MAINSTREAM RENEWABLE POWER

Construction of a Solar Energy Facility in, Kimberley, Northern Cape Province of South Africa

Visual Impact Assessment Report – EIA Phase

Issue Date: 3 June 2011
Revision No.: 1
Project No.: 10273

Date:	3 June 2011
Document Title:	Construction of a Solar Energy Facility – Visual Impact Assessment Report – EIA Phase
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Revision Number:	1
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Approved:	
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* Please note that all maps included in this document have been printed on A3 size and are included as an Appendix to this report.

GLOSSARY OF TERMS

Abbreviations

CSP	Concentrating Solar Plant
CPV/PV	Concentrating Photovoltaic / Photovoltaic
DTM	Digital terrain model
EIA	Environmental Impact Assessment
ENPAT	Environmental Potential Atlas
GIS	Geographic Information System
I&AP	Interested and/or Affected Party
SANBI	South African National Biodiversity Institute
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment

Definitions

Sense of place: The unique quality or character of a place, whether natural, rural or urban. It relates to uniqueness, distinctiveness or strong identity.

Scenic route: A linear movement route, usually in the form of a scenic drive, but which could also be a railway, hiking trail, horse-riding trail or 4x4 trail.

Sensitive visual receptors: An individual, group or community that is subject to the visual influence of the proposed development and is adversely impacted by it. They will typically include locations of human habitation and tourism activities.

Viewpoint: A point in the landscape from where a particular project or feature can be viewed.

Viewshed: The outer boundary defining a visual envelope, usually along crests and ridgelines.

Visual absorption capacity: The ability of an area to visually absorb development without noticeable intrusion or change to the visual character of the area as a result of screening topography, vegetation or structures in the landscape.

Visual envelope: A geographic area, usually defined by topography, within which a particular project or other feature would generally be visible.

Visual exposure: The relative visibility of a project or feature in the landscape.

Visual impact: The effect of an aspect of the proposed development on a specified component of the visual, aesthetic or scenic environment within a defined time and space.

Visual receptors: An individual, group or community that is subject to the visual influence of the proposed development but is not necessarily adversely impacted by it. They will typically include commercial activities and motorists travelling along routes that are not regarded as scenic.

MAINSTREAM RENEWABLE POWER

CONSTRUCTION OF A SOLAR ENERGY FACILITY IN KIMBERLEY

VISUAL IMPACT ASSESSMENT REPORT – EIA PHASE

1 INTRODUCTION

SiVEST have been appointed by Mainstream Renewable Power to undertake an EIA study for the proposed development of a Concentrating Solar Plant (CSP) and a Concentrating Photovoltaic /Photovoltaic (CPV/PV) plant in Kimberley, Northern Cape Province. As part of the EIA studies being conducted for the proposed development, the need to undertake a visual impact assessment was identified. During the Scoping Phase of the EIA, a desktop assessment of the visual environment within the study area was undertaken in order to characterise the area and broadly identify all the potential visual impacts and issues relating to the proposed development. This visual assessment undertaken during the EIA phase focuses on the potential sensitive receptor locations, and provides both a day-time and night-time assessment of the magnitude and significance of the visual impacts associated with the proposed solar energy facility. The main deliverable of this study is the generation of maps indicating visual receptors within the various distance bands and visualisation imagery, as well as this report indicating the findings of the study.

2 PROJECT DESCRIPTION

2.1 CSP Project Description

The project will consist of two components:

a. CSP Power Plant
b. Associated infrastructure

- **CSP Power Plant**

The Concentrated Solar Power plant will consist of the following infrastructure:

a. Solar field
b. Power block
c. Water Pipeline

d. Evaporation ponds
e. Buildings

These are described in detail below:

f. Solar field

The solar field will consist of parabolic trough mirrors. The mirrors require an area of approximately 600 hectares. This area will be required to be graded with terraces if required depending on the slope of the site.

Figure 1: Parabolic trough solar collector assembly

The parabolic trough plants will have solar collector assemblies (**Figure 1**) which hold the mirrors and the solar energy receivers in place. The assemblies are oriented south-north and are able to rotate on one axis during the day to track the sun as it moves.

Depending on the soil conditions on site, the foundations for the parabolic troughs could be Shallow foundations or deep foundations. Shallow foundations refer to concrete slabs which are laid close to the surface of the soil and spread the load of the trough to the earth near the surface. If the soils on site are not suitable (e.g. compressible soils) then deep foundations will be required, however it is unlikely that foundations deeper than 1m will be required.

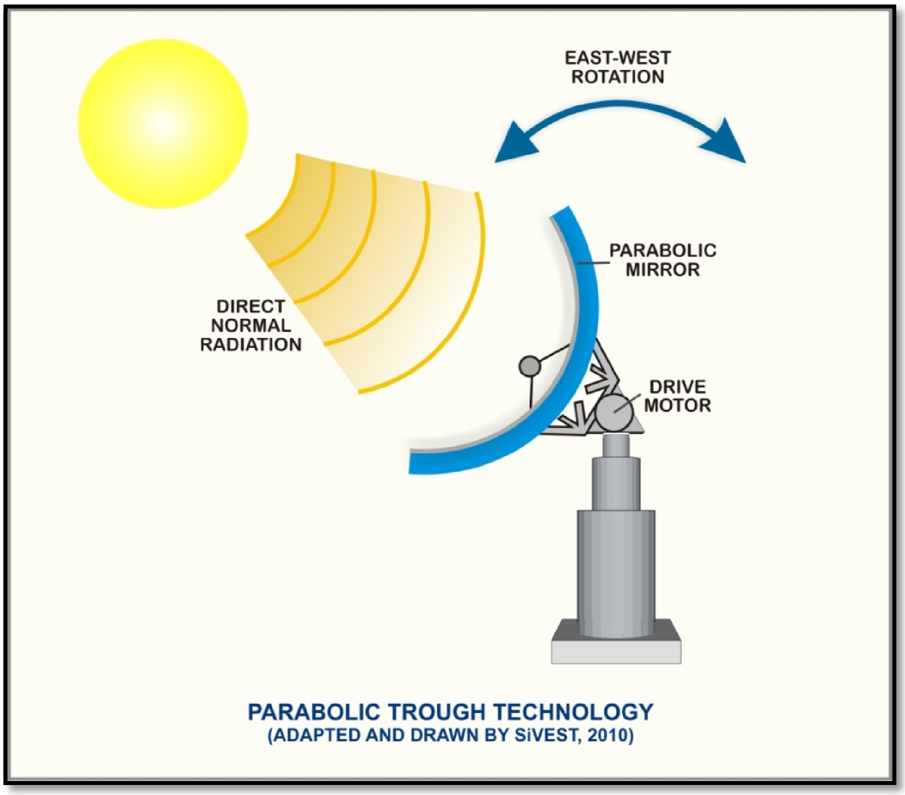

Figure 2: Functioning of the Parabolic Troughs

The rotation of the parabolic mirrors is typically operated using hydraulic arms (Figure 2). Maximum height of the mirrors during rotation will be approximately 8 meters above ground level. The mirrors are manufactured from low-iron glass, typically between 4-5mm in thickness. Solar energy is collected in the receivers which transfer that energy to synthetic oil, typically Therminol (VP-1), which is piped throughout the solar field. Therminol is a heat transfer fluid designed to meet the demanding requirements of high temperature systems.

g. Power Block

The solar field will have a Power Block where the heat captured in the solar field is converted into electrical energy. The principal components (Figure 3) of the power block are solar steam generators (which include heat exchangers where heat in the synthetic oil Heat Transfer Fluid is used to generate steam), a Steam Turbine (which converts the energy in the steam to electricity) and a Wet Cooling Tower (which cools the condenser and condenses the process steam).

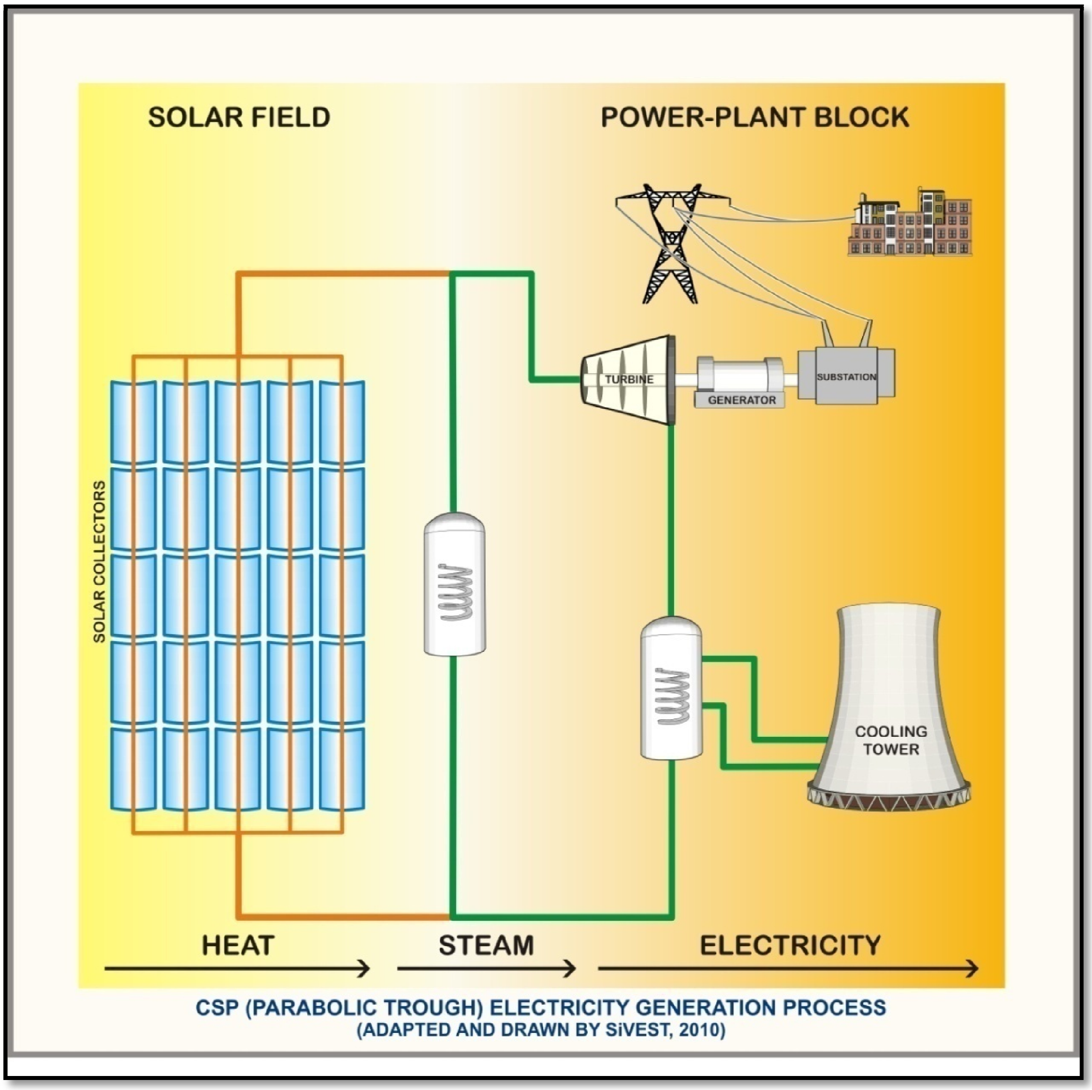

Figure 3: The CSP Process illustrated

h. Water Pipeline

A water pipeline will be used to deliver cooling water to the cooling tower. It is envisaged that a 350mm diameter pipe will be sufficient to provide required flow. Water is likely to be sourced from the Municipal Sewage Treatment Plant (south of Kamfers Dam), however the option to extract water from the Vaal is also being investigated. The route of this pipeline will be determined in later design stages although following the N12 road appears preferable at this stage.

It must be noted that a pipeline is currently proposed to transport water from the Municipal Water Treatment Works to a nearby pan. This is being proposed in order to release the pressure on

Kamfers Dam that is currently being experienced. The status of this project is not known at this stage however it would be preferable to feed off this pipeline for this proposed project and not have to construct a new pipeline. This will be investigated in more detail in the EIA phase.

i. Evaporation ponds

An Evaporation Pond(s) for storage of waste water (e.g. cycle water blowdown, chemical waste water, etc) will be installed adjacent to the solar field (Figure 4).

