HARI PV (PTY) LTD

THE PROPOSED HARI PV PROJECT, NEAR UPINGTON IN THE NORTHERN CAPE PROVINCE

LANDSCAPE & VISUAL IMPACT ASSESSMENT

MARCH 2020

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TABLE OF CONTENTS

1 INTRODUCTION

1.1 GENERAL

This Landscape and Visual Impact Assessment (LVIA) study forms part of the Basic Assessment process that is being undertaken for the proposed Hari PV project by Cape EAPrac (Pty) Ltd on behalf of Hari PV (Pty) Ltd.

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 LVIA Report has been prepared for inclusion in the project Basic Assessment Report.

1.2 PROJECT LOCATION

The proposed Solar Photovoltaic (PV) Facility will be located on the following property:

- Geel Kop Farm No 456.

The site is located approximately 23.1km southwest of Upington within the Ka! Garib Local Municipality and the ZF Mgcawu District Municipality in the Northern Cape Province.

(Map 1: Site Location).

No site alternatives are under consideration.

1.3 BACKGROUND OF SPECIALIST

Jon Marshall qualified as a Landscape Architect in 1978. He also has extensive experience of Environmental Impact Assessment. Jon 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 tourism development, major buildings, mining projects, industrial development, infrastructure and renewable energy projects. He 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 AND RELEVANT GUIDELINES

The brief is to assess the possible impact of the proposed project on surrounding landscape character as well as the potential visual impact on sensitive receptors.

LVIA work will 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.

Together these documents provide a basis for the level and approach of a LVIA as well as the necessary tools for assessment and making an assessment legible to stakeholders.

1.5 LIMITATIONS AND ASSUMPTIONS

The following limitations and assumptions should be noted:

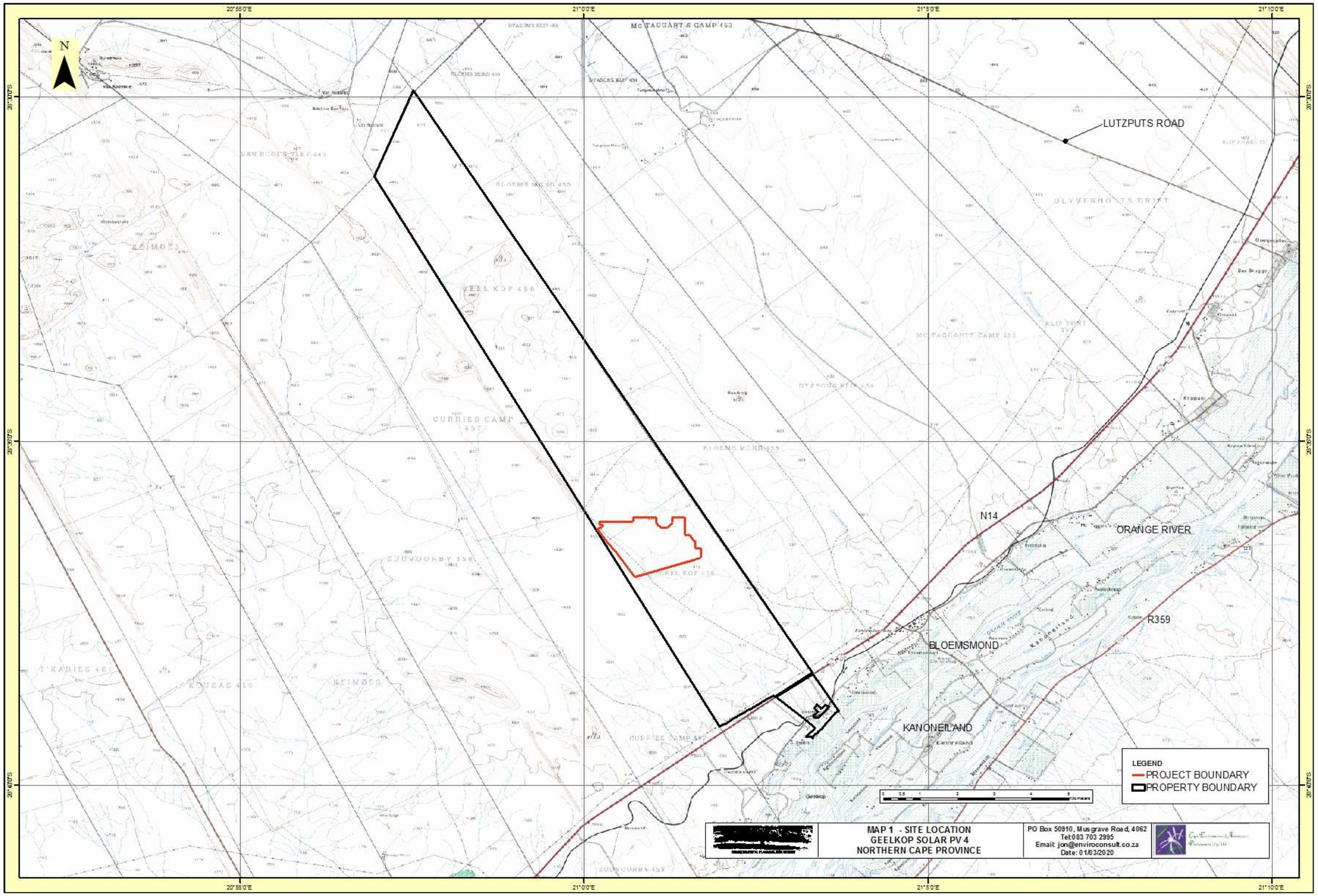
In the assessment tables the subjective judgement as to whether an impact is negative or positive is based on the assumption that the majority of people are likely to prefer to view a natural or a rural landscape than an industrial landscape.

A site visit was undertaken over a two day period (27th – 28th February 2020 to verify the likely visibility of the proposed development, the nature of the affected landscape and affected receptors.

The site visit was planned to ensure that weather conditions were clear providing maximum visibility.

The timing of photography was planned to ensure that the sun was as far as possible behind the photographer to ensure that as much detail as possible was recorded in the photographs.

The approximate extent of the development visible from each viewpoint as indicated in Section 5.3 has been approximated by measuring on plan the angle of the view that the development occupies given that each view was taken with a 28mm lens which has an approximate angle of vision of just over 74°. This has been cross referenced with known land marks.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LUTZPUTS ROAD
N14
ORANGE RIVER
R359
BLOEMSMOND
KANONEILAND
LEGEND
PROJECT BOUNDARY
PROPERTY BOUNDARY
MAP 1 - SITE LOCATION
GEELKOP SOLAR PV 4
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2. PROJECT DESCRIPTION

2.1 MOTIVATION AND PROJECT CONTEXT

Refer to **Map 2, Project Context**

In response to the Department of Energy's requirement for renewable energy generation projects, the applicant is proposing the establishment of a PV solar energy generation facility with a generating capacity of up to 100MW.

Considering the impact that carbon emissions from existing coal-fired power stations have on the environment, PV panels are designed to operate with low maintenance and no ongoing carbon emissions for more than 20 years.

The project is proposed to be part of the Department of Energy's (DoE) Renewable Energy Independent Power Producer Programme (REIPPPP).

The area within which the project is proposed has been identified as a key area for renewable energy generation by the South African Department of Environmental Affairs in their strategic assessment which identifies seven Renewable Energy Development Zones (REDZ). The area in which this project is located is the Upington REDZ 7.

The objective of this strategic assessment is to focus renewable energy projects within the most suitable areas. This also has the benefit of ensuring that less suitable areas are likely to be relatively undeveloped.

Currently within a 30km radius of the proposed project property there are fourteen other properties on which renewable energy projects are proposed. These consist of both Concentrated Solar Projects (CSP) as well as Solar Photovoltaic projects (PV).

There is one existing CSP project approximately 9.0km to the north east of the project site (Khi Solar 1).

There are also ten proposed and authorised PV projects on the Farms McTaggarts, Klip Punt and Tungsten Lodge RE/638 which are located directly to the north west and south east of Khi Solar 1. A number of these projects were under construction at the time of reporting.

The number of renewable energy projects in the vicinity of the proposed project has resulted in the development of both strategic high voltage electrical infrastructure including the Upington MTS as well as power line connections to individual renewable energy projects.

2.2 DESCRIPTION

Refer to **Map 3, Site Layout**

A development area with an extent of ~252ha has been identified by Hari PV (Pty) Ltd as a technically suitable site for the development of a solar PV facility with a contracted capacity of up to 100MW. Within this area, a total site area of approximately 240ha has been selected.

The entire study area and the development area are located within Focus Area 7 of the Renewable Energy Development Zones (REDZ), which is known as the Upington REDZ. Due to the location of the study area and development area within a REDZ, a Basic Assessment (BA) process will be undertaken in accordance with GN R114 as formally gazetted on 16 February 2018.

The Hari PV project is proposed to accommodate the following infrastructure, which will enable the solar PV facility to supply a contracted capacity:

» Fixed-tilt or single axis / dual axis tracking solar PV panels with a maximum height of 3.5m;
» Centralised inverter stations or string inverters;
» A temporary laydown area of ± 3-5 ha;
» A permanent laydown area of approximately 1ha will be required during the operational phase.
» Cabling between the panels, to be laid underground where practical;
» A 22kV or 33kV/132kV on-site substation (within a substation complex) of up to 5 000m^2 in extent to facilitate the connection between the solar PV facility and the electricity grid;
» A site access road to the development area with a maximum width of 8m;
» Internal access roads within the PV panel array;
» Operation and Maintenance buildings including a gate house and security building, control centre, offices, storage and a workshop.

The power generated from the project will be sold to Eskom and will feed into the national electricity grid. Ultimately, the project is intended to be a part of the renewable energy projects portfolio for South Africa, as contemplated in the Integrated Resource Plan.

A separate basic assessment process will be undertaken for the grid connection infrastructure to connect the Hari Solar PV project to the Upington Main Transmission Substation (MTS).

It is possible that the facility could either be developed as static, fixed mounted PV system or as a tracking PV systems.

Tracking systems can utilise single axis of dual access trackers. A 'single axis tracker' will track the sun from east to west, while a dual axis tracker will in addition be equipped to account for the seasonal waning of the sun. These systems utilise moving parts and complex technology, including solar irradiation sensors to optimise the exposure of PV panels to sunlight.

2.3 MAIN PROJECT COMPONENTS

A solar energy facility typically uses the following primary components:

2.3.1 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 20 years with minimal

maintenance required. It is envisaged that the plant will operate after this design lifetime

2.3.2 Support Structure

The photovoltaic (PV) modules will be mounted to steel support structures. As indicated above, 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 with a maximum tilt angle of 60°.

2.3.3 Inverters

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

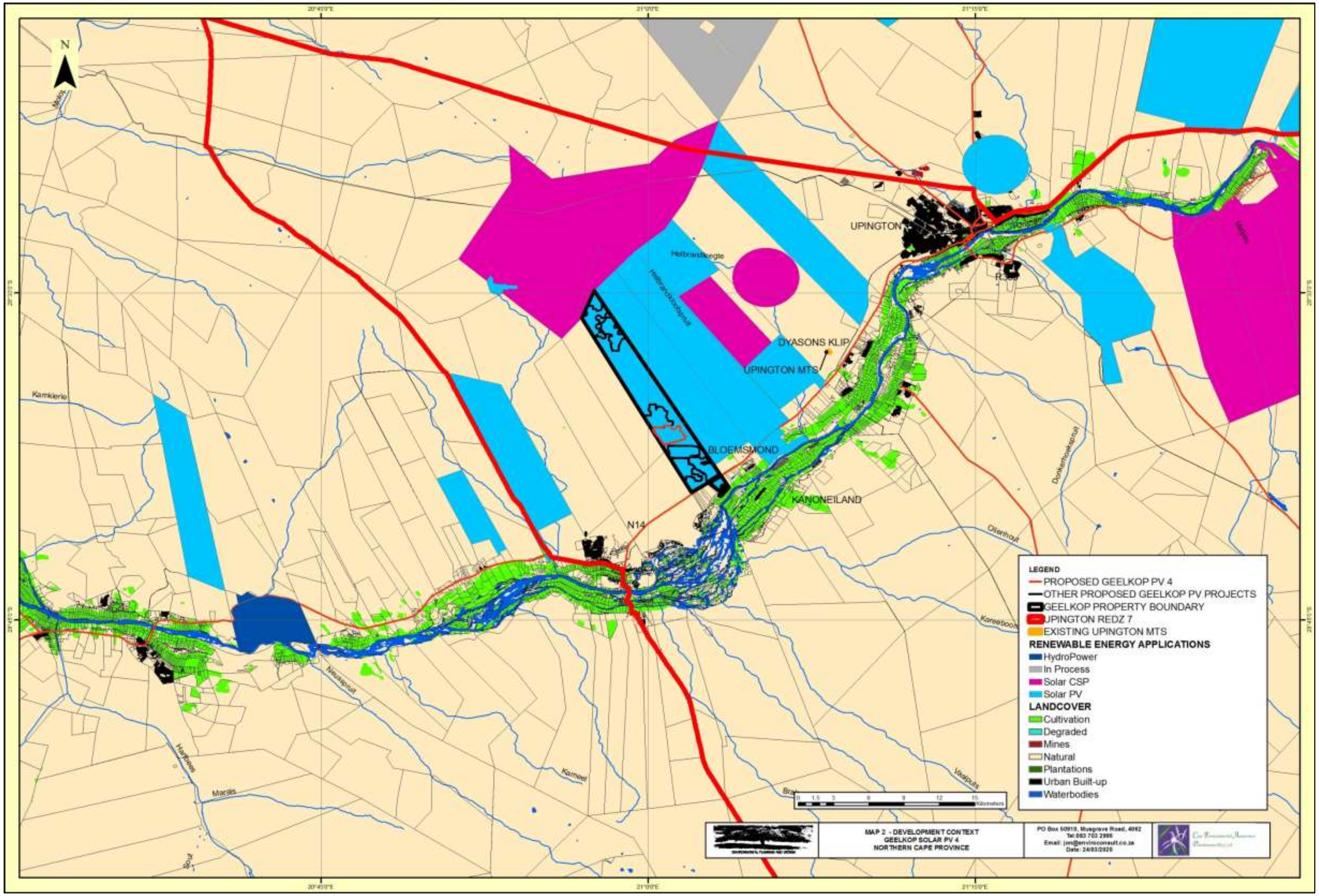
The inverters generally have a height lower than or similar to the surrounding PV panels.

2.3.4 Transformer and Grid Connection

The inverters feed AC current to the onsite substation which steps it up for transmission of the power to the national grid. The main infrastructure within the substation is comprised of transformers that will stand approximately 10m high.

The project is intend to connect from the onsite sub-station to the Upington MTS (400/132 kV), via the 132kV Geelkop Collector Substation (this basic assessment process only includes the IPP portion of the onsite sub-station, while the remainder of the grid connection is being assessed in a separate BAR process

Plate 1, Existing Upington Main Transmission Substation viewed from the Lutzputs Road.



