VISUAL IMPACT REPORT

HARMONY JOEL SOLAR PV IMPACT ASSESSMENT JANUARY 2023

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Harmony Joel Solar PV Facility, Free State

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Report Revision No: 1
Date Issued: 21 January 2023
Reference: Eco Thunder Consulting (2022) Visual Impact Assessment for Harmony Joel Solar PV Facility Impact Assessment.

ACRONYMS, ABBREVIATIONS AND GLOSSARY

Acronyms & Abbreviations	
BAR	Basic Assessment Report
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GYLA	Graham Young Landscape Architect
SACLAP	South African Council for the Landscape Architectural Profession
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment
Glossary	
Aesthetic Value	Aesthetic value is the emotional response derived from the experience of the environment with its natural and cultural attributes. The response can be either to visual or non-visual elements and can embrace sound, smell and any other factor having a strong impact on human thoughts, feelings, and attitudes (Ramsay, 1993). Thus, aesthetic value encompasses more than the seen view, visual quality, or scenery, and includes atmosphere, landscape character and sense of place (Schapper, 1993).
Aesthetically significant place	A formally designated place visited by recreationists and others for the express purpose of enjoying its beauty. For example, tens of thousands ofpeople visit Table Mountain on an annual basis. They come from around the country and even from around the world. By these measurements,one can make the case that Table Mountain (a designated National Park) is an aesthetic resource of national significance. Similarly, a resource thatis visited by large numbers who come from across the region probably has regional significance. A place visited primarily by people whose place of origin is local is generally of local significance. Unvisited places either have no significance or are "no trespass" places. (after New York, Department of Environment 2000).
Aesthetic impact	Aesthetic impact occurs when there is a detrimental effect on the perceived beauty of a place or structure. Mere visibility, even startling visibility of a Project proposal, should not be a threshold for decision making. Instead a Project, by its visibility, must clearly interfere with or reduce (i.e. visual impact) the public's enjoyment and/or appreciation of the appearance of a valued resource e.g. cooling tower blocks a view from a National Park overlook (after New York, Department of Environment 2000).
Cumulative Effects	The summation of effects that result from changes caused by a development in conjunction with the other past, present, or reasonably foreseeable actions.
Glare	The sensation produced by luminance within the visual field that is sufficiently greater than the luminance to which the eyes are adapted, which causes annoyance, discomfort, or loss in visual performance and visibility. *See* Glint. (USDI 2013:314)
Glint	A momentary flash of light resulting from a spatially localized reflection of sunlight. *See* Glare. (USDI 2013:314)
Landscape Character	The individual elements that make up the landscape, including prominent or eye-catching features such as hills, valleys, woods, trees, water bodies, buildings, and roads. They are generally quantifiable and can be easily described.
Landscape Impact	Landscape effects derive from changes in the physical landscape, whichmay give rise to changes in its character and how this is experienced (Institute of Environmental Assessment & The Landscape Institute 1996).

Study area	For the purposes of this report this Project the study area refers to the proposed Project footprint / Project site as well as the 'zone of potential influence' (the area defined as the radius about the centre point of the Project beyond which the visual impact of the most visible features will be insignificant) which is a 5,0km radius surrounding the proposed Project footprint / site.
Project Footprint / Site	For the purposes of this report the Project *site* / *footprint* refers to theactual layout of the Project as described.
Sense of Place (genius loci)	Sense of place is the unique value that is allocated to a specific place or area through the cognitive experience of the user or viewer. *A genius locus literally means* 'spirit of the place'.
Sensitive Receptors	Sensitivity of visual receptors (viewers) to a proposed development.
Viewshed analysis	The two-dimensional spatial pattern created by an analysis that defines areas, which contain all possible observation sites from which an object would be visible. The basic assumption for preparing a viewshed analysis is that the observer eye height is 1,8m above ground level.
Visibility	The area from which Project components would potentially be visible.Visibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation, and distance.
Visual Exposure	Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion and visual acuity, which is also influenced by weatherand light conditions.
Visual Impact	Visual effects relate to the changes that arise in the composition of available views because of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity available views because of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visualamenity.
Visual Intrusion	The nature of intrusion of an object on the visual quality of the environment resulting in its compatibility (absorbed into the landscape elements) or discord (contrasts with the landscape elements) with the landscape and surrounding land uses.
Visual absorption capacity	Visual absorption capacity is defined as the landscape's ability to absorb physical changes without transformation in its visual character and quality. The landscape's ability to absorb change ranges from low- capacity areas, in which the location of an activity is likely to cause visual change in the character of the area, to high-capacity areas, in which the visual impact of development will be minimal (Amir & Gidalizon 1990).
Worst-case Scenario	Principle applied where the environmental effects may vary, for example, seasonally or collectively to ensure the most severe potential effect isassessed.
Zone of Potential Visual Influence	By determining the zone of potential visual influence, it is possible to identify the extent of potential visibility and views which could be affected by the proposed development. Its maximum extent is the radius around an object beyond which the visual impact of its most visible features will be insignificant primarily due to distance.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1. Project Overview and Background