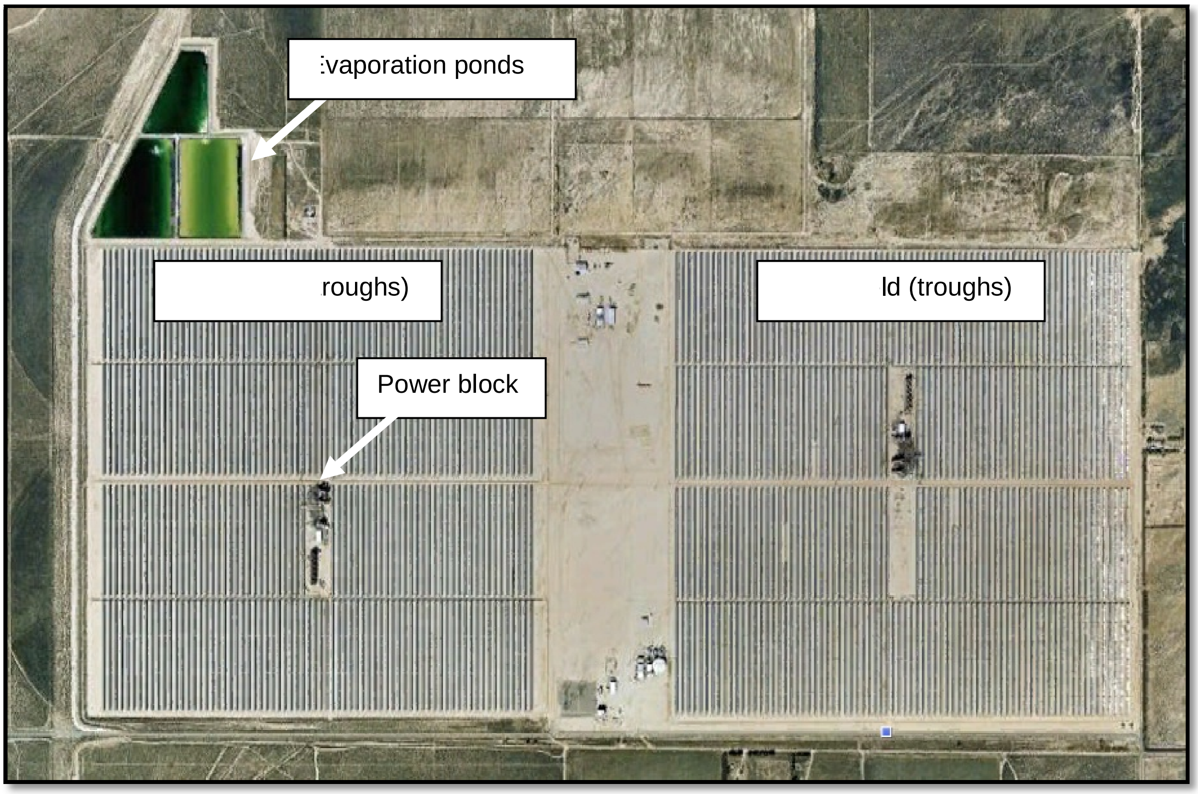

Figure 4: Google Earth Image© of the SEGS VIII and IX parabolic trough plants (Combined 160MW capacity) – Harper Lake, USA

- **Associated infrastructure**

a. Building infrastructure

The solar field will require on site buildings which will relate to the daily operation of the plant. The plant will require administration buildings (offices) (12m high, 70m long, 12m wide), a control room which may be housed in the main power block (16m high, 30m long, 30m wide). a fabrication building for the solar field (12m high, 150m long, 40m wide) and possibly a warehouse for storage. The office will be used for telecoms and ablution facilities will be included. Security will be required. Small amounts of fuel and oils associated with the solar field will be stored on site. These amounts will be below the thresholds requiring environmental assessments as stipulated in the NEMA EIA regulations. All materials will be bunded accordingly.

b. Thermal Storage tanks

Thermal Storage tanks will be on site which will contain several thousand tonnes of salt associated with the functioning of a CSP plant.

c. Water Treatment Plant

A water treatment plant will be installed to ensure that the water removed from the sewage treatment plant is suitable for the cooling process.

d. Electrical Connections

The project will provide electricity which will need to feed into the national grid. In order for this to occur, a new distribution substation needs to be constructed. The distribution substation compound will be approximately 90m x 120m in size and will ideally be located in close proximity to the existing power lines that traverse part of the site of the proposed development. The distribution substation voltage is unknown at this stage. It will include transformer bays which will contain transformer oils. Bunds will be constructed to ensure that any oil spills are suitably attenuated and not released into the environment. The distribution substation will be fenced for security purposes.

If the substation is located beside the existing power line the connection to the line will be via drop-down conductors. If the line is remote from the substation the connection will be by overhead power line, using either pole or pylon construction depending on the voltage. This will be determined in the EIA phase.

e. Roads

Upgrading of certain existing public roads along the equipment transport route may need to take place. An access road with a gravel surface from an adjacent public road onto the site will be required. An internal site road network to provide access to the solar field, power block & other infrastructure (substation & buildings) will also be required. Existing farm roads will be used where possible. The site road network will include turning circles for large trucks, passing points and where necessary, may include culverts over gullies and rivers/ drainage lines. All site roads will require a width of approximately 10m. Drainage trenches along the side of the internal road network will be installed. In addition, silt traps at the outfall of the drainage trenches to existing watercourses will be installed.

f. Fencing

For health and safety and security reasons, the plant will be required to be fenced off from the surrounding farm.

g. Solar Resource Measuring Station

A permanent solar resource measuring station which will measure 100m^2 and 5m in height will be required on site to measure incoming solar radiation levels on the site.

h. Temporary work areas / activities during construction

A lay down area of a maximum of 10 000m^2, adjacent to the site or access route will be required. This will be temporary in nature (unless the property owner wishes to continue using it long term). Associated with this will be the contractors site offices which will require a maximum of 5000m^2. This will be leased from the landowner and rehabilitated after construction.

i. Borrow pits

Borrow pits may be required, which are subject to appropriate permits via a separate process. These would be distributed around the site. Existing borrow pits will be used as far as possible. The size of these pits will be dependent on the terrain and need for granular fill material for use in construction.

The need and locality of these borrow pits will be determined in the EIA phase.

At the end of construction these pits will be backfilled as much as possible using surplus excavated material from the foundations and vegetation will be rehabilitated as indicated in the EMPR

2.2 CPV/PV Project Description

The project will consist of two components:

a. CPV/PV Power Plant
b. Associated infrastructure

- **CPV/PV Solar Power Plant**

The CPV/ PV plant will consist of the following infrastructure

a. Solar field
b. Buildings

These are described in detail below:

a. Solar field

Concentrated Photovoltaic (CPV) or Photovoltaic (PV) panel arrays with approximately 160 000 panels will be installed. An area of approximately 2km^2 is likely to be required for the CPV/PV. The area required does not need to be cleared or graded however no tall vegetation such as trees can remain on the site.

The panel arrays are approximately 15m x 4m in area. These are mounted into metal frames which are usually aluminium. Concrete or screw pile foundations are used to support the panel arrays. The arrays are either fixed on a tracking system (CPV is always on a tracking system and contains a slightly different panel) or tilted at a fixed angle (PV) equivalent to the latitude at which the site is located in order to capture the most sun (Figure 5). Arrays usually reach up to between 5m and 10m above ground level. Either a CPV or PV plant will be installed.

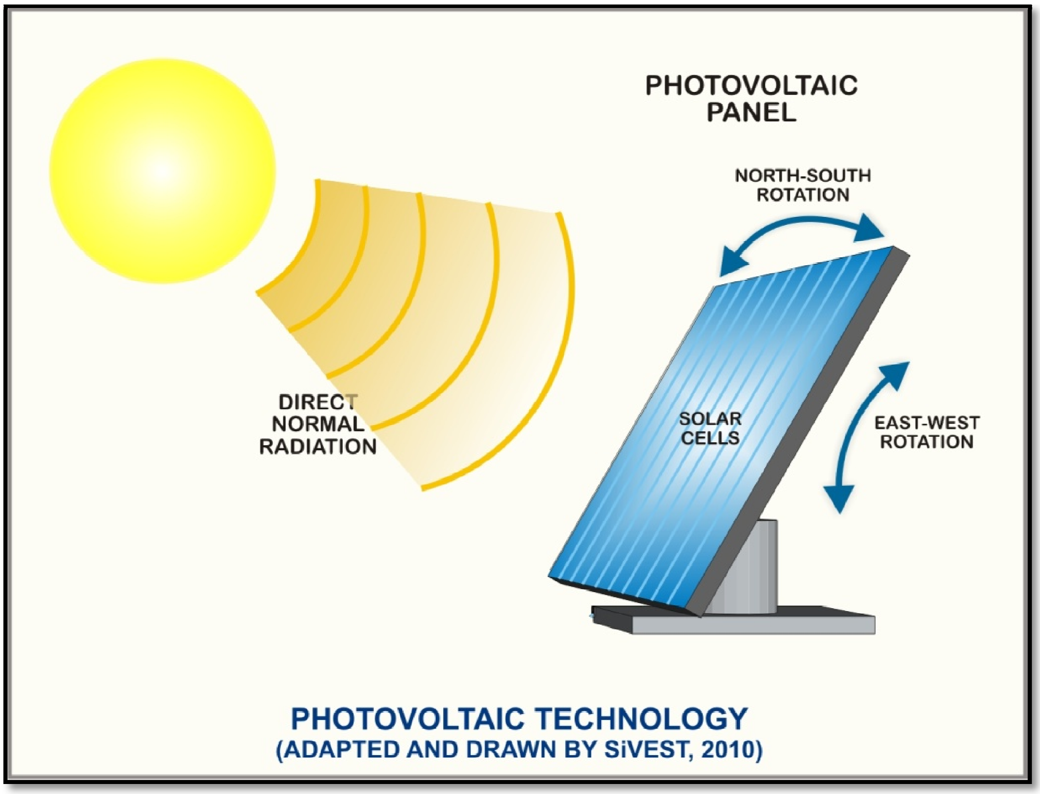

Figure 5: Illustration of how a CPV panel operates

b. Building infrastructure

The solar field will require on site buildings which will relate to the daily operation of the plant. The plant will require administration buildings (office) and possibly a warehouse for storage. The buildings will likely be a single storey building with warehouse / workshop space & access (e.g. 5m high, 20m long, 20m wide). The office will be used for telecoms and ablution facilities will be included. Security will be required.

- **Associated infrastructure**

a. Electrical Infrastructure

The PV arrays are typically connected to each other in strings and the strings connected to DC to AC inverters (Figure 6). The DC to AC inverters may be mounted on the back of the panel's support substructures / frames or alternatively in a central inverter station. The strings are connected to the inverters by low voltage DC cables. Power from the inverters is collected in medium voltage transformers through AC cables. Cables may be buried or pole-mounted depending on voltage level and site conditions.

The medium voltage transformers can be compact transformers distributed throughout the solar field or alternatively located in a central sub-station. It is likely to be a central substation in this instance.

The substation will be approximately 90m x 120m in size and will ideally be located in close proximity to the existing power lines that traverse a part of the site. The substation will be a distribution substation and will include transformer bays which will contain transformer oils. Bunds will be constructed to ensure that any oil spills are suitably attenuated and not released into the environment. The substation will be securely fenced.

If the substation is beside the existing power line the connection to the line will be via drop-down conductors. If the line is remote from the substation the connection will be by a newly constructed overhead power line, using either pole or pylon construction depending on the voltage.

