ESKOM HOLDINGS SOC LIMITED

THE PROPOSED LETHABO SOLAR PHOTOVOLTAIC (PV) FACILITY AND ASSOCIATED INFRASTRUCTURES WITHIN THE METSIMAHOLO LOCAL MUNICIPALITY, FEZILE DABI DISTRICT MUNICIPALITY, FREE STATE

VISUAL IMPACT ASSESSMENT
VISUAL IMPACT ASSESSMENT REPORT

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1 INTRODUCTION

1.1 GENERAL

This visual impact assessment (VIA) study forms part of the Scoping and Environmental Impact Assessment that is being undertaken for the proposed Lethabo Solar Photovoltaic PV Facility and associated infrastructures by Savannah Environmental (Pty) Ltd on behalf of Eskom Holdings SOC Limited.

In terms of the amended National Environmental Management Act (NEMA) Act No. 107 of 1998, the proposed development requires environmental authorisation. A key impact to be assessed comprises the visual impact that the facility will have on surrounding areas.

This Visual Impact Assessment Report has been prepared for inclusion in the project Environmental Impact Assessment Report following approval of the Scoping Report which included detailed methodology and assessment criteria.

1.2 LOCATION

The proposed Lethabo Solar Photovoltaic (PV) Facility is located between Sasolburg and Vereeniging, approximately 10 and 25 km's from the major towns in the Vaal Triangle in the Free State. The site falls within the Metsimaholo Local Municipality which falls within the Fezile Dabi District Municipality. **(Refer to Figures 1 and 2)**

The project will comprise of the development of 75MW Solar PV installation over approximately 52-130ha within the existing Eskom power station boundary.

During the scoping phase three sites were considered. One site was discarded at the scoping stage consequently there are two alternative sites under consideration.

Both alternative sites are situated on Portion 0 of Farm 1814. The areas and approximate location of the proposed sites are indicated in **Tables 1 and 2.**

Table 1: Extents and Generating Capacity of the Alternative sites

	Alternative 1	Alternative 2
Land size	130 ha	52 ha
MW	75	35

The geographical co-ordinates of centre point of the proposed sites are indicated in **Table 2** below:

Table 2: Coordinates of the alternative Sites

	Alternative 1			Alternative 2		
South	26^0	45′	01.94″	26^0	44′	55.62″
East	27^0	57′	40.24″	27^0	58′	28.88″

The PV Facility will include the following infrastructures:

- Arrays of photovoltaic (PV) panels.
- Mounting structures to support the PV panels.
- Cabling between the project components.
- Inverters/transformer enclosures.
- An on-site substation or switching station.
- A power line to facilitate the connection of the solar energy facility to the existing substation at the power station.
- Internal access roads.
- Buildings (which could include workshop area for maintenance and storage, and an on-site office)

1.3 BACKGROUND OF SPECIALIST

Jon Marshall qualified as a Landscape Architect in 1978. He is also a certified Environmental Impact Assessment Practitioner of South Africa. He has been involved in Visual Impact Assessment over a period of approximately 30 years. He has developed the necessary computer skills to prepare viewshed analysis and three dimensional modelling to illustrate impact assessments. He has undertaken visual impact assessments for major buildings, mining, industrial development, mining and infrastructure projects and has been involved in the preparation of visual guidelines for large scale developments.

A brief Curriculum Vitae outlining relevant projects is included as **Appendix I.**

1.4 BRIEF

The brief is to assess the visual impact that the facility will have on surrounding areas.

Work is to be undertaken in accordance with the following guideline documents;

a. The Government of the Western Cape Guideline for Involving Visual and Aesthetic Specialists in EIA Processes (Western Cape Guideline), which is the only local relevant guideline, setting various levels of assessment subject to the nature of the proposed development and surrounding landscape, and

b. The Landscape Institute and Institute of Environmental Management and Assessment (UK) Guidelines for Landscape and Visual Impact Assessment which provides detail of international best practice (UK Guidelines).

Refer to **Appendix II** for the Western Cape Guideline.

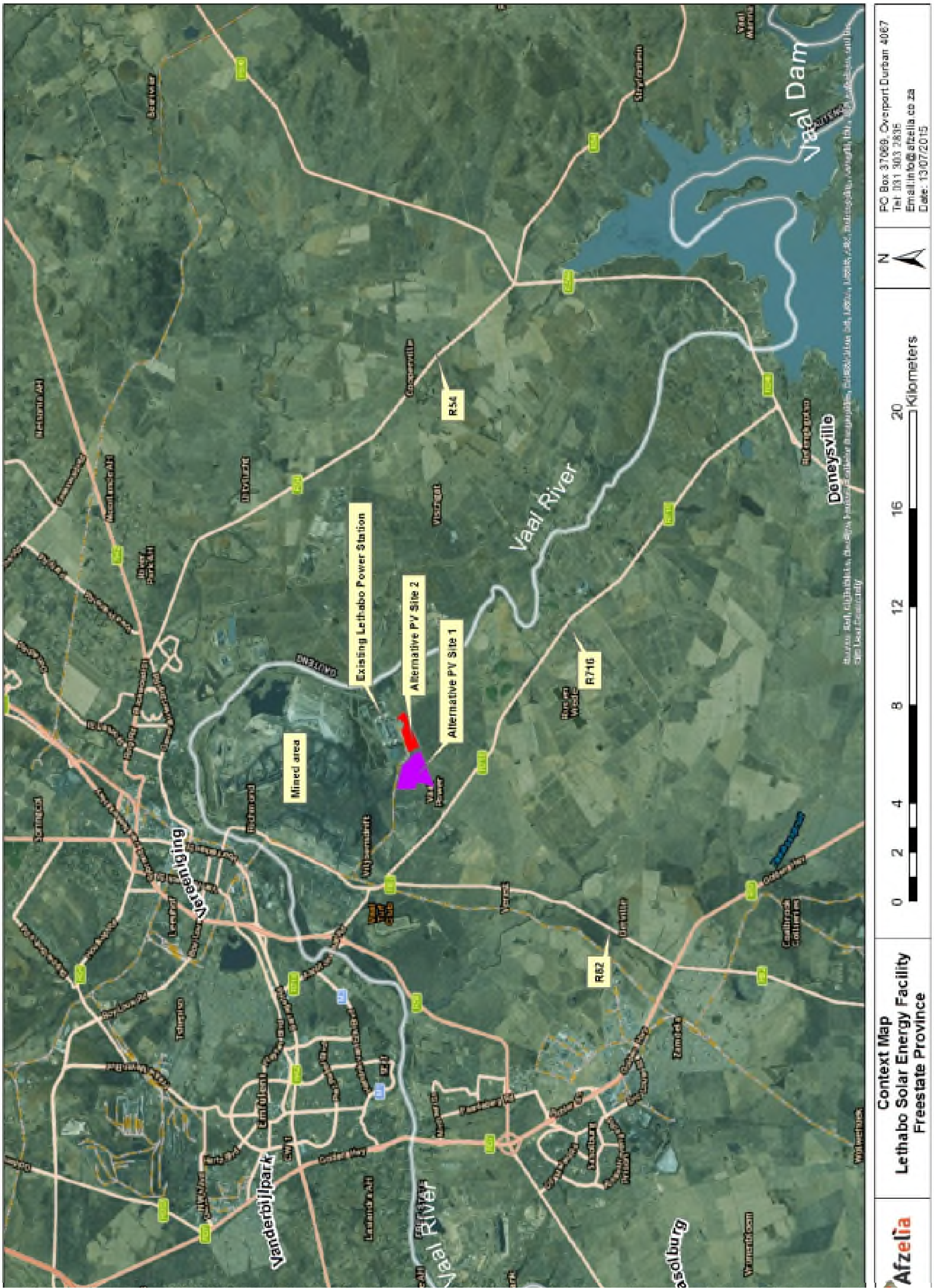
1.5 SPECIALIST REVIEW OF SCOPING DOCUMENT

Following the specialist review of the Scoping Document, it was recommended that the impact associated with glare that might be created by the proposed PV Array be addressed in the Visual Impact Assessment Report.

1.6 LIMITATIONS AND ASSUMPTIONS

No detailed site layouts were provided for the assessment. It was therefore assumed that the proposed solar array would be developed to cover the entire site area.

FIGURE 2, SITE CONTEXT



2 METHODOLOGY

As the need to address the issue of glare has been raised, the report covers two visual aspects;

1. Aesthetic change to the landscape that could relate to a change in character or a change in the way that a landscape is perceived by specific receptors.
2. Ocular impacts from glare that could result in nuisance or a physical danger.

2.1 AESTHETIC CHANGE TO THE LANDSCAPE

2.1.1 RELEVANT GUIDELINES

There are numerous guideline documents for visual impact assessment, most of which have a common approach. Key documents are listed in the References Section of this report.

As there are no national guidelines, the most relevant South African document was used to define the nature and extent of necessary input. The Western Cape Guidelines set levels of input subject to the likely sensitivity of a landscape as well as the scale and nature of a proposed development. It therefore provides a basis for justification and agreement of a required scope of work. This document is attached as **Appendix II** for reference.

2.1.2 LEVEL OF ASSESSMENT

From input undertaken at the scoping stage and based on the nature of the affected landscape and the proposed development, a Level 3 Assessment based on the Western Cape Guidelines was considered appropriate.

A Level 3 Assessment requires;

1. Identification of issues raised in scoping phase, and site visit;
2. Description of the receiving environment and the proposed project;
3. Establishment of view catchment area, view corridors, viewpoints and receptors;
4. Indication of potential visual impacts using established criteria;
5. Inclusion of potential lighting impacts at night;
6. Description of alternatives, mitigation measures and monitoring programmes.
7. Review by independent, experienced visual specialist (if required).

The Scoping Report indicated that this conclusion should be confirmed following a site visit.

During the site visit, it was confirmed that the proposed development will impact on the industrial landscape created by the Power Station but it also has potential to impact on surrounding agricultural areas. Whilst the power station might be categorised as a degraded landscape, surrounding agricultural areas could not be considered degraded. Because of the influence of the Power Station surrounding agricultural areas are considered to have low scenic significance in accordance with the guidelines.

The above assessment confirms the scoping conclusion that the proposed development might be expected to have moderate visual impact.

The Western Cape Guidelines indicate that if a moderate visual impact is expected, a Level 3 Assessment should be undertaken.

The required level of assessment is therefore confirmed as Level 3 in accordance with the guidelines.

2.1.3 DETAILED METHODOLOGY

a) Identification of issues raised in scoping phase, and site visit

As only general issues have been raised by scoping, issues have largely been drawn from the site visit and discussion with the Principal Consultant.

b) Description of the receiving environment and the proposed project

The description of the receiving environment has been prepared from observations made during the site visit and from reference and analysis of available GIS data sets.

c) Establishment of view catchment area, view corridors, viewpoints and receptors

The establishment of the view catchment area or Zone of Theoretical Visibility (ZTV) as it is defined in the latest edition of the UK Guidelines (previously referred to as Viewshed), was prepared using a digital terrain model and ARCGIS Spatial Analyst software during the scoping phase. This provides an analysis based on landform only and does not take into account distance to the horizon due to the earth's curvature, the effect of distance from the proposed lines or other objects such as the existing power station, vegetation or weather conditions.

The digital analysis therefore needs to be amended following a site visit to ground truth the assessment. This can either be undertaken by amending the identified area to take account of specific elements, or by making qualifications where there are conditions that affect visibility over large sections of the identified area.

Key viewpoints / receptors within the ZTV were also identified during the scoping stage. Subject to ground truthing of the ZTV, the impact assessment will focus on changes in view from these receptors.

d) Visual impacts identified at the scoping stage

Possible impacts that were identified during scoping include;

i. General landscape degradation or changes to landscape character areas that "the majority of people" are likely consider as negative. In this case this is likely to be a cumulative impact that would extent the influence of existing infrastructural elements to the detriment of the broader rural agricultural character. This is partly a subjective judgement as it is based on the assumption that the majority of people would prefer views over a more natural landscape (loss of rural characteristics is rated as a negative impact). It can however be measured in terms of likely extent of change.

ii. Change to the views of visual receptors. These impacts might relate to visual obstruction and / or intrusion as experienced from points or areas in the landscape that are given importance due to their use. The proposed assessment criteria are based on the assumption that the overriding character of existing views is largely that of a rural agricultural area with some existing degrading infrastructural elements such as the 400kV overhead power line that runs close to the proposed alternative sites. The criteria therefore relate to the degree of additional infrastructure that will be obvious within a key view and its influence on the character of the view.

e) *Criteria for assessment of identified impacts*

Criteria were proposed at the scoping stage. However, in order to ensure that the visual assessment can be readily integrated into the Environmental Impact Assessment document, the following assessment criteria have been adopted;

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional:
  - local extending only as far as the development site area – assigned a score of 1;
  - limited to the site and its immediate surroundings (up to 10 km) – assigned a score of 2;
  - will have an impact on the region – assigned a score of 3;
  - will have an impact on a national scale – assigned a score of 4; or
  - will have an impact across international borders – assigned a score of 5.
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5.
- The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
  - 0 is small and will have no effect on the environment;
  - 2 is minor and will not result in an impact on processes;
  - 4 is low and will cause a slight impact on processes;
  - 6 is moderate and will result in processes continuing but in a modified way;
  - 8 is high (processes are altered to the extent that they temporarily cease); and
  - 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:
  - Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
  - Assigned a score of 2 is improbable (some possibility, but low likelihood);
  - Assigned a score of 3 is probable (distinct possibility);
  - Assigned a score of 4 is highly probable (most likely); and
  - Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).
- The **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
- The **status**, which will be described as either positive, negative or neutral.
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources.
- The *degree* to which the impact can be *mitigated.*
- The **significance** is determined by combining the criteria in the following formula:
  - S=(E+D+M)P; where S = Significance weighting, E = Extent, D = Duration, M = Magnitude, P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

f) Inclusion of potential lighting impacts at night

The potential for light pollution is assessed based on a comparison of the density and intensity of existing lighting and likely level of lighting associated with a proposed development.

g) Description of alternatives, mitigation measures and monitoring programmes.

Alternatives will be described and assessed.

Mitigation and monitoring measures will be proposed based on the nature of possible impacts and the experience of the assessor.

h) Review by independent, experienced visual specialist (if required).

Confirmation of the requirement for an independent review is required.

2.2 OCULAR IMPACT FROM GLARE

An indication of a possible a glare issue at the same level as the array can be gained based on simple geometry using plots of sun angle and elevation relative to the face of the solar panels. This provides a two dimensional analysis. For multiple levels such as those associated with an aircraft flight path the mathematics becomes more complex although geometry can be used to check any one point.

Sandia National Laboratories[1], provide online tools for mapping solar glare and flux (http://www.sandia.gov/about/index.html) enabling lay persons to input key data including location, extent, height and power of a proposed array as well as set angles or tracking parameters. This enables the generation of a simple glare analysis providing an indication of timing as well as intensity.

Sandia is a US Government funded research agency similar to South Africa’s CSIR.

The Sandia model has therefore been used in the assessment of glare impacting on surrounding areas and receptors. Sun path data has been reviewed as part of the assessment in order to ensure that the results from the on line model can be broadly verified.

[1] Sandia National Laboratories is operated and managed by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation. Sandia Corporation operates Sandia National Laboratories as a contractor for the U.S. Department of Energy’s National Nuclear Security Administration (NNSA) and supports numerous federal, state, and local government agencies, companies, and organizations. As a Federally Funded Research and Development Center (FFRDC), Sandia may perform work for industry responding to certain types of federal government solicitations. The solicitation must allow FFRDC participation and meet the requirements of Sandia's management and operating contract with DOE/NNSA.

3 PROJECT MOTIVATION AND DESCRIPTION

3.1 GENERAL

The purpose of the project is to generate electricity for export into the national electricity grid.

The project is motivated by the need to expand the renewable energy programme in line with the National Climate Change Response White Paper (2011).

The project will participate in the Department of Energy's Small Projects Renewable Energy Independent Power Producer Procurement Programme (RE-IPPPP). The RE-IPP Programme and has been designed to contribute towards the South African government's renewable energy target of 10,000GWh of renewable energy and to stimulate the renewable industry in South Africa.

3.2 PROJECT DESCRIPTION

The PV facility is intended to generate electricity by harnessing solar energy (from the sun) by utilising photovoltaic (PV) technology. The main components of the facility include:

- Arrays of photovoltaic (PV) panels.
- Mounting structures to support the PV panels.
- Cabling between the project components.
- Inverters/transformer enclosures.
- An on-site substation or switching station.
- A power line to facilitate the connection of the solar energy facility to the existing substation at the power station.
- Internal access roads.
- Buildings (which could include workshop area for maintenance and storage, and an on-site office)

The facility is proposed to have a generating capacity of up to 68 MW (Alternatives 1 and 3). Alternative 2 will have a generating capacity of just less than 50% of Alternatives 1 and 3.

It is understood that the entire area of the selected site will be developed.

3.3 MAIN PROJECT COMPONENTS

The main visible components of a solar energy facility typically include the following:

3.3.1 Photovoltaic Panels

Solar photovoltaic (PV) panels consist primarily of glass and various semiconductor materials and in a typical solar PV project, will be arranged in rows to form solar arrays. The PV panels are designed to operate continuously for more than 25 years with minimal maintenance required. The panels will be up to 3m in height.

Project details indicate that 275,350 No. 1.64m x 0.98m x 0.04m PV panels will be used and that they will be set at a maximum height of 3m above ground level. All panels will be fixed mounted which means that they will not change position to optimise their angle to the sun during the day.

3.3.2 Support Structure

The photovoltaic (PV) modules will be mounted to steel support structures. These can either be mounted at a fixed tilt angle, optimised to receive the maximum amount of solar radiation and dependent on the latitude of the proposed facility, or a tracking mechanism where at a maximum tilt angle of 45° the modules would be approximately 0.3m off the ground. The Project Details indicate that the support structures will be fixed at an angle of 25° and orientated facing north.

3.3.3 Inverters

The photovoltaic effect produces electricity in direct current (DC). Therefore inverters must be used to change it to alternating current (AC) for transmission in the national grid. The inverters convert the DC electric input into AC electric output. The PV combining switchgear (PVCS), which is dispersed among the arrays, collects the power from the arrays for transmission to the project's substation.