Eco-Thunder Consulting was commissioned by Savannah Environmental (Pty) Ltd to carry out a Visual Impact Assessment (VIA) of the proposed Harmony Joel Solar PV Facility near Theunissen in the Free State Province. The VIA focuses on the potential impact of the physical aspects of the proposed developments (i.e., form, scale, and bulk), and their potential impact within the local landscape and receptor context.

The VIA focuses on the potential impact of the physical aspects of the proposed developments (i.e., form, scale, and bulk), and their potential impact within the local landscape and receptor context.

1.2. Project Description

Freegold Harmony (Pty) Ltd (a subsidiary of Harmony Gold Mining Company Ltd) is looking to supplement its energy supply by implementing Photovoltaic (PV) generation, aiding their transition to a more sustainable and environmentally friendly energy mix.

The development of a solar photovoltaic (PV) facility with a generating capacity of up to 18MW is proposed 900m north east of the Harmony Joel operations, approximately ~20km north east of the town of Theunissen within the Masilonyana Local Municipality and within the Lejweleputswa District Municipality, Free State Province. The PV facility is located on Portion 0 of the Farm Leeuwbult 580. The solar PV development will be known as Harmony Joel Solar PV Facility.

The preferred site for the project is on a property which is privately owned by the Mine and are available for the proposed project and is therefore deemed technically feasible by the project developer for such development to take place.

A project site[1] considered to be technically suitable for the development of the solar PV facility, with an extent of approximately 1000ha, was identified. A development area[2] of ~220ha was demarcated within this project site and allows an adequate footprint (~47ha)[3] for the installation of a solar PV facility with a contracted capacity of up to 18MW, while allowing for the avoidance of environmental site sensitivities.

The infrastructure associated with the 18MW solar PV facility will include:

- PV modules and mounting structures
- Inverters and transformers a SCADA room, and maintenance room
- Cabling between the project components, to be laid underground where practical
- Access roads, internal roads and fencing around the development area.
- Temporary and permanent laydown areas and O&M buildings.
- Grid connection solution including an on-site facility substation, switching station, to be connected to the Shafts 1 & 2 HJ Joel Mining Substation via an overhead power line (located ~830m south west of the development footprint).

As of 2019, the Industrial sector was the leading electricity consumer in South Africa, with up to 56 percent of the total consumption (Ratshomo 2019). *Mining* and quarrying accounted for 10% of the industrial *consumption* while non-ferrous metals and non-metallic both accounted for 8% and 5%, respectively (Chamber of Mines of South Africa, 2017).

[1] The project site comprises the affected properties for that identified area within which the development area and development footprint are located. It is the broader geographic area assessed as part of the EIA process, within which direct effects of the proposed project may occur. The project site is ~920ha in extent.

[2] The development area is that identified area where the 18MW PV facility is planned to be located. This area has been selected as a practicable option for the facility, considering technical preference and constraints. The development area is ~220ha in extent.

[3] The development footprint is the defined area (47ha) located within the development area) where the PV panel array and other associated infrastructure for the Harmony Joel Solar PV facility is planned to be constructed. This includes the actual footprint of the facility, and the area which would be disturbed.

The successful development of the renewable energy projects will enable Harmony Gold to make a valuable and meaningful contribution towards growing the green economy within the province and South Africa. This will assist the Free State in creating green jobs and reducing Green House Gas emissions, whilst reducing the energy demand on the National Grid.