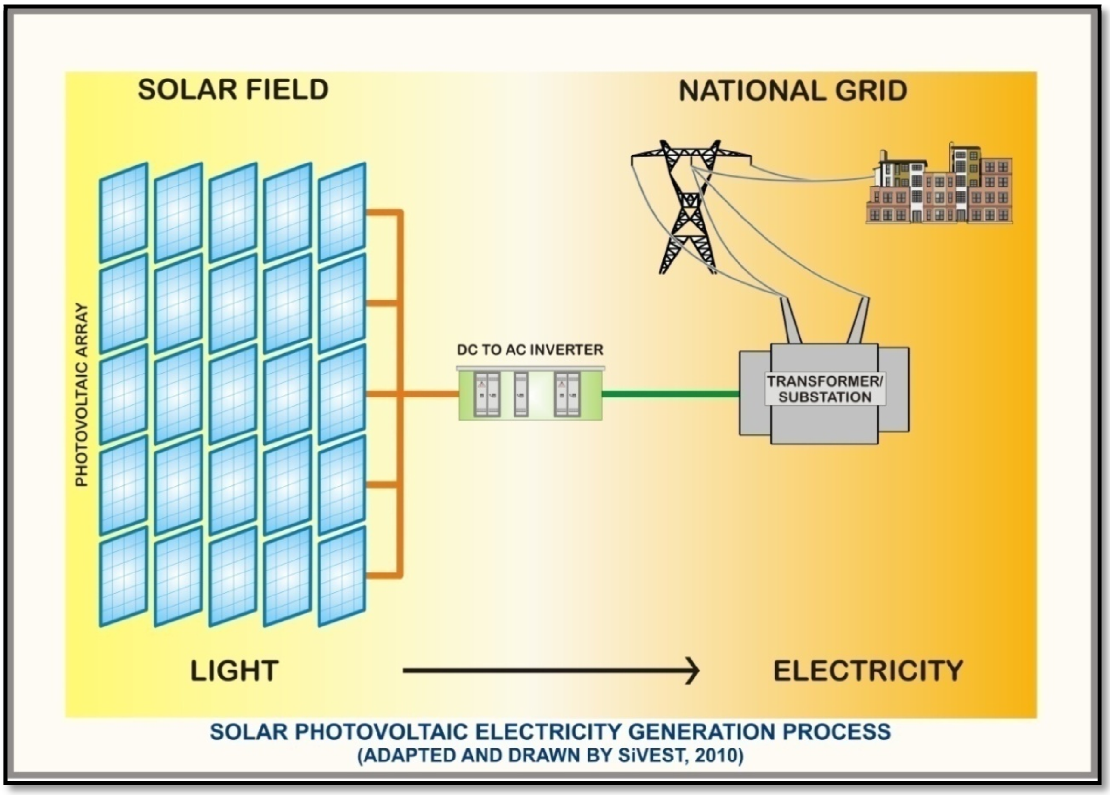

Figure 6: CPV/PV process

b. Roads

Upgrading of certain existing public roads along the equipment transport route may take place. An access road with a gravel surface from the public road onto the site will be required. An internal site road network to provide access to the solar field, power block & other infrastructure (substation & buildings) will also be required. Existing farm roads will be used where possible. The site road network will include turning circles for large trucks, passing points and where necessary, may include culverts over gullies and rivers/ drainage lines. All site roads will require a width of approximately 10m. Drainage trenches along the side of the internal road network will be installed. In addition, silt traps at the outfall of the drainage trenches to existing watercourses will be installed.

c. Fencing

For health & safety and security reasons, the plant will be required to be fenced off from the surrounding farm.

d. Solar Resource Measuring Station

A permanent solar resource measuring station which will measure $100m^2$ and which will be 5m in height will be required on site to measure incoming solar radiation levels on the site.

e. Temporary work areas / activities during construction

A lay down area of a maximum of 10 000m^2, adjacent to the site or access route will be required. This will be temporary in nature (unless the property owner wishes to continue using it in the long term). Associated with this will be a contractors site offices which will require a maximum of 5000m^2.

f. Borrow pits

Borrow pits may be required, which are subject to appropriate permits via a separate process. These would be distributed around the site. Existing borrow pits will be used as far as possible. The size of these pits will be dependent on the terrain and need for granular fill material for use in construction.

The need and locality of these borrow pits will be determined in the EIA phase.

At the end of construction these pits will be backfilled as much as possible using surplus excavated material from the foundations and vegetation will be rehabilitated as indicated in the EMPR.

3 SUMMARY OF SCOPING PHASE VISUAL STUDY

3.1 Physical Landscape Characteristics

As part of the visual characterisation, the physical landscape characteristics are described in terms the prevailing topography, vegetation cover and landuse in the study area.

3.1.1 Topography

Generally speaking, the study area is characterised by a relatively flat, topographically featureless landscape which slopes down gradually in a north-westerly direction towards the Vaal River Valley (see Figure 7). Variations in the topographical uniformity occur in the form of localised high points and ridges in the north and south-east of the site and slightly lower ground in the south-western portion of the site. The generally flat nature of the southern part of the site is indicated by the presence of a number of pans which only occur where the topography is too flat for surface drainage to flow away from the area.

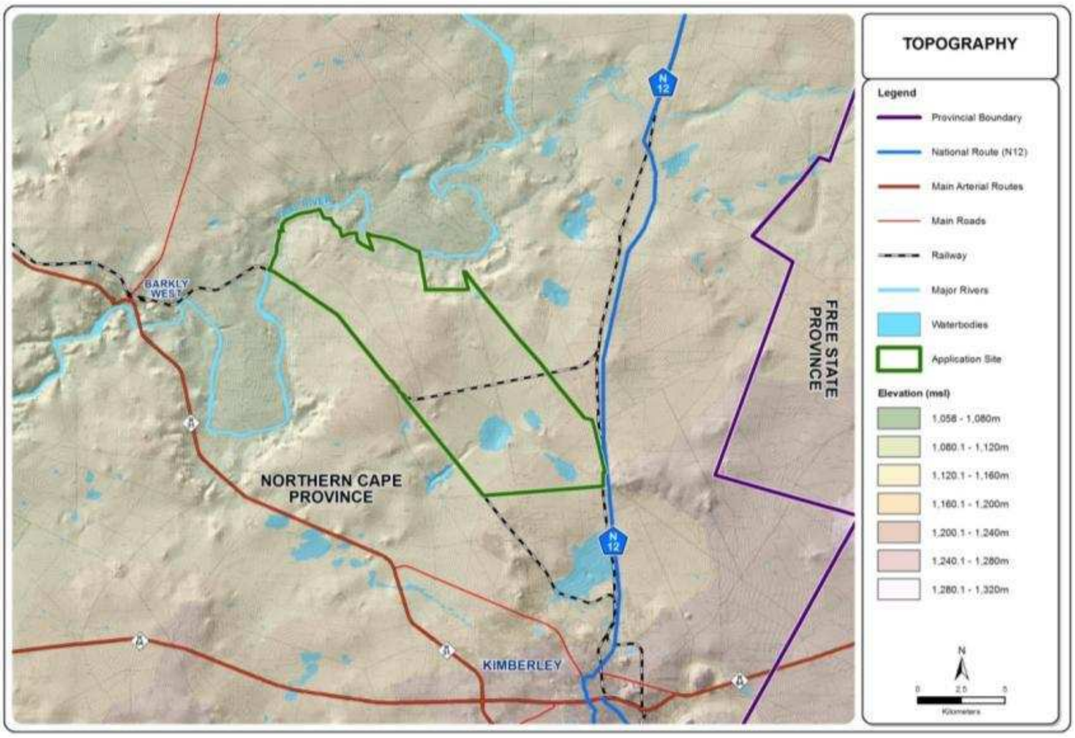

Figure 7: Topography within the study area

Visual Implications

The relatively flat topography on the site will result in typically wide-ranging vistas of the site, especially from locally higher elevations.

3.1.2 Vegetation

The dominant vegetation unit in the study area is Kimberley Thornveld, which is characterised by a well developed tree and shrub layer with an underlaying grass layer (Mucina and Rutherford, 2006). Much of this natural vegetation has however been previously cleared and replaced by open grasslands for agricultural purposes, except in the south-western parts of the site where natural thornveld vegetation is still present.

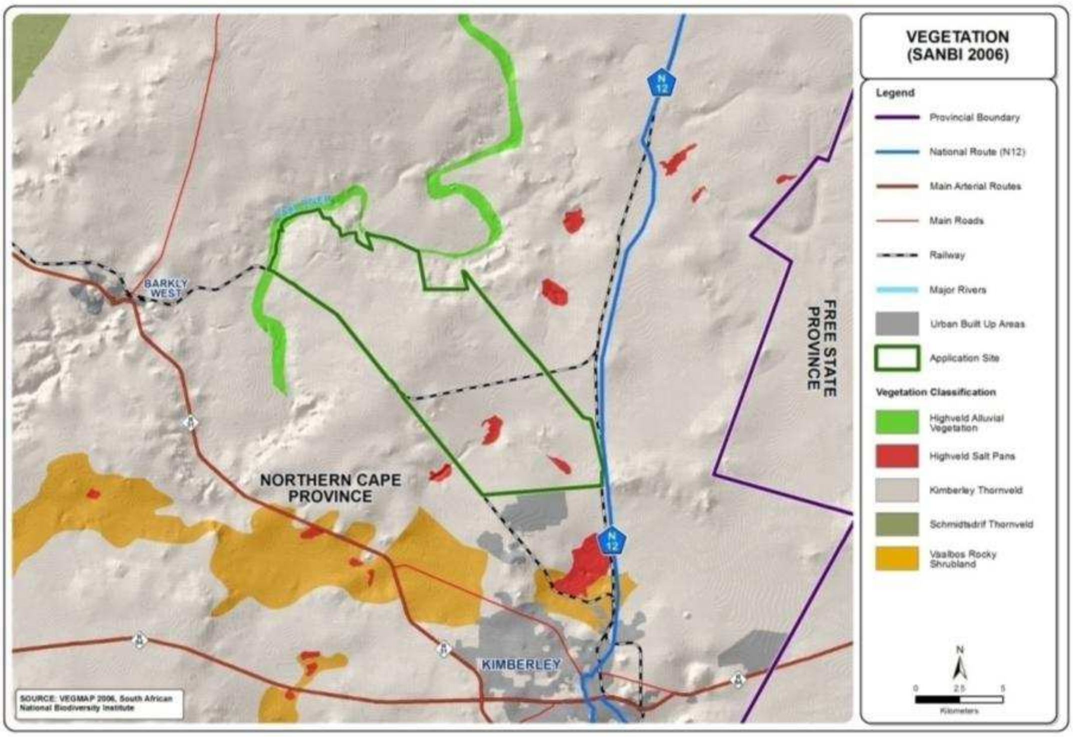

Figure 8: Map showing vegetation within the study area

<u>Visual Implications</u>

The short open grasslands will promote wide open vistas of the proposed site. Where natural trees and shrubs are still present they will restrict views and effectively screen objects that are the same height or lower.

3.1.3 Landuse

Most of the natural vegetation has been cleared from the proposed site and replaced by grassy plains used as grazing land for cattle. The surrounding area has been partly transformation by urban and suburban environments, with the town of Riverton directly to the north-east of the site along the Vaal River and the community of Roodepan situated to the south-west of the site. Intensive commercial agriculture occurs adjacent to the Vaal River, in and to the north of the site and mining activities which belong to the De Beers Consolidated Mines Ltd mostly occur to the south-east. Kimberley is the largest urban area and is located approximately 7km to the south of the site.

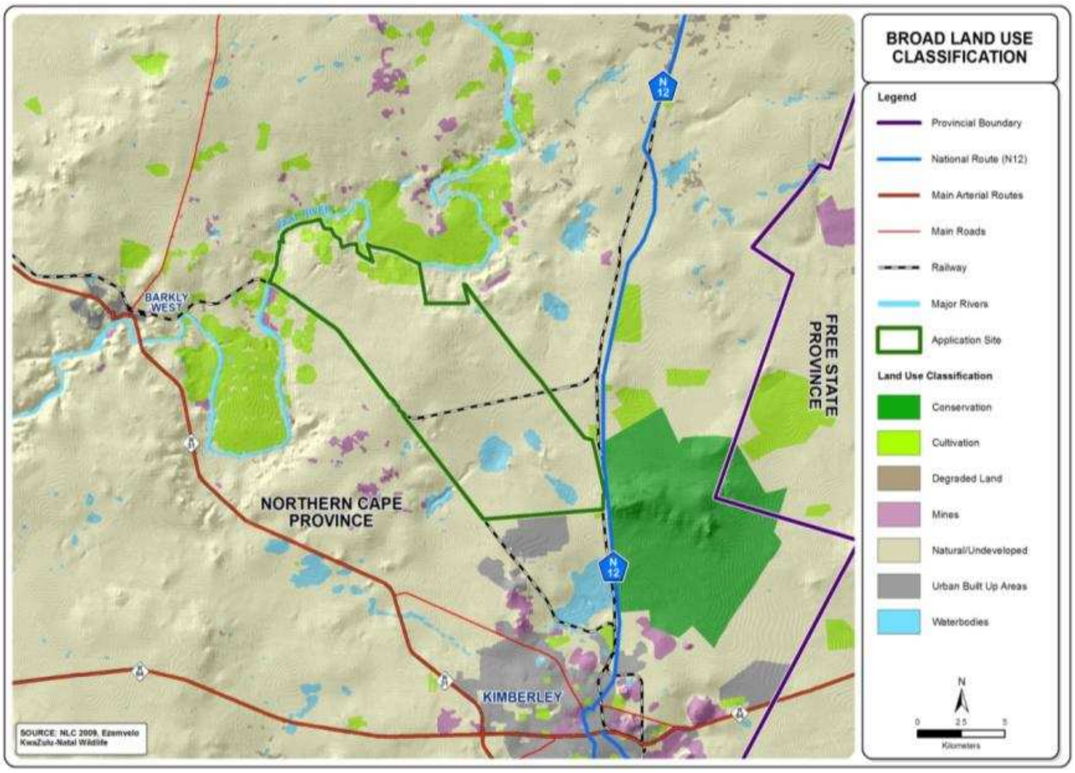

Figure 9: Landuse within the study area

<u>Visual Implications</u>
Clearance of the natural vegetation for urban and suburban landuses has partially transformed the natural visual character and resulted in wide open vistas.

3.2 Visual Character

The above physical landscape characteristics as well as the presence of built infrastructure influences the visual character of the study area. Visual character is defined based on the level of transformation from a completely natural setting (little evidence of human transformation), with varying degrees of transformation engendering different visual characteristics.