The inverters that the Applicant intends to use on the project have a height of approximately 2.6m. It is estimated that 136 inverters will be required distributed amongst the PV array. It is likely that the inverters will be bolted to concrete pads that are similar in footprint size to the inverters.

3.3.4 Transformer

The inverters feed AC current to the transformer which steps it up to up to Medium Voltage (MV) either 11kV or 22kV for on-site transmission of the power.

Project Details indicate that the transformer will be approximately 2.6m high and will be located within a cabin. The height stated includes the cabin height.

3.3.5 Over Head Power Line

From the transformer, the power produced will be distributed to the Grid Connection via an overhead power line. No detail of this power line has been provided for the assessment other than an indication that an MV line will be used and it will connect to the grid within the Power Station Boundary. Information provided by the Applicant does indicate that current could be stepped up to 22kV on site. It is assumed that standard Eskom MV structures will be used to support the overhead power line. These are typically in the order of 11m from ground level to the lowest conductor (**Appendix III**).

3.3.6 Other Infrastructure

Other infrastructure will include a 2.6m high office building and control room, a 2m high fence and a permanent access road.

4 THE NATURE OF POSSIBLE VISUAL IMPACTS

As indicated in Section 2, the report addresses the following;

1. Aesthetic change to the landscape that could relate to a change in character or a change in the way that a landscape is perceived by specific receptors.

2. Ocular impacts from glare that could result in nuisance or a physical danger.

4.1 AESTHETIC CHANGE TO THE LANDSCAPE

As indicated in Section 2, this section of the assessment will focus on;

a. Generally landscape change or degradation. This is particularly important for protected areas where the landscape character might be deemed to be exceptional or rare. However it can also be important in non-protected areas particularly where landscape character is critical to a specific use such as tourism or for general enjoyment of an area. This is generally assessed by the breaking down of a landscape into components that make up the overall character and understanding how proposed elements may change the balance of the various elements. The height, mass, form and colour of new elements all help to make new elements more or less obvious as does the structure of an existing landscape which can provide screening ability or texture that helps to assimilate new elements. This effect is known as visual absorption capacity.

b. Change in specific views within the affected area from which the character of a view may be important for a specific use or enjoyment of the area. These impacts may be broken down into visual intrusion or visual obstruction.

    - Visual intrusion is a change in a view of a landscape that reduces the quality of the view. This can be a highly subjective judgement, subjectivity has removed as far as is possible by classifying the landscape character of each area and providing a description of the change in the landscape that will occur due to the proposed development. The subjective part of the assessment is to define whether the impact is negative or positive. Again to make the assessment as objective as possible, the judgement is based on whether the level of dependency of the use in question on existing landscape characteristics.

    - Visual obstruction is the blocking of views or foreshortening of views. This can generally be measured in terms of extent.

    Due to the nature of the proposed development, visual impacts are expected to relate to a combination of intrusion and obstruction with views from areas close to the development being likely to experience a high degree of obstruction.

4.1.1 THE NATURE OF THE DEVELOPMENT

During the construction phase, it is expected that traffic will be slightly higher than normal as trucks will be required to transport materials and equipment such as PV panels and frames to the site.

Depending on the topography of the proposed layout, site preparation will generally include the following activities:

- vegetation clearance – removal or cutting of any vegetation if present (bush cutting);
- levelling and grading of areas where the array will be sited would normally occur, the development description indicates that the land is relatively flat so only minor grading will be required;
- levelling of hard-standing areas, e.g. for temporary laydown and storage areas, as indicated above only minor grading is likely to be necessary;
- erection of site fencing, site alternative 2 is within the existing Eskom Security Fence so additional fencing will not be required for this alternative. Alternatives 1 and 3 are outside the existing security fence and so additional fencing is likely to be required. Alternative Site 2 is already fenced;
- construction of a temporary construction camp which will occur within a laydown area within the overall site (1-2ha).

These activities are only likely to be visible from the immediate vicinity of the site.

As the site is developed, concrete bases will be constructed, the support structures will then be assembled and PV panels attached, ancillary structures and buildings will also be constructed.

The development will therefore appear on a progressive basis in the landscape, however once the concrete bases are constructed, the structures are likely to be assembled rapidly.

The overhead power line that will link the facility to the grid within the power station boundary are also likely to appear in the landscape progressively. This will follow the same pattern as the PV array, with concrete bases being constructed first followed by assembly of structures and finally stringing of overhead lines.

The construction phase is programmed to take 20 months.

By the end of the construction process, the array has been assembled, minor buildings constructed and overhead lines have been strung between towers, the full visual impact of the project will be experienced. The operational phase is highly unlikely to result in any significant additional impact. It is possible however, that crews will be visible from time to time undertaking maintenance within the facility and on individual towers.

The main visible elements therefore are likely to include;

a) Overhead power lines, and

b) The solar array located within a fence line with associated minor buildings and structures.

a) Overhead Power Lines

Refer to **Appendix III** for detail of likely standard Eskom structures to be utilised.

These structures will be located against the backdrop of other, much larger power station infrastructure including overhead HV power lines.

Plate 1 indicates an overhead power line similar to that proposed. The view is taken during a period of good visibility along the line of towers which have a spacing of +/- 250m. In total 9 towers are visible along the line before it connects to a line running at right angles. The last tower in the line which is a solid pole structure is just visible at +/- 2.5km. The towers of the line running at right angles are lattice pylons, these are barely visible.

From the photograph and considering the backdrop, the following conclusions can be drawn;

- The visual mass of the overhead power line is unlikely to be obvious within the landscape from close views (within 2.5km).
- The visual effects of the assumed MV 22kV transmission lines are unlikely to be significant given the backdrop against which they will be experienced.

b) The Solar Array

No layout has been provided for the proposed solar array. From experience of similar projects, it is possible for groups of PV panels to be mounted either on individual supports or on continuous supports.

Individual supports are usually used when a tracking system is installed. The smaller structure allows the PV panels to be rotated to follow the sun during the day.

Continuous supports aligned in rows are generally used when the PV panels are fixed and are set at an angle and direction to maximise the average efficiency during the day.

From information provided, the facility will have PV panels supported in rows and set at an angle to maximise exposure to solar radiation. They will be orientated towards the north. However, the rows of PV units will be set at an angle of 25°. **Refer to Plates 2, 3, 4 and 5** for images of similar arrays.

From areas to the north a solar array, whether it is constructed on individual supports or continuous rows, is likely to appear as a continuous structure in the landscape.

The nature of the impact is also likely to vary with location and elevation;

- If the array is located on a hillside or if it is viewed from a higher level, the rows of PV units are likely to visually combine and will be read as a single unit. From a distance this is results in a PV array having a similar appearance as a large industrial structure when viewed from above.

- From the south, east and west the dark face of the PV units will not be obvious and subject to the colour of the undersides of the units, the supporting structures are likely to become more apparent. With distance however, the shadow cast by the structures is likely to be obvious and the facility will probably appear much as the northern face, a long dark structure.

Because of the contrast in colour with the surrounding landscape, the likely length of the rows when viewed from the north and combined area when viewed from above, if the landscape does not have significant visual absorption capacity, the array could be obvious to the limit of visibility. Subject to the colour and reflectivity of the underside of the PV units and supporting structure, it is possible that a similar level of impact could also be experienced from the south, east and west.

Mitigation or screening of views is possible at least from close views. This can be achieved either by earthworks berms by planting or by a combination of both. From a distance and particularly from higher areas to the north, east and west, mitigation is likely to be less feasible as the height of any screen is likely to cast shadow over the PV units. From the south however mitigation of distance views may be feasible.

In addition to the way that a solar array may change a landscape, the nuisance factor associated with resulting glare has also been raised by stakeholders on similar projects. However, PV units are designed to absorb as much energy as possible and are not generally designed to reflect light. This issue is generally more likely to be associated with a focussed array which tracks the suns path during the day and uses reflective surfaces to focus energy onto receptors. It is therefore not expected that this will be a significant issue with a PV array such as the one proposed.

4.2 OCULAR IMPACTS ASSOCIATED WITH GLARE

Solar reflections are commonplace occurrences for most people either from wet roads, expanses of water, or windows and mirrors of cars and buildings.

Solar cells are designed to absorb light to generate electricity, not reflect it, and so are much less reflective than other sources of solar reflection.

Solar reflections can only occur when the sun is shining. They have virtually no significance when the sun appears very close to the reflecting object – in angular terms, i.e., in almost the same direction – as seen by an observer (i.e., the observed angle between the sun and its reflection is close to 0°) since the much brighter sun will completely mask any reflections and the observer’s eyes will be attuned to brightness when looking in that direction thus reducing the apparent intensity of any reflections.

Conversely, solar reflections are at their worst when an observer is facing the reflecting object, is in shade from the bright sun so that his/ her eyes aren’t attuned to brightness, and the sun is behind the observer (i.e., the angle between observed reflections and the sun is close to 180°).

There are numerous publications reporting on the subject many of which are produced by solar panel manufacturers and solar power companies. Whilst these are useful and indicate methods that are used to minimise the problem including the use of transparent non reflective polymers to the face of solar panels to reduce reflection and maximise generation efficiency, they are not impartial.

There are also numerous reports from affected individuals that are generally emotive but they do indicate that there could potentially be a glare problem associated with PV installations.

The following section, that has been extracted from a 2012 Report prepared by Stephen Shea of the solar company Suniva, clearly indicates the nature of the issue.

> *The great majority of solar modules are made with a front surface of "Solar Glass". This is a tempered "soda-lime" float glass very similar to tempered window glass except that it has a much lower Iron (Fe) content. The lower Fe content makes solar glass much more transparent than regular window glass, (which has a slightly greenish tint due to absorption of light by Fe oxide complexes within the glass). Soda lime glass has an index of refraction of about 1.50-1.52. As stated above, the reflection from the first surface is a function of index of refraction alone, and does not depend on the Fe content. Thus, while solar glass is more transparent than window glass, its reflection properties are very similarly.*
>
> *As is the case with window glass, solar glass can be treated in ways that change the index of refraction of the front surface in order to minimize reflection. This treatment can take the form of either a coating or of a chemical modification of a shallow layer of the glass itself. Both treatments are optically the same, but the chemical treatment lasts longer in the field because it modifies the surface of the glass, rather than being a coating on the surface that can be more easily damaged or worn away. Generally, these treatments create a front surface index of refraction between 1.20 and 1.30. Glass treated in either of these ways is referred to as "Anti-Reflective" (AR) glass. Window glass is often treated in the same manner and with optically the same effect.*
>
> *So the reflectance of sunlight from solar panels is in its essence simply a variation on the commonly understood phenomenon of reflectance from glass used in, for example: building facades; skylights; automobiles and other common objects.*
>
> *Air has an index of refraction of 1.00, and reduction of reflection when light coming through air strikes a surface is basically a matter of reducing the index of refraction of that surface as close to 1.00 as possible (if the surface has an index of exactly 1.00, then it is optically identical to the air, and the light responds as if the interface surface is not even there). A familiar reflective material is water, which has an index of refraction of 1.333. In windless weather a quiet pond will have a very smooth, reflective surface. Reviewing the information above, one would expect that non-AR glass would be more reflective than the pond water (Index 1.52 versus Index 1.333), while AR glass would be less reflective than water (Index 1.20-1.30 versus Index 1.333).*

Indeed, this is the case. Figure 3 is a chart of reflection from all three surfaces as a function of angle of incidence (where angle of incidence is measured from "normal" incidence in which the light strikes the glass or the water straight on). Note that, for all angles, the reflectance from the water surface falls between the reflectance curves for the two different types of glass. Note also, that the calculation for the water surface assumes that the water is completely still, so that all the reflection is specular (like a mirror). This is of course the worst case for glare from the water. Any wind across the water surface will "roughen" the surface and create a more diffuse reflectance and therefore less intense glare.

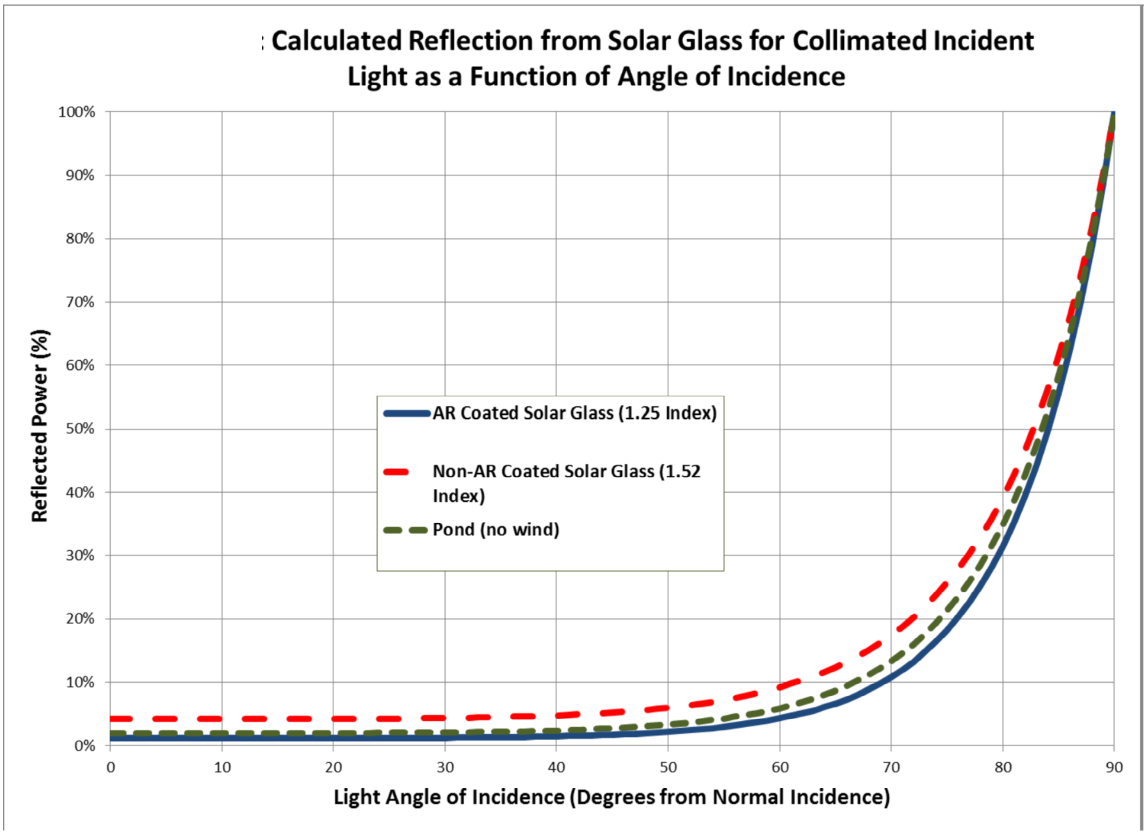


Figure 3, Reflected intensity of the light ("Power") as a percentage of the incoming intensity.

It is immediately apparent that the reflected intensity is quite low with respect to incoming intensity for incident angles below 60o to 70o, and then rises rapidly for higher (more "glancing" angles). That is, the percentage of the incoming sunlight that is reflected is low for high sun angles (most of the day) and increases for very low sun angles (near dawn and sunset). Since the sun covers a sky angle of 15o in an hour, the reflection will be above about 20% for roughly the first hour and the last hour of the day.

This indicates that the intensity of glare is likely to increase with glancing angles as less light is absorbed and more light reflected. These conditions are likely to occur when the elevation of the sun is low during early morning and late afternoon for viewers at a similar level as the array. For observers that are significantly higher than the array however, such as those on an aircraft flight path above the site, the timing of adverse conditions will vary subject to the location of the aircraft relative to the array.

Glare is also likely to be a temporary impact in most instances only causing nuisance during a certain time of day and possibly time of year. **Refer to Plate 6**.

Plate 1, view of similar line to that proposed. Note pylons on the horizon (approx 2.5km distance) are just visible.

Plate 2, PV array viewed from approximately the same ground level as the array. Note the array appears as a linear dark element in the landscape

Plate 3, PV array viewed from above. Note the array rows are read as one and have a similar impact as the roof of a large industrial building might.

Plate 4, PV array viewed from behind and the side. The dark face of the PV units are not obvious and subject to the colour of the undersides of the units, the supporting structures are likely to become more apparent. This might appear as a long industrial structure from close quarters. From a distance however, the shadow cast by the structure will be read and will probably appear similar in nature to the front view of the array.

Plate 5, PV array screened by low vegetation. It is possible to screen a PV array from close viewpoints at a similar level to ground level within the array.

Plate 6, Glare experienced in the Control Tower at Boston Regional Airport from a PV array

5 DESCRIPTION OF RECEIVING ENVIRONMENT AND RECEPTORS

5.1 ASSESSMENT LIMIT

The GIS based assessment of Zones of Theoretical Visibility does not take the curvature of the earth into account. In order to provide an indication of the likely limit of visibility due to this effect a universally accepted navigational calculation (**Appendix IV**) has been used to calculate the likely distance that the proposed structures might be visible over. This indicates that in a flat landscape a structure 4m high could be visible at a distance of approximately 7km. In order to make allowances for local ground level variations a safety margin of 3km has been added to the visibility limit buffer. From experience, the author is confident that the proposed structures are unlikely to be visible outside this buffer.

Section 4 also indicates that due to the nature of the structures involved, the proposed overhead power lines are unlikely to be obvious at a distance greater than 2.5km.

An approximate Visual Horizon of 10km is therefore considered to be appropriate for this study.

5.2 LANDSCAPE CHARACTER

Landscape character is defined as "a distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another".

As indicated previously, this scoping assessment was undertaken without site visits. Landscape character has therefore been defined from the author's knowledge of the area and from reference to available online mapping and aerial photography. It is thought that the key character components have been identified but they will be subject to verification

Landscape Character is a composite of a number of influencing factors including;

- Landform and drainage
- Nature and density of development
- Vegetation patterns

5.2.1 Landform and Drainage

The proposed alternative site areas are located in a bowl that has been formed by a major meander in the Vaal River. The base of the bowl is set at around 1445m amsl. Land rises gently to north, south, east and the west to between 1495 to 1510m amsl.

The proposed alternative sites are located close to the slopes of the southern edge of the bowl. This adjacent landform is likely to have a significant influence on the extent of visibility to the south.

The Vaal River is the main drainage feature of the area. This is a major river with an overall channel width in the order of 100m to 200m. The river banks rise at a slope in the order of 1:3 to 1:6 to a height of 2m to 5m above the river level.