1.3. Objective of the Specialist Study

The scope of the work includes a scoping level visual assessment of the issues related to the visual impact. The scoping phase is the process of determining the spatial and temporal boundaries (i.e., extent) and key issues to be addressed in an impact assessment. The main purpose is to focus the impact assessment on a manageable number of important questions on which decision-making is expected to focus and to ensure that only key issues and reasonable alternatives are examined.

The study area for the visual assessment encompasses a geographical area of approximately 600km² (the extent of the full-page maps displayed in this report) and includes a minimum 10km buffer zone (area of potential visual influence) from the proposed project site.

The study area includes predominantly mining land, farmland and industrial areas within the Theunissen area.

1.4. Terms and Reference

A specialist study is required to establish the visual baseline and to identify and potential visual impacts arising from the proposed development based on the general requirements for a comprehensive VIA. The following terms of reference were established:

- Data collected allows for a description and characterization of the receiving environment.
- Describe the landscape character, quality and assess the visual resource of the study area.
- Describe the visual characteristics of the components of the Project.
- Identify issues that must be addressed in the impact assessment phase.
- Propose mitigation options to reduce the potential impact of the Project.

1.5. Specialist Details

Eco–Thunder Consulting (ETC) is a 100% woman-owned, private company that specializes in a range of specialist studies, such as Visual Impact Assessments socio-economic research, economic development planning, development programme design and implementation as well as community trust management.

Eco–Thunder Consulting is registered with ECSA and landscape architects with interest and experience in landscape architecture, urban design, and environmental planning. The company has carried out visual impact assessments throughout Africa and specialize in project optimization in the environmental space. Aspects of this work also include landscape characterization studies, end-use studies for quarries, and computer modelling and visualization.

Based in Johannesburg, South Africa, Eco-Thunder has established itself as an expert on the conditions, needs and assets of communities that are linked to independent power generation facilities.

ETC also implements development programmes in energy communities, which ensures a comprehensive understanding of the how to drive positive social impact.

1.6. Level of Confidence

Level of confidence[4] is determined as a function of:

- The information available, and understanding of the study area by the practitioner:
    - 3: A high level of information is available of the study area and a thorough knowledge base could be established during site visits, surveys etc. The study area was readily accessible.

[4] Adapted from Oberholzer (2005).

- 2: A moderate level of information is available of the study area and a moderate knowledge base could be established during site visits, surveys etc. Accessibility to the study area was acceptable for the level of assessment.
- 1: Limited information is available of the study area and a poor knowledge base could be established during site visits and/or surveys, or no site visit and/or surveys were carried out.

- The information available, understanding of the study area and experience of this type of project by the practitioner:
  - 3: A high level of information and knowledge is available of the project and the visual impact assessor is well experienced in this type of project and level of assessment.
  - 2: A moderate level of information and knowledge is available of the project and/or the visual impact assessor is moderately experienced in this type of project and level of assessment.
  - 1: Limited information and knowledge is available of the project and/or the visual impact assessor has a low experience level in this type of project and level of assessment.

The level of confidence for this assessment is determined to be **9** and indicates that the author's confidence in the accuracy of the findings is high:

- The information available, and understanding of the study area by the practitioner is rated as **3** and
- The information available, understanding and experience of this type of project by the practitioner is rated as **3**

1.7. Assumptions, Uncertainties, and Limitations

The following assumptions and limitations have been made in the study:

- The assessment has been based on the requirements of the Western Cape Guidelines.
- Whilst the majority of homesteads and housing areas were visited during the site visit in order to confirm their nature and likely visibility of the development, it was not possible to visit all homesteads and housing areas.
- The description of project components is limited to what has been supplied to the author before the date of completion of this report.
- The Project report uses the concept of 'worst case scenario' to identify issues and rate visual impacts. This scenario assumes that all facilities along with the associated grid infrastructure and sub-stations would be constructed at the same time. At the time of writing there was no evidence to the contrary. This assumption is also based on the nature of visual impact and the fact that receptors would experience all facilities with in the same visual envelope from their respective locations or as they travel along adjacent roads.
- The assessment of cumulative impacts is partly based on information provided by the DFFE Website This source provides detail of all other renewable energy applications and has been used to indicate other possible solar energy sites within 30km of the application site.