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DYASONS KLIP
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KANONEILAND
N14
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Kareeboom
Donkerhoekspruit
Neuskspruit
Kameel
Vaalputs
Marais
LEGEND
PROPOSED GEELKOP PV 4
OTHER PROPOSED GEELKOP PV PROJECTS
GEELKOP PROPERTY BOUNDARY
UPINGTON REDZ 7
EXISTING UPINGTON MTS
RENEWABLE ENERGY APPLICATIONS
HydroPower
In Process
Solar CSP
Solar PV
LANDCOVER
Cultivation
Degraded
Mines
Natural
Plantations
Urban Built-up
Waterbodies
0 1.5 3 6 9 12 15 Kilometers
MAP 2 - DEVELOPMENT CONTEXT
GEELKOP SOLAR PV 4
NORTHERN CAPE PROVINCE
PO Box 50910, Musgrave Road, 4062
Tel:083 703 2995
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Date: 24/03/2020
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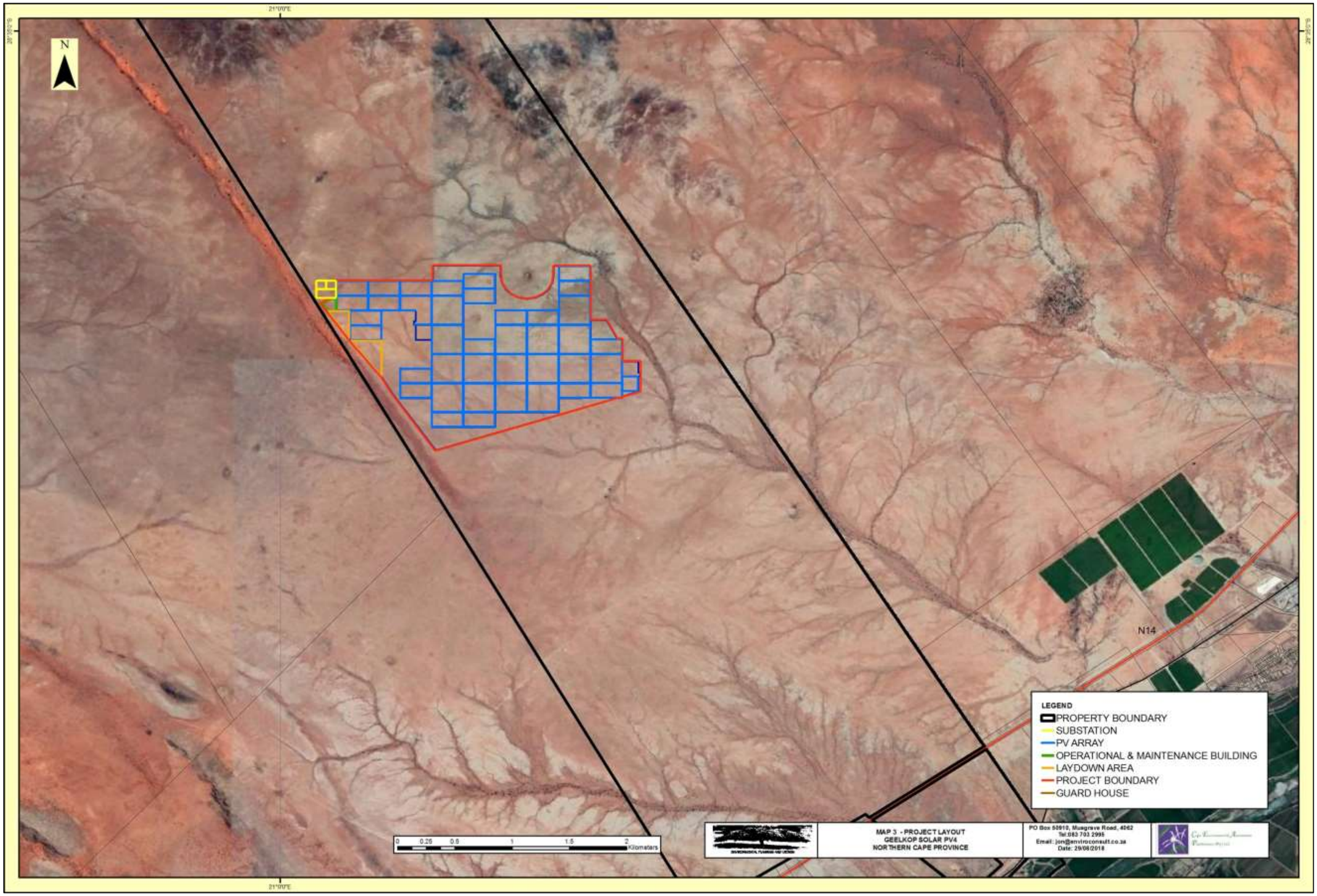
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N14
LEGEND
PROPERTY BOUNDARY
SUBSTATION
PV ARRAY
OPERATIONAL & MAINTENANCE BUILDING
LAYDOWN AREA
PROJECT BOUNDARY
GUARD HOUSE
0 0.25 0.5 1 1.5 2
Kilometers
MAP 3 - PROJECT LAYOUT
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3 DESCRIPTION OF RECEIVING ENVIRONMENT AND RECEPTORS

3.1 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".

Landscape Character is a composite of influencing factors including;

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

3.1.1 Landform and Drainage

The topography of the region is relatively homogenous and is described predominantly as lowlands with hills and dune hills to the north. Relatively prominent small hills occur towards the west and south-west of the study area.

The terrain surrounding the farm is predominantly flat with an even south-eastern slope towards the Orange River valley that forms a distinct regional hydrological feature.

The proposed Project site is located within an area of relatively flat topography approximately 6.0km to the northwest of the Orange River Valley.

The surrounding area is generally comprised of fairly flat-lying terrain between inselbergs or isolated steep rocky outcrops. The inselbergs in the vicinity of the site are concentrated to the north and north-west of the site where they form the upper valley slopes and ridgelines.

There are two minor non-perennial watercourses, that drain the site towards the south east as well as one minor non-perennial water course that runs close to the eastern boundary of the proposed site. The three watercourses join to make one more major non-perennial channel that drains to the south east directly into the Orange River to the south east of the site.

Whilst the region surrounding the site is relatively flat, a degree of relief is provided by minor ridgelines that formed by an historic dune field that runs in a general northwest to southeast direction at regular intervals. From the air, these minor ridgelines appear as a series of waves in the arid landscape. These ridgelines rise between three and five metres above the valley floor. Whilst they are minor they are likely to have a visual influence in that they will provide a degree of screening for relatively low structures.

The non-perennial water courses that flow into the Orange River at intervals fall from the undulating plain into the Orange River Valley, due to the intermittent quantity of water that flows through the channels and also due to the slightly steeper gradient as they fall towards the Orange River, they have created larger and slightly deeper valleys than can be found on the plain. This is particularly obvious driving along the N14 which is located on the edge of the river valley. This section of road runs through valleys that are approximately 15m deep from floor to the crest of the ridgelines. These valley lines are likely to have significant influence over the visibility of the project from the road.

Refer to Map 4, Landform & Drainage.

Plate 2, View from the N14 to the southeast of the project site looking along the road. The gently undulating nature of the landform on the edge of the Orange River Valley is clear from the road profile. When in one of the valleys, visibility over the surrounding landscape is restricted.

Plate 3, View from close to the N14 looking down into the Orange River Valley. The shallow valley sides slope gently down to the river.

3.1.2 Landcover

The Orange River has, to a large degree, dictated the settlement pattern in this arid region by providing a source of perennial water for the cultivation of grapes and cotton. This and the associated production of wine and dried fruit (raisins and sultanas) are the primary agricultural activity of this district.

The majority of cultivation and settlement in the region occurs around the Orange River.

Upington is a major regional centre that lies approximately 23.1km to the northeast of the Project Site. Due to distance and the relatively flat terrain, it is highly unlikely that the proposed project will have any visual impact on this area.

In the vicinity of the proposed project there are extensive vineyards within the Orange River Valley.

Settlement in the form of small townships and groups of farm buildings are located on the edges of the river valley and within the cultivated areas. This cultivation and settlement generally extends to the N14 which runs along the upper edge of the River Valley. Because the majority of settlement is within the River Valley and at a lower level than the project site, it is likely that the proposed development will be largely screened, particularly from settlement located on the northern side of the Orange River.

Other than areas located around the Orange River, settlement in the region is sparse.

From the site visit only one tourism landuse was obvious. This was the Bezalel Wine Farm, the entrance to which is located on the N14 approximately 7.0km to the east of the property on which the project is proposed. The farm itself including accommodation, restaurant and wine tasting area is located within the valley. Views of the proposed project will not be possible from this operation.

As can be seen from **Map 2 (Project Context)**, there are a significant number of solar power projects planned for the region in the vicinity of the proposed project. These include:

- Khunab (McTaggarts PV 1, 2 and 3 and Klip Punt PV 1) Solar PV Projects
- Sirius Solar PV Projects 1, 2, 3 and 4 are located on a property immediately to the south of the subject property. These projects have been authorised and one was under construction at the time of reporting; and
- Khi Solar One which is a Concentrated Solar Power project (solar tower technology) that has been developed on the property immediately to the southwest of the subject property. This project provides a major landmark that is visible for a significant distance.

Refer to Map 5, Landcover.

Plate 4, View of the Bezalel Wine Farm within the Orange River Valley. Because of its location within the River Valley, this tourism operation is unlikely to have a view of solar projects.

Plate 5, View of Khi Solar One from the Lutzputs Road to the north east. Other planned and under construction solar power projects will change the landscape surrounding the proposed project site.

Plate 6, View of Sirius Solar PV project under construction (centre picture) from the Lutzputs Road.

3.1.3 Vegetation Patterns

The following vegetation types are evident within the study area;

a) Natural vegetation that is generally associated with the rural landscape; and
b) Vegetation within the Orange River Valley that is generally associated with agricultural operations.

These vegetation types are indicated on **Map 6, Vegetation Types**.

a) Natural Vegetation

Mucina and Rutherford[1] indicate that the natural vegetation of the area includes:

- Bushmanland Arid Grassland;
- Kalahari Karroid Shrubland; and
- Gordonia Dunveld.

Mucina and Rutherford's description of Bushmanland Arid Grassland includes;

Extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses (Stipagrostis species) giving this vegetation type the character of semidesert 'steppe'. In places low shrubs of Salsola change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected.

[1] The Vegetation of South Africa, Lesotho and Swaziland

Mucina and Rutherford's description of Kalahari Karroid Shrubland includes;

Low karroid shrubland on flat, gravel plains. Karoo-related elements (shrubs) meet here with northern floristic elements, indicating a transition to the Kalahari region and sandy soils.

Mucina and Rutherford's description of Gordonia Dunveld includes;

Parallel dunes about 3–8 m above the plains. Open shrubland with ridges of grassland dominated by Stipagrostis amabilis on the dune crests and Acacia haematoxylon on the dune slopes, also with A. mellifera on lower slopes and Rhigozum trichotomum in the interdune straaten.

Whilst botanically these vegetation types may be very different, in visual terms the most important characteristics include:

- They are key components of the natural, semi-desert, landscape of the region;
- The description of Gordonia Duneveld picks up on the regular, wave like, dunes that are a dominant feature of the landscape surrounding Upington; and
- All the descriptions highlight the fact that vegetation in the area is low and provides little screening potential for development.

b) Vegetation within the Orange River Valley

Vegetation within this area is comprised of a matrix of:

- Crop vegetation that is largely comprised of grapes for wine making and fruit;
- Patches of low natural vegetation particularly on the upper valley slopes;
- Ornamental vegetation including large trees around homesteads and small settlements; and
- Patches of largely alien vegetation particularly on the edges of cultivation.

3.2 LANDSCAPE CHARACTER AREAS

3.2.1 Landscape Character Area 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"[2].

Visual Absorption Capacity (VAC) is *defined* as the landscape's ability to absorb physical changes without transformation in its visual character and quality. Where elements that contrast with existing landscape character are proposed, VAC is dependent on elements such as landform, vegetation and other development to provide screening of a new element. The scale and texture of a landscape is also critical in providing VAC, for example; a new large scale industrial development located within a rural small scale field pattern is likely to be all the more obvious due to its scale.

The affected landscape can generally be divided into the following LCAs that are largely defined by vegetation and drainage patterns.

[2] UK Guidelines.

- **Plateau LCA** which includes the gently undulating, arid plateau above the Orange River Valley. The gently undulating landform is punctuated by inselberg that often form a chain aligned in a general north to south direction. This area is generally natural in character with very little settlement. It is obvious from **Map 2 (Project Context)** that the natural character of this area is in transition in that solar projects are likely to create an industrial aesthetic within a matrix of natural vegetation. VAC within this area is provided by the inselbergs and on a limited basis by the regular, low, dune formation as well as slopes of the slightly larger minor valleys that are associated with the non-perennial water courses that flow into the Orange River Valley.
- **The Orange River Corridor LCA** which is comprised of the shallow valley area surrounding the Orange River. This area is generally inward looking drawing little character influence from the surrounding plateau. Landform, vegetation and development all play a role in screening views of surrounding areas and contribute to significant VAC.

These LCAs are indicated on **Map 7, Landscape Character Areas**.

3.3 VISUAL RECEPTORS

Visual Receptors are defined as "individuals and / or defined groups of people who have the potential to be affected by the proposal"[3].

3.3.1 Identified visual receptors

It is 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 highlights possible Receptors within the landscape which due to use could be sensitive to landscape change. They include:

- Area Receptors which include the minor urban settlement areas that are located within the Orange River Corridor LCA. From the site visit it appears that the majority of settlement areas relate to agricultural use of the River Valley. It is likely that the residents of these minor settlements are predominantly focused on agricultural production of the area. As these settlements are located within the River Valley LCA, it is also likely that views of the proposed development particularly from the northern side of the valley will be difficult. However, vegetation within the River Valley will help screen views of the proposed development that may be possible from the valley;
- Linear Receptors or routes through the area that include the N14, the R359, the Lutzputs road and the Upington to Kakamas Spur Railway Line. Both of the N14 and the R359 roads have tourism significance, although the N14 is possibly the most important in this regard. The Lutzputs road is an unsurfaced road that runs approximately 13.7km to the north east of the subject property, this road is likely

[3] UK Guidelines

to be mainly used by local people. The Upington to Kakamas Spur Railway Line is used for transporting goods and so is not considered further;

- Point Receptors that include individual homesteads that are located both within the River Valley LCA and the Plateau LCA. From the site visit, it is unlikely that individual homesteads on the northern side of the Orange River will have views over the proposed development. It is however possible that homesteads on the higher sections on the southern side of the valley could have views of the proposed development. These however will be distance views and they are likely to be softened by vegetation on the fringes of the River Valley.

Visual receptors that include places and routes that may be sensitive to landscape change are indicated on **Map 7.**

LANDSCAPE CHARACTER AREAS

Plate 7, Plateau LCA

Plate 8, River Corridor LCA

SENSITIVE RECEIVERS

Plate 9, View from the R359 across the River Valley LCA.

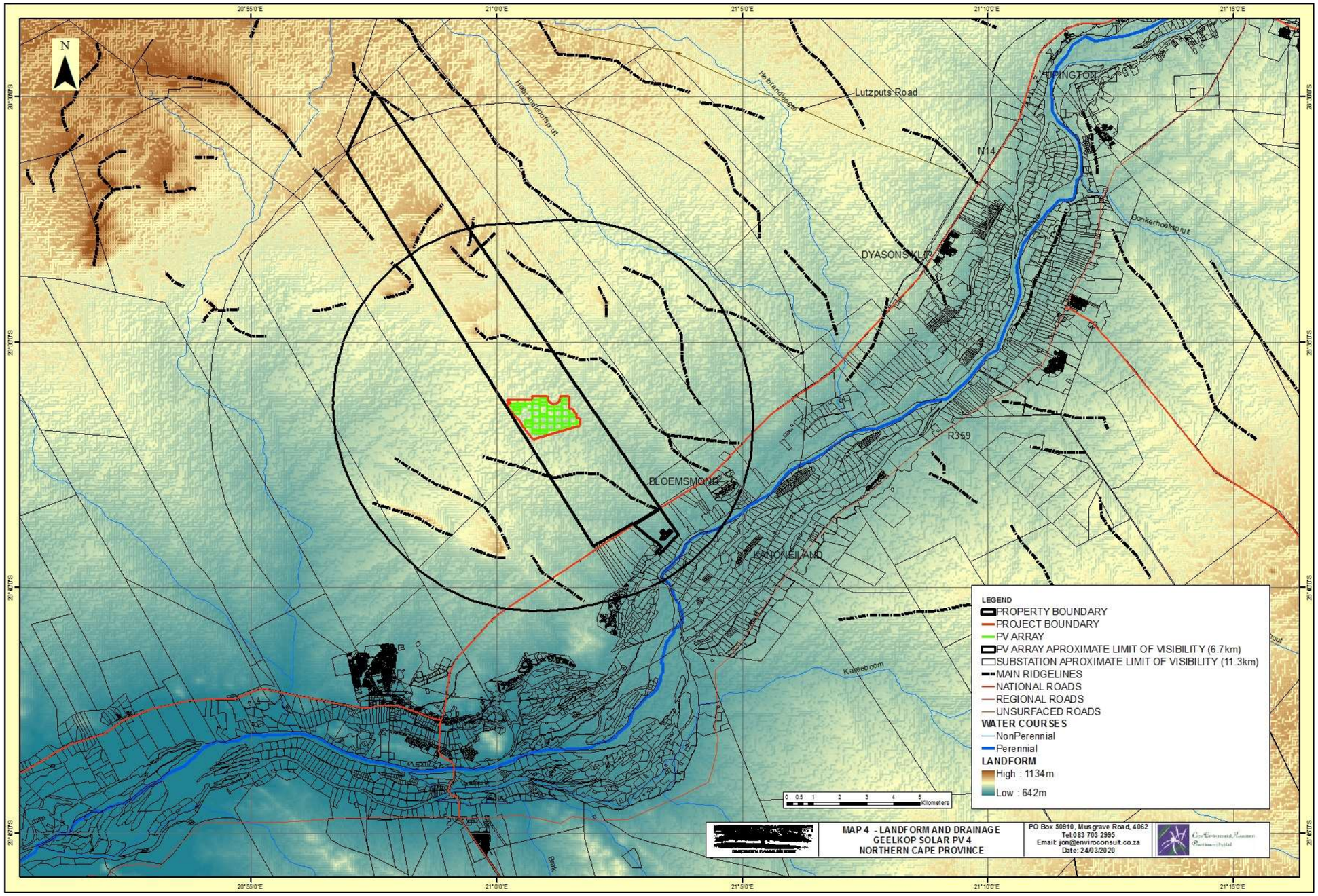
Plate 10, Settlement and homesteads within the River Valley LCA

Plate 11, The N14. This is a major regional route that runs close to the southern edge of the proposed development and is important for tourism.