A number of tributaries flow into the Vaal in the vicinity of the proposed alternative sites. These tributaries bisect the elevated landform of the bowl edges creating minor valleys through the ridgelines.

The Vaal Dam lies approximately 19km to the south east of the proposed alternative sites. The outfall from the dam provides the main flow within the river.

There is a minor ridgeline approximately 500m to the south and west of the alternative sites that is likely to limit visibility in those directions.

The Vaal River is located in a depressed river channel which limits views from this area.

The landform on the northern side of the Vaal River rises gradually into a series of west to east running ridgelines. This could help to open up views over the alternative sites from this area.

Refer to Figure 3 for analysis of the landform.

5.2.2 Nature and Density of Development

Development within the study area can be divided into the following types;

- **Heavy industrial development** which includes the adjacent Lethabo Power Station, open cast mining areas to the north and west of the proposed alternative sites, Mittal Steel to the north of Vereeniging and the Sasol refinery in Sasolburg to the south west. These activities include large industrial structures such as cooling towers, overhead conveyors and other industrial buildings that are visible over a wide area. They have an overwhelming impact on landscape character from immediately adjacent areas but also influence landscape character over a wider area.
- **Urban development** including Vereeniging and Vanderbijlpark to the north of the Vaal and Sasolburg to the south west. These are relatively dense urban areas that are generally inward looking. Views of the broader landscape are generally only possible from the edges of the developed areas.
- **Agricultural development** which includes small holdings to the south of the proposed alternative sites and closer to the urban areas and larger farming units that are generally located to the south and east. Farms are generally a mixture of arable and pasture.

5.2.3 Vegetation Patterns

Vegetation patterns can be divided into the following;

- Urban Vegetation generally consists of street trees and ornamental garden vegetation. This has a major influence on outlook as it softens hard urban structures, helps to limit visibility from within the area and provides points of interest.

- Riverine Vegetation particularly on the banks of the Vaal River has a major influence on views from within this corridor. Vegetation is generally comprised of alien trees such as the *Salix babylonica* (weeping willow). Over much of the adjacent river bank, this vegetation screens adjacent areas from within the river corridor.
- Boundary vegetation and vegetation on non-productive sections of agricultural areas. This is largely comprised of individual and groups of alien trees and scrub. Whilst the patches may be isolated allowing a degree of permeability, the combined effect of these patches is generally a significant foreshortening of views.

5.2.4 Landscape Character Areas and Visual Absorption Capacity

Landscape Character Areas (LCAs) are defined as "single unique areas which are the discrete geographical areas of a particular landscape type".

The affected landscape can be divided into the following general character areas that are largely defined by development.

- **Industrial Landscape Character Areas** that are located around heavy industrial and large mining areas. The structures associated with these uses dominate the landscape. Existing industrial structures are likely to provide significant screening particularly from middle distance and distance views. From a distance small scale development may also be viewed against a backdrop of larger industry which is also likely to make it less obvious. In terms of sensitivity to possible landscape change due to the proposed development these areas are not likely to be sensitive. The relatively low elements that are proposed are likely to have little or no influence on the nature of the areas.
- **Urban Landscape Character Areas** that are generally inward looking residential and commercial areas, consequently adjacent industrial areas have minimal influence. Minor development close to the edge or within these areas might influence their character, however small scale development away from the edge is highly unlikely to have any influence on the way that these areas are used or perceived.
- **Rural Landscape Character Areas.** This is a mainly productive landscape. These areas are interspersed with smaller extractive industry and because they are relatively open, larger industrial operations influence character particularly from northern sections that are closer to the Power Station and Sasolburg Refinery. This character area cannot therefore be considered as a pristine agricultural landscape although the further to the south and east one travels towards the Vaal Dam, the smaller the influence of industry and mining becomes and the greater the perception there is of it being a cohesive agricultural landscape. The vegetation pattern results in a high degree of screening of low level development such as that proposed. This is likely to mean that occasional glimpses of the development may be possible from these areas particularly from adjacent areas, however as the viewer moves to the south and east, existing vegetation is likely to screen views.
- **Riverine Corridor Landscape Character Areas**. This is far from a pristine landscape mainly due to adjacent development and the extent of alien vegetation; however, it does have local significance as it is a relatively natural corridor within a densely developed area. Due to elevation and the extent of riverine vegetation views out of this corridor are limited. This is likely to mean that the proposed development is unlikely to be obvious.

5.2.5 Landscape quality and importance

From review of existing mapping there do not appear to be any protected landscape areas.

The **Industrial Landscape Character Area**, in which the proposed development is located is a functional area first and foremost. Its only importance is related to ensuring that the industry including power production and mining, functions efficiently. The main visual elements include power station and mine buildings and dumps. The natural landscape is highly degraded. There are blocks of alien trees close to the northern and western edges of the power station that do screen many of the lower elements within the complex particularly from the north, east and west.

The **Urban Landscape Character Area** are possibly the most cohesive character areas, as once inside settlement areas, existing buildings and street / garden trees block the majority of views of surrounding areas. Consequently, views towards the site are only possible from the urban edge and from elevated areas particularly overlooking undeveloped or open areas within the urban structure. Whilst the urban area has a diverse range of uses, the use that could possibly be most sensitive to infrastructure development such as that proposed is the residential component. It is likely however that the distance between the urban edge and the proposed development, the extent of exiting industrial development that is already obvious and the screening effect of existing vegetation will mean that the degree of sensitivity to the development will be low.

Rural Landscape Character Areas cover two areas that have some key differences and might be considered separate character areas;

- The rural area to the south and west of the Vaal River are highly impacted by industrial infrastructure and urban fringe elements such as substations and old mine dumps. This area also has a number of small holdings. This means that the rural area is generally more degraded and land units are more divided and generally smaller scale when compared to the rural area to the east of the Vaal River. The main agricultural activity within this area appears to be livestock grazing.
- The rural area to the east of the Vaal River appears to include larger scale agricultural units and a more diverse agricultural mix including both arable and livestock grazing. The area is also less impacted by infrastructure than the area to the west of the River.

In both rural areas, the focus is on agricultural production which means that most users of the areas are unlikely to view negatively a development that has no impact on production.

The area to the west of the Vaal River is also already impacted by infrastructure and mining. The addition of the proposed development within the power station boundary is not likely to add to these existing impacts.

The rural area to the east of the Vaal River is used as a corridor for people travelling to the Vaal Dam which has regional and possibly national importance for water based recreation. Any development that changes the character of this approach corridor might be considered to have negative connotations for these users. Given the power station context within which the proposed development will take place and the distance, it is unlikely that there will be any change of character due to the proposal. However, this needs to be addressed during the assessment.

The Riverine Landscape Character Area is an important local recreational resource. It has also been used by recreational, tourism and residential development as a setting for these activities and so has obvious aesthetic importance within the area.

The river channel is generally depressed below the adjacent landscape character areas. It is also in the main lined with tall riverine vegetation which generally includes alien tree species such as *Salix babylonica* (weeping willow). This level difference and surrounding vegetation result in views from the corridor being largely blocked. In the main, it is only the larger industrial elements such as chimney stacks and cooling towers of the power station that may be visible.

This area could therefore be sensitive to development that would change its character in any way that would make it less attractive for recreation or recreational, tourism and residential development. However, given the extent of existing screening, the extent of industrial development adjacent to this character area and the distance between the proposed sites and the river channel, it seems unlikely that any significant impact will occur. This needs to be addressed as part of the assessment.

These LCAs have been ground truthed and mapped, refer to **Figure 4**.

5.3 VISUAL RECEPTORS

Visual receptors are defined as "individuals and / or defined groups of people who have the potential to be affected by the proposal".

5.3.1 Identified Visual Receptors

It is also possible that an area might be sensitive due to an existing use. The nature of an outlook is generally more critical to areas that are associated with recreation, tourism and in areas where outlook is critical to land values.

This section is intended to highlight Sensitive Receptors or places within the landscape which due to use could be sensitive to landscape change. They include;

- Area Receptors which include;
  - Urban areas on the fringes of Sasolburg, Vereeniging and Vanderbijlpark. Should there be a significant impact on these areas, it is possible that there could be significant objection from residents. However, the landscape analysis and field investigation has indicated that, due to the distance between the site and receptors and due to the extent of existing vegetation whilst sections of the proposed development may be visible, it is unlikely that it will be obvious to these areas.
  - Two small residential areas close to and to the south of the proposed sites. These areas include housing associated with the adjacent mine as well as a school and social club. At the time of the site visit, the housing area had been abandoned and sections were under demolition. Due to the extent of vegetation

within the housing area and the aspect of the development, views over the proposed sites was only possible from small eastern most sections of this receptor. The existing school and social club overlook the proposed sites, however the sites are only visible from the northern extremity of this area receptor.

  - Areas that re important for tourism and recreational use such as local golf courses, Emerald Resort, the Vaal River Corridor and the Vaal Racecourse. As with the urban landscape areas, the landscape analysis and field investigation has indicated that, due to the distance between the site and receptors and due to the extent of existing vegetation it is unlikely that the proposed development will be visible from any of these areas.

- Linear Receptors which include main routes through the area. The most sensitive of these is likely to be the R54 as this is the main route to the Vaal Dam which is a major local recreation and tourism destination. The landscape analysis and field investigation has indicated that, due to the distance between the site and receptors and due to the extent of existing vegetation the proposed development is unlikely to be visible from the R54. It is possible that it could be visible over a short section of the R716 and R82 roads, however due to the extent of existing vegetation the full extent of development is not likely to be obvious and it will only be visible over a short section of road.
- Point Receptors that include isolated and small groups of homesteads that are generally located within the Rural Landscape to the south and east of the area. The landscape analysis and field investigation has indicated that, due largely to landform, the proposed development will not be visible to any of the identified point receptors to the south of the alternative sites and due to distance and existing vegetation, parts of the proposed development may be visible but are unlikely to be obvious from point receptors to the east of the alternative sites.

Possible visual receptors that may be sensitive to landscape change are indicated on **Figures 6 and 7 (Zones of Theoretical Visibility).**

URBAN LANDSCAPE CHARACTER AREA

RURAL LANDSCAPE CHARACTER AREA

RIVERINE LANDSCAPE CHARACTER AREA

INDUSTRIAL LANDSCAPE CHARACTER AREA

FIGURE 4, LANDFORM AND DRAINAGE

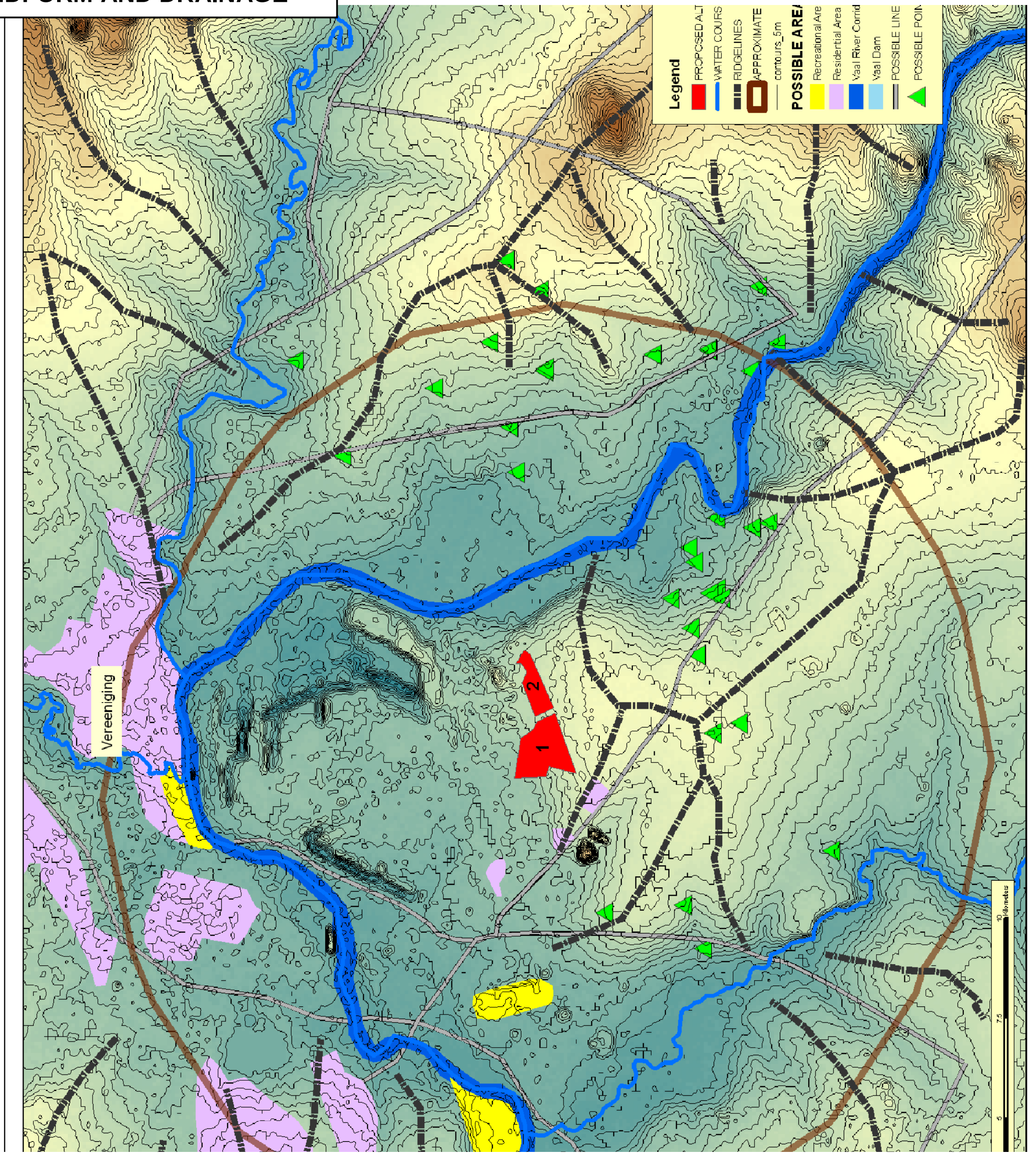
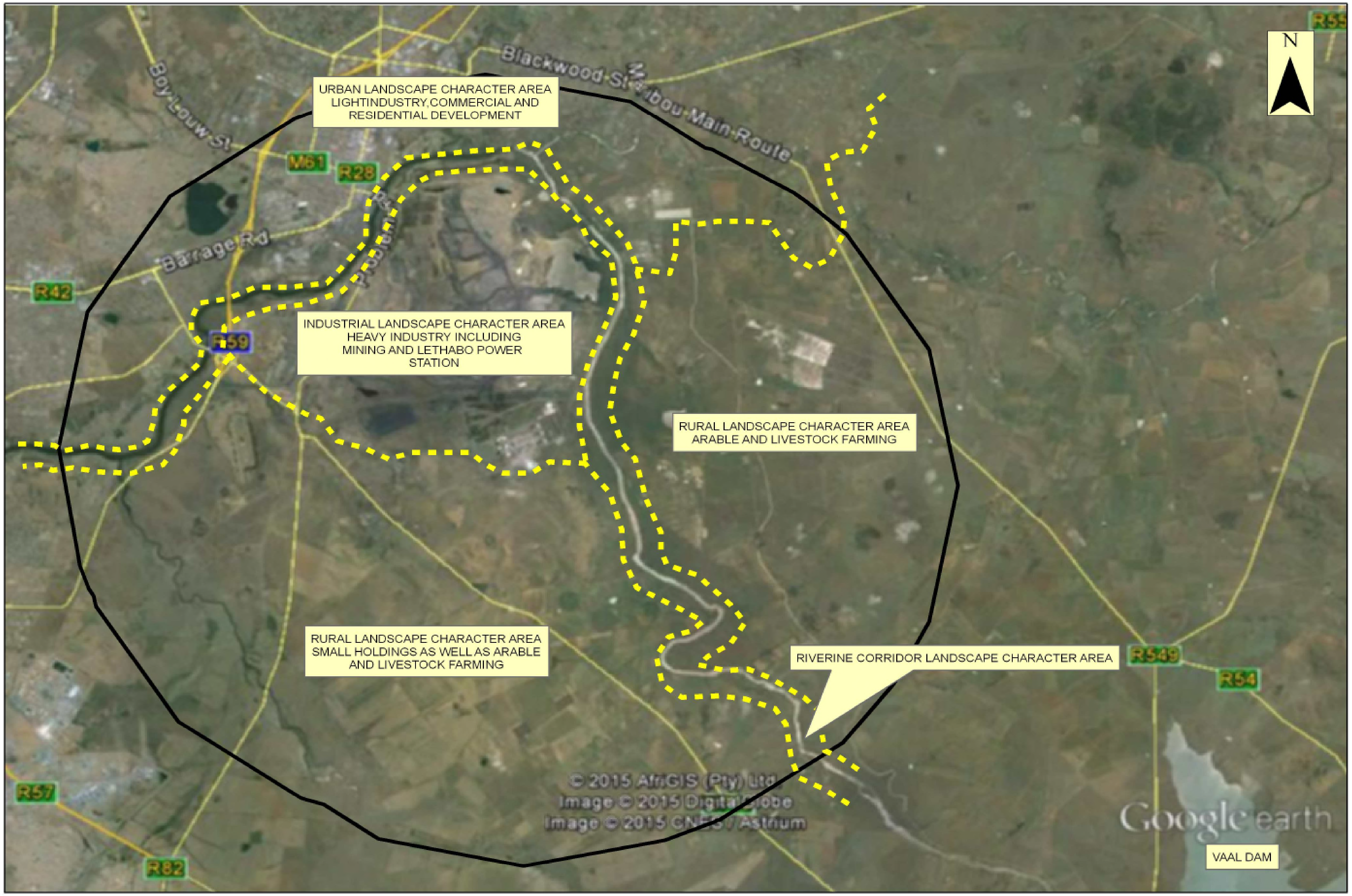


FIGURE 5. EXTENT OF LANDSCAPE CHARACTER AREAS



Afzelia	**MAP 4 - Landscape Character Areas (LCAs)** **Lethabo Solar EnergyFacility** **Freestate Province**	**PO Box 37069, Overport, Durban,4067** **Tel:031 303 2835** **Email:andrew@afzelia.co.za** **Date: 19/02/2015**	ENVIRONMENTAL PLANNING AND DESIGN

6 VISIBILITY OF THE PROPOSED DEVELOPMENT

6.1 ZONES OF THEORETICAL VISIBILITY

Zones of Theoretical Visibility (ZTV) are defined as "a map usually digitally produced showing areas of land within which a development is theoretically visible".