Most of the study area is considered to have a natural visual character with certain parts displaying a pastoral component where pasture land occurs, therefore introducing a solar field into this largely natural context is likely to alter the 'sense of place'.
Human infrastructure within the proposed site occurs at a low density and includes; transmission lines which traverse the site, the railway line on the western and eastern boundary, the road to Riverton on north-eastern boundary and the N12 highway on the eastern boundary. The surrounding landscape is relatively undisturbed with human transformation limited to agriculture and mining activities, scattered residential settlements, the N12 highway and the R31 to Barkly

West. The Dronfield Nature Reserve is located directly to the south-east of the site and contributes to the natural scenic character of the area by conserving the natural thornveld vegetation.

At present the area is largely undeveloped with a low density of human habitation and therefore the proposed solar energy facility is likely to degrade the natural visual character of the area. A large residential development, known as Northgate, has however been planned approximately 3km south of the proposed solar energy facility. Once erected, this residential development will increase the urban footprint and is likely to degrade the natural visual character of the study area.

3.2.1 Visual Absorption Capacity

The visual absorption capacity (VAC) of an area / landscape refers to the ability of the area / landscape to absorb the development without any noticeable intrusion or change to the visual character of the area. It is measured on a scale from high (an area which has a high capacity to absorb the development) to low (an area in which a development would be highly visible). It is a function of topography, landuse and land cover, with urban areas having a high VAC and natural areas having a low VAC.

The area surrounding the proposed site has a largely natural visual character, with a very low density of human settlement. The wooded component of the natural vegetation will impede views toward the site from several places along the N12, however majority of the study area is assigned a low VAC value as these trees and shrubs are scattered and will offer incomplete visual screening.

3.3 Visual Sensitivity

Visual Sensitivity is expressed as the sensitivity of an area to a proposed development which could be perceived as a visual impact. It is based on the, VAC, presence of existing infrastructure and visual character in an area, but also relates to the spatial distribution of potential receptors and likely value judgement of these receptors based on the perceived aesthetic appeal of an area. It is categorised as **high** (visually intrusive, negatively perceived by receptors), **moderate** (receptors present, limited negative perception) or **low** (little opposition, not negatively perceived).

The table below explores in more detail the inputs into categories of visual sensitivity:

Table 1 - Environmental factors used to define visual sensitivity classes

Visual Sensitivity Category	Visual Absorption Capacity	Presence and size of Existing	Presence of Sensitive	Visual Character	Other factors influencing visual sensitivity

		Infrastructure	Receptors		
High	Low	Absent or at very low densities	Present	-Natural / largely natural -Rural / pastoral	- Areas of natural vegetation (conserved) -Practice of economic activities (esp. tourism) which place value on the scenic / beauty character of the area
Moderate	Moderate	Present – not high densities	Present	-Rural / pastoral -Urban	
Low	High	Present – high densities, often a very large or tall	Absent	-Urban -Industrial	

As discussed above, the study are has a largely natural visual character, a low density of human infrastructure and a low VAC. Although there is limited human settlement in the immediate vicinity, the area is important from a tourism perspective as; the N12 on the eastern site boundary forms part of the Diamond Route, Dronfield Nature Reserve is located directly to the south-east and a number of recreational facilities associated with the Vaal River are located in Riverton. Due to these factors the area is categorised as having a high visual sensitivity.

4 STUDY APPROACH

4.1 Assessment Methodology

4.1.1 Field work and photographic review

On the 26th and 27th of March 2011 the proposed site was visited in order to;

- verify the landscape characteristics identified during the scoping phase visual study;
- capture photos to be used to visually model the solar plant (see Figure 10);
- verify the sensitivity of visual receptors previously identified during the scoping phase; and
- identify any additional visually sensitive receptors within the study area.

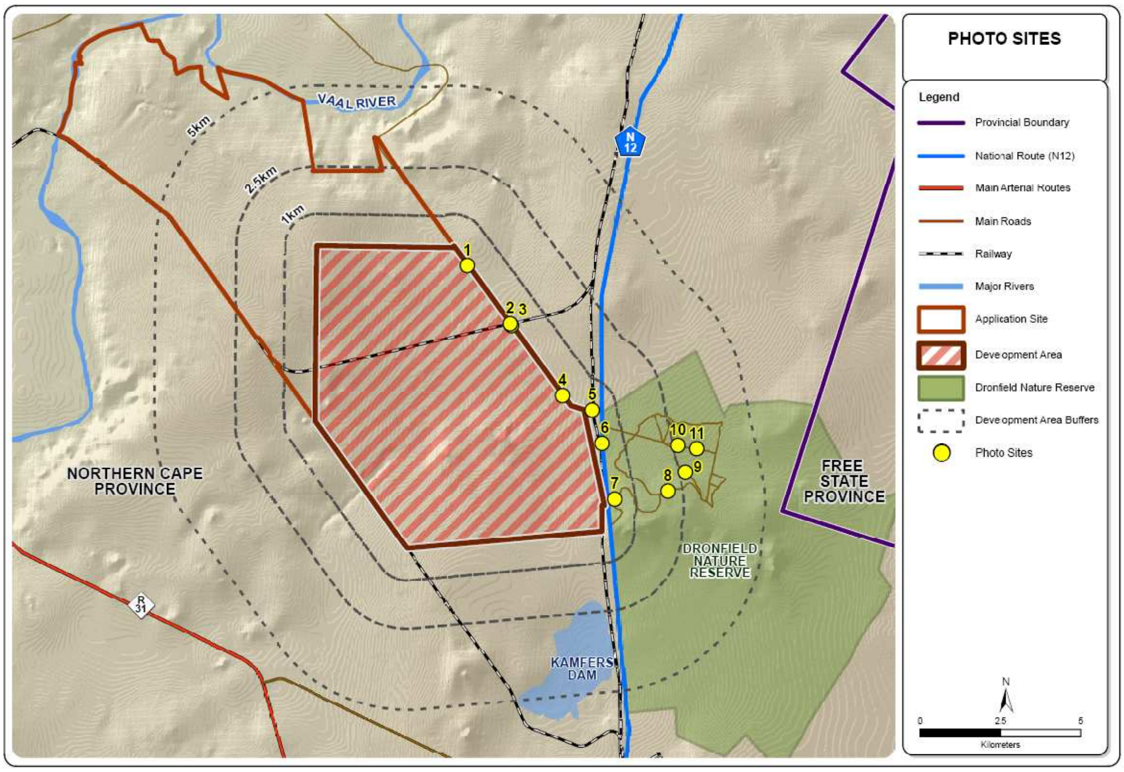

Figure 10: Location of photo sites within the study area

4.1.2 Physical landscape characteristics

Site visits and digital information from spatial databases such as ENPAT and SANBI were sourced to provide information on the topography, vegetation and landuse in the study area. These physical landscape characteristics are important factors which influence the visual character, the visual absorption capacity and visual sensitivity of the study area.

4.1.3 Identification of sensitive receptors

During the field investigation potentially sensitive visual receptor locations and routes within the study area, such as any scenic routes, tourism facilities and residences, were identified as these may potentially be sensitive to the visual impacts associated with the proposed development.

4.1.4 Impact Assessment

A rating matrix was used to objectively evaluate the significance of the visual impacts associated with the proposed development, both before and after implementing mitigation measures. Mitigation measures were identified (where possible) in an attempt to minimise the visual impact of the proposed development. The rating matrix made use of a number of different factors including geographical extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect and intensity in order to assign a level of significance to the different categories of visual impact during the various phases of the project (e.g. planning, construction, operation and decommissioning). A separate rating matrix was used to assess the visual impact of the proposed solar energy facility on sensitive receptor locations. This matrix is based on the distance of a receptor from the proposed development, primary orientation of a receptor and presence of screening factors. The layout alternatives within the study area were thereafter comparatively assessed in order to ascertain preferred alternative from a visual perspective.

4.1.5 Visualisation modelling

Visual simulations were produced from specific viewpoints in order to support the findings of the visual assessment. The CSP troughs and CPV/PV panels were modelled at the correct scale and superimposed onto the landscape photographs which were taken during the site visit. These were used to accurately demonstrate the visibility of the solar facility from various sensitive locations and to assist with the visual impact assessment.

4.1.6 Consultation with I&APs

Continuous consultation with Interested and Affected Parties (I&APs) undertaken during the public participation process will be used to help establish how the proposed solar energy facility will be perceived by the various receptor locations and the degree to which the impact will be regarded as negative. Although I&APs have not as yet provided any feedback during the EIA-stage, the report will be updated to include relevant information as and when it becomes available.

4.2 Assumptions and Limitations

For the purpose of this visual study, a development area incorporating all the proposed layout alternatives was been defined within the boundaries of the application site. The study area is assumed to encompass a zone of 5km from this development area. This area was assigned as distance is a critical factor when assessing visual impacts and beyond 5km the impact of the solar fields will be insignificant, and therefore not necessary to investigate. This is discussed further in section 6.1.6 Viewing distance.

Due to the varying scales and sources of information as well as the fact that only 20m contours were available to establish the Digital Terrain Model (DTM); maps and visual models may have minor inaccuracies.

No viewsheds were generated during this visual study as detailed digital data was not available and the topography within the study area is relatively flat. Generating viewsheds from coarse-grained DTMs would only take the large scale topographical variations into account and not minor topographical features, vegetative screening, or man-made structures which are important factors influencing the severity of visual impacts in this context.

Feedback received during the scoping phase public participation process has been incorporated into this report and any additional feedback relevant to the visual environment received during the EIR-phase public comment period will be incorporated into further drafts of this report.

It should be noted that the 'experiencing' of visual impacts is subjective and largely based on the perception of the viewer or receptor. The presence of a receptor in an area potentially affected by the proposed development does not thus necessarily mean that a visual impact will be experienced.

5 VISUAL RECEPTORS

For the purpose of this report, a sensitive receptor is defined as a receptor which would potentially be adversely impacted by the proposed development. This takes into account a subjective factor on behalf of the viewer – i.e. whether the viewer would consider the impact as a negative impact. An adverse impact is often associated with the alteration of the visual character of the area in terms of the intrusion of a new development into a 'view', which may affect the 'sense of place'. Thus receptors of visual impacts in areas / landscapes where the current visual character of the environment is part of the appeal of an area, and thus has a socio-economic importance, are likely to be considered sensitive receptors.

A distinction must be made between receptor locations and sensitive receptor locations – receptor locations are locations from where the proposed solar power plant may be in view, but from where the receptor may not necessarily be adversely affected by any visual intrusion associated with the facility. Receptor locations include locations of commercial activities and certain movement corridors, such as roads that are not tourism routes. Sensitive receptor locations typically include locations of human habitation and tourism activities which are likely to be adversely impacted by a proposed project.

During the EIA Phase, it was confirmed that relatively few potentially sensitive visual receptors are present within the study area (see Figure 11). This is mainly due to the limited human settlement within the immediate vicinity of the site.

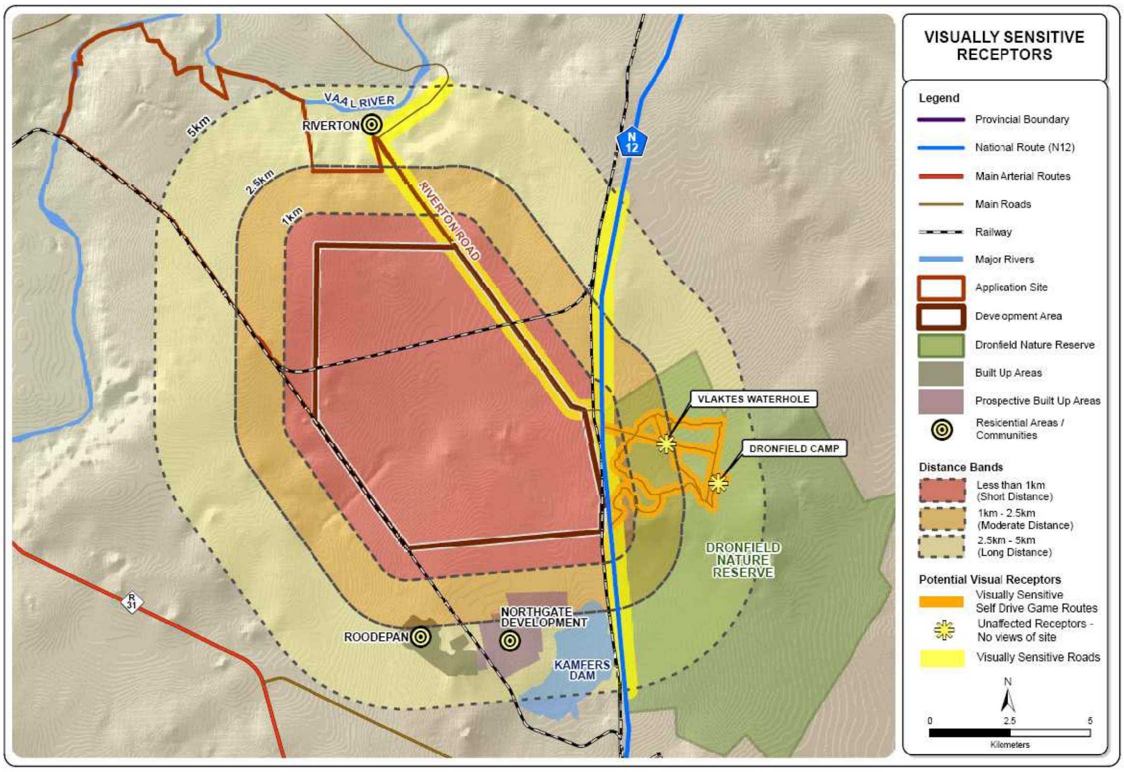

Figure 11: Visual Receptors within the study area

As depicted above, distance bands have been assigned from the development area of the proposed project as the visibility of the solar energy facility will diminish exponentially over distance. The proposed solar energy facility will be more visible to receptors located within a short distance and as a result these receptors will experience a higher adverse visual impact than those located at a moderate or long distance from the proposed solar energy facility. The distance of visually sensitive receptors from the development area will be taken into account when rating the visual impact of the proposed project on these receptors.