Plate 12, Homesteads within the Plateau LCA.

Plate 13, The Lutzputs Road. This is an un-surfaced local road that runs to the north and east of the proposed project. It is likely to be largely used by local people.

Plate 14, The Upington to Kakamas Branch Line. This line is used for the transport of fruit and goods from Kakamas.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Donkerhoekspruit
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KANONEILAND
Kareeboom
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PROPERTY BOUNDARY
PROJECT BOUNDARY
PV ARRAY
PV ARRAY APROXIMATE LIMIT OF VISIBILITY (6.7km)
SUBSTATION APROXIMATE LIMIT OF VISIBILITY (11.3km)
MAIN RIDGELINES
NATIONAL ROADS
REGIONAL ROADS
UNSURFACED ROADS
WATER COURSES
NonPerennial
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LANDFORM
High : 1134m
Low : 642m
0 0.5 1 2 3 4 5 Kilometers
MAP 4 - LANDFORM AND DRAINAGE
GEELKOP SOLAR PV 4
NORTHERN CAPE PROVINCE
PO Box 50910, Musgrave Road, 4062
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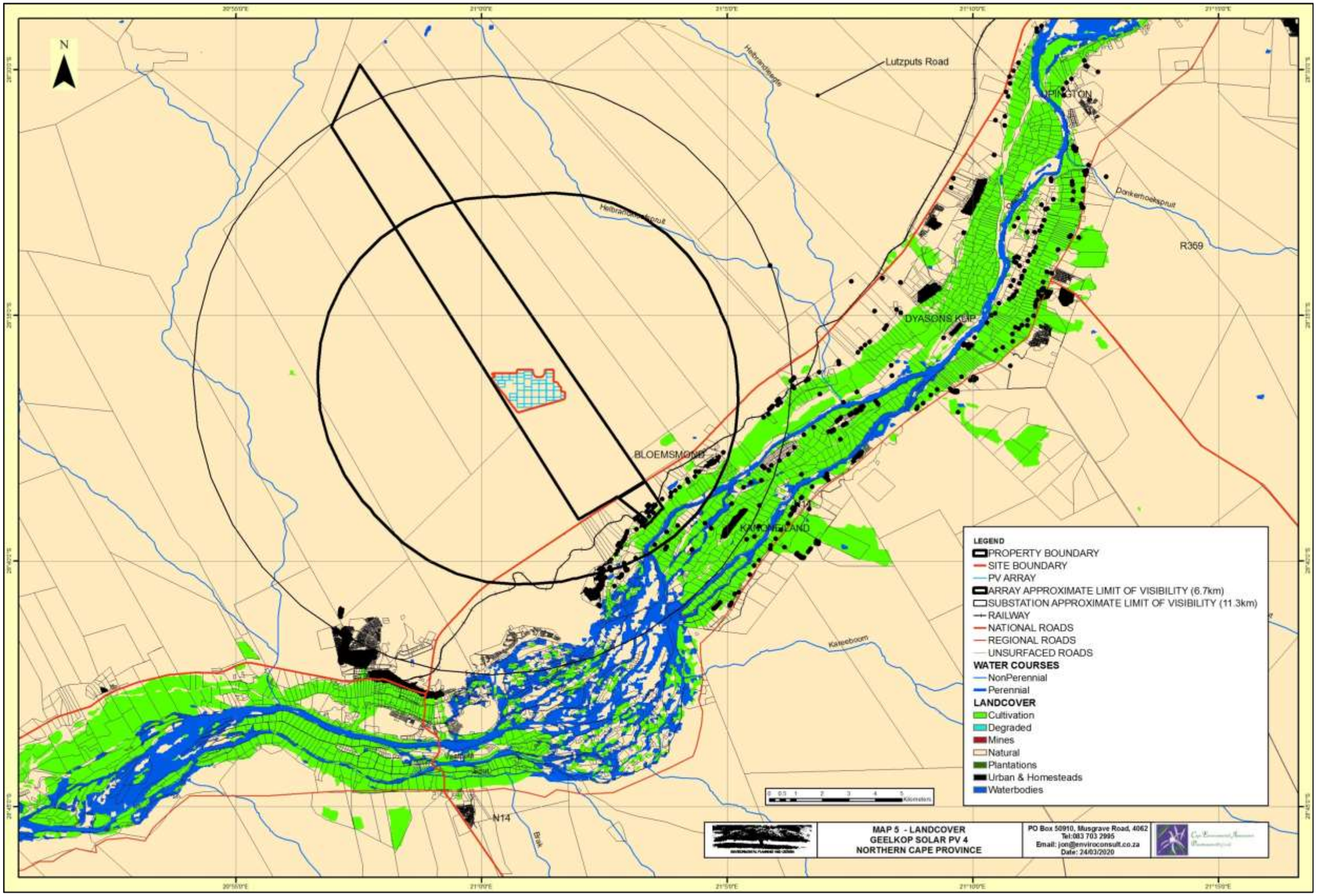
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SUBSTATION APPROXIMATE LIMIT OF VISIBILITY (11.3km)
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WATER COURSES
NonPerennial
Perennial
LANDCOVER
Cultivation
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Mines
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Plantations
Urban & Homesteads
Waterbodies
MAP 5 - LANDCOVER
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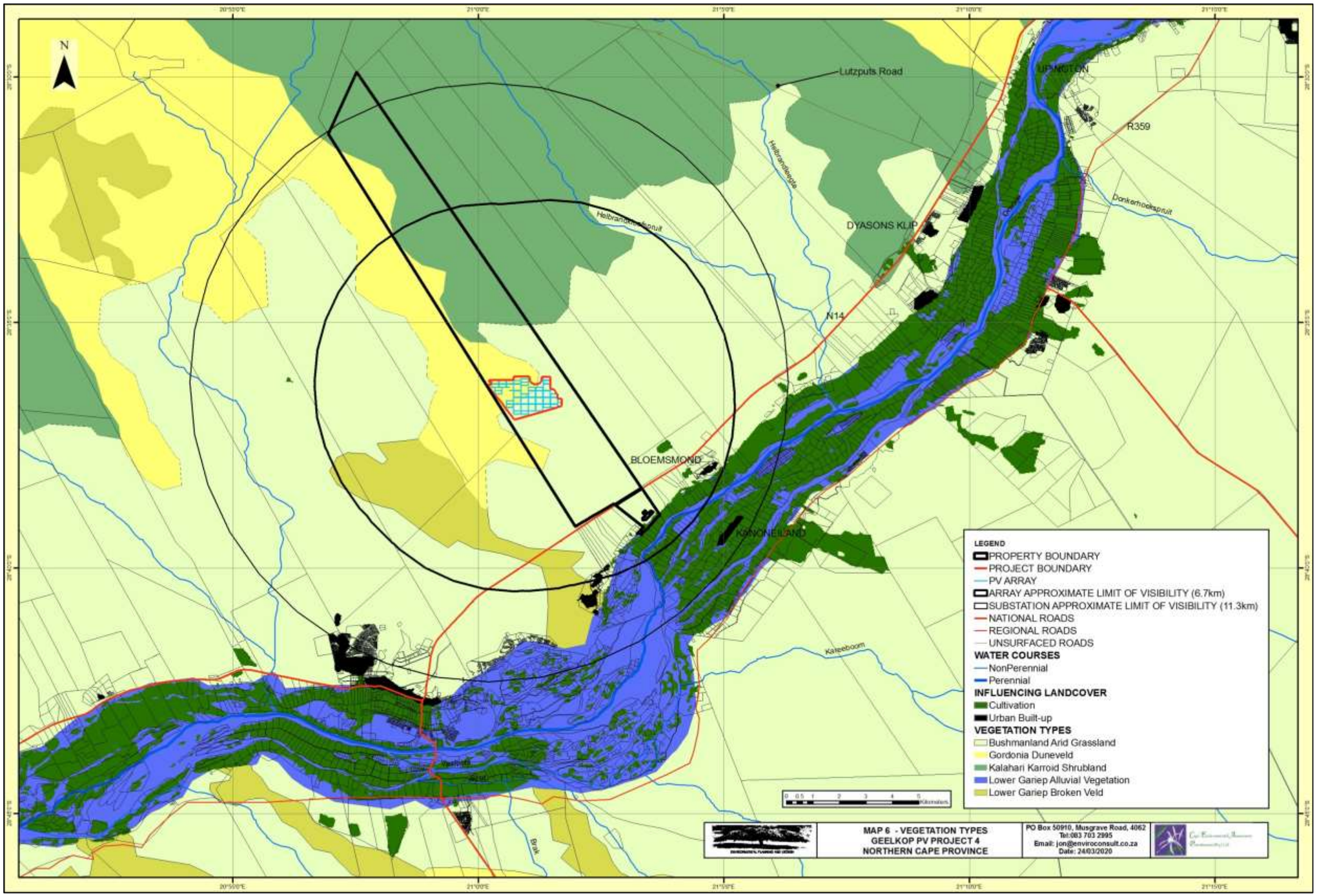
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PV ARRAY
ARRAY APPROXIMATE LIMIT OF VISIBILITY (6.7km)
SUBSTATION APPROXIMATE LIMIT OF VISIBILITY (11.3km)
NATIONAL ROADS
REGIONAL ROADS
UNSURFACED ROADS
WATER COURSES
NonPerennial
Perennial
INFLUENCING LANDCOVER
Cultivation
Urban Built-up
VEGETATION TYPES
Bushmanland Arid Grassland
Gordonia Duneveld
Kalahari Karroid Shrubland
Lower Gariep Alluvial Vegetation
Lower Gariep Broken Veld
MAP 6 - VEGETATION TYPES
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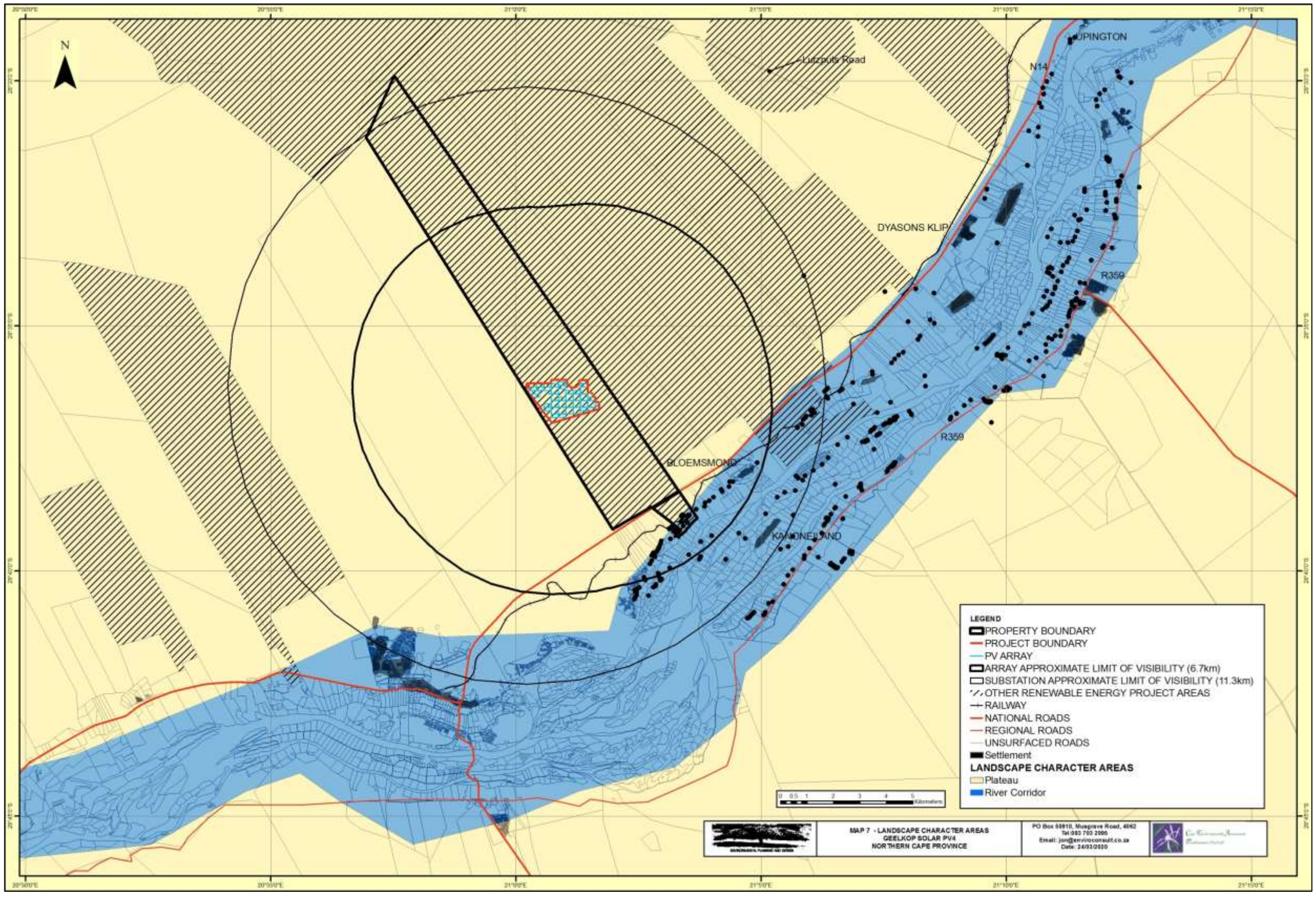

N
Lutzputs Road
UPINGTON
N14
DYASONS KLIP
R359
R359
BLOEMSMOND
KAKONEELAND
LEGEND
PROPERTY BOUNDARY
PROJECT BOUNDARY
PV ARRAY
ARRAY APPROXIMATE LIMIT OF VISIBILITY (6.7km)
SUBSTATION APPROXIMATE LIMIT OF VISIBILITY (11.3km)
OTHER RENEWABLE ENERGY PROJECT AREAS
RAILWAY
NATIONAL ROADS
REGIONAL ROADS
UNSURFACED ROADS
Settlement
LANDSCAPE CHARACTER AREAS
Plateau
River Corridor
MAP 7 - LANDSCAPE CHARACTER AREAS
GEELKOP SOLAR PV4
NORTHERN CAPE PROVINCE

4 THE GENERAL NATURE OF POTENTIAL VISUAL IMPACTS

4.1 GENERAL

Impacts could include general degradation of the relatively natural landscape in which the development is proposed as well as change of view for affected people and / or activities;

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 broad scale use such as tourism areas 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 that are visible. 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.
b. Change in specific views for specific receptors for which the character of a view may be important for a specific use or enjoyment of the area.
    - 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 however been 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 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 for receptors are expected to relate largely to intrusion. However this is likely to be limited by the fact that the existing Khi 1 CSP facility and other solar projects have largely altered views in the vicinity of the proposed facility.

4.2 THE NATURE OF LIKELY VIEWS OF THE DEVELOPMENT

4.2.1 Timing of Impacts

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.

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 assessment indicates that the land is relatively flat so only minor grading should 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; and
- construction of a temporary construction camp which will occur within a lay down area within the overall site.

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 (if required), the support structures will then be assembled and PV panels attached, ancillary structures and minor 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 construction phase is programmed to take approximately 18 months.

By the end of the construction process, the array will be assembled, minor buildings constructed and 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.

The main visible elements therefore are likely to include:

1. The solar array including minor buildings and structures located within a fence line with an associated on-site substation that is slightly taller than surrounding elements; and

2. Possible night time lighting which may be required for operations, security and maintenance purposes.

4.2.2 The likely Nature of Views of the Proposed Solar Array

The proposed project layout is indicated on **Map 2**. If a fixed array is used then the PV panels will be mounted on continuous supports and orientated to face north away from the N14 and the Orange River Corridor.

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 or have a basic tracking set up that varies the angle of tilt of the unit in order to improve efficiency.

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

A tracking array is also constructed in rows that also generally face a northerly direction. Each row however is divided into units that can be manoeuvred by actuators to follow

the solar azimuth and altitude. Visually this results in greater variety in the nature of the view of the facility with the dark face of the panels being more obvious from the east in the morning and the west in the afternoon. This also means that the outline of the array appears as a jagged edge particularly from close views and the supporting structure may also be more or less exposed depending on the time of day.