ZVTs for each alternative development site have been assessed using Arc Spatial Analyst GIS.

The assessment is based on terrain data that has been derived from satellite imagery. This data was originally prepared by NASSA and is freely available on the CIAT-CCAFS website (http://www.cgiar-csi.org). This data has been ground truthed using a GPS and an online mapping programme.

Whilst the ZTV has been calculated from terrain data only, existing vegetation and development could have a significant modifying effect on the areas indicated.

As indicated in Section 5.1, the Approximate Visual Horizon is indicated on each map to highlight the area outside which the proposed development is unlikely to be visible.

6.2 APPROACH TO THE ASSESSMENT

6.2.1 PV Array and ancillary infrastructure

As indicated, no layout has been provided for the proposed alternative PV array sites. It has therefore been assumed that each site as identified will be developed in its entirety.

Each ZVT has therefore been calculated assuming that 3m high structures will be located from corner to corner evenly across the site. From the information provided it seems that this approach will cover all small buildings, ancillary infrastructure and fences and should be a worst case scenario.

6.2.2 MV Tie In to the National Grid

As indicated previously, no detailed information has been provided regarding the overhead power line that will be needed for each alternative site to tie in to the national grid. It is however known that this will be internal to the power station.

Given the lack of information it is not possible to provide a detailed assessment indicating the zone of theoretical visibility. The approach taken therefore is to make comment based on understanding of the requirement and the brief visibility assessment included in section 4.

6.3 VISIBILITY OF ALTERNATIVE SITES

Figures 6 and 7 indicate the ZTV for each alternative PV array development.

The assessment indicates that;

i. The Power Station structures play a major role in limiting views of the proposed development to the north. Alternative Site 1 particularly is well screened by these structures as it is surrounded to the north and west by conveyors and to the east by the main power station structures.

ii. Alternative Site 1 is largely visible to the north and east whereas Alternative Site 2 is largely visible to the east.

iii. A minor ridgeline to the east of the Vaal River will screen views of Alternative Site 2 from the R54.

iv. A series of minor ridgelines to the north of the alternative sites will screen views of all alternative sites from areas to the north.

6.5 KEY VIEWPOINTS

Key viewpoints that are adjudged to afford the best view of or towards the alternative sites from the identified visual receptors / LCAs are located on **Figures 6 to 7 inclusive**. Photographs from these viewpoints are included as Plates 2 to 10 inclusive.

FIGURE 6, ZONES OF THEORETICAL VISIBILITY – SITE ALTERNATIVE 1

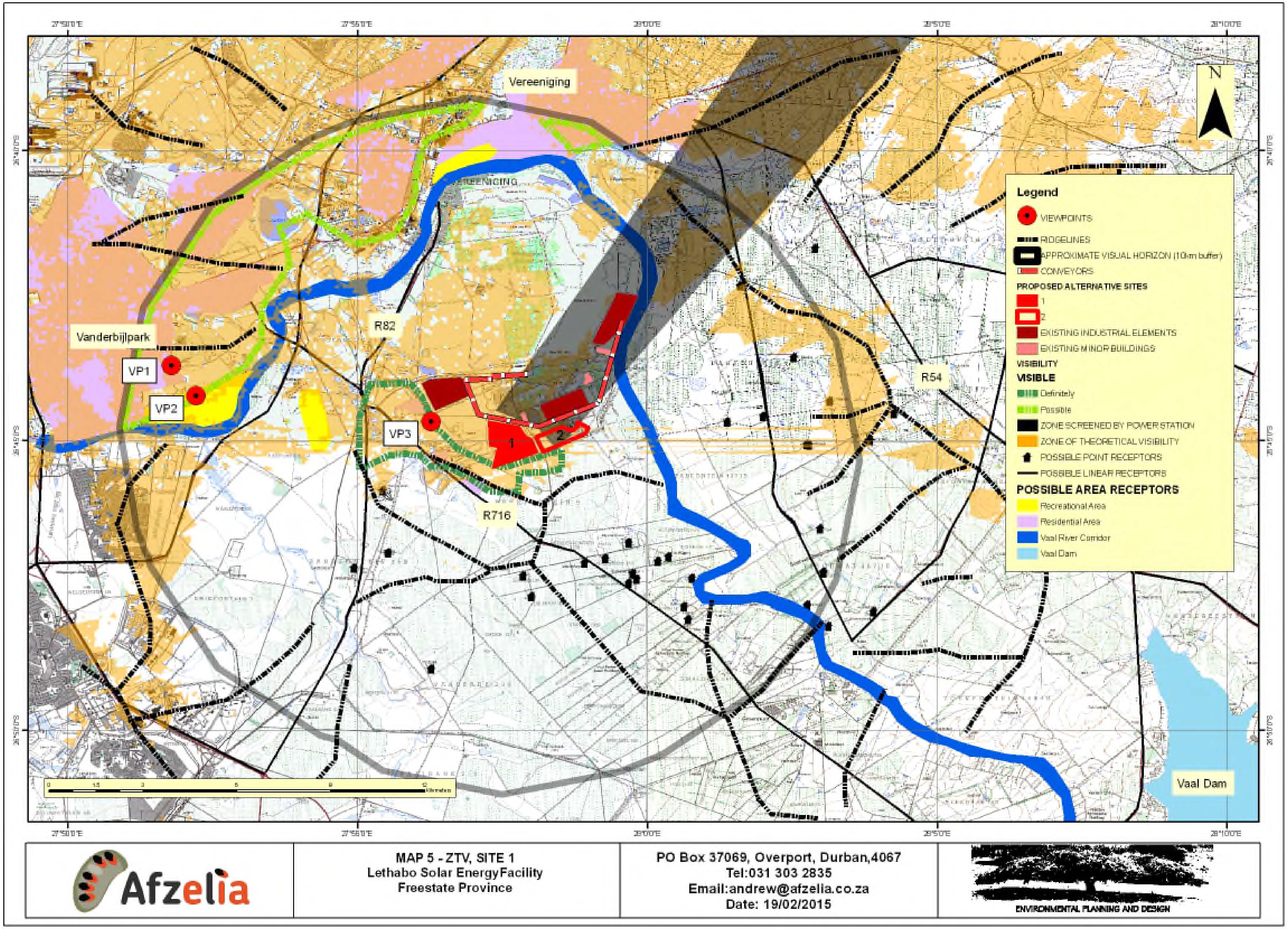
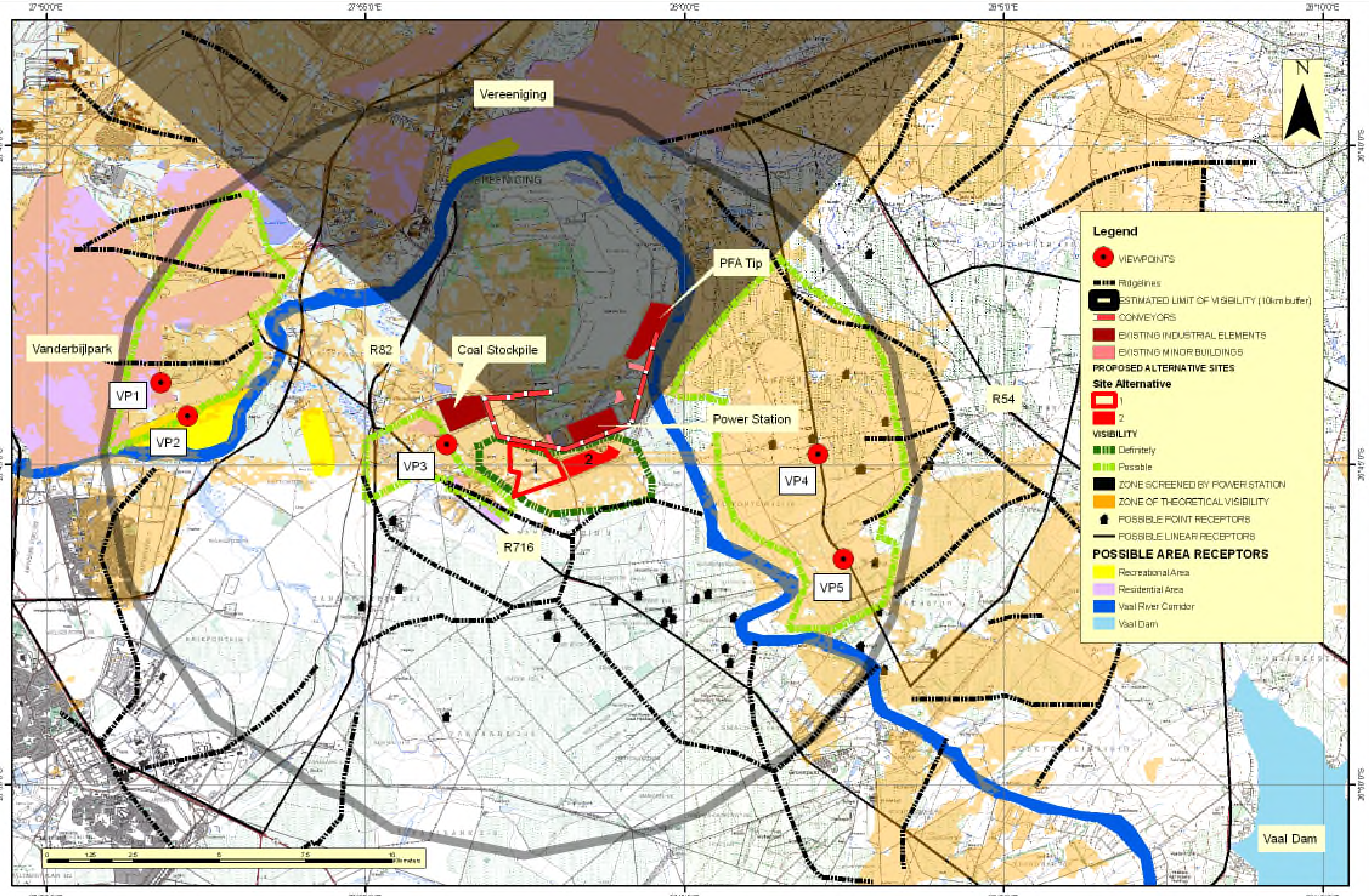


FIGURE 7, ZONES OF THEORETICAL VISIBILITY – SITE ALTERNATIVE 2



Afzelia	MAP 6 - ZVT, SITE 2 Lethabo Solar Energy Facility Freestate Province	PO Box 37069, Overport, Durban,4067 Tel:031 303 2835 Email:andrew@afzelia.co.za Date: 19/02/2015	ENVIRONMENTAL PLANNING AND DESIGN

PLATE 7, VIEWPOINT 1 (VANDERBIJLPARK), SITE ALTERNATIVE 1
The development will be partially screened by existing vegetation from this viewpoint.

PLATE 8, VIEWPOINT 1 (VANDERBIJLPARK), SITE ALTERNATIVE 2
The development will be largely screened by the power station. The section that could be visible from this viewpoint will be partially screened by existing vegetation.

PLATE 9, VIEWPOINT 2 (EMERALD RESORT), SITE ALTERNATIVES 1 & 2
This viewpoint is lower than Viewpoint 1, consequently both alternative development sites are screened by existing vegetation

PLATE 10, VIEWPOINT 3 (E EDGE OF DERELICT MINE HOUSING), SITE ALTERNATIVE 1
The development will be viewed slightly from above. From most of the housing area, social club and school site oblique views over the array are possible.

PLATE 11, VIEWPOINT 3 (E EDGE OF DERELICT MINE HOUSING), SITE ALTERNATIVE 2
The development will be viewed in profile. From most of the housing area, social club and school site no views over the site are possible.

PLATE 12, VIEWPOINT 4 (E SIDE OF VAAL RIVER), SITE ALTERNATIVE 2
The development may be partially visible but will be largely screened by existing vegetation. Distance helps to mitigate impact. It would be possible to use screen planting to completely hide the array.

PLATE 13, VIEWPOINT 5 (E SIDE OF VAAL RIVER), SITE ALTERNATIVE 2
The eastern end of the development could be partially visible but the majority of the development will be screened by landform and existing vegetation. Distance helps to mitigate impact. It would be possible to use screen planting to completely hide the array.

7 AREAS AFFECTED BY GLARE

Sandia National Laboratories[2], provide online tools for mapping solar glare and flux (http://www.sandia.gov/about/index.html) enabling lay persons to input key data including location, extent, height and power of a proposed array as well as set angles or tracking parameters. This enables the generation of a simple glare analysis providing an indication of timing as well as intensity.

As indicated in Section 2.2, the Sarndia National Laboratories online glare model has been used to predict areas that are likely to be affected by glare.

The array areas were plotted as well as possible receptors in residential areas to the north (1), residential areas to the west (2) as well as a smallholding to the east. Details of the array in terms of power, height, orientation and tilt were also input.

Figure 8, Location of alternative arrays and possible sensitive receivers input into the glare model

[2] Sandia National Laboratories is operated and managed by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation. Sandia Corporation operates Sandia National Laboratories as a contractor for the U.S. Department of Energy's National Nuclear Security Administration (NNSA) and supports numerous federal, state, and local government agencies, companies, and organizations. As a Federally Funded Research and Development Center (FFRDC), Sandia may perform work for industry responding to certain types of federal government solicitations. The solicitation must allow FFRDC participation and meet the requirements of Sandia's management and operating contract with DOE/NNSA.

Findings indicate that both alternatives could result in minor degree of glare occurring to the east of the Vaal River from February to March and September and October.

No other areas appear to be affected by glare.

Figure 9 and 10 indicate graph print outs from the model indicating likely timing and severity of the impact of glare for Alternative 1 and Alternative 2 respectively.

The Solar plot (**Figure 11**) confirms that at the time of the anticipated impact the elevation of the sun is below 10° and the azimuth is approximately -100 °. This fits with the models predictions.

The full report of from the Sandia Laboratories glare model is attached as **Appendix V.**

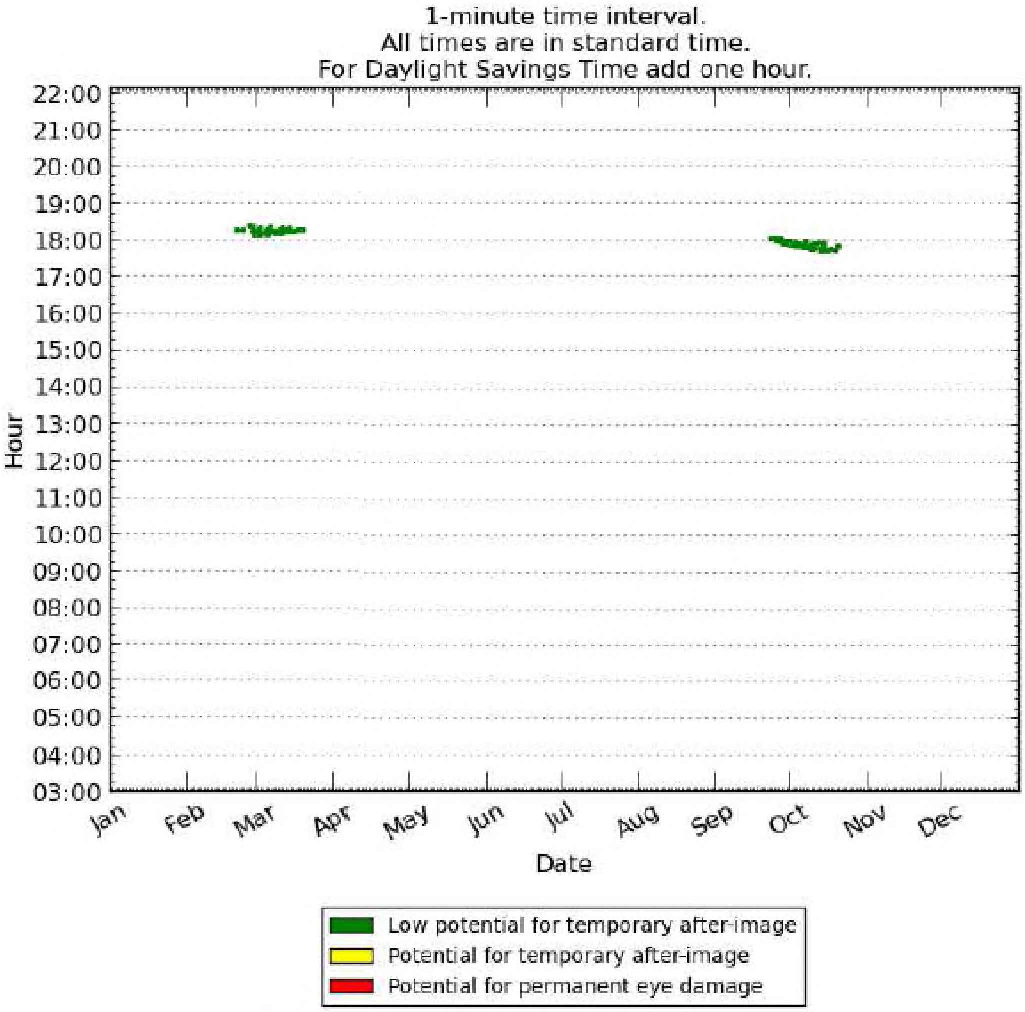


Figure 9, Array 1 - Point 3 (east of Vaal River) Glare Report.
Results indicate that between late February and through March as well as late September and October a low level of glare might be experienced to the east at around 18h00 in the late afternoon.

