscape

Colour selection

(i) Natural surfaces are usually well-textured and have shade and shadow effects that darken it. Surfaces of structures are usually smooth and reflect light even if dull-finished paint is used. Colours on smooth structures therefore need to be two or three shades darker that the background colours to compensate for shadow patterns created by natural textures that make colours appear darker.

(ii) Use earth-tone paints and stains. Colours that blend with or are in harmony with the existing colours of the surrounding earth, rocks and vegetation, are usually more visually pleasing and attract less attention that colours that are chosen to match the colour of the sky.

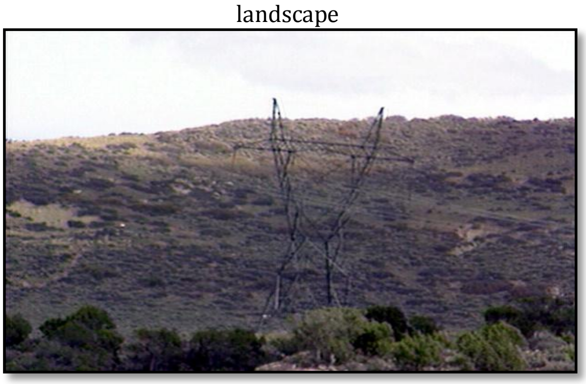
(iii) Galvanized steel on structures should be darkened to prevent glare. Low lustre paints should be used wherever possible to reduce glare.

(iv) The colour selection for all structures should be made to achieve the best blending with the surrounding landscape in the winter and summer.

(v) Select paint finishes with low levels of reflectivity.

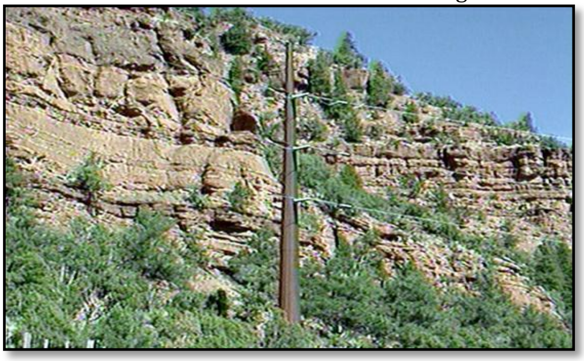
(vi) Screening the structure from view through the use of natural landforms and vegetation.

The dark green transmission tower blends in with landscape



The white tank color forms a strong contrast against surrounding vegetation

The color selected for this electrical tower blends well with the rock formations surrounding it.



This mix of colors increases contrast within the site and attracts attention.

6.2.3 Structures

(i) Minimizing the number of structures and combining different activities in one structure where possible.

(ii) Attempt to repeat the form, line, colour and texture of the surrounding landscape to reduce the contrast between the landscape and the proposed infrastructure.

(iii) Using natural stone in wall surfaces if possible.

(iv) Burying all or part of the structure.

This water tank is set back from the crest of the hill, thereby reducing the visual impact; however, the access road could have been better located and the color selection could have been better

The open lattice design of this electrical transmission tower virtually disappears in the landscape.

6.2.4 Earthwork

(i) Hauling in or hauling out excessive earth cut or fill in sensitive viewing areas.

(ii) Bending slopes to match existing landforms.

(iii) Retaining existing rock formations, vegetation, drainage, etc., whenever possible.

(iv) Toning down freshly broken rock faces through the use of asphalt emulsions, rock stains, etc.

(v) Protecting roots from damage during excavations.

(vi) Avoiding soil types that will generate strong contrasts with the surrounding landscape when they are disturbed.

(vii) Prohibiting dumping of excess earth/rock on downhill slopes.

6.2.5 Proper siting and location

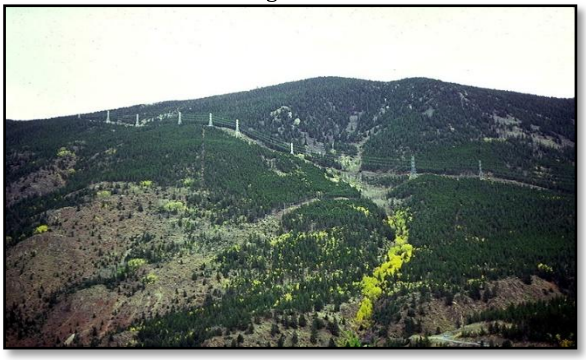
Choosing the proper location for a proposed project is one of the easiest design techniques to understand and apply, and one that will normally yield the most dramatic results.

The following considerations can be helpful in choosing a project location:

- Visual contrasts or impacts decrease as the distance between the viewer and the proposed development increases, so projects should be located as far away from prominent viewing locations as possible.
- The human eye is naturally drawn to prominent topographic features, so projects should not be located on or near such features.
- The shape and placement of projects should be designed to blend with topographic forms and existing vegetation patterns.
- Both topographic features and vegetation should be used to screen proposed development.

Using existing openings, lines, and shapes in the landscape can help reduce visual impacts.

This linear alignment does not repeat the forms, lines, colors, and textures of the landscape, thereby creating strong contrast



6.2.6 Reducing unnecessary disturbance

As a general rule, reducing the amount of land disturbed during the construction of a project reduces the extent of visual impact.

- Techniques that help reduce surface disturbance include:
- Colocating several projects within the same right-of-way.
- Placing underground utilities either along the edge or under the surface of an existing road.
- Placing several underground utilities within the same trench.
- Establishing limits of disturbance that reflect the minimum area required for construction.
- Consolidating development of a similar nature within a common structure.
- Planning projects so that they utilize existing infrastructure whenever possible.
- Maximizing slope when it is aesthetically and technically appropriate.
- Locating construction staging and administrative areas in less visually sensitive areas.

There is a notable difference in the disturbed areas for these two similar developments.

This pipeline location avoids the wooded area and minimizes disturbance.

6.2.7 Restoration

Strategies for restoration and reclamation are very much similar to the design strategies for earthwork, as well as the design fundamentals of repeating form, line, color, and texture and reducing unnecessary disturbance. The objectives of restoration and reclamation include reducing long-term visual impacts by decreasing the amount of disturbed area and blending the disturbed area into the natural environment while still providing for project operations.

Though restoration and reclamation are a separate part of project design, they should not be forgotten or ignored. It is always a good idea to require a restoration/reclamation plan as part of the original design package. All areas of disturbance that are not needed for operation and maintenance should be restored as closely as possible to previous conditions.

Several strategies that can enhance any restoration or reclamation effort include:

- Stripping, saving, and replacing topsoil on disturbed earth surfaces.
- Enhancing vegetation by:
  - Mulching cleared areas
  - Using planting holes on cut/fill slopes to retain water.
  - Choosing indigenous plant species.
  - Fertilizing, mulching, and watering vegetation.
  - Replacing soil, brush, rocks, forest debris, etc., over disturbed earth surfaces when appropriate, thus allowing for natural regeneration rather than introducing an unnatural looking grass cover.
- Minimizing the number of structures and combining different activities in one structure wherever possible.

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