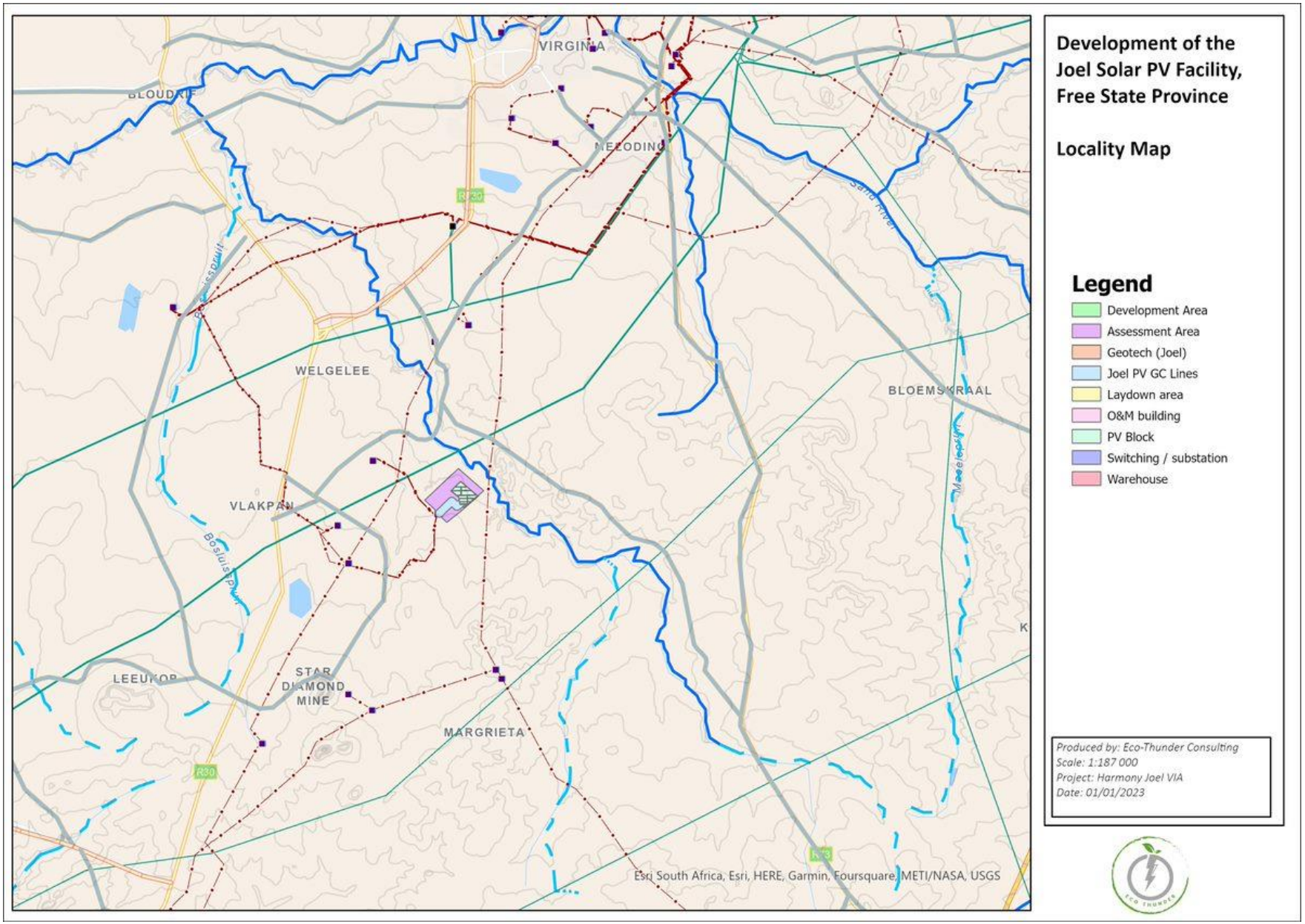

Figure 1: Proposed Development location map.

2. LEGAL REQUIREMENTS AND GUIDELINES

This report adheres to the following legal requirements and guideline documents.

2.1. National Legislation and Guidelines

National Environmental Management Act (Act 107 of 1998), EIA Regulations

The specialist report is in accordance with the specification on conducting specialist studies as per Government Gazette (GN) R 982 of the National Environmental Management Act (NEMA) Act 107 of 1998. The mitigation measures as stipulated in the specialist report can be used as part of the Environmental Management Programme (EMPr) and will be in support of the Environmental Impact Assessment (EIA) and Appendix 6 of the EIA Regulations 2014, as amended on 7 April 2017.