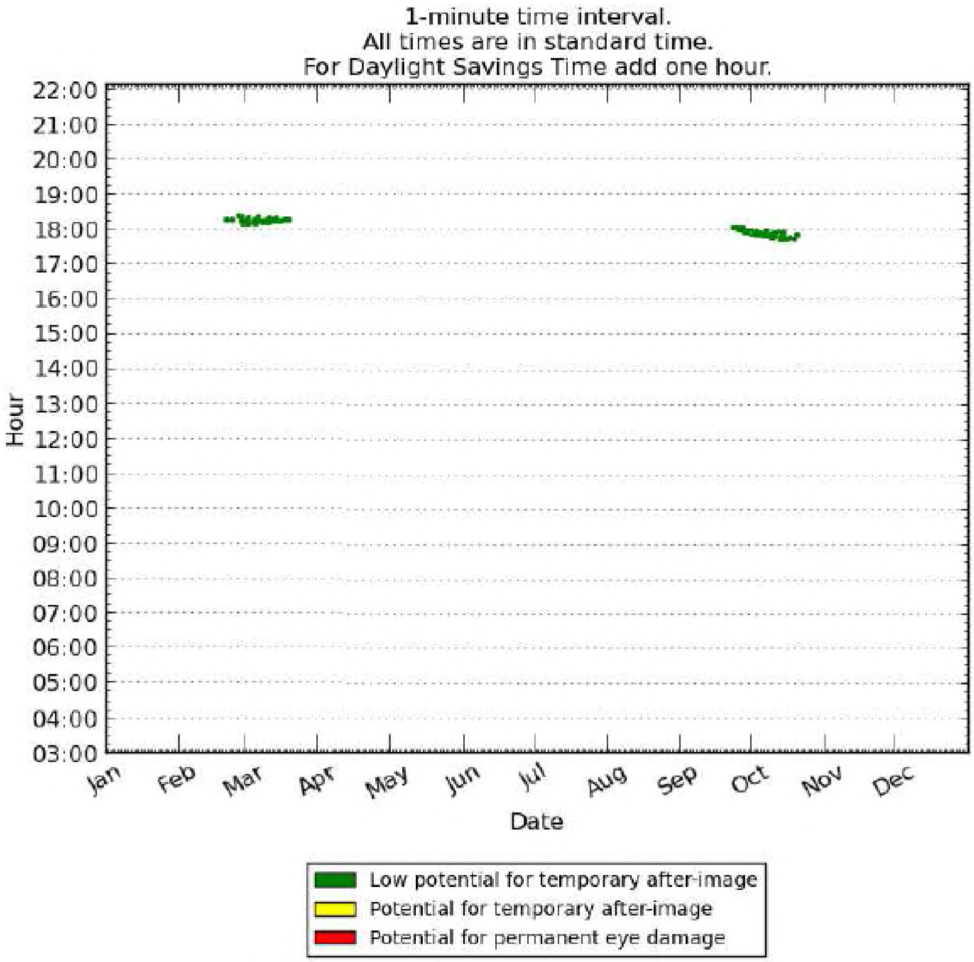


Figure 10, Array 2 - Point 3 (east of Vaal River) Glare Report.
Results indicate that between late February and through March as well as late September and October a low level of glare might be experienced to the east at around 18h00 in the late afternoon.

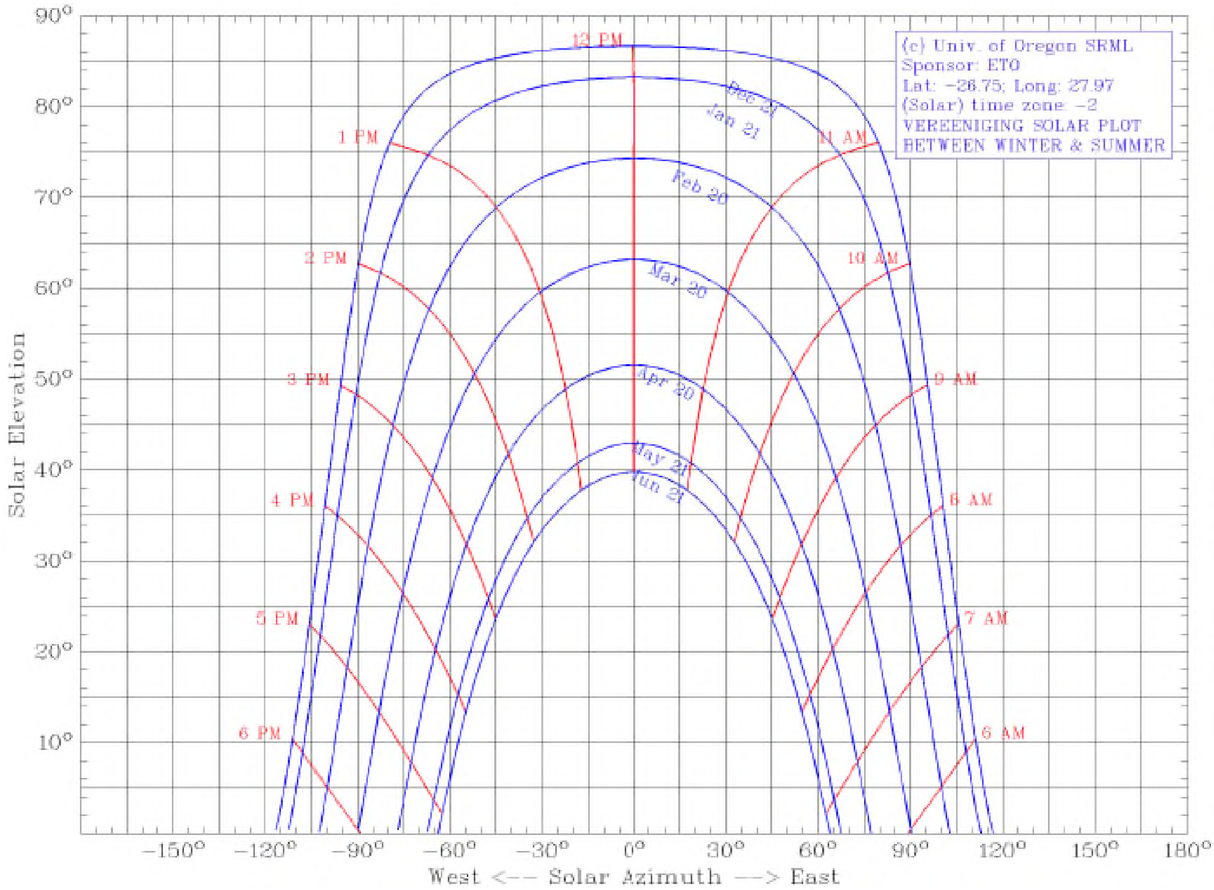


Figure 11, Vereeniging Solar Plot

8 POTENTIAL VISUAL IMPACTS AND POSSIBLE MITIGATION MEASURES

Criteria for the assessment are indicated in Section 2, Methodology.

Although a separate ZTV has been developed for each alternative array, these are considered together in the assessment.

Impacts associated with development alternatives fall into three categories including;

1. Landscape degradation,
2. Change of view for visual receptors.
3. Ocular impacts associated with glare.

8.1 LANDSCAPE DEGRADATION

The key areas that could be sensitive to change of character identified at the scoping stage and confirmed during the site visit include;

1. The Urban Landscape Character Area. The main concern relates to further industrial influence at the edges of the LCA.
2. The Rural Landscape Character Area. The main concern relates to the area to the east of the Vaal River which is less degraded by industry and mining than the area to the west of the river. This area is also important as it forms part of the access corridor to the Vaal Dam.
3. The Riverine Landscape Character Area. This is an important local recreation resource. The scoping study indicated that this LCA would be subject to minimal impact. This was confirmed during the site visit when it was found impossible to obtain a view of the site from the river corridor. There will therefore be no impact on this LCA due to development of any of the site alternatives.

8.1.1 Urban Landscape Character Area

Table 3, Landscape Degradation Urban LCA

Nature of impact: Further industrial influence at the edges of the LCA.		
	Without mitigation	**With mitigation**
Extent	**<u>Alternatives 1 and 2</u>** Site and immediate surroundings **(2)**	No mitigation possible
Duration	**<u>Alternatives 1 and 2</u>** Long term **(4)**	No mitigation possible
Magnitude	**<u>Alternatives 1</u>** The proposed development is unlikely to be highly obvious from urban areas. **(2)** **<u>Alternatives 2</u>** The proposed development is unlikely to be visible from urban areas. **(0)**	No mitigation possible
Probability	**<u>Alternatives 1</u>**	No mitigation possible

	Significant impact is improbable **(2)** **<u>Alternatives 2</u>** Significant impact is very improbable **(1)**	
Significance	**<u>Alternatives 1</u>** Low **(16)** **<u>Alternatives 2</u>** Very low **(6)**	No mitigation possible
Status	**<u>Alternatives 1</u>** Negative. **<u>Alternatives 2</u>** Neutral.	N/A
Irreplaceable loss	The project can be dismantled. Therefore there will be no irreplaceable loss.	N/A
Can impacts be mitigated?	Mitigation is not possible.	
Mitigation / Management: Mitigation is not possible. ***Explanatory note:*** Development of Alternative Sites 1 and 2 are likely to be visible from higher urban areas to the north of the Vaal Dam and particularly in higher areas of Vanderbijl Park. However, views of the alternative developments will be at least part screened by existing vegetation and distance will also help to significantly reduce the influence of this development. Alternative 2 is also largely screened by the existing plant and is further from urban areas than Alternative 1. It is therefore not expected that the development of alternative 1 or 2 would have any significant impact on existing urban LCA the edges of which are already impacted by industry. No mitigation measures are necessary as existing vegetation will significantly break views of both alternatives.		
Cumulative Impacts: Both alternative 1 and 2 will increase the extent of industrial development and reduce the extent of green space obvious in the views from the selected viewpoints. However, Alternative 2 will largely be viewed with the plant as a backdrop whereas Alternative 1 will visually extend industrial development into a green space. Cumulative impacts associated with Alternative 1 are therefore unlikely to be noticeable whereas the cumulative impact associated with Alternative 2 is likely to be un-noticeable.		
Residual Impacts: As mitigation of this impact is not possible the impact indicated above is residual.		

8.1.2 Rural Landscape Character Area

Table 4, Landscape Degradation Rural LCA

Nature of impact:
Degradation of the Rural LCA particularly the corridor leading to the Vaal Dam.

	Without mitigation	With mitigation
Extent	<u>**Alternatives 1 and 2**</u> Site and immediate surroundings **(2)**	No mitigation possible
Duration	<u>**Alternatives 1 and 2**</u> Long term **(4)**	No mitigation possible
Magnitude	<u>**Alternatives 1**</u> The proposed development is unlikely to be visible from key rural areas. **(0)** <u>**Alternatives 2**</u> The proposed development is unlikely to be highly obvious from rural areas. **(2)**	<u>**Alternatives 2**</u> The proposed development is very unlikely to be highly obvious from rural areas. **(1)**
Probability	<u>**Alternatives 1**</u> Significant impact is very improbable **(1)** <u>**Alternatives 2**</u> Significant impact is improbable **(2)**	<u>**Alternatives 2**</u> Significant impact is improbable **(1)**
Significance	<u>**Alternatives 1**</u> Very low **(6)** <u>**Alternatives 2**</u> Low **(16)**	<u>**Alternatives 2**</u> Very low **(7)**
Status	<u>**Alternatives 1**</u> Neutral. <u>**Alternatives 2**</u> Negative.	N/A
Irreplaceable loss	The project can be dismantled. Therefore there will be no irreplaceable loss.	N/A
Can impacts be mitigated?	Yes	

Mitigation / Management:
There is slight concern regarding the extent of visibility of alternative 2 to areas to the east of the Vaal Dam. There currently is a block of alien trees within Eskom land that will help to screen this view. Mitigation measures might include, ensuring that this block of vegetation is retained and augmented / extended. It would be possible to completely screen this alternative from areas to the east within three to five years if screen planting is undertaken around the south eastern and eastern sections of the proposed site.

Explanatory note:

a) Landform to the south and west of the alternative development sites significantly limits visibility from those directions. Existing vegetation also helps in this regard. Impacts on the Rural LCA to the west of the Vaal River resulting from all development alternatives is therefore negligible.
b) Development of Alternative Site 1 will not be visible to the Rural LCA to the east of the Vaal River.

Development of Alternative Site 2 is likely to be visible to the Rural LCA to the east of the Vaal River. It will however be largely screened by both landform and existing vegetation. Distance will also play an important role in minimising this impact as the array will be viewed in profile meaning that at most a 4m high band will be visible.

Cumulative Impacts:
Alternative 1 will not increase the extent of industrial development as seen from rural

areas. Hence there is no cumulative impact. Alternative 2 could marginally increase the extent of industrial development that is seen from rural areas and hence the impact indicated above is cumulative.
Residual Impacts: Residual impacts associated with Alternative 2 after mitigation are likely to be negligible.

8.2 CHANGE OF VIEW FOR VISUAL RECEPTORS

The assessment indicates that the following Visual Receptors could be impacted;

1. Residential areas particularly those on the edges of the Urban LCA and in close proximity to alternative development sites.
2. Recreational facilities including the Emerald Resort, the Riviera Country Club and other facilities within the Riverine LCA.
3. Main routes (linear receptors) through the area particularly the R54, R716 and R82.
4. Adjacent Farmsteads particularly the closest properties to the south and east of the alternative development sites.

8.2.1 Residential Receptors

Table 5, Residential Receptors change of view.

Nature of impact: Further Industrialisation and reduction in rural character of the view.		
	Without mitigation	**With mitigation**
Extent	**Alternatives 1 and 2** Site and immediate surroundings **(2)**	No mitigation possible
Duration	**Alternatives 1 and 2** Long term **(4)**	No mitigation possible
Magnitude	**Alternatives 1** The proposed development is unlikely to be highly obvious from urban areas. **(2)** **Alternatives 2** The proposed development is unlikely to be visible from urban areas. **(0)**	No mitigation possible
Probability	**Alternatives 1** Significant impact is improbable **(2)** **Alternatives 2** Significant impact is very improbable **(1)**	No mitigation possible
Significance	**Alternatives 1** Low **(16)** **Alternatives 2** Very low **(6)**	No mitigation possible
Status	**Alternatives 1** Negative.	N/A

	Alternatives 2 Neutral.	
Irreplaceable loss	The project can be dismantled. Therefore there will be no irreplaceable loss.	N/A
Can impacts be mitigated?	Mitigation is not really possible due to relative levels nor is it necessary.	

Mitigation / Management:
No mitigation measures are necessary as existing vegetation will significantly break views of the alternatives 1 and 2.

Explanatory note:

a) The one residential area that is associated with the adjacent coal mine that overlooks alternative 1 was under demolition at the time of the site visit. Even though the residential area is in close proximity to the alternative sites, the orientation of the houses and existing vegetation result in it being very difficult to gain a clear view over the proposed alternative sites. Therefore even if this site is to be redeveloped for residential use, it is unlikely to affect the assessment.

Development of Alternative Sites 1 and 2 will be visible to higher areas of residential areas to the north of the Vaal River. However, the development will be seen at a distance and will be largely screened by existing vegetation. From the majority of areas it is unlikely that whilst the development may be visible, its nature will not be discernible.

Cumulative Impacts:
Alternative 1 could add slightly to the extent of industrial development visible from residential areas, hence this is a cumulative impact.

Residual Impacts:
As mitigation is not possible the impacts indicated above will be residual.

8.2.2 Recreational Receptors

Table 6, Recreational Receptors change of view.

Nature of impact: Further Industrialisation and reduction in rural character of the view.		
	Without mitigation	**With mitigation**
Extent	**Alternatives 1 and 2** Site and immediate surroundings **(2)**	N/A
Duration	**Alternatives 1 and 2** Long term **(4)**	N/A
Magnitude	**Alternatives 1 and 2** The proposed development is unlikely to be visible from recreational areas. **(0)**	N/A
Probability	**Alternatives 1 and 2** Significant impact is very improbable **(1)**	N/A
Significance	**Alternatives 1 and 2** Very low **(6)**	N/A
Status	**Alternatives 1 and 2** Neutral.	N/A

Irreplaceable loss	The project can be dismantled. Therefore there will be no irreplaceable loss.	N/A
Can impacts be mitigated?	Mitigation is not necessary.	
Mitigation / Management: No mitigation measures are necessary as existing vegetation will significantly break views of the alternatives 1 and 2. ***Explanatory note:*** a) It is highly unlikely that development of Alternative Site 1 and 2 will be visible to any of the recreational areas within the Riverine LCA. No mitigation is necessary as none of the alternative development areas would negatively impact on these receptors.		
Cumulative Impacts: If a small impact occurs it would add slightly to existing impacts associated with industry, it is therefore cumulative.		
Residual Impacts: If a small impact occurs it is not mitigatable and therefore is residual.		

8.2.3 Linear Receptors

Table 7, Linear Receptors change of view.

Nature of impact: Impacts on main routes (linear receptors) through the area particularly the R54, R716 and R82.		
	Without mitigation	**With mitigation**
Extent	**Alternatives 1 and 2** Site and immediate surroundings **(2)**	N/A
Duration	**Alternatives 1 and 2** Long term **(4)**	N/A
Magnitude	**Alternatives 1** The proposed development could be visible to small sections of main routes particularly to the west. **(2)** **Alternative 2** The proposed development is unlikely to be visible from main routes. **(0)**	N/A
Probability	**Alternatives 1 and 2** Significant impact is very improbable **(1)**	N/A
Significance	**Alternatives 1** Very low **(8)** **Alternatives 2** Very low **(6)**	N/A
Status	**Alternatives 1 and 2** Neutral.	N/A

Irreplaceable loss	The project can be dismantled. Therefore there will be no irreplaceable loss.	N/A
Can impacts be mitigated?	Mitigation is not necessary.	

Mitigation / Management:
No mitigation measures are necessary as existing vegetation will significantly break views of the alternatives 1 and 2.

Explanatory note:

a) Development of Alternative Site 1 could be visible to small sections of the R82 and the R716, however, existing vegetation largely screens these views.
b) Development of Alternative Site 2 is unlikely to be visible to the R54 as existing landform screens this view.

Cumulative Impacts:
If a small impact occurs it would add slightly to existing impacts associated with industry, it is therefore cumulative.

Residual Impacts:
If a small impact occurs it is not mitigatable and therefore is residual.

8.2.4 Adjacent Farmsteads

Table 8, Adjacent Farmsteads Receptors change of view.

Nature of impact:
Impacts on farmsteads particularly those to the east of the Vaal River.