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 results in a PV array having a similar appearance as a large industrial structure when viewed from above. It should be noted that the proposed project is unlikely to be viewed from a higher elevation due to the fact that the inselbergs are located on private land and so this type of view will not be possible for the majority of people;
- From the north and if the project is viewed from a similar level, the front row of PV units will be seen in elevation. This is likely to result in the project being seen as a continuous dark line in the landscape possibly with slightly higher elements such as the on-site substation extending above the line. How obvious the dark line is, is likely to be dependent on the distance of the viewer from the project as well as the extent to which the view of the elevation is broken by other elements such as vegetation and landform.
- From the south, east and west the dark face of the PV units is not 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 more obvious and the facility will probably appear much as the northern face, a long dark structure. If the sun should reflect of the rear face of PV panels which is most likely during early morning and late afternoon however, it is likely that the light coloured face of the rear of the panels will make the array obvious;
- If the landscape does not have significant Visual Absorption Capacity (VAC), because of the contrast in colour with the surrounding landscape, the array could be visible 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. It should be noted that the VAC of the landscape surrounding the proposed development is largely dependent on minor undulations in the surrounding landform as well as vegetation in the Orange River Valley to the south.
- 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 elevated view points, mitigation is likely to be less feasible as the height of any screen is likely to cast shadow over the PV units.
- In addition to the way that a solar array may change a landscape, the nuisance factor associated with resulting glare is often raised by stakeholders on similar projects. The front faces of PV units, however, are designed to absorb as much energy as possible. It needs to be borne in mind that the key factor of reflectance is the position of PV modules relative to the sun. A panel that absorbs 90% of direct sunlight may reflect up to 60% when not directly facing the sun. This situation is common for low-tilt panels during sunset and sunrise. The often repeated claim that PV panels reflect less than 5% of sunlight only holds true

when the panels directly face the sun. This means that glare from the front face of PV panels is likely to be less problematic for tracking systems where the angle of panels is optimised throughout the day and is more likely for a fixed array particularly during the early morning and late evening when the sun is lowest.

The site and surrounding area is relatively flat. This means that the array is likely to be viewed largely in elevation or at a low level oblique angle. With the exception of adjacent inselbergs which are all located on private property, there will be no areas from which an overview of the facility will be possible.

To the south of the project the land falls away into the shallow Orange River Valley. Because the project does not extend to the ridgeline on the edge of the valley, it is likely to be largely screened from this area.

Because the proposed PV panels will be set at a maximum height of 3.5m, it is likely that minor buildings, stored equipment within lay down areas and inverters will largely be screened by the array or will be seen below the level of the PV panels.

A new solar array has been developed adjacent to Upington Airport. This array has been developed in two sections on either side of the airport runway. It is somewhat smaller than the subject project, covering approximately 25ha and the longest edge of the array being approximately 500m long. The PV panels are mounted on fixed frames approximately 2m high. Despite obvious differences compared with the proposed project, it does illustrate the effect of distance in mitigating the visibility of the solid line of solar panels.

Plate 15 indicates the location of the existing array at Upington Airport. **Plates 16, 17 and 18**, illustrate how the array is seen from distances of approximately 700m, 1500m and 5000m respectively.

The following effects are noted;

- From 700m the array is clearly visible. For the same effect relative to a 3.5m high array, this distance will be approximately 1225m.
- From 1500m, the array is visible but even with the minimal vegetation providing screening at the airport, the dark line of panels is starting to blend into the background. The array is visible but might be missed by a casual viewer. For the same effect relative to a 3.5m high array, this distance will be approximately 2625m.
- From 5000m, the line of panels is indistinguishable from the horizon. For the same effect relative to a 6m high array, this distance will be approximately 8750m.

A single axis tracking system could slightly increase the height of structures particularly during late afternoon and early morning when the units are tilted to their fullest extent.

Plate 15, Existing solar arrays at Upington Airport as seen from the air

Plate 16, Existing array seenin a flat landscape from approximately 700m. The array is clearly visible.

Plate 17, Existing array seenin a flat landscape from approximately 1500m. The array is visible but even with the minimal vegetation providing screening at the airport, the dark line of panels is starting to blend into the background. The array is clearly visible but might be missed by a casual viewer who was not aware of its existence.

Plate 18, **Existing array seenin a flat landscape from approximately 5000m**. The line of panels is barely distinguishable. The viewer would have to know where to look to be able to differentiate the array from surrounding landscape features.

4.2.3 The likely Nature of Views of the Proposed On-Site Substation

The proposed on-site substation is reported to have solid elements up to 10m high. These are likely to be comprised of transformers and will appear as solid elements over the height of the adjacent array. These will be viewed as an isolated higher section of the development. It is likely that other taller elements will largely be comprised of steel lattice structures such as bus bars that will facilitate the connection between the onsite substation and the grid connection infrastructure.

4.2.4 Glare from the PV array

With a fixed array glare generally occurs when the sun is low in the sky and the angle of incidence is such that light is reflected rather than refracted through the panel surface. The risk of this occurring therefore generally occurs during early morning and late afternoon when the sun hits the PV panels at an acute angle.

Due to the fact that a tracking system realigns receptors to capture as much energy as possible between sunrise and sunset and because of this the sun doesn't hit the PV panels at acute angles, the risk of glare is significantly reduced.

In South Africa, affected areas due to a fixed array during the early morning will generally vary from the west of the array during summer months to the north west of the array during winter months when the rising sun is further north. Affected areas during the late afternoon will generally vary from the east of the array during summer months to the north east of the array during winter months when the setting sun is further north.

An indication of a possible 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.

Due to the fact that the proposed PV project is located relatively close to the N14, a proprietary set of tools that are available on the "Forgesolar" website (https://www.forgesolar.com/) have been used to provide an assessment of likely impacts associated with glare. These tools were originally developed by the Sandia National Laboratories[4]. They provide online tools for mapping solar glare and flux 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.

[4]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 Centre (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.

Sandia is a US Government funded research agency similar to South Africa's CSIR. The tools have subsequently been privatised. They are however run and maintained by personnel who undertook their original development.

The Forgesolar 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.

Assessments undertaken using the Forgesolar tools are generally accepted by the US Federal Aviation Authority.

4.2.6 Security Lighting

The facility will be lit by security lights to a level sufficient to ensure that security cameras can operate at night. This could result in the array being obvious at night from surrounding areas.

5 VISIBILITY AND THE LIKELY NATURE OF VIEWS OF THE PROPOSED DEVELOPMENT

5.1 THE EXTENT OF POSSIBLE IMPACTS

The bulk of the proposed project is comprised of the array of PV panels. The majority of other elements including the inverters and buildings will be located amongst the array and will be of a similar or lower height.

The tallest elements are likely to be the transformers associated with the on-site substation. These will be solid elements and could be in the order of 10m high. Other electrical infrastructure such as the bus bars to which the power lines will connect may be taller but these will be largely comprised of lattice structures that are likely to be relatively transparent and will fall within the ZTV of the proposed grid connection.

The development can therefore be described as generally being comprised of elements of a similar height but with an isolated taller element.

In order to provide an indication of the likely limit of visibility, a universally accepted navigational formula has been used to calculate the likely distance that the proposed structures might be visible over (**Appendix III**). This indicates that in a flat landscape the proposed structures may be visible for the following distances;

Approximate limit of Visibility (ALV)

ELEMENT	APPROXIMATE LIMIT OF VISIBILITY
Solar PV panels 3.5m high	6.7 kilometres
Substation 10m high	11.3 kilometres

In reality these distances could be reduced by:

- Weather conditions that limit visibility. This could include hazy conditions during fine weather as well as mist and rain; and
- Scale and colour of individual elements making it difficult to differentiate structures from the background.
- The fact that as a viewer approaches the ALV only a small portion of the development will be visible to the extent that it is likely to be indiscernible to the human eye.

The ALV for Solar PV panels and the on-site substation have been used to define the study area and they are indicated on mapping.

The lay down area is largely a temporary facility for use during construction. The extent of views of the lay down area are difficult to assess. It is likely that equipment stored in this area will be of similar height or lower than the proposed PV array. For this reason it is assumed that equipment stockpiled will be visible or will be incorporated into views of the array. It is possible however that from time to time activity and / or the use of large equipment may make it more obvious.

A smaller lay down area will be required during the operational phase of the project. Again it is assumed that equipment stored here for maintenance operations will be of a similar scale and will have an ALV similar to the PV array.

5.2 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"[5].

ZTVs of the proposed development have been assessed using Arc Spatial Analyst GIS.

The detailed location of the proposed array has been provided by the developer **(Map 3)**. In order to generate the ZTV for the proposed array, it has been assumed that entire area of the array will be set at a uniform maximum height of 3.5m. Points have been set at each change in direction of the array boundary, an additional point at the centre of the array and a high points in the development footprint all with 3.5m offsets for generation of the ZTV using the Viewshed option in Arc Spatial Analyst.

Similar methodology was adopted for the onsite substation for which a 10m offset has been used to produce the ZTV.

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

The ZTV analysis is indicated on the following maps:

- **Map 8** indicates the ZTV for the proposed PV array and internal infrastructure;
- **Map 9** indicates the ZTV the on-site substation; and

5.2.1 General Visibility

The assessment indicates that the proposed project may be visible to the following areas;

i. The proposed array and the substation are likely to be visible over similar areas;
ii. Views of the proposed array and the substation will be constrained to the north, east and west by minor ridgelines with the development likely to be most visible to the south;
iii. Limited views of the proposed development could be visible over a small section of the mid to upper southern valley slopes within the Orange River Valley. However these are likely to be largely screened by vegetation;
iv. From the N14, views of the proposed development (array and substation) are likely to be mostly visible from approximately 1.5km of the road that is adjacent to the project;
v. The ZTV analysis indicates that the proposed project is unlikely to be visible from the Lutzputs Road or the R359.

5.2.2 Specific considerations regarding the nature of impacts

The PV panels will generally be orientated to face north away from the N14 and the Orange River Valley.

From the south and south east, which is the direction from which the majority of receptors will view the proposed projects, the back side of the PV panels and support structures will be visible.

[5] UK Guidelines

If a fixed array is used and because the terrain is relatively flat, this will mean that the projects will be viewed largely in profile and will be seen as a dark line in the landscape from these directions.

If a tracking array is used the profile from the south east and the south west is likely to change during the day. However it is still unlikely that the face of the panels will be obvious.

The surrounding landscape has been shown to generally have a relatively low level of VAC. This is likely to mean that long views of the project may be possible particularly for views from across the River valley from which the minor changes in landform will have limited screening effect.

In the vicinity of the project the low height of the development combined with the relatively gentle undulations in the plateau landform is likely to mean that a degree of screening will be provided from adjacent sections of the N14. The project is likely to be most visible from a 1.5km stretch of the road that is closest (approximately 4.25km) to the project. Views are only likely to be possible from immediately adjacent sections of the road.

From the Lutzputs road both distance and the generally undulating landform are likely to mean that the proposed project is largely screened. This road lies well outside the ALV so even if the project is visible it is unlikely to be visually obvious.

Due to the fact that the proposed project is located in a REDZ, a number of additional solar energy projects are likely to be developed in the vicinity of the proposed project. The strategic nature of the REDZ should ensure that there is less demand for similar development in other more sensitive landscape areas. It is therefore highly likely that solar energy projects will become a common sight in the vicinity of the proposed project.

Whilst the majority of the current outlook is relatively natural, the Khi Solar 1 project which is comprised of a Solar Power Tower and surrounding heliostats is located approximately 8.7km to the north east. The Power Tower is 205m high and is potentially visible over a radius of 51km. This facility has therefore already transformed the local landscape. It is also likely that other projects as they are developed will result in the landscape becoming progressively more industrialised.

Industrialisation of the landscape appears to be inevitable, however, this cannot mean that an "anything goes" approach should be allowed to occur. The importance of the N14 as a tourism route and the need for amenity space around settlements and homesteads must be considered. In order to achieve this it will be important to ensure that key landscape features are retained and that industrialisation does not completely dominate views from the road.

Views from the N14

Due to its tourism importance, the N14 is likely to be one of the most sensitive visual receptors.

The ZTV indicates that the proposed project is likely to be obvious from approximately 1.5km of this road. This will be mitigated to a degree by the fact that the development is within a REDZ and that other solar PV projects as well as the Khi Solar 1 CSP project will also be visible within the area.

Views from the R359
The ZTV analysis indicates that the proposed project could be visible from approximately 5km of the R359. However this section of this road falls outside the ALV of the proposed array and project substation.

Due to distance and the fact that the extent of existing vegetation within and on the fringes of the Orange River Valley will provide screening, the project is unlikely to be obvious from this road.

Views from Adjacent Settlements and Homesteads
Settlements and homesteads in the vicinity of the proposed project that may be affected are generally associated with agricultural activities within the Orange River Valley.

No individual homesteads within the plateau area appear likely to be affected.

The ZTV analysis indicates that the proposed array and project substation are only likely to be visible to homesteads on the southern side of the Orange River Valley. These largely fall outside the ALV of these elements. It is also likely that existing vegetation will screen the project.

Glare
There are two areas where glare may be a concern for stakeholders including:

- Pilots on the approaches to Upington Airport; and
- Motorists on the N14.

Two array configurations were tested including:

- A fixed array configuration; and
- A single axis tracking configuration.

The applicant has confirmed that the latter configuration was the most likely to be used.

Results indicate that:

- The fixed configuration could result in a low level of glare affecting pilots on the northern approach to the secondary runway (shorter) at Upington Airport during afternoons (around 15h00) in early January and during afternoons (around 15h00) in mid November. Levels of glare predicted to have a low potential to create an after image that might temporarily make vision difficult for a pilot.
- The fixed configuration could result in glare that could affect motorists on the N14 during late afternoons in early March and late September to early October. The assessment indicates that the section of road that could be affected is to the east and north east of the project. The level of glare has the potential to cause an after image that could temporarily affect vision. The ZTV of the array indicates that it is only likely to be visible from three small sections of the road each of which is 250m or less in extent. Glare could therefore only affect three very limited sections of the road.
- The single axis tracking configuration is unlikely to create glare that will affect pilots on the approaches to Upington Airport or motorists on the N14.

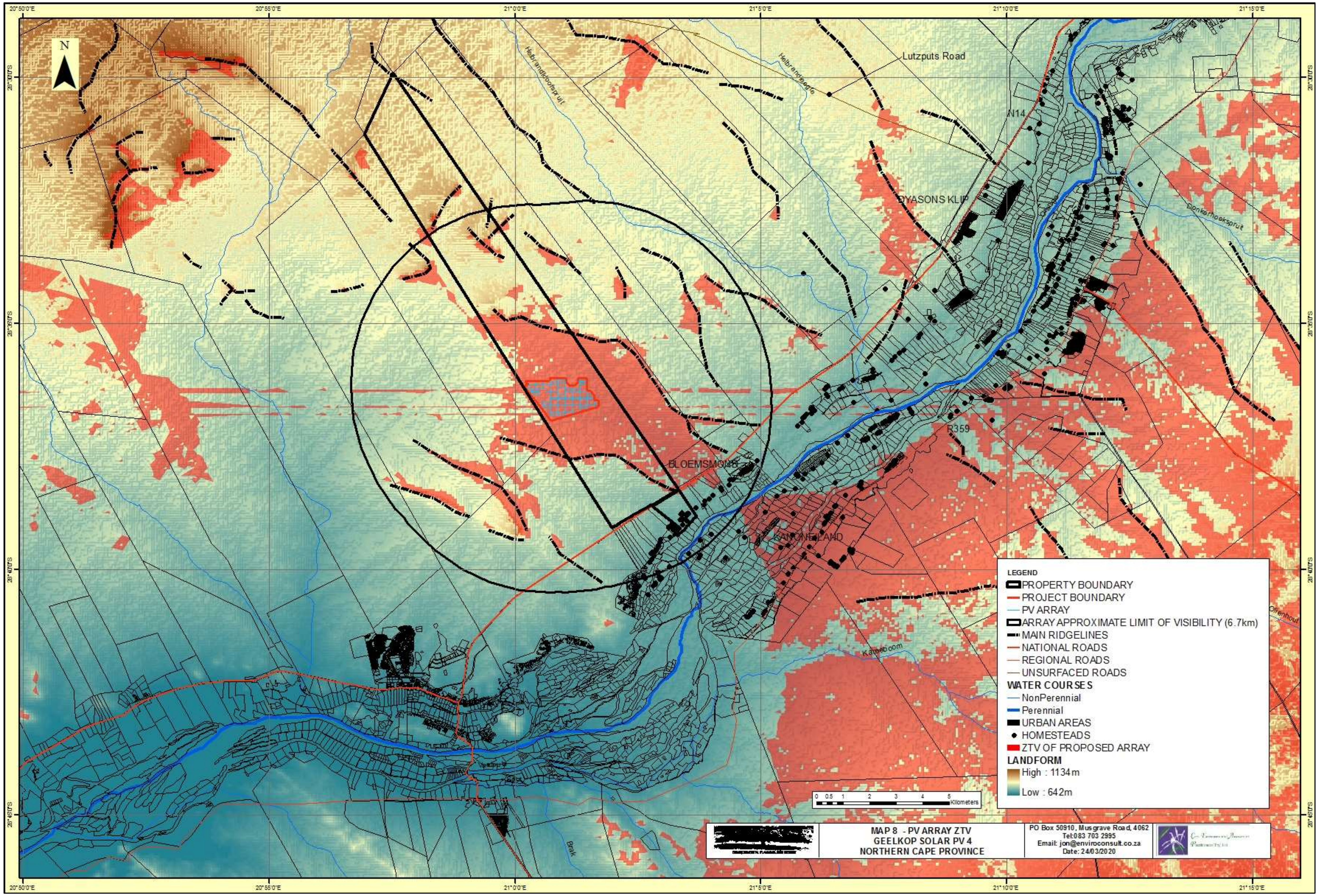
The assessment is attached as **Appendix IV.**

Due to the fact that glare is not likely to impair a pilot's vision, this is not considered to be a critical impact. However the temporary loss of vision for a motorist could be significant.