Based on the extensive height and scale of this project and the fact that visual exposure diminishes exponentially over distance (refer to section 6.1.6 Viewing distance), the radii chosen to assign these distance bands are as follows:

- 0 – 1km (Short distance)
- 1km – 2.5km (Moderate distance)
- 2.5km – 5km (Long distance)

The table below provides details of the visually sensitive receptors that were identified during the field investigation.

Table 2: Visually sensitive receptors in the study area

Name	Receptor Type	Primary Orientation	Distance from the proposed site
Dronfield self drive routes	Recreational activity	Partially toward proposed site	Moderate distance
N12 highway	National route	Partially toward proposed site	Short distance
Riverton road	Secondary road	Partially toward proposed site	Short distance

5.1 Receptor Roads

Roads that form tourist routes can be regarded as sensitive receptor locations as they are frequently accessed as a way of appreciating the natural beauty of an area or to access tourism facilities. The N12 Highway is regarded as a visually sensitive receptor as it forms part of the Diamond Route, which links eight important sites across the northern parts of South Africa, and more significantly it is an important arterial route between Gauteng and the Western/Northern Cape. The solar power plant in this context will have a transient visual impact on motorists travelling along this route as they bypass the study area. Although the N12 runs directly along the eastern site boundary for approximately 3km in the southern portion of the site, natural wooded vegetation will partially restrict views of the proposed solar energy facility from this section of road (see Figure 12).

Figure 12: View from the N12 showing vegetative screening in the southern portion of the application site

The Riverton road runs along the north-eastern site boundary and is considered a visually sensitive road as it is used to access the water sporting activities (e.g. fishing and boating) which take place on the banks of the Vaal River to the north of the proposed site. The vegetation in this part of the proposed site is dominated by short grassy plains which do not provide any visual screening and therefore motorists travelling along this route will be highly exposed to the visual impacts associated with the proposed solar energy facility. A high point is encountered as this road crosses the railway line. Wide-ranging vistas of the proposed solar fields and associated infrastructure will be experienced from this point (see Figure 13).

Figure 13: View south south-west from the rail overpass on the Riverton road toward the application site (Photo Site 3 on Figure 10)

5.2 Receptor Locations

Tourism in the vicinity of the study area is also an important factor in determining visually sensitive receptor locations which may be impacted by the proposed development. Unlike roads, tourism facilities will be subject to permanent visual impacts if a proposed development is visible from them. The Dronfield Nature Reserve is located directly east of the southern portion of the proposed site. It is valued as a breeding site for the White-backed Vulture and for preserving endangered antelope which breed in the reserve. The reserve boasts a restaurant, an accommodation and conferencing facility and self drive game routes. Although it is situated directly opposite the proposed site, it covers an extensive area and thus large portions of the reserve will be situated at a distance from where the visual impact of the proposed solar energy facility will be negligible (beyond 5km). The natural thornveld vegetation within the reserve will also restrict visibility from the camp and the Vlaktes Waterhole and views of the site from the main offices will be screened by a ridge within the reserve.

The self drive game routes in the western portion of the reserve are regarded to be visually sensitive as visitors travelling these routes will be visually exposed to the proposed solar energy facility. The visual impact of the proposed solar energy facility will be most prominent where the Vlaktes self drive game route gets relatively close to the western boundary of the reserve. This portion of the site is however not regarded to be particularly scenic as the visual character has already been degraded by the existing powerlines, the railway line and the N12 highway. Trees and shrubs will also partially restrict views and limit visibility toward the development area from sections of these self drive game routes (see Figure 14).

Figure 14: Thornveld vegetation restricting visibility of the site from the self drive game route within Dronfield Nature Reserve

The town of Riverton and the banks of the Vaal River were identified as a potential visual receptor location in the visual study undertaken during the scoping phase. Although water sporting activities occur in this area, this town is not regarded as a sensitive receptor location as extensive wooded vegetation and a ridge in the northern reaches of the site will screen the proposed solar energy facility from this area.

Northgate is a prospective residential development located approximately 3km to the south of the proposed solar energy facility. Although the proposed solar power plant may be viewable from parts of this development once it has been erected, it has not been assessed as a visually sensitive receptor location in this visual study as it is still in the early stages of development and no construction activities have commenced. It should also be noted that this residential development is located directly east of Roodepan which is not regarded to be visually sensitive, as the proposed site is not visible from this location.

6 IMPACT ASSESSMENT

6.1 Generic Visual Impacts of CSP and CPV/PV Plants

In this section, the potential visual issues / impacts related to the establishment of CSP and CPV/PV Plants as proposed, are discussed.

6.1.1 Surface coverage and height

The solar field for a CSP plant consists of numerous large parabolic trough mirrors which cover an extensive area of approximately 6km². These structures rotate on an axis and can reach a height of 8m above the ground (approximate in height to 2½-storeys of a building). The solar field for a CPV/PV plant is made up of approximately 160 000 photovoltaic panel arrays and will cover an area of approximately 2km². The arrays are either at a fixed angle (PV) or on a tracking system (CPV) that can reach heights between 5m and 10m above the ground (10m being approximate in height to a 3-storey building). Both these types of solar energy facilities will be highly visible due to the large surface area they cover in combination with the considerable height of the parabolic trough mirrors and solar arrays. The visual prominence of the facility will be exacerbated if located within natural settings or on a ridge top.

6.1.2 Associated infrastructure

In addition to the structures mentioned above, the building infrastructure associated with CSP Plants includes various structural components. The vertical dimensions of these components range from 10-12m high (approximate in height to a building of 4-5 storeys). This infrastructure will therefore stand out above the solar fields and magnify the visual prominence of the solar energy facility. In addition the power block required to convert the heat generated by a CSP plant into electricity reaches heights of 16m (approximate in height to a 5 storey building) and will be visible for great distances from the solar energy facility. The visual impact of these components will be highly intrusive when located on flat sites in natural settings where there is limited tall wooded vegetation present to conceal the impact.

Electrical infrastructure associated with CSP and CPV/PV plants will include two distribution substations (approximately 90m x 120m) and overhead power lines connecting the distribution substations to the existing power line. Power lines and substations are by their nature large objects and will typically be visible for great distances. Distribution power lines consist of a series of tall towers (approximately 25m high) thus making them highly visible. Power lines and substations are not features of the natural environment, but are representative of human (anthropogenic) alteration. Thus when placed in largely natural landscapes, they will be perceived to be highly incongruous in this setting. Conversely, the presence of other anthropogenic objects associated with the built environment, especially other power lines or substations, may result in the visual environment being considered to be 'degraded' and thus the introduction of a new power line into this setting may be less of a visual impact than if there was no existing built infrastructure visible.

6.1.3 Vegetation clearing

Both CSP and CPV/PV plants will require vegetation to be cleared. This clearing will be more intensive for CSP plants as the land will need to be graded and terraced where necessary, in order to provide a level surface for foundations. For CPV/PV plants only the taller vegetation will need to be cleared. This practice of clearing vegetation will intensify the visibility of the solar energy facility, particularly in locations where natural woody vegetation still exists, but to a lesser degree when the proposed facility is located on land that has already been cleared of woody vegetation or where woody vegetation does not occur.

6.1.4 Reflection

Reflection from the parabolic trough mirrors of the CSP Plant was raised as an issue of concern by I&APs during the public participation process undertaken in the Scoping Phase of the EIA, however this is not regarded to be a visual issue. The curvature of the parabolic tough mirrors that make up the CSP solar field will focus the incoming sunlight on a central receiver, thereby limiting the number of stray reflections. The glare experienced by someone observing the solar field is therefore not considered to be a visual hazard to oncoming traffic / train drivers as reflections from the solar field would be comparable to that of a body of water.

6.1.5 Experiencing visual impacts

It is important to note that visual impacts are only experienced when there are receptors present to experience this impact; thus in a context where there are no human receptors or viewers present it is unlikely that visual impacts will be experienced. The perception of the viewer/receptor toward an impact is also highly subjective and involves 'value judgements' on behalf of the receptor. It should be considered as certain receptors may not consider the development of a solar energy facility to be a negative visual impact.

CSP and CPV/PV plants are likely to be perceived as visual impacts in areas that have a natural scenic quality and where tourism activities based upon the enjoyment of, or exposure to, the scenic or aesthetic character of the area are practiced. Residents and visitors to these areas may regard solar energy facilities to be an unwelcome intrusion which degrades the natural character and scenic beauty of the area, and which would potentially even compromise the practising of tourism activities in the area. If a solar energy facility is associated with employment creation, social upliftment and the general development and progression of an area, it may not be associated with any negative visual impacts and even have positive connotations. It should be noted that solar energy facilities are considered to be an environmentally sustainable option of generating electricity, and this may positively alter the viewer's perceived experience of the visual impact.

The presence / existence of other anthropogenic objects associated with the built environment may not only obstruct views but also influence the perception of whether a solar energy facility is a visual impact. In industrial areas where structures, buildings and other infrastructure exist, the visual environment could be considered to be 'degraded' and thus the introduction of a solar power plant into this setting may be considered to be less of a visual impact than if there was no existing built infrastructure visible. In this case value may not be placed in the aesthetic quality of the landscape, and the solar energy facility may not necessarily be considered to be visually intrusive.

6.1.6 Viewing distance

Viewing distance is a critical factor in the experiencing of visual impacts, as beyond a certain distance, even large developments such as a solar power plant tend to be much less visible, and are difficult to differentiate from the surrounding landscape. The visibility of an object is likely to decrease exponentially with increasing distance away from the object, with maximum impact being exerted on receptors at a distance of 1000m or less. The impact decreases exponentially as one moves away from the source of impact, with the impact at 2000m being a quarter of the impact at 1000m away (see Figure 15). At 5000m away or more, the impact would be negligible.

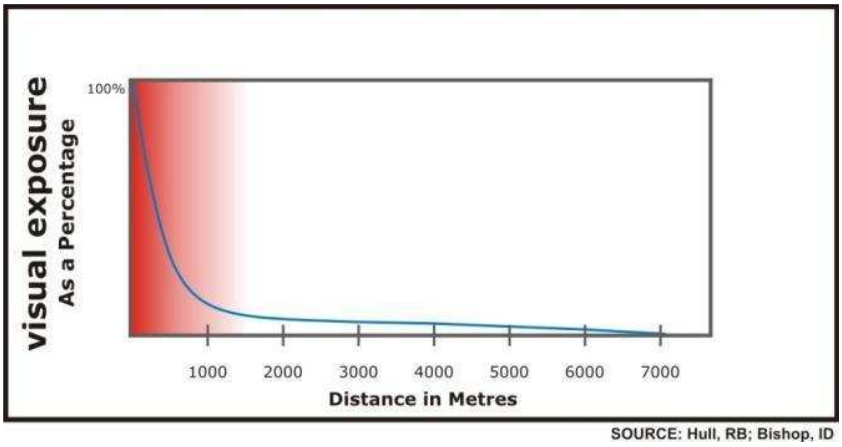

Figure 15: Diagram illustrating diminishing visual exposure over distance

6.2 Visual Receptor Rating

In order to assess the impact of the proposed solar energy facility on the visually sensitive receptors listed above (refer to section 5 Visual Receptors), a matrix that takes into account a number of factors has been developed, and is applied to each receptor location.

The matrix has been based on a number of factors as listed below:

- Distance of receptor away from the proposed development (distance banding)
- Primary focus / orientation of the receptor
- Presence of screening factors (topography, vegetation etc.)