	Without mitigation	With mitigation
Extent	**Alternatives 1 and 2** Site and immediate surroundings **(2)**	N/A
Duration	**Alternatives 1 and 2** Long term **(4)**	N/A
Magnitude	**Alternative 1** The proposed development is unlikely to be visible. **(0)** **Alternative 2** The proposed development is unlikely to be highly obvious from urban areas. **(2)**	N/A
Probability	**Alternatives 1 and 2** Significant impact is very improbable **(1)**	N/A
Significance	**Alternative 1** Very low **(6)** **Alternative 2** Very low **(8)**	N/A
Status	**Alternative 1** Neutral. **Alternative 2** Negative.	N/A

Irreplaceable loss	The project can be dismantled. Therefore there will be no irreplaceable loss.	N/A
Can impacts be mitigated?	Yes	
Mitigation / Management: There is slight concern regarding the extent of visibility of alternative 2 to areas to the east of the Vaal Dam. There currently is a block of alien trees within Eskom land that will help to screen this view. Mitigation measures might include, ensuring that this block of vegetation is retained and augmented / extended. It would be possible to completely screen this alternative from areas to the east within three to five years if screen planting is undertaken around the south eastern and eastern sections of the proposed site. ***Explanatory note:*** a) Development of Alternative Site 1 and 2 will be screened from all farmsteads to the south by landform. b) Development of Alternative Site 2 will be visible to a small number of farmsteads to the east of the Vaal River. However views of the development will be largely screened by existing vegetation.		
Cumulative Impacts: If a small impact occurs with Alternative 2, it will add slightly to existing impacts associated with industry, it is therefore cumulative.		
Residual Impacts: If a small impact occurs it is not mitigatable and therefore is residual.		

8.3 OCULAR IMPACTS ASSOCIATED WITH GLARE

Table 9, Impact of glare affecting surrounding areas

Nature of impact: Glare impacting on adjacent roads and residential areas		
	Without mitigation	**With mitigation**
Extent	**<u>Alternatives 1 and 2</u>** Site and immediate surroundings **(2)**	N/A
Duration	**<u>Alternatives 1 and 2</u>** Long term **(4)**	N/A
Magnitude	**<u>Alternatives 1 and 2</u>** The proposed development is unlikely to any significant impact associated with glare. **(0)**	N/A
Probability	**<u>Alternatives 1 and 2</u>** Significant impact is very improbable **(1)**	N/A
Significance	**<u>Alternatives 1 and 2</u>** Very low **(6)**	N/A
Status	**<u>Alternatives 1 and 2</u>** Neutral to negative.	N/A
Irreplaceable loss	The project can be dismantled. Therefore there will be no irreplaceable loss.	N/A
Can impacts	Yes through the use of a textured glass with an anti-reflective	

be mitigated?	coating on the face of each panel.
Mitigation / Management: The impact is likely to be so low that it probably will not be noticed. Mitigation is not necessary.	
Cumulative Impacts: There are no major sources of glare currently noticeable. This impact is therefore not cumulative.	

9 IMPACT STATEMENT

9.1 GENERAL LANDSCAPE CHANGE

The proposed development will take place within a landscape that is already heavily impacted by large scale industrial development including mining operations and the Lethabo Power Station.

The most sensitive landscape areas include the rural landscape to the east of the Vaal River, the urban landscape to the north of the Vaal River and the Vaal River Corridor itself. Distance, existing vegetation and topography will largely mitigate potential impacts on these areas.

There is slight concern regarding the extent of visibility of alternative 2 to rural areas to the east of the Vaal Dam. There currently is a block of alien trees within Eskom land that will help to screen this view. Mitigation measures might include, ensuring that this block of vegetation is retained and augmented / extended. It would be possible to completely screen this alternative from areas to the east within three to five years if screen planting is undertaken around the south eastern and eastern sections of the proposed site.

9.2 VISUAL RECEPTORS

The proposed development of alternative sites 1 and 2 could be visible to residential receptors to the north of the Vaal River. Development of Alternative 2 is likely to be visible to a small number of farmsteads to the east of the Vaal River and the development of Alternative Site 1 could be visible to a small section of adjacent regional roads to the west.

The assessment has shown however that these impacts will be largely screened by existing vegetation and are likely to be negligible given the existing industrial context within which the views will be seen.

9.3 OCULAR IMPACTS ASSOCIATED WITH GLARE

Areas to the east of the arrays could be affected to a small degree by glare during early mornings in February, March, September and October. The area impacted is not highly developed nor does a major route run through it. The impact is also so minor that it is likely to be un-noticeable and is therefore negligible.

9.4 CUMULATIVE IMPACTS

Other than ocular impacts, all other impacts identified are associated with an extension of the visual influence of industry within the local landscape. They are therefore cumulative in nature.

9.5 ALTERNATIVE FAVOURED ON VISUAL GROUNDS

Alternatives 1 and 2 are located on high areas and because of this they will be exposed to viewers within the urban area to the north and rural area to the east of the Vaal River. However, these impacts are not likely to be significant and given the industrial context in which the proposed development will be set are unlikely to degrade the landscape to any noticeable degree.

Therefore on visual grounds both alternatives are acceptable.

10 ENVIRONMENTAL MANAGEMENT PLAN

Table 10: Management programme – Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the Proposed Solar (PV) Project.		
Project Component/s	Construction site	
Potential Impact	Landscape degradation for surrounding LCAs and Sensitive Receivers.	
Activity/Risk Source	The viewing of the above mentioned by observers from a distance.	
Mitigation: Target/Objective	Minimise the area of disturbance	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Ensure that vegetation is not unnecessarily cleared or removed during the construction period.	Project Proponent /contractor	Early in the construction phase.
Reduce the construction period through careful logistical planning and productive implementation of resources.	Project Proponent /contractor	Early in the construction phase.
Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).	Project Proponent /contractor	Throughout the construction phase.
Rehabilitate all disturbed areas, construction areas, servitudes etc. immediately after the completion of construction works. If necessary, an ecologist should be consulted to assist or give input into rehabilitation specifications.	Project Proponent /contractor	Throughout and at the end of the construction phase.
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact (i.e. full cover as per natural vegetation within the environment) with no evidence of degradation or erosion.	
Monitoring	Monitoring of vegetation clearing during construction (by contractor as part of construction contract). Monitoring of rehabilitated areas quarterly for at least a year following the end of construction (by contractor as part of construction contract).	

Table 11: Management programme – Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the Proposed Solar (PV) Project.		
Project Component/s	The solar energy facility and ancillary infrastructure (i.e. panels, access roads, substation, workshop and power line).	
Potential Impact	Landscape degradation for surrounding LCAs and Sensitive Receivers.	
Activity/Risk Source	The viewing of the above mentioned by observers from a distance.	
Mitigation: Target/Objective	Maintain and augment existing surrounding vegetation.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Alternative 2 – maintain and augment existing vegetation to the south and east.	Project Proponent /operator	Throughout the operational phase.
Monitor the implementation of mitigation measures, and implement remedial action as and when required.	Project Proponent /operator	Throughout the operational phase.
Maintain roads and servitudes to forego erosion and to suppress dust.	Project Proponent /operator	Throughout the operational phase.
Monitor rehabilitated areas, and implement remedial action as and when required.	Project Proponent /operator	Throughout the operational phase.
Performance Indicator	Visibility of the Alternative 2 facility from the south and east.	
Monitoring	Monitoring of effectiveness of screening vegetation (by operator).	

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APPENDIX I

SPECIALIST'S BRIEF CV

ENVIRONMENTAL PLANNING AND DESIGN

Name	JONATHAN MARSHALL
Nationality	British
Year of Birth	1956
Specialisation	Landscape Architecture / Landscape & Visual Impact Assessment / Environmental Planning / Environmental Impact Assessment.
Qualifications	
Education	Diploma in Landscape Architecture, Gloucestershire College of Art and Design, UK (1979) Environmental Law, University of KZN (1997)
Professional	Chartered Member of the Landscape Institute (UK) Registered Landscape Architect (South Africa) Certified Environmental Assessment Practitioner of South Africa. Member of the International Association of Impact Assessment, South Africa
Languages	English - Speaking - Excellent - Reading - Excellent - Writing - Excellent
Contact Details	Post: PO Box 2122 Westville 3630 Republic of South Africa Phone: +27 31 2668241, Cell: +27 83 7032995

Key Experience

Jon qualified as a Landscape Architect (Dip LA) at Cheltenham (UK) in 1979. He has been a chartered member of the Landscape Institute UK since 1986. He has also been a Certified Environmental Assessment Practitioner of South Africa since 2009.

During the early part of his career (1981 - 1990) He worked with Clouston (now RPS) in Hong Kong and Australia. During this period he was called on to undertake visual impact assessment (VIA) input to numerous environmental assessment processes for major infrastructure projects. This work was generally based on photography with line drawing superimposed to illustrate the extent of development visible.

He has worked in the United Kingdom (1990 - 1995) for a major supermarket chain and prepared CAD based visual impact assessments for public enquiries for new green field store development. He also prepared the VIA input to the environmental statement for the Cardiff Bay Barrage for consideration by the UK Parliament in the passing of the Barrage Bill.

His more recent VIA work (1995 to present) includes a combination of CAD and GIS based work for a new international airport to the north of Durban, new heavy industrial operations, overhead electrical transmission lines, mining operations in West Africa and numerous commercial and residential developments.

VIA work undertaken during the last eighteen months includes assessments for proposed new mine developments in Ghana and Guinea, numerous solar plant projects for Eskom and private clients, proposed wind farm development and a proposed tourism development within the Isimangaliso Wetland Park World Heritage Site .

Jon has also had direct experience of working with UNESCO representatives on a candidate World Heritage Site and has undertaken LVIAs within and adjacent to other World Heritage Sites.

Relevant Visual Impact Assessment Projects

1. **Bhangazi Lake Tourism Development** – Visual impact assessment for a proposed lodge development within the Isimangaliso Wetland Park World Heritage Site. This work is ongoing.
2. **Quarry Development for the Upgrade of Sani Pass –** Visual Impact Assessments for two proposed quarry developments on the edge of the uKhalamba-Drakensburg World Heritage Site.
3. **Mtubatuba to St Lucia Overhead Power Line** – Visual Impact Assessment for a proposed power line bordering on the Isimangaliiso Wetland Park World Heritage Site for Eskom.
4. **St Faiths 400/132 kV Sub-Station and Associated Power Lines** - Visual Impact Assessment for a proposed new major sub-station and approximately 15km of overhead power line for Eskom.
5. **Isundu 765/400 kV Sub-Station and Associated Power Lines** - Visual Impact Assessment for a proposed new major sub-station for Eskom. This work is ongoing.
6. **Clocolan to Ficksburg Overhead Power Line** – Visual Impact Assessment for a proposed power line for Eskom.
7. **Solar Plant Projects including Photovoltaic and Concentrating Solar Power Plants** – Numerous projects for Eskom and private clients in the Northern Cape, Limpopo, Mpumalanga and the Free State.
8. **Moorreesburg Wind Farm.** Visual impact assessment for a proposed new wind farm in the Western Cape.
9. **AngloGold Ashanti, Dokyiwa (Ghana)** – Visual Impact Assessment for proposed new Tailings Storage Facility at a mine site working with SGS as part of their EIA team.
10. **Camperdown Industrial Development** - Visual Impact Assessment for proposed new light industrial area to the north o Camperdown for a private client.
11. **Wild Coast N2 Toll Highway** – Peer review of VIA undertaken by another consultant.
12. **Gamma to Grass Ridge 765kv transmission line** – Peer review of VIA undertaken by another consultant.
13. **Gateway Shopping Centre Extension (Durban)** – Visual Impact Assessment for a proposed shopping centre extension in Umhlanga, Durban.
14. **Kouroussa Gold Mine (Guinea)** – Visual impact assessment for a proposed new mine in Guinea working with SGS as part of their EIA team.
15. **Mampon Gold Mine (Ghana)** - Visual impact assessment for a proposed new mine in Ghana working with SGS as part of their EIA team.
16. **Telkom Towers** – Visual impact assessments for numerous Telkom masts in KwaZulu Natal
17. **Dube Trade Port, Durban International Airport** – Visual Impact Assessment for a new international airport.
18. **Sibaya Precinct Plan** – Visual Impact Assessment as part of Environmental Impact Assessment for a major new development area to the north of Durban.
19. **Umdloti Housing** – Visual Impact Assessment as part of Environmental Impact Assessment for a residential development beside the Umdloti Lagoon to the north of Durban.
20. **Tata Steel Ferrochrome Smelter** - Visual impact assessment of proposed new Ferrochrome Smelter in Richards Bay as part of EIA undertaken by the CSIR.
21. **Diamond Mine at Rooipoort Nature Reserve near Kimberley** – Visual impact assessment for a proposed diamond mine within an existing nature reserve for De Beers.
22. Durban Solid Waste Large Landfill Sites **– Visual Impact Assessment of proposed development sites to the North and South of the Durban Metropolitan Area. The project utilised 3d computer visualisation techniques.**
23. Hillside Aluminium Smelter, Richards Bay **- Visual Impact Assessment of proposed extension of the existing smelter. The project utilised 3d computer visualisation techniques.**
24. **Estuaries of KwaZulu Natal Phase 1 and Phase 2 –** Visual character assessment and GIS

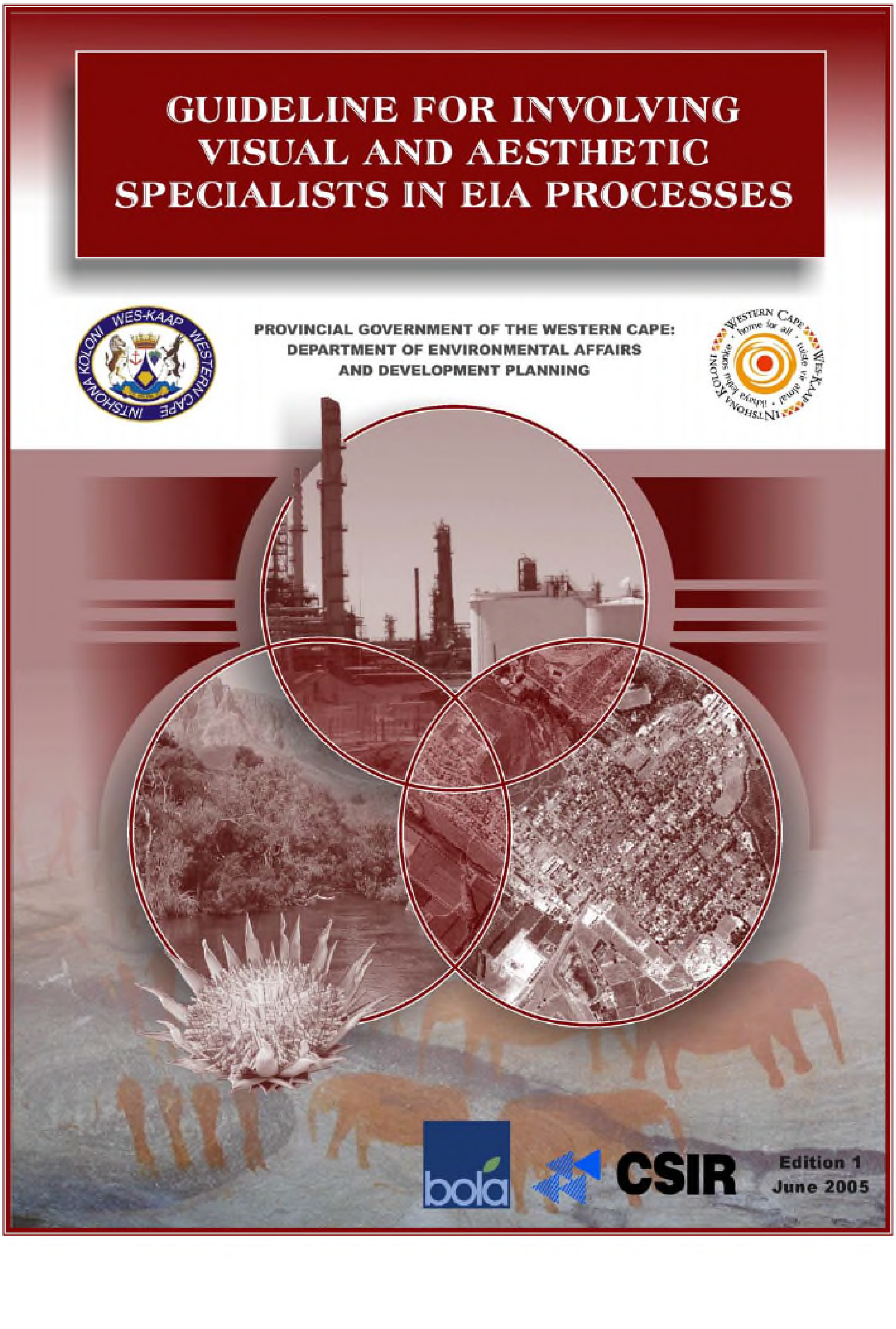
mapping as part of a review of the condition and development capacity of eight estuary landscapes for the Town and Regional Planning Commission. The project was extended to include all estuaries in KwaZulu Natal.

25. **Signage Assessments** – Numerous impact assessments for proposed signage developments for Blast Media.
26. **Signage Strategy** – Preparation of an environmental strategy report for a national advertising campaign on National Roads for Visual Image Placements.
27. **Zeekoegatt, Durban** - Computer aided visual impact assessment. Acted as advisor to the Province of KwaZulu Natal in an appeal brought about by a developer to extend a light industrial development within a 60 metre building line from the National N3 Highway.
28. **La Lucia Mall Extension** - Visual impact assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed extension to shopping mall for public consultation exercise.
29. **Redhill Industrial Development** - Visual impact assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed new industrial area for public consultation exercise.
30. **Avondale Reservoir** - Visual impact assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed hilltop reservoir as part of Environmental Impact Assessment for Umgeni Water.
31. **Hammersdale Reservoir** - Visual impact assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed hilltop reservoir as part of Environmental Impact Assessment for Umgeni Water.
32. **Southgate Industrial Park, Durban** - Computer Aided Visual Impact Assessment and Landscape Design for AECI.
33. **Sainsbury's Bryn Rhos (UK)** - Computer Aided Visual Impact Assessment/ Planning Application for the development of a new store within the Green Wedge North of Swansea.
34. **Ynyston Farm Access (UK)** - Computer Aided Impact Assessment of visual intrusion of access road to proposed development in Cardiff for the Land Authority for Wales.
35. **Cardiff Bay Barrage (UK)** - Concept Design, Detail Design, Documentation, and Visual Input to Environmental Statement for consideration by Parliament in the debate prior to the passing of the Cardiff Bay Barrage Bill. The work was undertaken for Cardiff Bay Development Corporation.
36. **A470, Cefn Coed to Pentrebach (UK)** - Preparation of frameworks for the assessment of the impact of the proposed alignment on the landscape for The Welsh Office.
37. **Sparkford to Illchester Bye Pass (UK)** - The preparation of the landscape framework and the draft landscape plan for the Department of Transport.
38. **Green Island Reclamation Study (Hong Kong)** - Visual Impact Assessment of building massing, Urban Design Guidelines and Masterplanning for a New Town extension to Hong Kong Island.
39. **Route 3 (Hong Kong)** - Visual Impact Assessment for alternative road alignments between Hong Kong Island and the Chinese Border.
40. **China Border Link (Hong Kong)** - Visual Impact Assessment and initial Landscape Design for a new border crossing at Lok Ma Chau.
41. **Route 81, Aberdeen Tunnel to Stanley (Hong Kong)** - Visual Impact Assessment for alternative highway alignments on the South side of Hong Kong Island.