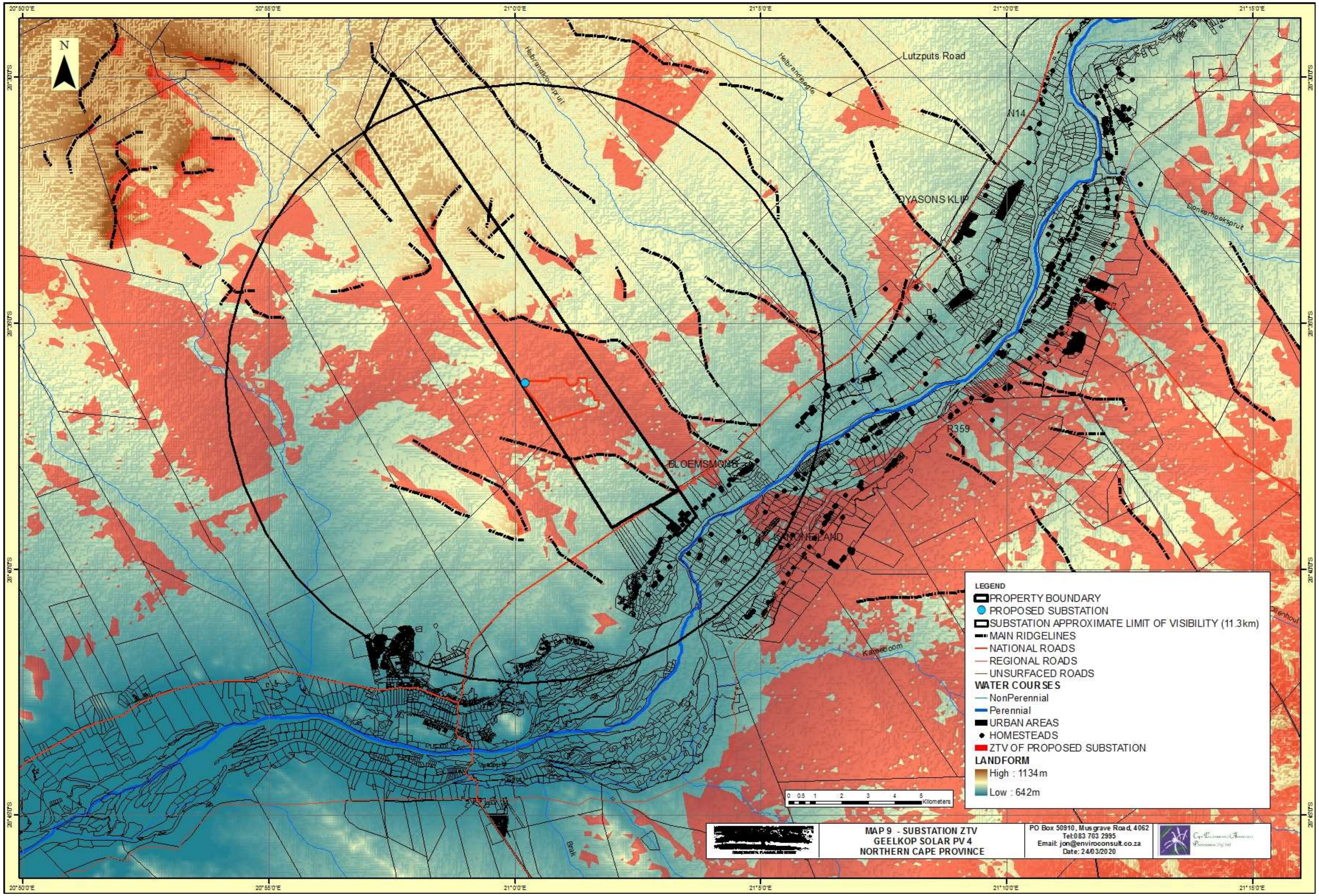
Mitigation measures might include:

- The use of proprietary surface finishes to minimise glare;
- The use of screening in the form of fencing or earth bunds; or
- The use of a tracking array.

TO BE COMPLETED
Plate 20 - View from VP1 on the N14



Lutzputs Road
Helbrandsdoorspruit
Helbrandsdrift
N14
DYASONS KLIP
Donkermoekspruit
R359
BLOEMSMOND
KANONEILAND
Kaleeboom
Brak
LEGEND
PROPERTY BOUNDARY
PROJECT BOUNDARY
PV ARRAY
ARRAY APPROXIMATE LIMIT OF VISIBILITY (6.7km)
MAIN RIDGELINES
NATIONAL ROADS
REGIONAL ROADS
UNSURFACED ROADS
WATER COURSES
NonPerennial
Perennial
URBAN AREAS
HOMESTEADS
ZTV OF PROPOSED ARRAY
LANDFORM
High : 1134m
Low : 642m
0 0.5 1 2 3 4 5 Kilometers
MAP 8 - PV ARRAY ZTV
GEELKOP SOLAR PV 4
NORTHERN CAPE PROVINCE
PO Box 50910, Musgrave Road, 4062
Tel:083 703 2995
Email: jon@enviroconsult.co.za
Date: 24/03/2020



LEGEND
PROPERTY BOUNDARY
PROPOSED SUBSTATION
SUBSTATION APPROXIMATE LIMIT OF VISIBILITY (11.3km)
MAIN RIDGELINES
NATIONAL ROADS
REGIONAL ROADS
UNSURFACED ROADS
WATER COURSES
NonPerennial
Perennial
URBAN AREAS
HOMESTEADS
ZTV OF PROPOSED SUBSTATION
LANDFORM
High : 1134m
Low : 642m
0 0.5 1 2 3 4 5 Kilometers
[redacted]
MAP 9 - SUBSTATION ZTV
GEELKOP SOLAR PV 4
NORTHERN CAPE PROVINCE
PO Box 50910, Musgrave Road, 4062
Tel:083 703 2995
Email: jon@enviroconsult.co.za
Date: 24/03/2020
Lutzputs Road
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20°50'0"E
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21°5'0"E
21°10'0"E
21°15'0"E

6 VISUAL IMPACT ASSESSMENT

The previous section of the report identified specific areas where visual impacts may occur as well as their likely nature. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the identified issues.

6.1 ISSUES TO BE ADDRESSED

The following list of possible impacts have been identified;

a) The proposed development could change the character and sense of place of the landscape setting;
b) The proposed development could change the character of the landscape as seen from the N14;
c) The proposed development could change the character of the landscape as seen from the R359;
d) The proposed development could change the character of the landscape as seen from the un-surfaced Lutzputs Road to the north and east;
e) The proposed development could change the character of the landscape as seen from local settlements and homesteads;
f) Glare impacts; and
g) Lighting impacts.

These impacts have to be addressed in terms of the proposed solar array and associated infrastructure.

It should be noted that the impacts identified will all gradually increase from the current situation to the impact level indicated during the construction phase, be consistent at the impact levels indicated during the operational phase and decrease again from the levels indicated to close to the current situation during the decommissioning phase.

6.2 ASSESSMENT METHODOLOGY

The methodology for the assessment of potential visual impacts includes:

- 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).

6.2 VISUAL IMPACT ASSESSMENT

6.2.1 The proposed development could change the character and sense of place of the landscape setting (Landscape Change)

Nature of impact:

The proposed solar project is located within an arid plateau landscape area which is within approximately 5.0km from the closest section of the verdant Orange River Corridor. The difference between these landscape areas is marked with the semi desert of the plateau contrasting strongly with the green arable landscape of the River Valley.

Because the potentially affected sections of the valley are outside the ALV of the proposed project and because there is significant LAC due to the amount of vegetation within the valley area it is highly unlikely that this project will have a significant impact on the Orange River Valley LCA.

Views of the bulk of the proposed development within the plateau landscape will be largely limited to areas in the immediate vicinity of the affected property by minor ridgelines. These ridgelines will limit views of the development to approximately 2.0km or less to the north, north east, the east and the west and the south west. To the south west views of the development are likely to be possible for approximately 5km.

The landscape change will be viewed in the context of other solar projects within the area including the Khi Solar I CSP project which is located approximately 9.5km to the north east.

	Without mitigation	**With mitigation**
Extent	**Orange River LCA** Site and immediate surroundings, **(2)** **Plateau LCA** Site and immediate surroundings, **(2)**	**Orange River LCA** Site and immediate surroundings, **(2)** **Plateau LCA** Site and immediate surroundings, **(2)**
Duration	**Orange River LCA** Long term, **(4)** **Plateau LCA** Long term, **(4)**	**Orange River LCA** Long term, **(4)** **Plateau LCA** Long term, **(4)**
Magnitude	**Orange River LCA** Small, **(0)** **Plateau LCA** Small to minor, **(1)**	**Orange River LCA** Small, **(0)** **Plateau LCA** Small, **(0)**
Probability	**Orange River LCA** Very Improbable, **(1)** **Plateau LCA** Probable, **(3)**	**Orange River LCA** Very Improbable, **(1)** **Plateau LCA** Probable, **(3)**
Significance	**Orange River LCA** Low, **(6)**	**Orange River LCA** Low, **(6)**

	Plateau LCA Low, **(21)**	**Plateau LCA** Low, **(18)**
Status	**Negative**	**Negative**
Reversibility	High	High
Irreplaceable loss	The proposed development can be dismantled and removed at the end of the operational phase. There will therefore be **no irreplaceable loss**. However, given the likely long term nature of the project, it is possible that a proportion of stakeholders will view the loss of view as irreplaceable.	**No irreplaceable loss**
Can impacts be mitigated?	**Yes**	**N/A**

Mitigation / Management:

Planning:

- Plan to maintain the height of structures as low as possible;
- Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development;

Operations:

- Reinstate any areas of vegetation that have been disturbed during construction;
- Remove all temporary works;
- Monitor rehabilitated areas post-construction and implement remedial actions;
- Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use of the site;
- Rehabilitate and monitor areas post-decommissioning and implement remedial actions.

Cumulative Impacts:

The proposed project will extend the general influence of development and specifically solar projects in the area.

The overall cumulative impact is assessed as having a medium significance, however, the contribution of the proposed project to this cumulative impact is assessed as low. **See appendix V.**

Residual Risks:

The residual risk relates to loss of natural vegetation cover being obvious on decommissioning of the proposed project. It is therefore critical that effective rehabilitation is undertaken.

6.2.2 The proposed development could change the character of the landscape as seen from the N14.

Nature of impact:

The ZTV analysis indicates that views of the proposed array and substation will be limited to a approximately a 1.5km stretch of the road that is closest (approximately 4.25km) to the project. Views are only likely to be possible from immediately adjacent sections of the road.

The proposed project will also be viewed in the context of numerous other solar projects within the REDZ 7 including the Khi Solar 1 project which is visible over a wide area.

The proposed project will be set back approximately 4.25km from the road. Whilst it will be visible from approximately 1.5km of the road, due to the setback it is unlikely to dominate views.

It should be noted that three other PV projects are under consideration between the PV project and the N14. Should these be developed, they are likely to screen views of this project from the road.

Should Mitigation in the form of an earthwork bund be employed to help soften the impact of the projects closest to the road, this is likely to also screen the proposed project.

	Without mitigation	**With mitigation**
Extent	Site and immediate surroundings **(2)**	Site and immediate surroundings **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Small to Minor **(1)**	Small **(0)**
Probability	Probable **(3)**	Improbable **(2)**
Significance	Low **(21)**	Low **(12)**
Status	Given that the area is developing as a renewable energy development zone, it is possible that some people will see the development in a positive light. For those visiting the area for its natural attributes and for residents whose view is affected the change is likely to be seen as a **Negative Impact.**	**Negative Impact**
Reversibility	High	High
Irreplaceable loss	The proposed development can be dismantled and removed at the end of the operational phase. There will therefore be **no irreplaceable loss**.	**No irreplaceable loss.**
Can impacts be mitigated?	**Yes**	

Mitigation / Management:

Planning:

- Plan to maintain the height of structures as low as possible;
- Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development;

Operations:

- Reinstate any areas of vegetation that have been disturbed during construction;
- Remove all temporary works;
- Monitor rehabilitated areas post-construction and implement remedial actions;
- Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use of the site;
- Rehabilitate and monitor areas post-decommissioning and implement remedial actions.

Cumulative Impacts:

The proposed project will have a low level impact on the N14 without mitigation.

A detailed visual analysis of other solar projects in the area has not been undertaken, however, it is likely that other solar projects in the area could have a significant greater impact.

The overall cumulative impact is assessed as having a medium significance. The contribution of the proposed project to this cumulative impact is assessed as low both with and without mitigation.

See Appendix V.

Residual Risks:

The residual risk relates to loss of natural vegetation cover being obvious on decommissioning of the proposed project. It is therefore critical that effective rehabilitation is undertaken.

6.2.3 The proposed development could change the character of the landscape as seen from the R359.

Nature of impact:

The ZTV analysis indicates that the proposed project could be visible to approximately 5km of this road. The entire section that could potentially be affected lies outside the ALV of both the array and the project substation. Given the high level of VAC due to extensive vegetation within the Orange River Valley, the proposed project is not likely to have a significant impact on this road.

	Without mitigation	**With mitigation**
Extent	Site and immediate surroundings **(2)**	Site and immediate surroundings **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Small **(0)**	Small **(0)**
Probability	Very improbable **(1)**	Very improbable **(1)**
Significance	Low **(6)**	Low **(6)**
Status	Given that the area is developing as a renewable energy development zone, it is possible that some people will see the development in a positive light. For those visiting the area for its natural attributes and for residents whose view is affected, the change may be seen as a Negative Impact. However, due to distance and likely screening and because if small sections of the development are visible they will be seen in the context	**Neutral Impact**

	and behind other solar projects, the change in view is likely to be seen as a **neutral impact**.	
Reversibility	High	High
Irreplaceable loss	The proposed development can be dismantled and removed at the end of the operational phase. There will therefore be **no irreplaceable loss**.	**No irreplaceable loss.**
Can impacts be mitigated?	**Yes** but mitigation is unlikely to affect the assessed levels of impact.	

Mitigation / Management:

Planning:

- Plan to maintain the height of structures as low as possible;
- Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development;

Operations:

- Reinstate any areas of vegetation that have been disturbed during construction;
- Remove all temporary works;
- Monitor rehabilitated areas post-construction and implement remedial actions;
- Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use of the site;
- Rehabilitate and monitor areas post-decommissioning and implement remedial actions.

Cumulative Impacts:

The proposed project will have a low level impact on the R359.

A detailed visual analysis of other solar projects in the area has not been undertaken, however, it is likely that only CSP projects in the area which have taller elements could have a significant impact on this road.

The overall cumulative impact is assessed as having a Medium significance. The contribution of the proposed project to this cumulative impact is assessed as low.

See Appendix IV.

Residual Risks:

The residual risk relates to loss of natural vegetation cover being obvious on decommissioning of the proposed project. It is therefore critical that effective rehabilitation is undertaken.

6.2.4 The proposed development could change the character of the landscape as seen from the Lutzputs Road.

Nature of impact:

The ZTV analysis indicates that the proposed project is highly unlikely to be visually obvious from this road.

There will therefore also be no impact and no contribution to cumulative impacts.