These factors are considered to be the most important factors when assessing the visual impact of a proposed development on a sensitive receptor. It must be remembered that the experiencing of visual impacts is a complex and qualitative phenomenon, and thus difficult to accurately quantify; thus the matrix should be seen as a representation of the likely visual impact at a receptor location. The matrix should be viewed in combination with the visualisation images below to gain an understanding of the likely visual impact associated with the proposed solar power plant.

An explanation of the matrix is as follows.

Table 3: Rating matrix used to assess the impact of a development on visually sensitive receptors

Factor	**Classes and Scores**		
Distance of Receptor away from proposed	0-1km (Short distance)	1-2.5km (Moderate distance)	2.5-5km (Long distance)

development (distance banding)	Score: 3	Score:2	Score:1
Primary Focus / orientation of receptor	'Arc of view' directly towards proposed solar energy facility Score:3	'Arc of view' partially towards proposed solar energy facility Score:2	'Arc of view' in opposite direction of proposed solar energy facility Score:1
Presence of Screening Factors	No screening factors – solar energy facility highly visible Score:3	Screening factors partially obscure the solar energy facility Score:2	Screening factors completely block any views towards the solar energy facility Score:1

Categories of Visual Impact:
Low Visual Impact = 2-6
Medium Visual Impact = 7-12
High Visual Impact = 13-18

As discussed above (6.1.6 Viewing distance) the distance of the viewer / receptor location away from the solar power plant is an important factor in the context of the experiencing of visual impacts. The highest rating has thus been assigned to receptor locations that are located within 1km of the proposed solar energy facility. Beyond 1km, the visual impact associated with a solar power plant is likely to be moderate, and any receptor location beyond 2.5km from the proposed development has been allocated into the lowest class. Receptors beyond 5km from the proposed solar energy facility have not been rated as the impact will be negligible.

The orientation of a receptor becomes important in many cases, as the receptor location is typically oriented in a certain direction, e.g. with views towards a certain area / part of the landscape from a highly frequented area like a porch or garden. The visual impact of a solar field could be potentially much greater if intruded into such a view, and thus the highest rating has been given to a situation where the solar energy facility would be directly within an 'arc of view / orientation' – i.e. the 180^{o} panorama in a certain direction.

The presence of screening factors, such as vegetation, buildings and topography is the most influential factor to be considered when rating the impact of proposed development on visually sensitive receptors. For example a sensitive receptor within close proximity (<1km) and oriented directly towards a solar energy facility may have no views of the facility if a screening factor such as a tall grove of trees is situated directly between the receptor and the solar energy facility. As a result the solar energy facility will have a low visual impact on the receptor despite the orientation and proximity of the receptor to the solar energy facility. Topography (relative elevation and aspect) plays a similar role as a receptor location in a deep or incised valley will have a very limited viewshed and may not be able to view an object that is close by, but not in its viewshed. The opposite would apply to tall objects crossing a ridge, which would be highly visible.

The visual impact rating of the proposed solar energy facility on each visually sensitive receptor is calculated by scoring each factor according to the above matrix and thereafter applying the following formula in order to categories the visual impact:

(Distance + Orientation) x Screening

Screening was used to weight the sum of distance and orientation as this is the most significant factor when categorising the visual impact.

The table below presents the results of the visual impact matrix.

Table 4: Visual impact rating of visually sensitive receptors

Receptor Location	Distance	Orientation	Screening	Visual Impact
Dronfield self drive routes	2	2	2	**Medium**
N12 highway	3	2	2	**Medium**
Riverton road	3	2	3	**High**

As depicted in the above table, the visual impact of the proposed solar energy facility will have a high visual on the Riverton road which runs along the north-eastern site boundary and a medium visual impact on both the N12 and the self drive game routes in Dronfield Nature Reserve. Due to the linear nature of all the visually sensitive receptors, they will cross all three distance bands, however they have been scored according to the distance band in which most of the visual impact will be experienced.

6.3 Visual Modelling

Visualisation modelling has been undertaken for the proposed solar energy facility from key sensitive receptor locations to provide a realistic picture of how the visual environment may be affected and to strengthen the findings of the visual impact assessment.

Visual models were created of views toward the proposed site from the N12 highway and selected points along the Riverton road. These photo sites were chosen in order to illustrate how views from these visually sensitive receptors will be transformed by the proposed development once erected. Views from the self drive game drives in Dronfield Nature Reserve were not modeled as it was established that large portions of the solar facility will be restricted by the wooded vegetation both within the reserve and in the southern portion of the site.

The following assumptions and limitations are of relevance for the visual models:

- In order to support the findings of the comparative assessment of alternative (refer to section 6.6 Comparative Assessment of Alternatives), visualisation modeling was undertaken for both alternative 1 and 2 of the CSP and CPV/PV site positions.

- The visual models represent a visual environment that assumes all vegetative clearing will be restored to its current state after the construction phase. This is however an improbable scenario as some trees and shrubs may be removed which will reduce the accuracy of the models generated.

- Detailed layout plans have not been finalised and therefore certain infrastructure associated with the facility may not be included in the models and the layout of the solar field as depicted may change.

6.3.1 View 1 – West from the N12 Highway (Photo Site 6 on Figure 10)

This photo site is situated on the N12 highway directly opposite the eastern site boundary. The view is indicative of what motorists travelling along the N12 highway would see when looking in westerly direction toward the site. Alternative 1 of the CSP and CPV/PV solar fields have been visually modelled from this point (see Figure 16 and Figure 17).

Figure 16: Existing panoramic view toward CSP and CPV/PV alternative 1 from the N12 highway

Figure 17: Visually modelled post-construction panoramic view toward CSP and CPV/PV alternative 1 from the N12 highway

As depicted above, portions of the solar energy facility will be visible from this point, particularly the PV solar field which is situated within close proximity. The natural wooded vegetation will provide partial visual screening and the presence of the railway line reduces the natural scenic quality of views from this road. The solar energy facility will therefore have a medium visual impact on motorists travelling along this section of road.

6.3.2 View 2 – West from the Riverton Road (Photo Site 4 on Figure 10)

This photo site is situated on the bend of the Riverton road directly opposite the north-eastern site boundary. The view is indicative of what motorists travelling along the Riverton road would see when looking in westerly direction toward the site. Alternative 2 of the CSP and CPV/PV solar fields have been visually modelled from this point (see Figure 18 and Figure 19).

Figure 18: Existing panoramic view toward CSP and CPV/PV alternative 2 from bend on the Riverton Road

Figure 19: Visually modelled post construction panoramic view toward CSP and CPV/PV alternative 2 from bend on the Riverton Road

As depicted above, a portion of both the CSP and CPV/PV solar fields will be visible from this road, with the PV solar field appearing in the foreground as it is situated directly west of the road. The short nature of the grassy plains will offer no visual screening and as a result the solar energy facility will have a high visual impact on motorists travelling along this road.

6.3.3 View 3 – South-west from the Riverton Road (Photo Site 1 on Figure 10)

This photo site is situated further north on the Riverton road to the east of CSP alternative 2. This view is indicative of what motorists travelling along the Riverton road would see when looking in south-westerly direction toward the site. Alternative 2 of the CSP and CPV/PV solar fields have been visually modelled from this point (see Figure 20 and Figure 21).

Figure 20: Existing panoramic view toward CSP and CPV/PV alternative 2 from the Riverton Road (further north)

Figure 21: Visually modelled post construction panoramic view toward CSP and CPV/PV alternative 2 from the Riverton Road (further north)

As indicated above, the CSP solar field will become more visible as one travels further north along the Riverton Road. The vegetation remains short and as a result the solar energy facility will have a high visual impact on motorists travelling along this road.

It should be noted that although the solar energy facility will be highly visible to motorists travelling along the Riverton and partially visible to motorists travelling along the N12 highway, it may not necessarily be perceived negatively, as renewable solar energy is a new concept in South Africa which may evoke curiosity.

6.4 Night-time Impacts

The visual impact of lighting on the nightscape is largely dependent on the existing light pollution in the surrounding area, as the night scene in areas where there are numerous light sources will be visually degraded and therefore additional light sources are unlikely have a significant impact on the nightscape. It is thus important to identify a night-time visual baseline before exploring the potential visual impact of the proposed solar energy facility at night.

The area in the direct vicinity of the proposed site is largely undeveloped and as a result there are few existing light sources present and the visual environment is characterised by a relatively dark night scene with low levels of light pollution. The main source of light within the study area is the urban area of Kimberly located approximately 7km south of the proposed site.

Operational and security lighting at night will be required for the proposed solar energy facility and the two substations proposed within the development footprint. The type and intensity of lighting required was unknown at the time of writing this report and therefore the assessment is based on the effect that additional light sources will have on the ambiance of the night scene and impact on visually sensitive receptors.

The lighting required for the proposed project will intrude on the nightscape and create glare, which will have some significance as it will contrast with the relatively dark backdrop in the immediate vicinity. The Dronfield Nature Reserve directly south-east of the proposed site is a tourism destination and as such will be particularly sensitive to lighting impacts which may alter the night time sense of place. Existing night time views toward the proposed site from the visually sensitive receptors are characteristic of a relatively dark night scene with several light sources visible in the distance and as a result lighting impacts from the proposed solar energy facility will increase the existing light pollution in the surrounding area.

The visual impact rating of the night-time visual impact of the proposed solar energy facility, both before and after mitigation measures, is outlined in section 6.5.2 below.

6.5 Overall Visual Impact Rating

6.5.1 Potential day-time visual impact of the proposed solar energy facility

- Planning

No visual impacts are expected during planning.

- Construction

Table 5: Rating of day-time visual impacts during construction

IMPACT TABLE FORMAT	
Environmental Parameter	**Visual environment:** The aesthetic or scenic nature of the environment within a defined time and space, which covers the broad range of visual, cultural and spiritual aspects of the landscape.
Issue/Impact/Environmental Effect/Nature	**Day-time visual impact during construction:** Large construction vehicles and equipment during the construction phase will alter the natural character of the study area and expose sensitive receptors to visual impacts associated with the construction phase.
Extent	**Local/district:** Will affect the local area or district.
Probability	**Likely:** The impact will likely occur (Between a 50% to 75% chance of occurrence), depending on the perception of the viewer.
Reversibility	**Completely reversible:** The impact is reversible as it will only last the duration of the construction period.
Irreplaceable loss of resources	**No loss:** The impact will not result in the loss of any resources as it is temporary.
Duration	**Short term:** The impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
Cumulative effect	**Negligible:** The impact would result in negligible to no cumulative effects.
Intensity/magnitude	**Medium:** Impact alters the visual quality of the landscape but the system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
Significance Rating	**Prior to mitigation measures:** There will be a negative low impact i.e. the anticipated impact

IMPACT TABLE FORMAT		
	will have negligible negative effects and will require little to no mitigation. **After mitigation measures:** The negative low impact will persist after mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-18 (negative low)	-9 (negative low)
Mitigation measures	▪ Carefully plan to reduce the construction period. ▪ Locate laydown and storage areas in zones of low visibility i.e. behind exiting wooded vegetation or in lower lying areas. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. ▪ Maintain a neat construction site by removing rubble and waste materials regularly. ▪ Make use of existing gravel access roads where possible.	

- Operation

Table 6: Rating of day-time visual impacts during operation

IMPACT TABLE FORMAT	
Environmental Parameter	**Visual environment:** The aesthetic or scenic nature of the environment within a defined time and space, which covers the broad range of visual, cultural and spiritual aspects of the landscape.
Issue/Impact/Environmental Effect/Nature	**Day-time visual impact during operation:** The solar field and associated infrastructure will alter the natural character of the study area and expose sensitive receptors to visual impacts associated with the proposed solar power plant during operation.
Extent	**Local/district:** Will affect the local area or district due to the

IMPACT TABLE FORMAT	
	extensive size of the proposed project.
Probability	**Definite:** Impact will certainly occur (Greater than a 75% chance of occurrence).
Reversibility	**Irreversible:** The impact is irreversible and no mitigation measures exist.
Irreplaceable loss of resources	**Marginal loss:** Scenic / natural views are valuable visual resources that are almost impossible to replace. The impact will result in marginal loss of this resource as the N12 and Riverton road are not typically valued as scenic routes and the natural thornveld vegetation within Dronfield will limit the visual intrusion of the solar energy facility in scenic views from this reserve.
Duration	**Long term:** The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
Cumulative effect	**Negligible:** The impact would result in negligible to no cumulative effects.
Intensity/magnitude	**Medium:** Impact alters the visual quality of the landscape but the system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
Significance Rating	**Prior to mitigation measures:** There will be a negative medium impact i.e. the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** No mitigation measures, therefore the negative medium impact will persist.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	-32 (negative medium impact)	-32 (negative medium impact)

IMPACT TABLE FORMAT	
Mitigation measures	No mitigation measures.

- Decommissioning

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase.

6.5.2 Potential night-time visual impact of the solar energy facility

- Planning

No visual impacts are expected during planning.