APPENDIX II

GUIDELINES FOR INVOLVING VISUAL AND AESTHETIC SPECIALISTS IN EIA PROCESSES

(Preface, Summary and Contents for full document go to the Provincial Government of the Western Cape, Department of Environmental Affairs and Development Planning web site, http://eadp.westerncape.gov.za/your-resource-library/policies-guidelines)


GUIDELINE FOR INVOLVING VISUAL AND AESTHETIC SPECIALISTS IN EIA PROCESSES
PROVINCIAL GOVERNMENT OF THE WESTERN CAPE: DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND DEVELOPMENT PLANNING
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GUIDELINE FOR INVOLVING VISUAL AND AESTHETIC SPECIALISTS IN EIA PROCESSES

Edition 1

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Stakeholders engaged in the guideline development process:

These guidelines were developed through a consultative process and have benefited from the inputs and comments provided by a wide range of individuals and organizations actively working to improve EIA practice. Thanks are due to all who took the time to engage in the guideline development process.

In particular, thanks are due to Jan Glazewski (University of Cape Town), Keith Wiseman (City of Cape Town), Paul Britton (SANPARKS), Graham Young (University of Pretoria), Lisa Parkes (Ninham Shand) and Paul Claassen (Environomics) for providing useful information and in-depth comments.

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PREFACE

The purpose of an Environmental Impact Assessment (EIA) is to provide decision-makers (be they government authorities, the project proponent or financial institutions) with adequate and appropriate information about the potential positive and negative impacts of a proposed development and associated management actions in order to make an informed decision whether or not to approve, proceed with or finance the development.

For EIA processes to retain their role and usefulness in supporting decision-making, the involvement of specialists in EIA needs to be improved in order to:

- Add greater value to project planning and design;
- Adequately evaluate reasonable alternatives;
- Accurately predict and assess potential project benefits and negative impacts;
- Provide practical recommendations for avoiding or adequately managing negative impacts and enhancing benefits;
- Supply enough relevant information at the most appropriate stage of the EIA process to address adequately the key issues and concerns, and effectively inform decision-making in support of sustainable development.

It is important to note that not all EIA processes require specialist input; broadly speaking, specialist involvement is needed when the environment could be significantly affected by the proposed activity, where that environment is valued by or important to society, and/or where there is insufficient information to determine whether or not unavoidable impacts would be significant.

The purpose of this series of guidelines is to improve the efficiency, effectiveness and quality of specialist involvement in EIA processes. The guidelines aim to improve the capacity of roleplayers to anticipate, request, plan, review and discuss specialist involvement in EIA processes. Specifically, they aim to improve the capacity of EIA practitioners to draft appropriate terms of reference for specialist input and assist all roleplayers in evaluating whether or not specialist input to the EIA process is appropriate for the type of development and environmental context. Furthermore, they aim to ensure that specialist inputs support the development of effective, practical Environmental Management Plans where projects are authorised to proceed (refer to *Guideline for Environmental Management Plans*).

The guidelines draw on best practice in EIA in general, and within specialist fields of expertise in particular, to address the following issues related to the timing, scope and quality of specialist input. The terms "specialist involvement" and "input" have been used in preference to "specialist assessment" and "studies" to indicate that the scope of specialists' contribution (if required) depends on the nature of the project, the environmental context and the amount of available information and does not always entail detailed studies or assessment of impacts.

The guidelines draw on best practice in EIA in general, and within specialist fields of expertise in particular, to address the following issues related to the timing, scope and quality of specialist input. The terms "specialist involvement" and "input" have been used in preference to "specialist

assessment" and "studies" to indicate that the scope of specialists' contribution depends on the nature of the project, the environmental context and the amount of available information.

	ISSUES
TIMING	▪ When should specialists be involved in the EIA process; i.e. at what stage in the EIA process should specialists be involved (if at all) and what triggers the need for their input?
SCOPE	▪ Which aspects must be addressed through specialist involvement; i.e. what is the purpose and scope of specialist involvement? ▪ What are appropriate approaches that specialists can employ? ▪ What qualifications, skills and experience are required?
QUALITY	▪ What triggers the review of specialist studies by different roleplayers? ▪ What are the review criteria against which specialist inputs can be evaluated to ensure that they meet minimum requirements, are reasonable, objective and professionally sound?

The following guidelines form part of this first series of guidelines for involving specialists in EIA processes:

- Guideline for determining the scope of specialist involvement in EIA processes
- Guideline for the review of specialist input in EIA processes
- Guideline for involving biodiversity specialists in EIA processes
- Guideline for involving hydrogeologists in EIA processes
- Guideline for involving visual and aesthetic specialists in EIA processes
- Guideline for involving heritage specialists in EIA processes
- Guideline for involving economists in EIA processes

The *Guideline for determining the scope of specialist involvement in EIA processes* and the *Guideline for the review of specialist input in EIA processes* provide generic guidance applicable to any specialist input to the EIA process and clarify the roles and responsibilities of the different roleplayers involved in the scoping and review of specialist input. It is recommended that these two guidelines are read first to introduce the generic concepts underpinning the guidelines which are focused on specific specialist disciplines.

Who is the target audience for these guidelines?

The guidelines are directed at authorities, EIA practitioners, specialists, proponents, financial institutions and other interested and affected parties involved in EIA processes. Although the guidelines have been developed with specific reference to the Western Cape province of South Africa, their core elements are more widely applicable.

What type of environmental assessment processes and developments are these guidelines applicable to?

The guidelines have been developed to support project-level EIA processes regardless of whether they are used during the early project planning phase to inform planning and design decisions (i.e. during pre-application planning) or as part of a legally defined EIA process to obtain statutory approval for a proposed project (i.e. during screening, scoping and/or impact assessment). Where specialist input may be required the guidelines promote early, focused and appropriate involvement of specialists in EIA processes in order to encourage proactive consideration of potentially significant impacts, so that negative impacts may be avoided or effectively managed and benefits enhanced through due consideration of alternatives and changes to the project.

The guidelines aim to be applicable to a range of types and scales of development, as well as different biophysical, social, economic and governance contexts.

What will these guidelines not do?

In order to retain their relevance in the context of changing legislation, the guidelines promote the principles of EIA best practice without being tied to specific legislated national or provincial EIA terms and requirements. They therefore do not clarify the specific administrative, procedural or reporting requirements and timeframes for applications to obtain statutory approval. They should, therefore, be read in conjunction with the applicable legislation, regulations and procedural guidelines to ensure that mandatory requirements are met.

It is widely recognized that no amount of theoretical information on how best to plan and coordinate specialist inputs, or to provide or review specialist input, can replace the value of practical experience of coordinating, being responsible for and/or reviewing specialist inputs. Only such experience can develop sound judgment on such issues as the level of detail needed or expected from specialists to inform decision-makers adequately. For this reason, the guidelines should not be viewed as prescriptive and inflexible documents. Their intention is to provide best practice guidance to improve the quality of specialist input.

Furthermore, the guidelines do not intend to create experts out of non-specialists. Although the guidelines outline broad approaches that are available to the specialist discipline (e.g. field survey, desktop review, consultation, modeling), specific methods (e.g. the type of model or sampling technique to be used) cannot be prescribed. The guidelines should therefore not be used indiscriminately without due consideration of the particular context and circumstances within which an EIA is undertaken, as this influences both the approach and the methods available and used by specialists.

How are these guidelines structured?

The specialist guidelines have been structured to make them user-friendly. They are divided into six parts, as follows:

- **Part A**: Background;
- **Part B**: Triggers and key issues potentially requiring specialist input;
- **Part C**: Planning and coordination of specialist inputs (drawing up terms of reference);
- **Part D**: Providing specialist input;
- **Part E**: Review of specialist input; and
- **Part F**: References.

Part A provides grounding in the specialist subject matter for all users. It is expected that authorities and peer reviewers will make most use of Parts B and E; EIA practitioners and project proponents Parts B, C and E; specialists Part C and D; and other stakeholders Parts B, D and E. Part F gives useful sources of information for those who wish to explore the specialist topic.

SUMMARY

This guideline document, which deals with specialist visual input into the EIA process, is organised into a sequence of interleading sections. These follow a logical order covering the following:

- the background and context for specialist visual input;
- the triggers and issues that determine the need for visual input;
- the type of skills and scope of visual inputs required in the EIA process;
- the methodology, along with information and steps required for visual input;
- finally, the review or evaluation of the visual assessment process.

Part A is concerned with defining the visual and aesthetic component of the environment, and with principles and concepts relating to the visual assessment process. The importance of the process being logical, holistic, transparent and consistent is stressed in order for the input to be useful and credible.

The legal and planning context within which visual assessments take place indicate that there are already a number of laws and bylaws that protect visual and scenic resources. These resources within the Western Cape context have importance for the economy of the region, along with the proclaimed World Heritage Sites in the Province.

The role and timing of specialist visual inputs into the EIA process are outlined, with the emphasis being on timely, and on appropriate level of input, from the early planning stage of a project, through to detailed mitigation measures and management controls at the implementation stage.

Part B deals with typical factors that trigger the need for specialist visual input to a particular project. These factors typically relate to:

(a) the nature of the receiving environment, in particular its visual sensitivity or protection status;

(b) the nature of the project, in particular the scale or intensity of the project, which would result in change to the landscape or townscape.

The correlation between these two aspects are shown in a table, in order to determine the varying levels of visual impact that can be expected, i.e. from little or no impact, to very high visual impact potential.

Part C deals with the choice of an appropriate visual specialist, and the preparation of the terms of reference (TOR) for the visual input. Three types of visual assessment are put forward, each requiring different expertise, namely:

Type A: assessments involving large areas of natural or rural landscape;

Type B: assessments involving local areas of mainly built environment;

Type C: assessments involving smaller scale sites with buildings, or groups of buildings.

The scope of the visual input would in summary relate to the following:

- the issues raised during the scoping process;
- the time and space boundaries, i.e. the extent or zone of visual influence;

- the types of development alternatives that are to be considered;
- the variables and scenarios that could affect the visual assessment;
- the inclusion of direct, indirect and cumulative effects.

Approaches to the visual input relate to the level of potential impact and range from minimal specialist input, to a full visual impact assessment (VIA). A list of the typical components of a visual assessment is given, and the integration with other studies forming part of the EIA process is discussed.

Part D provides guidance for specialist visual input, and on the information required by specialists. Notes on predicting potential visual impacts are given, along with suggested criteria for describing and rating visual impacts. The assessment of the overall significance of impacts, as well as thresholds of significance are discussed.

Further aspects that need to be considered by visual specialists in EIA processes include:

- affected parties who stand to benefit or lose,
- risks and uncertainties related to the project,
- assumptions that have been made, and their justification,
- levels of confidence in providing the visual input or assessment,
- management actions that can be employed to avoid or mitigate adverse effects and enhance benefits, and
- the best practicable environental option from the perspective of the visual issues and impacts.

Finally, pointers for the effective communication of the findings are given.

Part E lists specific evaluation criteria for reviewing visual input by a specialist, where this becomes necessary. Further guidance on this is given in the document on *Guideline for the review of specialist input in EIA processes.*

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APPENDIX III

TYPICAL ESKOM OVERHEAD POWERLINE SUPPORTS

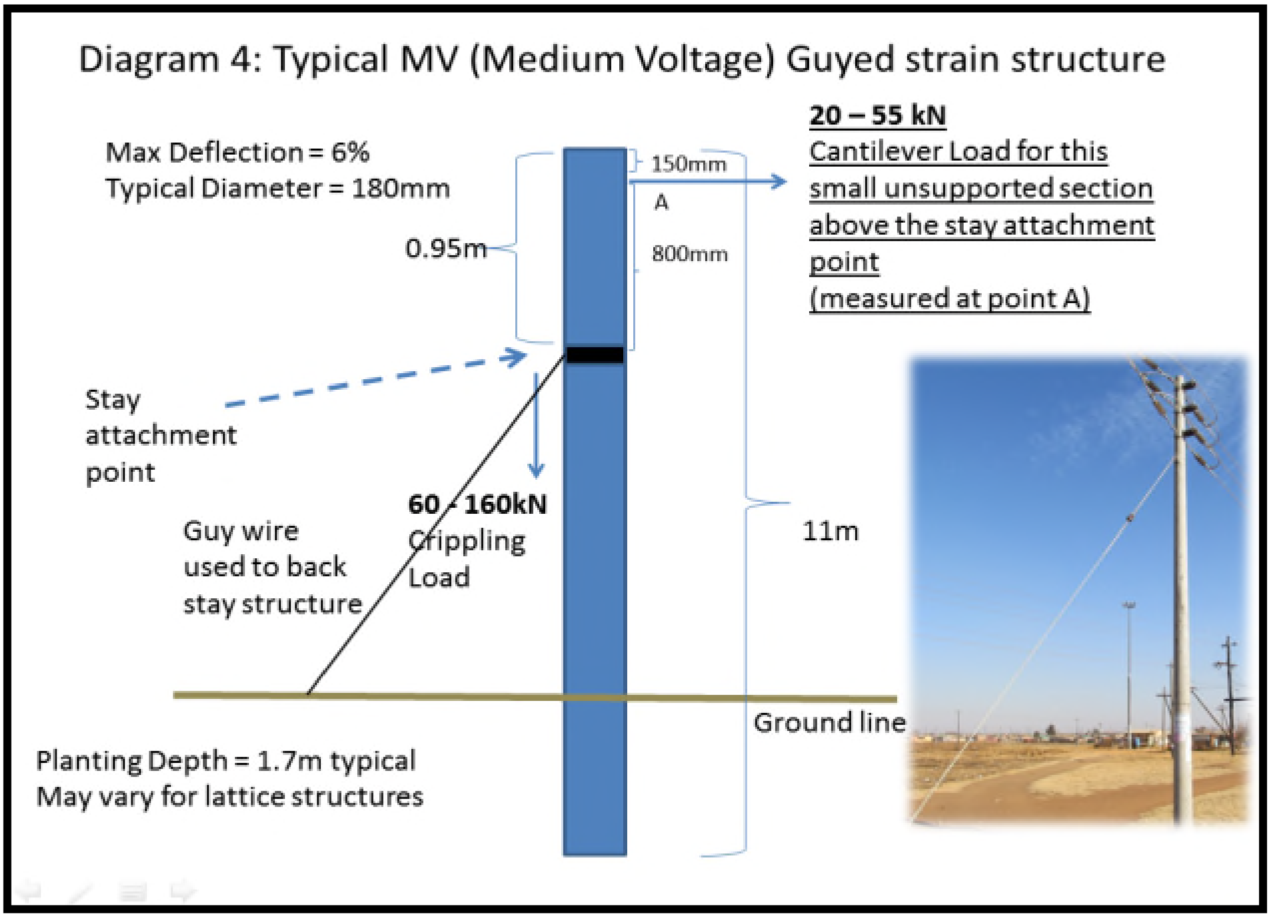


Diagram 4: Typical MV (Medium Voltage) Guyed strain structure
Max Deflection = 6%
Typical Diameter = 180mm
0.95m
150mm
A
800mm
20 – 55 kN
Cantilever Load for this small unsupported section above the stay attachment point (measured at point A)
Stay attachment point
60 - 160kN
Crippling Load
Guy wire used to back stay structure
11m
Ground line
Planting Depth = 1.7m typical
May vary for lattice structures