6.2.5 The proposed development could change the character of the landscape as seen from local settlements and homesteads.

Nature of impact:
Settlements and homesteads in the vicinity of the proposed project that may be affected are generally associated with agricultural activities within the Orange River Valley.

No individual homesteads within the plateau area appear likely to be affected.

The ZTV analysis indicates that the proposed array and project substation are only likely to be visible to homesteads on the southern side of the Orange River Valley. These largely fall outside the ALV of these elements. It is also likely that existing vegetation will screen the project.

It should be noted that three other PV projects are under consideration between the project and the N14. Should these be developed, they are likely to largely screen views of this project from areas to the south.

Should Mitigation in the form of an earthwork bund be employed to help soften the impact of the projects closest to the road, this is likely to also screen the project.

	Without mitigation	**With mitigation**
Extent	Site and immediate surroundings **(2)**	Site and immediate surroundings **(2)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Small to minor **(1)**	Small **(0)**
Probability	Improbable **(2)**	Very Improbable **(1)**
Significance	Low **(14)**	Low **(6)**
Status	Given that the area is developing as a renewable energy development zone, it is possible that some people will see the development in a positive light. Due to the fact that the project is unlikely to be viewed in a negative light by residents of homesteads. **Neutral.**	**Neutral**
Reversibility	High	
Irreplaceable loss	**No irreplaceable loss**	
Can impacts be mitigated?	No mitigation required	

Mitigation / Management:
Planning:

- Plan to maintain the height of structures as low as possible;

- Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development;

Operations:

- Reinstate any areas of vegetation that have been disturbed during construction;
- Remove all temporary works;
- Monitor rehabilitated areas post-construction and implement remedial actions;
- Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use of the site;

Rehabilitate and monitor areas post-decommissioning and implement remedial actions.

Cumulative Impacts:

Visual impacts on settlements and homesteads associated with the proposed project have been assessed as having a low significance.

General visual impacts in the region due to solar projects are also assessed as likely to have a low level of impact due to the fact that most settlements and homesteads are located within the Orange River Valley

The overall cumulative impact is assessed as having a Low significance. The contribution of the proposed project to this cumulative impact is also assessed as low.

See Appendix V.

Residual Impacts:

The residual risk relates to the infrastructure being left in place on decommissioning of the solar project. It is therefore critical that effective rehabilitation is undertaken.

6.2.6 Glare Impacts.

Nature of impact:

There are two areas where glare could be a concern to stakeholders, including:

a) Upington Airport; and
b) The N14.

Two array configurations have been tested including:

- A fixed array; and
- A single axis tracking array

The fixed configuration could result in glare that could affect motorists on the N14 during late afternoons in early March and late September to early October. The assessment indicates that the section of road that could be affected is to the east and north east of the project. The level of glare has the potential to cause an after image that could temporarily affect vision. The ZTV of the array indicates that it is only likely to be visible from three small sections of the road each of which is 250m or less in extent. Glare could therefore only affect three very limited sections of the road.

The single axis tracking configuration is unlikely to create glare that will affect pilots on the approaches to Upington Airport or motorists on the N14.

	Without mitigation	With mitigation
Extent	Region **(3)**	Region **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Minor to Low **(3)**	Small **(0)**
Probability	Improbable **(2)**	Very improbable **(1)**
Significance	Medium **(20)**	Low **(7)**
Status	**Negative**	**Neutral**
Irreplaceable loss	No irreplaceable loss	No irreplaceable loss
Reversibility	High	High
Can impacts be mitigated?	Yes	

Mitigation / Management:

- Adopt a tracking configuration for the proposed array; or
- Undertake screening on the southern / eastern boundary of the project either using an opaque fence, earth bund or a combination of both in order to block the glare.

Cumulative Impact:

There is potential for other arrays to also cause glare that could affect approaches to the airport.

The proposed array will result in a low level contribution to cumulative glare impacts. With mitigation, there will be no contribution to cumulative impacts.

See appendix IV.

Residual Risks:

No residual risk has been identified.

6.2.7 The potential visual impact of operational, safety and security lighting of the facility at night on observers.

Nature of impact:

The facility will be lit by security lights to a level sufficient to ensure that security cameras can operate at night. This is likely to result in the array being obvious at night from surrounding areas.

The Khi 1 Solar project immediately to the north appears relatively dark at night.

There are obvious lights from Upington as well as from passing traffic and small settlements and homesteads particularly in the Orange River Valley.

The area therefore is not totally dark during the night.

There is potential therefore for the project to add to these existing lighting levels.

	Without mitigation	With mitigation
Extent	Site and immediate surroundings **(2)**	Site **(1)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Small to minor **(1)**
Probability	Definite **(5)**	Improbable **(2)**
Significance	Medium **(50)**	Low **(12)**
Status	The appearance of a large lit area may be accepted by most people because it is so close to the N14.	If the lights are generally not visible then the occasional light is unlikely to be seen as negative.

	It is likely however that some people will see the expansion of lighting as a **negative** impact.	**Neutral**
Irreplaceable loss	It would be possible to change the lighting / camera system so the impact cannot be seen as an irreplaceable loss.	No irreplaceable loss
Reversibility	High	High
Can impacts be mitigated?	Yes	

Mitigation / Management:

- Use low key lighting around buildings and operational areas that is triggered only when people are present.
- Plan to utilise infra-red security systems or motion sensor triggered security lighting;
- Ensure that lighting is focused on the development with no light spillage outside the site; and
- Keep lighting low, no tall mast lighting should be used.

Cumulative Impact:

There is potential for security lighting and operational lighting associated with solar energy projects to further impact on the area but with mitigation the contribution of this project to possible cumulative impacts is likely to be of low significance.

See appendix V.

Residual Risks:

No residual risk has been identified.

7 IMPACT STATEMENT

7.1 VISIBILITY

The limited height of the bulk of the proposed development as well as its distance from sensitive receptors helps to limit visibility.

The natural grain of the landform is formed by small ridgelines that are remnants of an historic dune field running approximately north north-west to south south-east. This landform channels views to the north of the site. Due also to the relatively low height of the bulk of the proposed development this subtle landform is likely to play a major role in moderating views of the proposed development.

i. The proposed array and the substation are likely to be visible over similar areas;
ii. Views of the proposed array and the substation will be constrained to the north, east and west by minor ridgelines with the development likely to be most visible to the south;
iii. Limited views of the proposed development could be visible over a small section of the mid to upper southern valley slopes within the Orange River Valley. However these are likely to be largely screened by vegetation;
iv. From the N14, views of the proposed development (array and substation) are likely to be mostly visible from approximately 1.5km of the road that is adjacent to the project;
v. The ZTV analysis indicates that the proposed project is unlikely to be visible from the Lutzputs Road or the R359.

7.2 LANDSCAPE CHARACTER AREAS AND VISUAL ABSORPTION CAPACITY

The affected landscape can generally be divided into the following LCAs that are largely defined by vegetation, topography and drainage patterns.

- **Plateau LCA** which includes the gently undulating, arid plateau above the Orange River Valley. This area is generally natural in character with very little settlement. It is obvious form **Map 2 (Context)** that the character of this area is in transition in that solar projects are likely to create an industrial aesthetic within a matrix of natural vegetation. VAC within this area is only provided by the regular, low, dune formation as well as slopes of the slightly larger minor valleys that are associated with the non-perennial water courses that flow into the Orange River Valley.
- **The Orange River Corridor LCA** which is comprised of the shallow valley area surrounding the Orange River. This area is generally inward looking drawing little character influence from the surrounding plateau. Landform, vegetation and development all play a role in screening views of surrounding areas and contribute to significant VAC.

7.3 SENSITIVE RECEPTORS

Identified visual receptors include:

- Area Receptors which include the minor urban settlement areas that are located within the River Corridor LCA. From the site visit it appears that the majority of settlement areas relate to agricultural use of the River Valley. It is likely that the residents of these minor settlements are predominantly focused on agricultural

production of the area. As these settlements are located within the River Valley LCA, it is likely that views of the proposed development particularly from the northern side of the valley will be difficult. It is also likely that vegetation within the River Valley will at least partially screen any views of the proposed development that may be possible from the higher sections of the southern valley slopes;

- Linear Receptors or routes through the area that include the N14, the R359, and the Lutzputs road. Both of the N14 and the R359 roads have tourism significance, although the N14 is possibly the most important in this regard;
- The Lutzputs road is an un-surfaced road that at its closest runs approximately 14km to the north east of the proposed site; and
- Point Receptors that include individual homesteads that are located both within the River Valley LCA and the Plateau LCA. From the site visit, it is unlikely that settlement on the northern side of the Orange River will have views towards the proposed development. It is however possible that receptors on the higher sections on the southern side of the valley could have views of the proposed development. These however will be distance views and they are likely to be softened by vegetation within the River Valley.

7.4 VISUAL IMPACT

Visual impacts are likely to include;

a) The general change in character of the landscape due to the proposed development was assessed as low. This is due to the limited area over which the proposed development is likely to be visible as well as the fact that the landscape is partly industrialised by the Khi Solar 1 project and other solar projects that are under construction;
b) The impact due to the possible change in view as seen from the N14 was assessed as Low. This is due to the fact that the proposed project is approximately 4.25 km from the road and because it will be mainly visible from a short (1.5km) section of the road. The landscape within which the project will be viewed is also partly industrialised by the Khi Solar 1 project and other solar projects that are under construction;
c) The impact due to the possible change in view as seen from the R359 was assessed as low. This is due to the fact that views of the development are likely to be significantly screened / softened by vegetation within and on the edge of the Orange River Valley as well as the fact that the potentially affected section of the road lies outside the ALV of both the array and the substation;
d) The impact due to the possible change in view as seen from homesteads and settlements was assessed as low. This is due to the fact that only a small number of homesteads that are located on the opposite side of the Orange River Valley are potentially affected and existing vegetation within the valley that is likely to significantly screen / soften views of the proposed development;
e) A detailed glare assessment found that there The fixed configuration could result in a low level of glare affecting pilots on the northern approach to the secondary runway (shorter) at Upington Airport during afternoons (around 15h00) in early January and during afternoons (around 15h00) in mid November. Levels of glare predicted to have a low potential to create an after image that might temporarily make vision difficult for a pilot.
f) The fixed configuration could result in glare that could affect motorists on the N14 during late afternoons in early March and late September to early October. The assessment indicates that the section of road that could be affected is to the

east and north east of the project. The level of glare has the potential to cause an after image that could temporarily affect vision. The ZTV of the array indicates that it is only likely to be visible from three small sections of the road each of which is 250m or less in extent. Glare could therefore only affect three very limited sections of the road.

g) The tracking array is unlikely to create glare that may be problematic;
h) The impact of lighting in changing the nature of the night time landscape was assessed as high without mitigation but with mitigation lighting levels are likely to be similar to those in the surrounding area.

7.5 CUMULATIVE IMPACTS

In terms of general landscape change, the overall cumulative impact associated with solar projects was assessed as having a medium significance however, the contribution of the proposed project to this cumulative impact is assessed as low.

Cumulative visual impacts associated with solar projects on the N14 were assessed as having a low significance. The likely contribution to cumulative visual impacts associated with the proposed project was also assessed as having a low significance with and without mitigation.

Cumulative visual impacts associated with solar projects on the R359 were assessed as having a medium significance. The likely contribution to cumulative visual impacts associated with the proposed project was also assessed as having a low significance both with and without mitigation.

The proposed project is highly unlikely to have a visual impact on the Lutzputs Road. It is therefore unlikely to contribute to cumulative visual impacts on this receptor.

Impacts associated with the project could contribute to cumulative glare impacts in the region.

There is potential for security lighting and operational lighting associated with solar energy projects to have a significant impact in a rural region where lighting levels are limited to traffic on roads passing through the area and low level lighting associated with homesteads and small settlements. With appropriate mitigation however, general lighting levels are likely to be largely in keeping with surrounding areas.

7.5 CONCLUSION

The proposed project will generally result in a relatively limited level of visual impact within an area that is already impacted by a major solar project.

Visual impacts on sensitive receptors are all assessed as having a low significance. Given the fact that other solar projects are likely to be obvious due the REDZ status of the area, to a degree this landscape change may be expected.

The potential glare that might affect pilots on approaches to Upington Airport is considered minor as it is unlikely to have potential to create an after image thereby impairing vision. The potential glare impact on motorists on the N14 however could be significant. Mitigation might include screening on the southern and eastern edges of the array or the adoption of a tracking configuration.

In general terms therefore the proposed project is largely in keeping with its surroundings and with proposed mitigation measures will not impact significantly on receptors that are likely to be sensitive to landscape change associated with the project.

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APPENDIX I

SPECIALIST'S BRIEF CV

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	Registered Professional Landscape Architect (SACLAP) Chartered Member of the Landscape Institute (UK) Member of the International Association of Impact Assessment, South Africa
Languages	English- Speaking - Excellent - Reading - Excellent - Writing - Excellent
Contact Details	Post: PO Box 50910 Musgrave Road 4062 Republic of South Africa Cell: +27 83 7032995

General

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 is a registered Professional Landscape Architect and he has also worked as an Environmental Assessment Practitioner within South Africa.

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 landscape and visual impact assessment (LVIA) 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 major supermarket chains including Sainsbury's and prepared CAD based visual impact assessments for public enquiries for new store development. He also prepared the LVIA input to the environmental statement for the Cardiff Bay Barrage for consideration by the UK Parliament in the passing of the Barrage Act (1993).

His more recent LVIA 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.

LVIA work undertaken recently includes assessments for a new Eskom gas fired power station, two proposed private power stations, numerous solar and wind energy projects, a proposed cable car development in the Drakensberg and tourism related development within iSimangiliso Wetland Park and the Kruger National Park.

Select List of Landscape & Visual Impact Assessment Projects

- **Selati Railway Bridge** - Landscape and Visual Impact Assessment for proposed development of up-market accommodation on a railway bridge at Skukuza in the Kruger Park.
- **Eskom Combined Cycle Power Plant** - Landscape and Visual Impact Assessment for proposed gas power plant in Richards Bay, KwaZulu Natal Province.
- **Olifantshoek Power Line and Substation -** Landscape and Visual Impact Assessment for a proposed 31km 132kV power line and 10MVA substation in Olifantshoek in the Northern Cape Province.
- **Jozini TX Tower -** Landscape and Visual Impact Assessment for a proposed telecommunications mast above Jozini Dam in KwaZulu Natal Province.
- **Macapanstad Agri-Park Development** - Landscape and Visual Impact Assessment for a proposed agri-park in the North West Province.
- **Gunstfontein Wind Farm Amendment -** Landscape and Visual Impact Assessment for a proposed change in rotor size, hub height and layout of an authorised wind farm near Sutherland in the Northern Cape Province.
- **Great Karoo Wind Farm Amendment -** Landscape and Visual Impact Assessment for a proposed change in rotor size, hub height and layout of an authorised wind farm near Sutherland in the Northern Cape Province.
- **Mpushini Park Mixed Use Development** - Landscape and Visual Impact Assessment for a proposed change in development height and density of a mixed use development near Pietermaritzburg in KwaZulu Natal.
- **Aggeneys PV Solar Project** - Landscape and Visual Impact Assessment for a proposed solar farm near Aggeneys in the Northern Cape.
- **Sirius PV Solar Project** - Landscape and Visual Impact Assessment for a proposed solar farm near Upington in the Northern Cape.
- **Hyperion PV Solar Project** - Landscape and Visual Impact Assessment for a proposed solar farm in near Kathu in the Northern Province.
- **Moeding PV Solar Project** - Landscape and Visual Impact Assessment for a proposed solar farm in Vryburg.
- **Kangala Mine Extension -** Landscape and Visual Impact Assessment for a proposed extension to an open cast coal mine in Mpumalanga Province for Universal Coal.
- **N2 Section 20 Wild Coast, road upgrades, borrow pits and quarry sites** – Landscape and Visual Impact Assessment for the NRA through KSEMS Environmental Consulting
- **Establishment of Upmarket Tourism Accommodation on the Selati Bridge, Kruger National Park** – Assessment of visual implications of providing tourism accommodation in 12 railway carriages on an existing railway bridge at the Skukuza Rest Camp in the Kruger Park.
- **Palesa Power Station** - Landscape and Visual Impact Assessment for a new 600MW power station near Kwamhlanga in Mpumalanga for a private client.
- **Heuningklip PV Solar Project** – Landscape and Visual Impact Assessment for a solar project in the Western Cape Province for a private client.
- **Kruispad PV Solar Project** – Landscape and Visual Impact Assessment for a solar project in the Western Cape Province for a private client.
- **Doornfontein PV Solar Project** – Landscape and Visual Impact Assessment for a solar project in the Western Cape Province for a private client.
- **Olifantshoek Power Line and Substation** – Landscape and Visual Impact Assessment for a new 10MVA 132/11kV substation and 31km powerline, Northern Cape Province, for Eskom.
- **Noupoort Concentrating Solar Plants -** Scoping and Visual Impact Assessments for two proposed parabolic trough projects.
- **Drakensberg Cable Car –** Preliminary Landscape and Visual Impact Assessment and draft terms of reference as part of the feasibility study.