- Construction

Table 7: Rating of night-time visual impacts during construction

IMPACT TABLE FORMAT	
Environmental Parameter	**Visual environment:** The aesthetic or scenic nature of the environment within a defined time and space, which covers the broad range of visual, cultural and spiritual aspects of the landscape.
Issue/Impact/Environmental Effect/Nature	**Night-time visual impact during construction:** The night scene is characterised by a relatively dark night scene with several light sources visible in the distance. Most construction activities are likely to take place during day-time business hours and therefore the construction phase of the development is unlikely to have a significant impact on the visual quality of the area at night.
Extent	**Local/district:** Will affect the local area or district.
Probability	**Unlikely:** The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
Reversibility	**Completely reversible:** The impact is reversible as it will not last longer than the duration of the construction period.
Irreplaceable loss of resources	**No loss:** The impact will not result in the loss of any resource as it is temporary.

IMPACT TABLE FORMAT		
Duration	**Short term:** The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).	
Cumulative effect	**Negligible:** The impact would result in negligible to no cumulative effects.	
Intensity/magnitude	**Low:** Impact alters the visual quality and integrity of the nightscape in a way that is barely perceptible.	
Significance Rating	**Prior to mitigation measures:** There will be a negative low impact i.e. the anticipated impact will have negligible negative effects and will require little to no mitigation. **After mitigation measures:** The negative low impact will persist after mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	1	1
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-7 (negative low)	-6 (negative low)
Mitigation measures	▪ Limit construction activities to day-time hours in order to minimise night lighting during construction.	

- Operation

Table 8: Rating of night-time visual impacts during operation

IMPACT TABLE FORMAT	
Environmental Parameter	**Visual environment:** The aesthetic or scenic nature of the environment within a defined time and space, which covers the broad range of visual, cultural and spiritual aspects of the

IMPACT TABLE FORMAT	
	landscape.
Issue/Impact/Environmental Effect/Nature	**Night-time visual impact during operation:** The night scene is characterised by a relatively dark night scene with several light sources visible in the distance. The proposed development will therefore alter the visual quality of the area at night.
Extent	**Local/district:** Will affect the local area or district.
Probability	**Probable:** The impact will likely occur (Between a 50% to 75% chance of occurrence).
Reversibility	**Partly reversible:** The impact is partly reversible with the implementation of mitigation measures.
Irreplaceable loss of resources	**Marginal:** A night scene with minimal light pollution is a visual resource for eco-tourism facilities. The operational and security lighting will result in marginal loss of this resource as there are several existing light sources already visible in the distance and the natural thornveld vegetation within Dronfield will block out most light sources from the reserve.
Duration	**Long term:** The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
Cumulative effect	**Low:** The impact would result in insignificant cumulative effects by increasing the light pollution in the area at night.
Intensity/magnitude	**Medium:** Impact alters the visual quality and integrity of the nightscape but it still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
Significance Rating	**Prior to mitigation measures:** There will be a negative low impact i.e. the anticipated impact will have negligible negative effects and will require little to no mitigation. **After mitigation measures:** The negative low impact will persist after mitigation.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2

IMPACT TABLE FORMAT		
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	2	1
Intensity/magnitude	2	2
Significance rating	-28 (negative low)	-24 (negative low)
Mitigation measures	▪ Make use of fittings that focus the light and prevent light spill. ▪ Direct perimeter lighting in a downward direction toward the site in a western direction. ▪ Limit the use of flood lighting where possible.	

- Decommissioning

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase.

6.6 Comparative Assessment of Alternatives

As indicated in the map below CSP and CPV/PV site position alternatives have been investigated for the proposed project (see Figure 22). These alternatives will need to be comparatively assessed in order to determine the preferred alternative from a visual perspective.

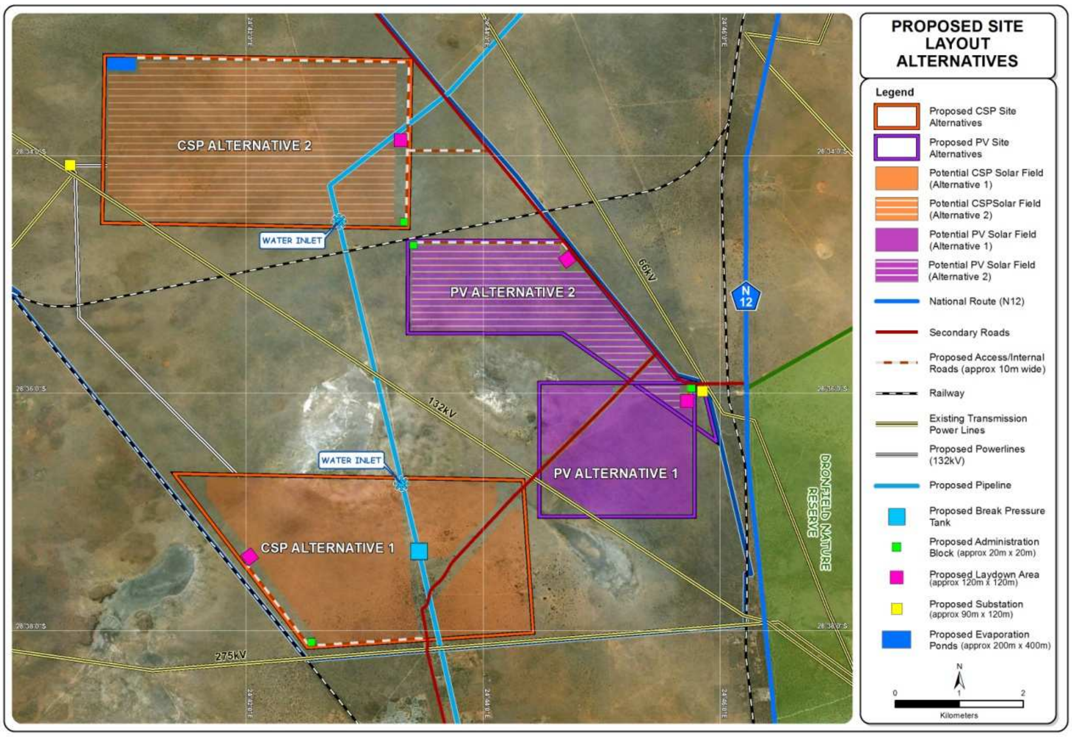

Figure 22: Site layout alternatives to be assessed

In order to comparatively assess the visual impact of the proposed CSP and CPV/PV alternatives a matrix specific to this proposed project has been developed based on the follow factors:

- the portion of the solar field within viewable distances from visually sensitive receptors (i.e. Dronfield self drive game routes, the N12 highway and Riverton road); and
- the presence of potential screening factors (i.e. topography, vegetation and infrastructure).

Alternative 1 and 2 for both the CSP and CPV/PV alternatives are situated in relative close proximity to each other, with the CPV/PV alternatives partially overlapping, and therefore rating the alternatives according to the presence of sensitive receptors within close proximity to each alternative would result in virtually equal impact ratings. Consequently, the portion of the solar field within various viewable distances from each visually sensitive receptor has been used as a factor to assess the CSP and CPV/PV alternatives. The highest rating has been assigned where almost the entire solar field is within a moderate distance (<2.5km) from a receptor and the lowest rating where only part of the solar field is within a long distance (<5km) from a receptor. The presence of screening factors has also been considered as vegetation, buildings and topography may affectively screen large portions of the solar field from visually sensitive receptors.

The table below provides an explanation of the matrix.

Table 9: Rating matrix used to assess the impact of CSP and CPV/PV layout alternatives

Factor	**Classes and Scores**		
Portion of solar field within viewable distance from a visually sensitive receptor	Almost entire solar field (75%<) within a moderate distance (<2.5km) of a visually sensitive receptor. Score: 3 (for each receptor)	Notable part of the solar field (25-75%) within a moderate distance (<2.5km) or almost entire solar field (75%<) within a long distance (<5km) of a visually sensitive receptor Score: 2 (for each receptor)	Notable part of the solar field (25-75%) within a long distance (<5km) of a visually sensitive receptor. Score: 1 (for each receptor)
Presence of screening factors	Limited screening factors, therefore the proposed solar field will be highly visible Score: 3	Screening factors partially obscure visibility of the proposed solar field. Score: 2	Screening factors will screen large portions of the proposed solar field. Score: 1

Categories of Visual Impact:

Low Visual Impact = 1-4

Medium Visual Impact = 5-8

High Visual Impact = 9-12

The visual impact rating for each alternative is calculated by scoring each factor according to the above matrix and thereafter applying the following formula in order to categories the visual impact:

Portion of solar field within viewable distance from a visually sensitive receptor + Presence of screening factors

The categories are described below:

High: The solar field will have a high visual impact on visually sensitive receptors.

Medium: The solar field will have a moderate visual impact on sensitive visual receptors.

Low: The solar field will have a low visual impact on sensitive visual receptors.

6.6.1 CSP site position alternatives

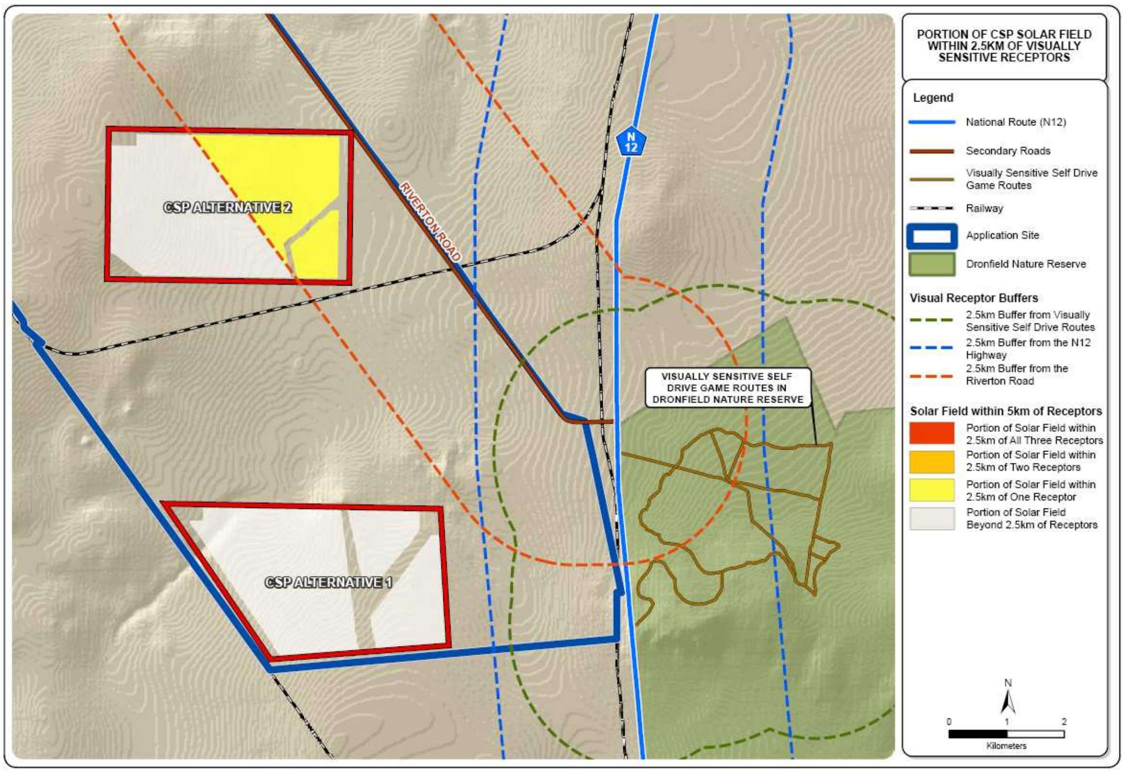

Figure 23: Portion of CSP solar field within 2.5km (moderate distance) from visually sensitive receptors