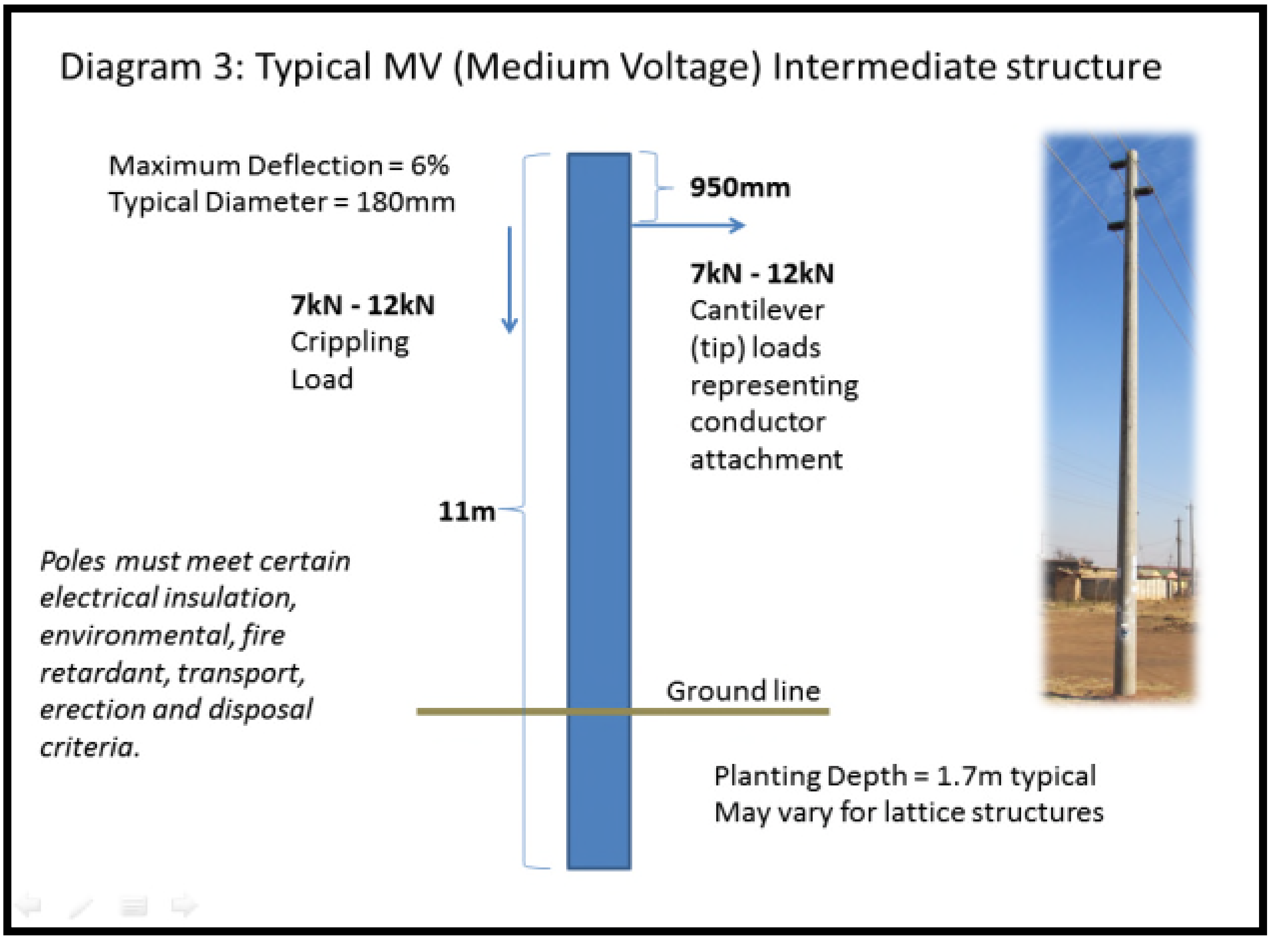


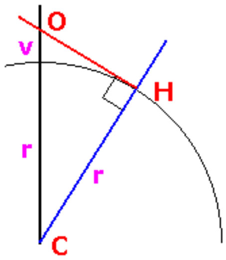
Diagram 3: Typical MV (Medium Voltage) Intermediate structure
Maximum Deflection = 6%
Typical Diameter = 180mm
950mm
7kN - 12kN
Crippling
Load
7kN - 12kN
Cantilever
(tip) loads
representing
conductor
attachment
11m
Poles must meet certain
electrical insulation,
environmental, fire
retardant, transport,
erection and disposal
criteria.
Ground line
Planting Depth = 1.7m typical
May vary for lattice structures

APPENDIX IV

FORMULA FOR DERIVING THE APPROXIMATE VISUAL HORIZON

The Mathematics behind this Calculation

This calculation should be taken as a guide only as it assumes the earth is a perfect ball 6378137 metres radius. It also assumes the horizon you are looking at is at sea level. A triangle is formed with the centre of the earth (C) as one point, the horizon point (H) is a right angle and the observer (O) the third corner. Using Pythagoras's theorem we can calculate the distance from the observer to the horizon (OH) knowing CH is the earth's radius (r) and CO is the earth's radius (r) plus observer's height (v) above sea level.



Sitting in a hotel room 10m above sea level a boat on the horizon will be 11.3km away. The reverse is also true, whilst rowing across the Atlantic, the very top of a mountain range 400m high could be seen on your horizon at a distance of 71.4 km assuming the air was clear enough.

APPENDIX V

REPORT PRODUCED BY SANDIA LABORATORIES GLARE MODEL

Solar Glare Hazard Analysis Report

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Inputs

Analysis name	LETHABO 1
PV array axis tracking	none
Orientation of array (deg)	0.0
Tilt of solar panels (deg)	25.0
Rated power (kW)	70000.0
Vary reflectivity	True
PV surface material	Smooth glass without ARC

Timezone offset	2.0
Subtended angle of sun (mrad)	9.3

Peak DNI (W/m^2)	1000.0
Ocular transmission coefficient	0.5
Pupil diameter (m)	0.002
Eye focal length (m)	0.017
Time interval (min)	1
Correlate slope error with material	False
Slope error (mrad)	10.0

PV array vertices

id	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Height of panels above ground (ft)	Total elevation (ft)
1	-26.7493660701	27.9667282104	4839.55	9.0	4848.55
2	-26.7538880602	27.9538536072	4840.4	9.0	4849.4
3	-26.7435408685	27.9514503479	4777.33	9.0	4786.33
4	-26.7459936213	27.9652690887	4814.93	9.0	4823.93

Observation Points

	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Eye-level height above ground (ft)
2	-26.7624716821	27.9248428345	4819.59	5.0

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Solar Glare Hazard Analysis Report

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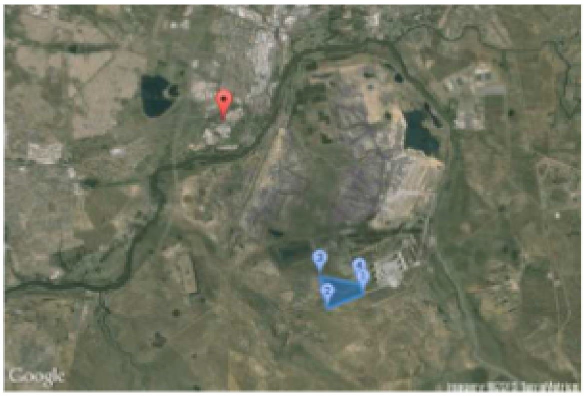

Inputs

Analysis name	LETHABO 1
PV array axis tracking	none
Orientation of array (deg)	0.0
Tilt of solar panels (deg)	25.0
Rated power (kW)	70000.0
Vary reflectivity	True
PV surface material	Smooth glass without ARC

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4	-26.7459936213	27.9652690887	4814.93	9.0	4823.93

Observation Points

	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Eye-level height above ground (ft)
1	-26.6943980232	27.9176330566	4732.5	5.0

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Solar Glare Hazard Analysis Report

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Glare found

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Inputs

Analysis name	LETHABO 1
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Orientation of array (deg)	0.0
Tilt of solar panels (deg)	25.0
Rated power (kW)	70000.0
Vary reflectivity	True
PV surface material	Smooth glass without ARC

Timezone offset	2.0
Subtended angle of sun (mrad)	9.3

Peak DNI (W/m^2)	1000.0
Ocular transmission coefficient	0.5
Pupil diameter (m)	0.002
Eye focal length (m)	0.017
Time interval (min)	1
Correlate slope error with material	False
Slope error (mrad)	10.0

PV array vertices

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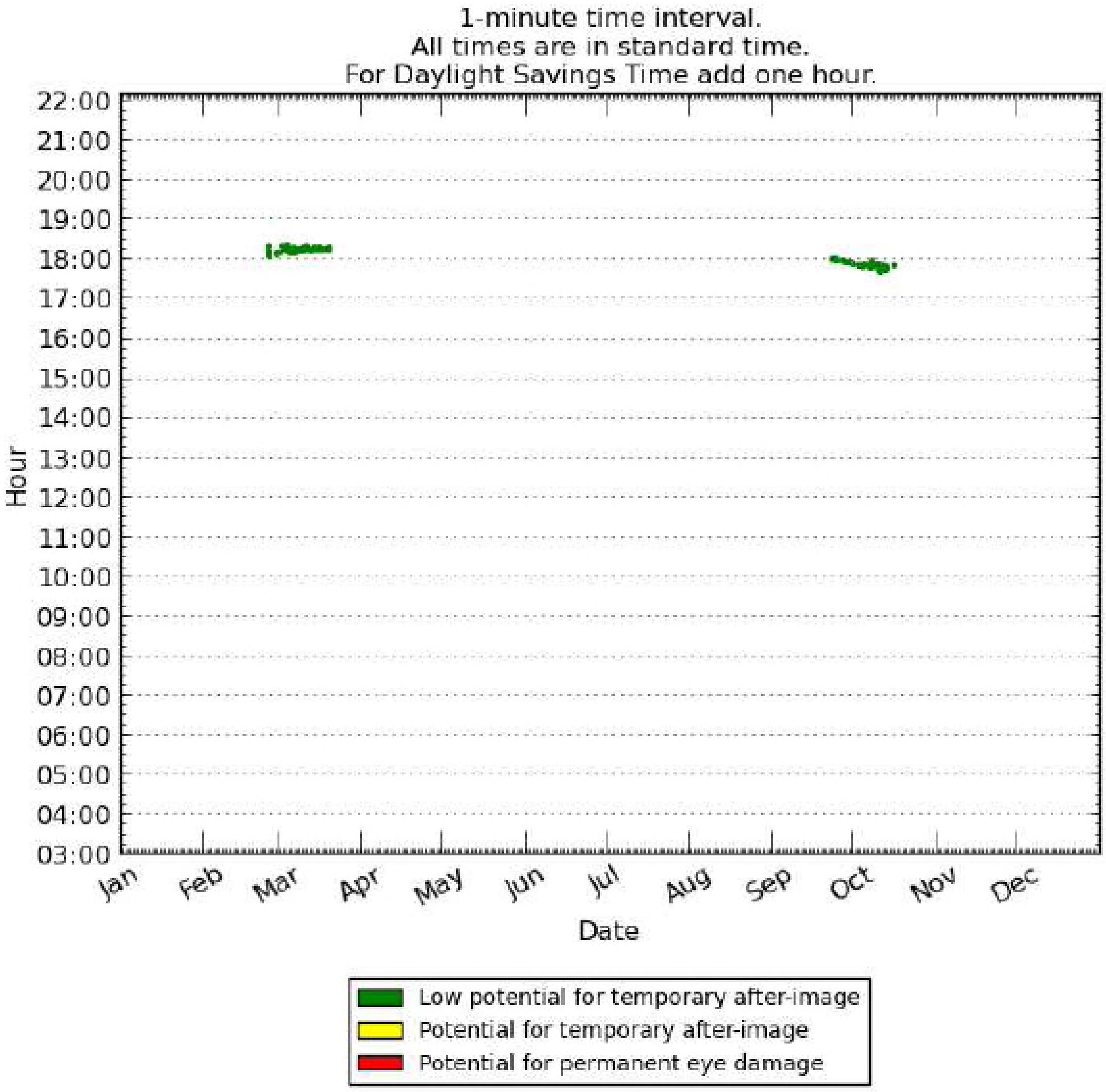
3	-26.7435408685	27.9514503479	4777.33	9.0	4786.33
4	-26.7459936213	27.9652690887	4814.93	9.0	4823.93

Observation Points

	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Eye-level height above ground (ft)
3	-26.7459169736	28.0178833008	4717.85	5.0

Glare Occurrence Plot

All times are in standard time. For Daylight Savings Time add one hour.


1-minute time interval.
All times are in standard time.
For Daylight Savings Time add one hour.
Hour
22:00
21:00
20:00
19:00
18:00
17:00
16:00
15:00
14:00
13:00
12:00
11:00
10:00
09:00
08:00
07:00
06:00
05:00
04:00
03:00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Date
Low potential for temporary after-image
Potential for temporary after-image
Potential for permanent eye damage

Solar Glare Hazard Analysis Report

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Inputs

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Orientation of array (deg)	0.0
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Rated power (kW)	70000.0
Vary reflectivity	True
PV surface material	Smooth glass without ARC

Timezone offset	2.0
Subtended angle of sun (mrad)	9.3

Peak DNI (W/m^2)	1000.0
Ocular transmission coefficient	0.5
Pupil diameter (m)	0.002
Eye focal length (m)	0.017
Time interval (min)	1
Correlate slope error with material	False
Slope error (mrad)	10.0

PV array vertices

id	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Height of panels above ground (ft)	Total elevation (ft)
1	-26.7528917049	27.9695606232	4871.94	9.0	4880.94
2	-26.7463002117	27.986125946	4822.76	9.0	4831.76
3	-26.7439241146	27.9848384857	4814.06	9.0	4823.06
4	-26.7504391009	27.9686164856	4848.68	9.0	4857.68

Observation Points

	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Eye-level height above ground (ft)
1	-26.6943980232	27.9176330566	4732.5	5.0

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Solar Glare Hazard Analysis Report

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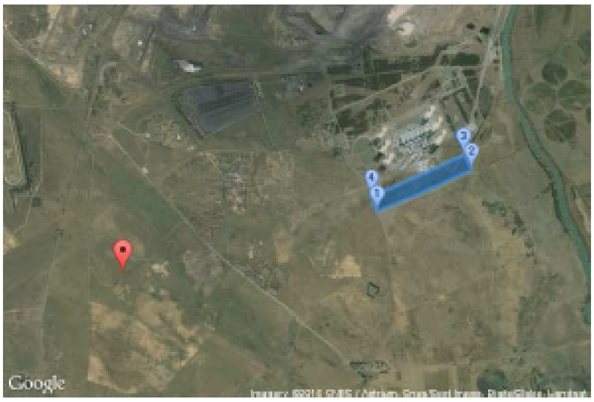

Inputs

Analysis name	LETHABO 1
PV array axis tracking	none
Orientation of array (deg)	0.0
Tilt of solar panels (deg)	25.0
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No glare found.

Solar Glare Hazard Analysis Report

Generated July 11, 2015, 7:39 a.m.

Glare found

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Inputs

Analysis name	LETHABO 1
PV array axis tracking	none
Orientation of array (deg)	0.0
Tilt of solar panels (deg)	25.0
Rated power (kW)	70000.0
Vary reflectivity	True
PV surface material	Smooth glass without ARC

Timezone offset	2.0
Subtended angle of sun (mrad)	9.3

Peak DNI (W/m^2)	1000.0
Ocular transmission coefficient	0.5
Pupil diameter (m)	0.002
Eye focal length (m)	0.017
Time interval (min)	1
Correlate slope error with material	False
Slope error (mrad)	10.0

PV array vertices

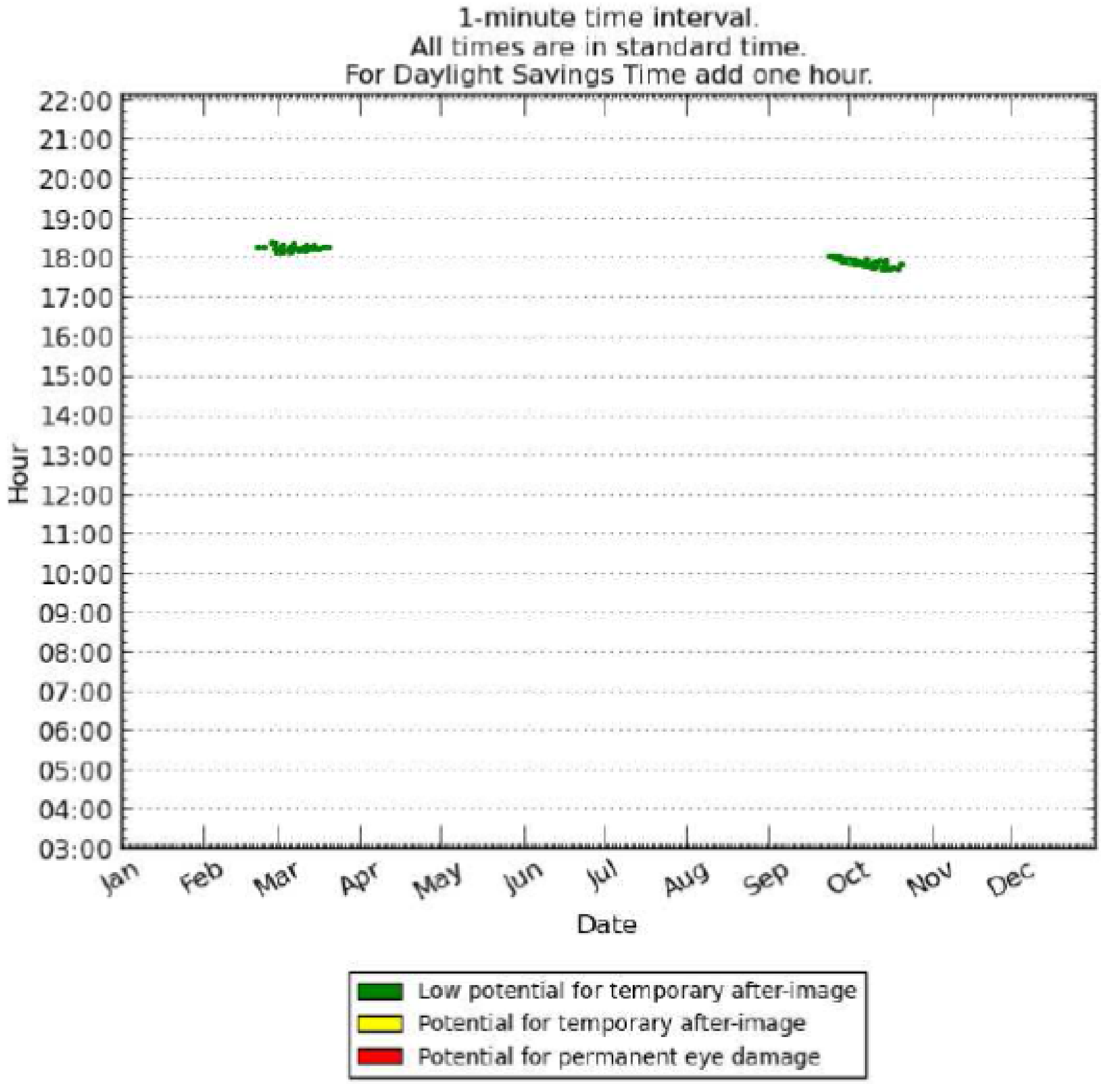
id	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Height of panels above ground (ft)	Total elevation (ft)
1	-26.7528917049	27.9695606232	4871.94	9.0	4880.94
2	-26.7463002117	27.986125946	4822.76	9.0	4831.76
3	-26.7439241146	27.9848384857	4814.06	9.0	4823.06
4	-26.7504391009	27.9686164856	4848.68	9.0	4857.68

Observation Points

	Latitude (deg)	Longitude (deg)	Ground Elevation (ft)	Eye-level height above ground (ft)
3	-26.7459169736	28.0178833008	4717.85	5.0

Glare Occurrence Plot

All times are in standard time. For Daylight Savings Time add one hour.


1-minute time interval.
All times are in standard time.
For Daylight Savings Time add one hour.
22:00
21:00
20:00
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Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Date
Low potential for temporary after-image
Potential for temporary after-image
Potential for permanent eye damage