- **Paulputs Concentrating Solar Plant (tower technology)** – Landscape and Visual Impact Assessment for a new CSP project near Pofadder in the Northern Cape.
- **Ilanga Concentrating Solar Plants 1, 2, 3, 4 & 5** – Scoping and Visual Impact Assessments for the proposed extension of five authorised CSP projects including parabolic trough and tower technology within the Karoshoek Solar Valley near Upington in the Northern Cape.
- **Ilanga Concentrating Solar Plants 1, 2, 3, 4 & 5 Shared Infrastructure** – Landscape and Visual Impact Assessment for the necessary shared infrastructure including power lines, substation, water pipeline and roads for these projects.
- **Ilanga Concentrating Solar Plants 7, 8 & 9** - Scoping and Visual Impact Assessments for three new CSP projects including parabolic trough and tower technology within the Karoshoek Solar Valley near Upington in the Northern Cape.
- **Sol Invictus Solar Plants** - Scoping and Visual Impact Assessments for three new Solar PV projects near Pofadder in the Northern Cape.
- **Gunstfontein Wind Energy Facility** – Scoping and Visual Impact Assessment for a proposed WEF near Sutherland in the Northern Cape.
- **Moorreeesburg Wind Energy Facility** – Landscape and Visual Impact Assessment for a proposed WEF near Moorreeesburg in the Western Cape.
- **Semonkong Wind Energy Facility** - Landscape and Visual Impact Assessment for a proposed WEF near Semonkong in Southern Lesotho.
- **Great Karoo Wind Energy Facility** – Addendum report to the Landscape and Visual Impact Assessment Report for amendment to this authorised WEF that is located near Sutherland in the Northern Cape. Proposed amendments included layout as well as rotor diameter.
- **Perdekraal East Power Line** – Landscape and Visual Impact Assessment for a proposed power line to evacuate power from a wind energy facility near Sutherland in the Northern Cape.
- **Tshivhaso Power Station** – Scoping and Landscape and Visual Impact Assessment for a proposed new power station near Lephalale in Limpopo Province.
- **Saldanha Eskom Strengthening** – Scoping and Landscape and Visual Impact Assessment for the upgrading of strategic Eskom infrastructure near Saldanha in the Western Cape.
- **Eskom Lethabo PV Installation** - Scoping and Landscape and Visual Impact Assessment for the development of a solar PV plant within Eskom's Lethabo Power Station in the Free State.
- **Eskom Tuthuka PV Installation** - Scoping and Landscape and Visual Impact Assessment for the development of a solar PV plant within Eskom's Thutuka Power Station in Mpumalanga.
- **Eskom Majuba PV Installation** - Scoping and Landscape and Visual Impact Assessment for the development of a solar PV plant within Eskom's Majuba Power Station in Mpumalanga.
- **Golden Valley Power Line** - Landscape and Visual Impact Assessment for a proposed power line to evacuate power from a wind energy facility near Cookhouse in the Eastern Cape.
- **Mpophomeni Shopping Centre** – Landscape and Visual impact assessment for a proposed new shopping centre close to the southern shore of Midmar Dam in KwaZulu Natal.
- **Rheeboksfontein Power Line** - Addendum report to the Landscape and Visual Impact Assessment Report for amendment to this authorised power line alignment located near Darling in the Western Cape.
- **Woodhouse Solar Plants** – Scoping and Landscape and Visual Impact Assessment for two proposed solar PV projects near Vryburg in the North West Province.
- **AngloGold Ashanti, Dokyiwa (Ghana)** – Landscape and Visual Impact Assessment for proposed new Tailings Storage Facility at a mine site working with SGS as part of their EIA team.
- **Gateway Shopping Centre Extension (Durban)** – Landscape and Visual Impact Assessment for a proposed shopping centre extension in Umhlanga, Durban.
- **Kouroussa Gold Mine (Guinea)** – Landscape and Visual impact assessment for a proposed new mine in Guinea working with SGS as part of their EIA team.
- **Mampon Gold Mine (Ghana)** - Landscape and Visual impact assessment for a proposed new

mine in Ghana working with SGS as part of their EIA team.

- **Telkom Towers** – Landscape and Visual impact assessments for numerous Telkom masts in KwaZulu Natal.
- **Eskom Isundu Substation** – Landscape and Visual Impact Assessment for a proposed major new Eskom substation near Pietermaritzburg in KwaZulu Natal.
- **Eskom St Faiths Power Line and Substation** – Landscape and Visual Impact Assessment for a major new substation and associated power lines near Port Shepstone in KwaZulu Natal.
- **Eskom Ficksburg Power Line** – Landscape and Visual Impact Assessment for a proposed new power line between Ficksburg and Cocolan in the Free State.
- **Eskom Matubatuba to St Lucia Power Line** – Landscape and Visual Impact Assessment for a proposed new power line between Mtubatuba and St Lucia in KwaZulu Natal.
- **Dube Trade Port, Durban International Airport** – Landscape and Visual Impact Assessment
- **Sibaya Precinct Plan** – Landscape and Visual Impact Assessment as part of Environmental Impact Assessment for a major new development area to the north of Durban.
- **Umdloti Housing** – Landscape and Visual Impact Assessment as part of Environmental Impact Assessment for a residential development beside the Umdloti Lagoon to the north of Durban.
- **Tata Steel Ferrochrome Smelter** - Landscape and Visual Impact Assessment of proposed new Ferrochrome Smelter in Richards Bay as part of EIA undertaken by the CSIR.
- **Durban Solid Waste Large Landfill Sites –** Landscape and Visual Impact Assessment of proposed development sites to the North and South of the Durban Metropolitan Area. The project utilised 3d computer visualisation techniques.
- **Hillside Aluminium Smelter, Richards Bay -** Landscape and Visual Impact Assessment of proposed extension of the existing smelter. The project utilised 3d computer visualisation techniques.
- **Estuaries of KwaZulu Natal Phase 1 –** 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.
- **Signage Assessments** – Numerous impact assessments for proposed signage developments for Blast Media.
- **Signage Strategy** – Preparation of an environmental strategy report for a national advertising campaign on National Roads for Visual Image Placements.
- **Zeekoegatt, Durban** - Computer aided Landscape and Visual Impact Assessment. EDP 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.
- **La Lucia Mall Extension** - Landscape and Visual Impact Assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed extension to shopping mall for public consultation exercise.
- **Redhill Industrial Development** - Landscape and Visual Impact Assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed new industrial area for public consultation exercise.
- **Avondale Reservoir** - Landscape and 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.
- **Hammersdale Reservoir** - Landscape and 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.
- **Southgate Industrial Park, Durban** - Computer Aided Landscape and Visual Impact Assessment and Landscape Design for AECI.

- **Sainsbury's Bryn Rhos** - Computer Aided Landscape and Visual Impact Assessment / Planning Application for the development of a new store within the Green Wedge North of Swansea.
- **Ynyston Farm Access** - Computer Aided Impact Assessment of visual intrusion of access road to proposed development of Cardiff for the Land Authority for Wales.
- **Cardiff Bay Barrage** – Preparation of the Visual Impact Statement for inclusion in the Impact Statement for debate by parliament (UK) prior to the passing of the Cardiff Bay Barrage Bill.
- **A470, Cefn Coed to Pentrebach** - Preparation of landscape frameworks for the assessment of the impact of the proposed alignment on the landscape for The Welsh Office.
- **Sparkford to Illchester Bye Pass** - The preparation of the landscape framework and the draft landscape plan for the Department of Transport.
- **Green Island Reclamation Study** - Landscape and Visual Impact Assessment of building massing, Urban Design Guidelines and Masterplanning for a New Town extension to Hong Kong Island.
- **Route 3** - Landscape and Visual Impact Assessment for alternative road alignments between Hong Kong Island and the Chinese Border.
- **China Border Link** - Landscape and Visual Impact Assessment and initial Landscape Design for a new border crossing at Lok Ma Chau.
- **Route 81, Aberdeen Tunnel to Stanley** - Landscape and Visual Impact Assessment for alternative highway alignments on the South side of Hong Kong Island.

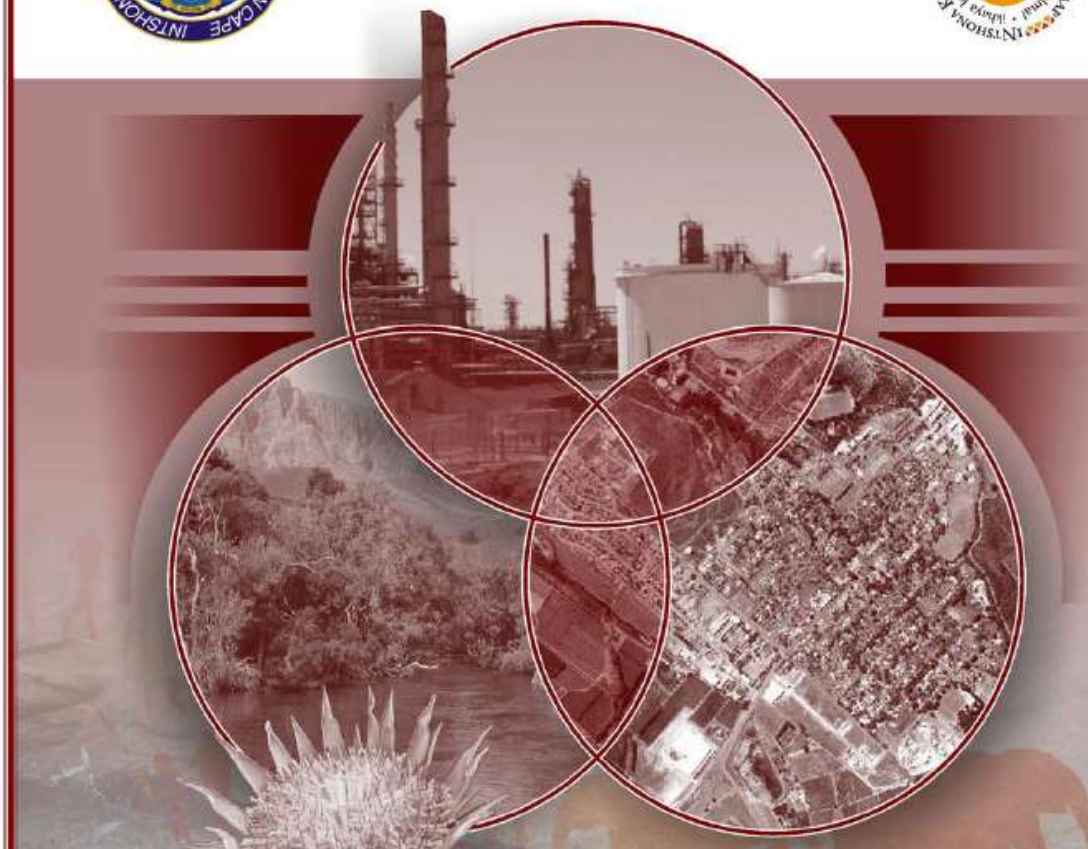
APPENDIX II

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



bola CSIR

Edition 1
June 2005

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.

Finalisation of report figures and formatting:

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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.*

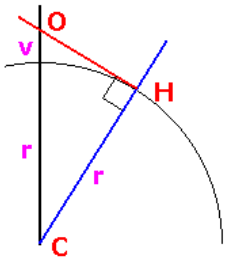
CONTENTS

APPENDIX III

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 IV

GLARE ASSESSMENT

ForgeSolar GlareGauge Glare Analysis Results

Site Configuration: PV 4 fixed array-temp-0

Project site configuration details and results.

Created **April 6, 2020 2:01 a.m.**
Updated **April 6, 2020 2:03 a.m.**
DNI **varies** and peaks at **1,000.0 W/m^2**
Analyze every **1** minute(s)
0.5 ocular transmission coefficient
0.002 m pupil diameter
0.017 m eye focal length
9.3 mrad sun subtended angle
Timezone **UTC2**
Site Configuration ID: 37579.6887

Summary of Results Glare with potential for temporary after-image predicted

PV name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV array 2	45.0	0.0	57	71	229,500,000.0

Component Data

PV Array(s)

Warning: This PV array encompasses a large surface area. This may reduce the accuracy of certain calculations if receptors are near the array. These calculations utilize the PV footprint centroid, rather than the glare-spot location, due to analysis method limitations. Additional analyses of array sub-sections may provide more information on expected glare. (Note that the subtended source angle is limited by the footprint surface area.)

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 45.0 deg
Orientation: 0.0 deg
Rated power: 100000.0 kW
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-28.602896	21.004411	834.12	3.50	837.62
2	-28.601691	21.021835	823.48	3.50	826.98
3	-28.601691	21.024324	820.57	3.50	824.07
4	-28.610432	21.028015	812.00	3.50	815.50
5	-28.611487	21.027929	811.86	3.50	815.36
6	-28.611939	21.026727	812.83	3.50	816.33
7	-28.614425	21.016685	818.23	3.50	821.73
8	-28.614350	21.011879	821.21	3.50	824.71
9	-28.607493	21.005441	834.03	3.50	837.53
10	-28.605157	21.004325	835.06	3.50	838.56

2-Mile Flight Path Receptor(s)

Name: FP 1
Description:
Threshold height: 15 m
Direction: 155.7 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

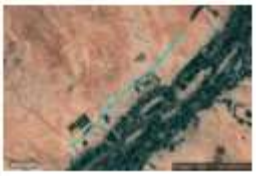
Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	-28.376964	21.250230	852.06	15.24	867.30
2-mile point	-28.350611	21.236897	863.68	172.31	1035.98

Name: FP 2
Description:
Threshold height : 15 m
Direction: 173.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	-28.392368	21.256067	851.00	15.24	866.24
2-mile point	-28.363670	21.252068	849.77	185.16	1034.92

Route Receptor(s)

Name: Route 1
Route type Two-way
View angle: 50.0 deg



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-28.635465	21.061638	781.94	1.50	783.44
2	-28.629436	21.071251	786.84	1.50	788.34
3	-28.623411	21.077946	788.00	1.50	789.50
4	-28.618137	21.082409	790.52	1.50	792.02
5	-28.614821	21.086014	780.19	1.50	781.69
6	-28.610602	21.090134	791.86	1.50	793.36
7	-28.606382	21.094426	801.89	1.50	803.39
8	-28.603669	21.099232	791.04	1.50	792.54
9	-28.600354	21.104382	798.10	1.50	799.60
10	-28.596737	21.109188	794.01	1.50	795.51
11	-28.593722	21.112793	789.03	1.50	790.53
12	-28.589502	21.117600	786.26	1.50	787.76
13	-28.581965	21.123951	800.97	1.50	802.47
14	-28.573372	21.132019	812.74	1.50	814.24

PV Array Results

PV array 2 potential temporary after-image

Warning: This PV array encompasses a large surface area. This may reduce the accuracy of certain calculations if receptors are near the array. These calculations utilize the PV footprint centroid, rather than the glare-spot location, due to analysis method limitations. Additional analyses of array sub-sections may provide more information on expected glare. (Note that the subtended source angle is limited by the footprint surface area.)