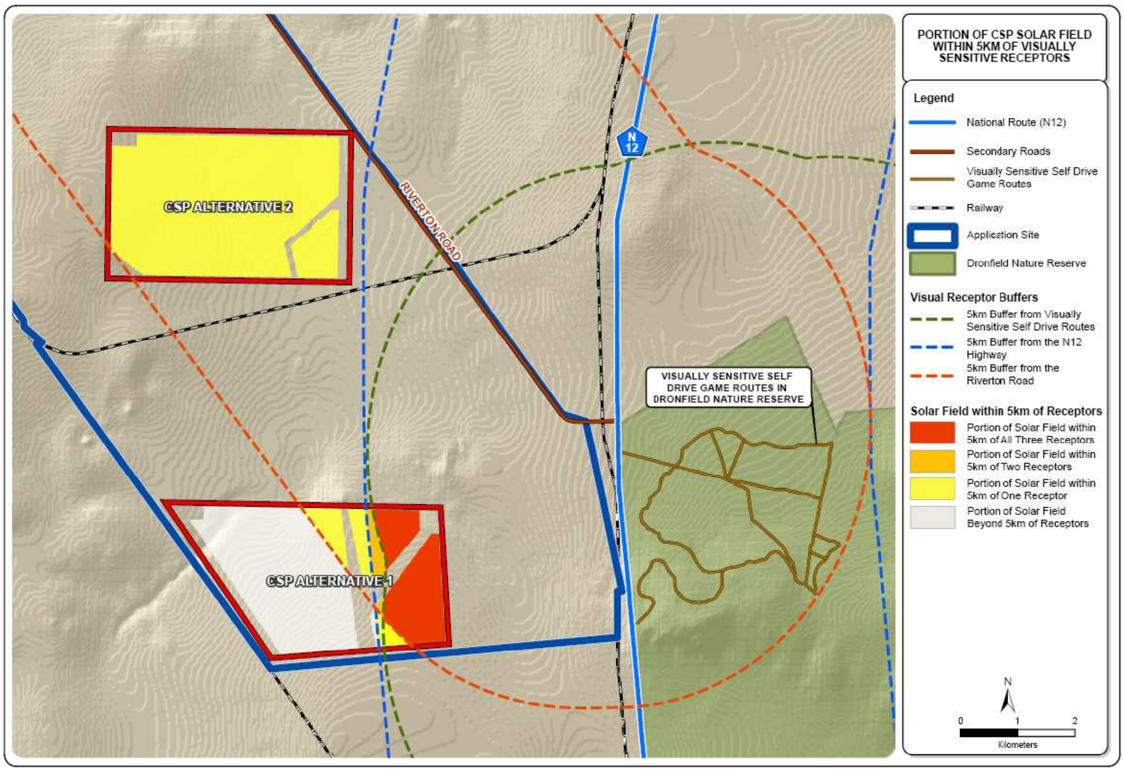

Figure 24: Portion of CSP solar field within 5km (long distance) from visually sensitive receptors

- CSP Alternative 1

This alternative is located in the south-western corner of the proposed site on slightly lower lying ground. The N12 highway, Riverton road and the self drive game routes within Dronfield are all located at a distance beyond 2.5km (moderate distance) from the from the boundary of the alternative, and only part of the solar field will be within 5km (long distance) from all three receptors. The slightly higher ground in the south-eastern part of the site and presence of wooded thornveld vegetation within Dronfield Nature Reserve and in the southern parts of the site will partially restrict views of the solar field from the self drive routes and the N12 highway. As a result, the CSP solar field will have a medium visual impact on the visually sensitive receptors if located in this position.

- CSP Alternative 2

Alternative 2 is located directly west of the Riverton road in the northern part of the development area. The N12 highway and the self drive game routes in Dronfield are all located at a distance beyond 5km (long distance) from the boundary of the alternative, with only part of the solar field within a moderate distance from the Riverton road. Grassy plains prevail in this portion of the site which will offer limited visual screening. Although the solar field will be highly visible to motorists travelling along the Riverton road if located in this position, it will have a negligible impact on people travelling along the N12 and self drive routes in Dronfield. This alternative is also rated as having a medium visual impact on visually sensitive alternatives and there neither alternative 1 nor 2 are preferred but both are acceptable from a visual perspective.

Table 10: Comparative assessment of CSP site alternatives 1 and 2

Alternative Position	Portion of solar field within viewable distance from a visually sensitive receptor	Presence of screening factors
Alternative 1	Notable part of the solar field within a long distance (<5km) of all three visually sensitive receptors (Dronfield self drive routes, N12 and Riverton road).	Wooded vegetation within Dronfield and in the southern portion of the site as well as lower lying topography in the south-western portion of the site will screen large portions of the solar field.
Alternative 2	Notable part of the solar field within a moderate distance (<2.5km) of one visually sensitive receptor (Riverton road).	Short grassy plains offer limited visual screening of the solar field from the Riverton road.

Table 11: Impact rating of CSP alternative 1 and 2

Alternative	Portion of solar field within viewable distance from a visually sensitive receptor	Presence of screening factors	Visual Impact
Alternative 1	3	2	**Medium**
Alternative 2	2	3	**Medium**

6.6.2 CPV/PV site alternatives

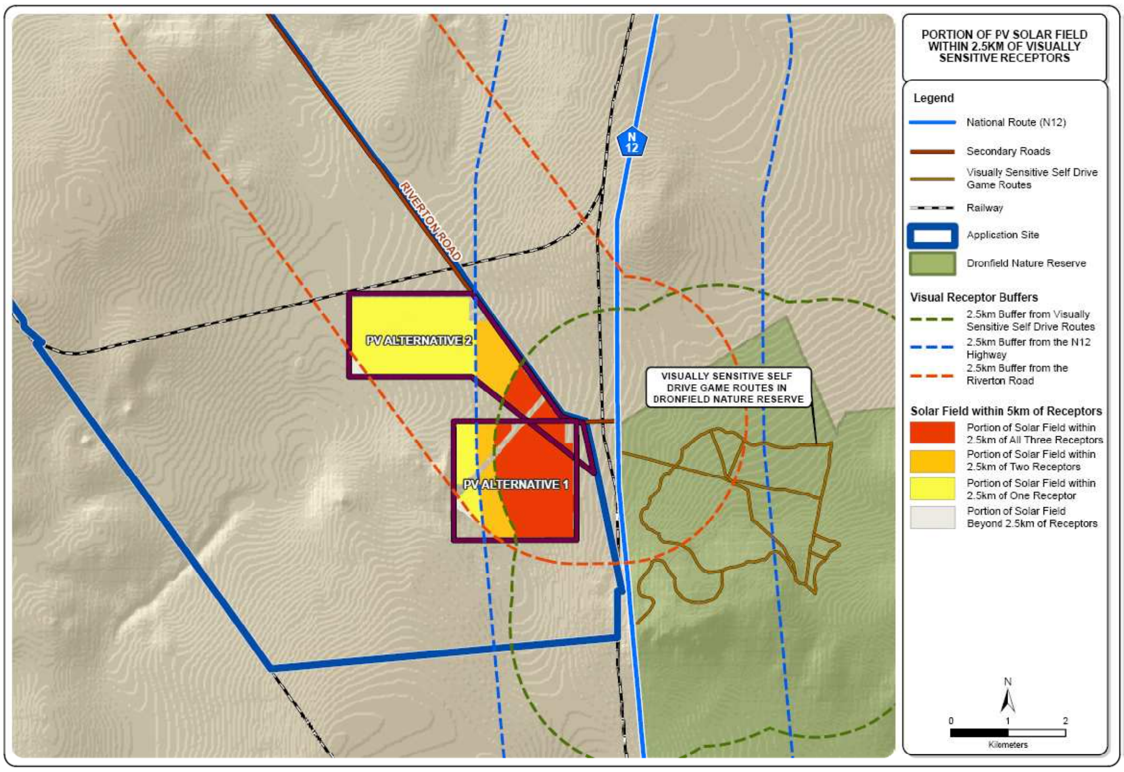

Figure 25: Portion of PV/CPV solar field within 2.5km (moderate distance) from visually sensitive receptors

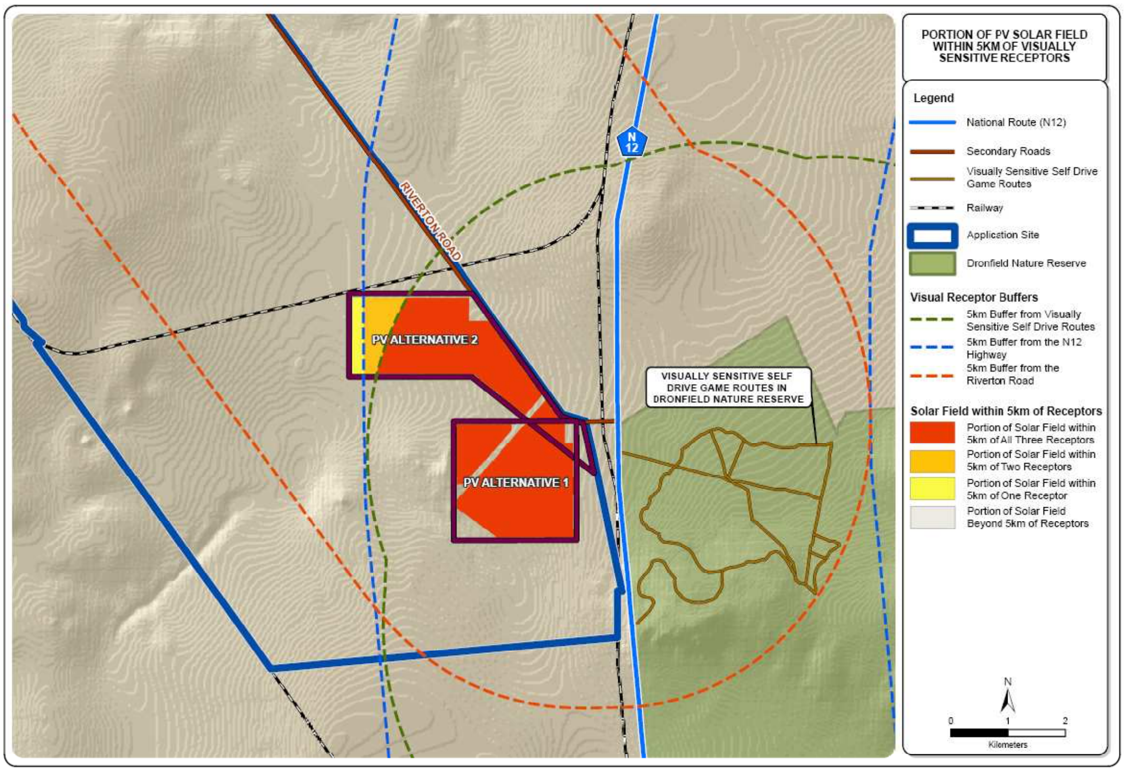

Figure 26: Portion of PV/CPV solar field within 5km (long distance) from visually sensitive receptors

- CPV/PV Alternative 1

This alternative is situated to the west of the N12 in the southern portion of the site. Although wooded vegetation within Dronfield and in the southern portion of the site will partially screen this portion of the site, almost the entire solar field is within a moderate distance from the N12 highway and the Riverton road, and a notable part is in within a moderate distance of the self drive game routes within Dronfield. The CPV/PV solar field will therefore have a high visual impact if located in this position and it is not regarded as the preferred alternative.

- CPV/PV Alternative 2

This alternative is located adjacent the Riverton road, and as a result almost the entire solar field will be within a moderate distance from this receptor road. A notable part of the solar field will be located within a moderate distance from the N12 highway and a long distance from the self drive routes in Dronfield. Wooden thornveld vegetation within Dronfield and in the southern portion of the site will provide partial screening from Dronfield and the N12. Alternative 2 has been assigned a medium visual impact and is regarded as the preferred alternative as the CPV/PV solar field will have a lower visual impact on visitors within Dronfield and motorists travelling along the N12 highway if located in this position.

Table 12: Comparative assessment of alternatives

Alternative Position	Portion of solar field within viewable distance from a visually sensitive receptor	Presence of screening factors
Alternative 1	Almost the entire solar field within a moderate distance (<2.5km) of two visually sensitive receptors (N12, Riverton road) and part of the solar field within a moderate distance (<2.5km) of one visually sensitive receptor (Dronfield self drive routes).	Wooded thornveld vegetation within Dronfield and in the southern portion of the site will partially obscure visibility of the proposed solar field.
Alternative 2	Almost the entire solar field within a moderate distance (<2.5km) of one visually sensitive receptor (Riverton road), part of the solar field within a moderate (<2.5km) of one visually sensitive receptor (N12) and part of the solar field within a long distance (<5km) of one visually sensitive receptor (Dronfield self drive routes).	Wooded thornveld vegetation within Dronfield and in the southern portion of the site will partially obscure visibility of the proposed solar field.

Table 13: Impact rating of CSP alternative 1 and 2

Alternative	Portion of solar field within viewable distance from a visually sensitive receptor	Presence of screening factors	Visual Impact
Alternative 1	8	2	**High**
Alternative 2	6	2	**Medium**

7 CONCLUSIONS

An EIA-level visual study was conducted to assess the magnitude and significance of the visual impacts associated with the development of a solar energy facility in Kimberley, Northern Cape Province. Majority of the study area has a natural visual character and is typically valued for its tourism significance and therefore introducing a solar energy facility into this context will alter the sense of place. It was established that the proposed development will have a high visual impact on motorists travelling along the Riverton road and a medium visual impact on motorists travelling along the N12 highway and visitors using the self drive game routes within the Dronfield Nature Reserve. The proposed solar energy facility will have a negative low visual impact during construction and a negative medium visual impact during operation, with very few mitigation measures available. Alternative 2 is the preferred site for the CPV/PV solar field, and both alternative 1 and 2 are regarded as acceptable positions for the CSP solar field.

8 REFERENCES

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Appendix A

A3 Maps

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