Predicted energy output: 229,500,000.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	0	0
FP: FP 2	38	0
Route: Route 1	19	71

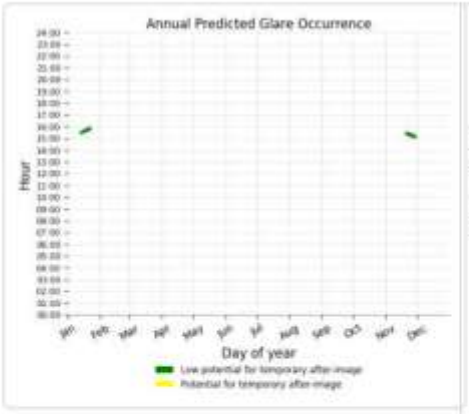
PV array 2 - Receptor (FP 1)

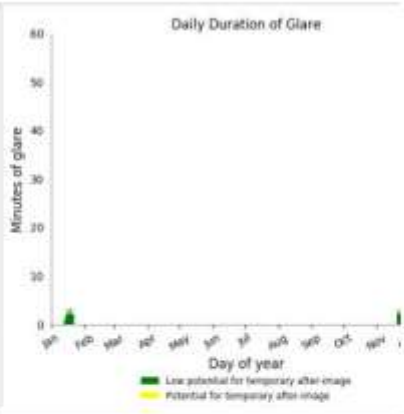
No glare found

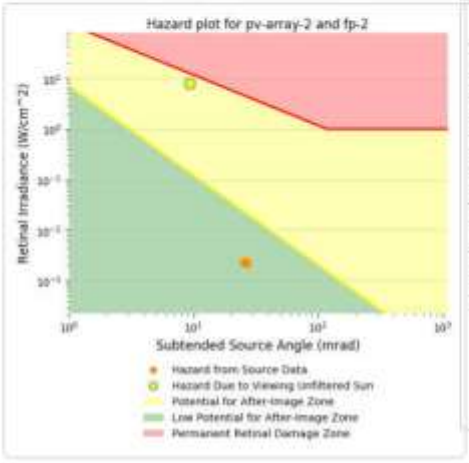
PV array 2 - Receptor (FP 2)

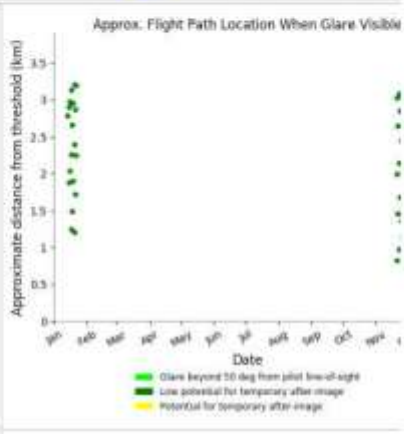
PV array is expected to produce the following glare for observers on this flight path:

- 38 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.





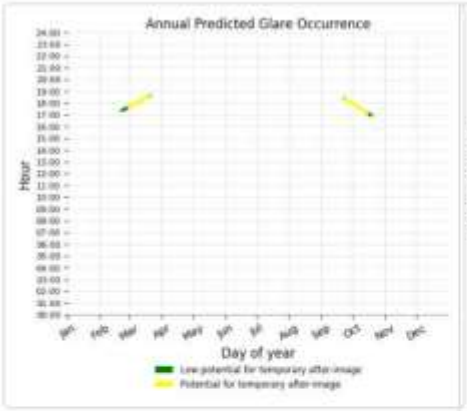


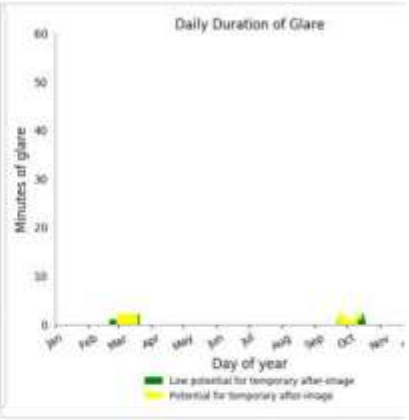


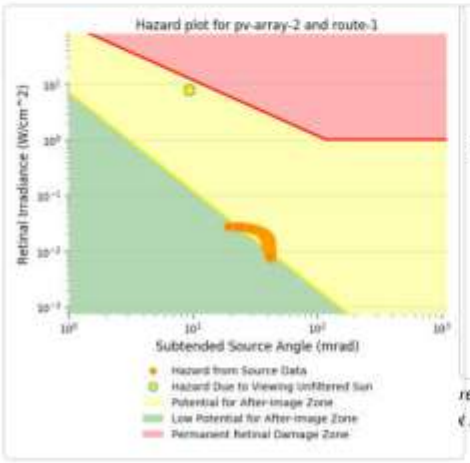
PV array 2 - Route Receptor (Route 1)

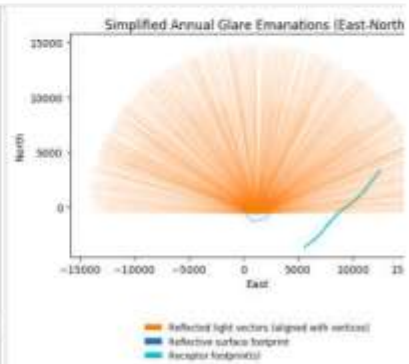
PV array is expected to produce the following glare for receptors at this location:

- 19 minutes of "green" glare with low potential to cause temporary after-image.
- 71 minutes of "yellow" glare with potential to cause temporary after-image.









re vectors placed at PV centroid for clarity. Actual glar
locations vary.

ForgeSolar GlareGauge Glare Analysis Results

Site Configuration: PV 4 fixed array-temp-1

Project site configuration details and results.

Created **April 6, 2020 2:14 a.m.**
Updated **April 6, 2020 2:16 a.m.**
DNI **varies** and peaks at **1,000.0 W/m^2**
Analyze every **1** minute(s)
0.5 ocular transmission coefficient
0.002 m pupil diameter
0.017 m eye focal length
9.3 mrad sun subtended angle
Timezone **UTC2**
Site Configuration ID: 37580.6887

Summary of Results No glare predicted!

PV name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV array 2	SA tracking	SA tracking	0	0	251,600,000.0

Component Data

PV Array(s)

Warning: This PV array encompasses a large surface area. This may reduce the accuracy of certain calculations if receptors are near the array. These calculations utilize the PV footprint centroid, rather than the glare-spot location, due to analysis method limitations. Additional analyses of array sub-sections may provide more information on expected glare. (Note that the subtended source angle is limited by the footprint surface area.)

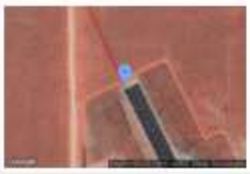
Name: PV array 2
Description: SINGLE AXIS TRACKING
Axis tracking: Single-axis rotation
Tracking axis orientation: 0.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 0.0 deg
Rated power: 100000.0 kW
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-28.602896	21.004411	834.12	3.50	837.62
2	-28.601691	21.021835	823.48	3.50	826.98
3	-28.601691	21.024324	820.57	3.50	824.07
4	-28.610432	21.028015	812.00	3.50	815.50
5	-28.611487	21.027929	811.86	3.50	815.36
6	-28.611939	21.026727	812.83	3.50	816.33
7	-28.614425	21.016685	818.23	3.50	821.73
8	-28.614350	21.011879	821.21	3.50	824.71
9	-28.607493	21.005441	834.03	3.50	837.53
10	-28.605157	21.004325	835.06	3.50	838.56

2-Mile Flight Path Receptor(s)

Name: FP 1
Description:
Threshold height : 15 m
Direction: 155.7 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevati
	deg	deg	m	m	m
Threshold	-28.376964	21.250230	852.06	15.24	867.3
2-mile point	-28.350611	21.236697	863.68	172.31	1035.9

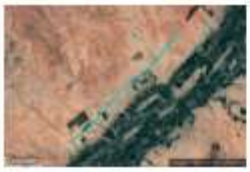


Name: FP 2
Description:
Threshold height : 15 m
Direction: 173.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevati
	deg	deg	m	m	m
Threshold	-28.392368	21.256067	851.00	15.24	866.2
2-mile point	-28.363670	21.252068	849.77	185.16	1034.9

Route Receptor(s)

Name: Route 1
Route type Two-way
View angle: 50.0 deg



Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	-28.635465	21.061638	781.94	1.50	783.44
2	-28.629438	21.071251	786.84	1.50	788.34
3	-28.623411	21.077946	788.00	1.50	789.50
4	-28.618137	21.082409	790.52	1.50	792.02
5	-28.614821	21.086014	780.19	1.50	781.69
6	-28.610602	21.090134	791.86	1.50	793.36
7	-28.606382	21.094426	801.89	1.50	803.39
8	-28.603669	21.099232	791.04	1.50	792.54
9	-28.600354	21.104382	798.10	1.50	799.60
10	-28.596737	21.109188	794.01	1.50	795.51
11	-28.593722	21.112793	789.03	1.50	790.53
12	-28.589502	21.117600	786.26	1.50	787.76
13	-28.581965	21.123951	800.97	1.50	802.47
14	-28.573372	21.132019	812.74	1.50	814.24

PV Array Results

PV array 2

Warning: This PV array encompasses a large surface area. This may reduce the accuracy of certain calculations if receptors are near the array. These calculations utilize the PV footprint centroid, rather than the glare-spot location, due to analysis method limitations. Additional analyses of array sub-sections may provide more information on expected glare. (Note that the subtended source angle is limited by the footprint surface area.)

Predicted energy output: 251,600,000.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
FP: FP 1	0	0
FP: FP 2	0	0
Route: Route 1	0	0

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
- Detailed system geometry is not rigorously simulated.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values and results may vary.
- Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
- The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
- Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
- Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
- Refer to the **Help page** for assumptions and limitations not listed here.

APPENDIX V

CUMULATIVE IMPACT ASSESSMENT

1 Landscape Change

Nature:
The proposed project will extend the general influence of development and specifically solar projects within the area.

The project is one of seven proposed solar PV projects on the same property.

Currently within a 30km radius of the proposed project property there are fourteen other properties on which renewable energy projects are proposed. These consist of both Concentrated Solar Projects (CSP) as well as Solar Photovoltaic projects (PV).

There is one existing CSP project approximately 10km to the north east of the project site (Khi Solar 1).

There are also ten proposed and authorised PV projects on the Farms McTaggarts, Klip Punt and Tungsten Lodge RE/638 which are located directly to the north west and south east of Khi Solar 1. A number of these projects were under construction at the time of reporting.

The number of renewable energy projects in the vicinity of the proposed project has resulted in the development of both strategic high voltage electrical infrastructure including the Upington MTS as well as power line connections to individual renewable energy projects.

The proposed project will therefore not extend the visual influence of industry, it will however intensify if within a relatively small area.

Whilst a detailed visual analysis of all other solar projects in the area has not been undertaken, the combined effect of all proposed solar projects could be significant. Because the proposed project will affect an area within which there is already significant industrial influence, it is only likely to have a relatively small contribution to landscape change.

As the impact of the proposed project on the Orange River Corridor is minimal and because it is more difficult to predict the impact of other projects on this area without undertaking a detailed analysis, only the impact of projects on the Plateau LCA is considered.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Site and surroundings **(2)**	Region **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Minor **(2)**	High **(8)**
Probability	Probable **(3)**	Probable **(3)**
Significance	**Low (24)**	**Medium (45)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No

2 Character of the landscape as seen from the N14.

Nature:
The ZTV analysis indicates that views of the proposed PV array and the substation will be limited to a short section of approximately 5km of this road at a distance of approximately 0.2km.

If visible, the proposed project will also be viewed in the context of the Khi Solar 1 project as well as a number of other solar PV projects.

Without mitigation, it is likely therefore that the subject project will be obvious from this road.

With mitigation however, the project is likely to be largely screened.

The assessment without mitigation is indicated below. With mitigation, the contribution to cumulative impacts reduces to low.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Site and immediate surroundings **(2)**	Region, **(3)**
Duration	Long term **(4)**	Long term, **(4)**
Magnitude	Low **(2)**	Moderate to low, **(5)**
Probability	Probable **(3)**	Probable, **(5)**
Significance	Medium **(24)**	Medium, **(60)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Unknown

3 Change in the character of the landscape as seen from the R359.

Nature:
The ZTV analysis indicates that the proposed project could be visible intermittently to sections of this road at a distance in excess of 5km. Given the distance and the extent of vegetation on the edge of the Orange River Valley, the proposed project is unlikely to be highly obvious from this road.

The proposed project is largely screened from the road by vegetation. Other solar PV projects are also likely to be largely screened from the road.

It is unlikely therefore that the subject project will be obvious from this road, its influence on this cumulative impact is therefore likely to be relatively low.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Site and immediate surroundings **(2)**	Regional **(3)**
Duration	Long term **(4)**	Long term, **(4)**
Magnitude	Minor **(2)**	Minor to Low, **(3)**

Probability	Very improbable **(1)**	Probable, **(3)**
Significance	Low **(8)**	Medium **(30)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No irreplaceable loss.	No

4 Change in the character of the landscape as seen from the Lutzputs Road.

Nature: The proposed development will not be visually obvious from this road. **It will therefore not contribute to cumulative impacts.**

5 Cumulative impact on local settlements and homesteads

Nature: Because the majority of homesteads are located within the Orange River Valley and are likely to be at least partially screened from PV projects to the north by landform and vegetation their cumulative visual impact is also anticipated to be low. The Solar CSP Power Tower projects such as the Khi Solar 1 project are likely to be obvious however. The cumulative impact of PV projects is therefore likely to have a low significance. The proposed project is assessed as having a low contribution to this impact.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Site and immediate surroundings **(2)**	Region **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Small to minor **(1)**	Minor **(2)**
Probability	Improbable **(2)**	Probable **(3)**
Significance	Low **(14)**	Low **(27)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No irreplaceable loss	No irreplaceable loss

6 Cumulative impact of glare affecting local receptors.

Nature:

Glare associated with the proposed project could have a significant impact on motorists on the N14. Without mitigation the impact was assessed as likely to have a medium level of significance. With mitigation however, the significance is likely to be low.

It is possible that other solar PV projects could create glare that affects local receptors. However, the majority of solar projects are set back more than 2km from the N14 and are some distance from the Upington Airport. It is therefore unlikely that glare arising from solar PV projects will be a significant issue in the area.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Region **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Small **(0)**	Minor **(2)**
Probability	Very improbable **(1)**	Probable **(3)**
Significance	Low **(7)**	Low **(27)**
Status (positive or negative)	**Neutral**	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No irreplaceable loss.	No irreplaceable loss.

7 Night Time Lighting Impacts

Nature:
Currently lighting in the area is arises from the settlement areas and homesteads within the Orange River Valley and traffic on the N14. There is also a background lighting level from the urban area of Upington

There is a risk that the proposed project will extend the influence of lighting however with appropriate mitigation lighting levels are anticipated to be low and in keeping with the current lighting pattern.

It is likely that the development of other solar projects in the area will increase lighting levels. However, with appropriate mitigation it is anticipated that this also will produce a low level of impact that is also in keeping with surrounding lighting levels.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Site **(1)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Small to minor **(1)**	Small to minor **(1)**
Probability	Improbable **(2)**	Improbable **(3)**
Significance	Low **(12)**	**Low (24)**
Status (positive or negative)	If the lights are generally not visible then the occasional light is unlikely to be seen as negative. **Neutral**	**Neutral**
Reversibility	High	High

Irreplaceable loss of resources?	No irreplaceable loss	No irreplaceable loss

APPENDIX VI
ENVIRONMENTAL MANAGEMENT PLAN

Project component/s	Hari PV, Construction, Operation and Decommissioning
Potential Impact	Change in Landscape Character and the nature of stakeholder views: • Extending the influence of development into relatively natural areas; • Changing the nature of views from the N14 and the R359; • Extending lighting impacts into natural areas that are currently dark during the hours of darkness; and
Activity/risk source	• The proposed array and substation are highly obvious from the N14 and visible from local homesteads to the south; • Engineered change in landform being obvious against natural contours; • Vegetation clearance and lack of rehabilitation during construction and decommissioning making the development more obvious particularly from a distance; • The development industrialising the outlook for stakeholders; and • Lighting extending into natural areas that are currently dark during the hours of darkness;
Mitigation: Target/Objective	• Plan platforms and earthworks to blend into surrounding natural contours. • Minimise and reinstate vegetation loss. • Maintain and augment exiting surrounding natural vegetation in order to soften views of the development and maintain continuity with the surrounding natural landscape. • Remove structures and rehabilitate site to its natural condition on decommissioning. • Ensure PV panels use non reflective surfaces in order to minimise the potential for glint and glare.

Mitigation: Action/control	**Responsibility** Contractor (C) Environmental Officer (EO) Environmental Liaison Officer (ELO)	**Timeframe** Construction Phase (C) Operational Phase (O) Decommissioning Phase (D)
Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.	C, EO	C
Reinstate any areas of vegetation that have been disturbed during construction.	C, EO	C
Maintain and augment vegetation within the area surrounding the development.	C, EO	D
Rehabilitate disturbed areas to their natural state on decommissioning.	C, EO	C, D

Monitor rehabilitated areas post-construction and post-decommissioning and implement remedial actions. Remove all temporary works. Remove infrastructure not required for the post-decommissioning use of the site.	C, EO C, EO C, EO	D D D
Performance Indicators	Visibility of the PV array from the N14 and areas to the south. Natural contours rather than rigid engineered land form. Vegetation presence and density. Visibility of the development from surrounding areas. Presence of unnecessary infrastructure.	
Monitoring	Evaluate visibility from the N14. Evaluate vegetation before, during and after construction. Evaluate vegetation growth and reinstatement during decommissioning and for a year thereafter. Take regular time-line photographic evidence. Responsibility: EO and ELO. Prepare regular reports.	