Specialist Screening Protocols are also required by the 2014 EIA Regulations. These were taken into consideration for each of the five projects. However, the Landscape (Solar) Theme Sensitivity was referenced as there is no specific 'visual' protocol.

Western Cape Department of Environmental Affairs & Development Planning: Guideline for Involving Visual and Aesthetic Specialists in EIA Processes Edition 1 (CSIR, 2005)

Although the guidelines were specifically compiled for the Province of the Western Cape[4], they provide guidance that is appropriate for any EIA process. The Guideline document also seeks to clarify instances when a visual specialist should get involved in the EIA process.

[4] The Western Cape Guidelines are the only official guidelines for visual impact assessment reports in South Africa and can beregarded as best practice throughout the country.

3. APPROACH AND METHODOLOGY

3.1. Approach

The effects of the development on a landscape resource and visual amenity are complex since it is determined through a combination of quantitative and qualitative evaluations. When assessing visual impact,the worst-case scenario is considered. Landscape and visual assessments are separate, although linked, procedures. The landscape, its analysis, and the assessment of impacts on the landscape all contribute to the baseline for visual impact assessment studies. The assessment of the potential impact on the landscape is carried out as an impact on an environmental resource, i.e., the physical landscape. Visual impacts, on the other hand, are assessed as one of the interrelated effects on people (i.e., the viewers and the impact of an introduced object into a view or scene).

The study was undertaken using Geographical Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed infrastructure. A detailed Digital Terrain Model (DTM) for the study area was created from topographical data provided by the Japan Aerospace Exploration Agency (JAXA), Earth Observation Research Centre, in the form of the ALOS Global Digital Surface Model "ALOS World 3D - 30m" (AW3D30) elevation model.

The scope of work for this report includes:

- Identify potentially sensitive visual receptors within the receiving environment.
- Determine the Visual Absorption Capacity of the landscape.
- Determine Visual Distance/Observer Proximity to the facility.
- Determine Viewer Incidence/Viewer Perception.
- Determine Significance of identified impacts.
- Propose mitigation to reduce or alleviate potential adverse visual impacts (to be structured as an EMPr).
- Assess the glint and glare of the PV panels
- Conclude with an Impact Statement of Significance and a project recommendation.

Visual Impact Assessment (VIA)

The VIA is determined according to the nature, extent, duration, intensity or magnitude, probability and significance of the potential visual impacts, and will propose management actions and/or monitoring programs and may include recommendations related to the proposed Solar PV Facility.

The visual impact is determined for the highest impact-operating scenario (worst-case scenario) and varying climatic conditions (i.e., different seasons, weather conditions, etc.) are not considered.

The VIA considers potential cumulative visual impacts, or alternatively the potential to concentrate visual exposure/impact within the region.

The determination of the potential visual impacts is undertaken in terms of nature, extent, duration, magnitude, probability and significance of the construction and operation of the proposed infrastructure.

Anticipated issues related to the potential visual impact of the proposed development include the following:

- The visibility of the facility to, and potential visual impact on, observers travelling along the major local roads traversing south and west of the proposed facility.
- The visibility of the facility to, and visual impact on, the larger built-up centres or populated places as well as the homesteads (farm residences) located within close proximity of the site.
- Potential cumulative visual impacts (or alternately, consolidation of visual impacts) with specific reference to the existing power line infrastructure adjacent to the proposed development area.
- The potential visual impact of the construction of ancillary infrastructure (i.e., the substation at the facility, associated power line and access roads) on observers in close proximity of the facility.

- The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in proximity of the facility.
- The visual absorption capacity of natural or planted vegetation (if applicable).
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts and inform the design process.

It is envisaged that the issues listed above may constitute a visual impact at a local scale.

3.1.1. Significance of Visual Impact

A combined quantitative and qualitative methodology, as supplied by the Environmental Practitioner, was used to describe the significance of impacts. Significance of impact is rated as *consequence* of impact multiplied by the *probability* of the impact occurring. Consequence is determined using intensity, spatial scale, and duration criteria.

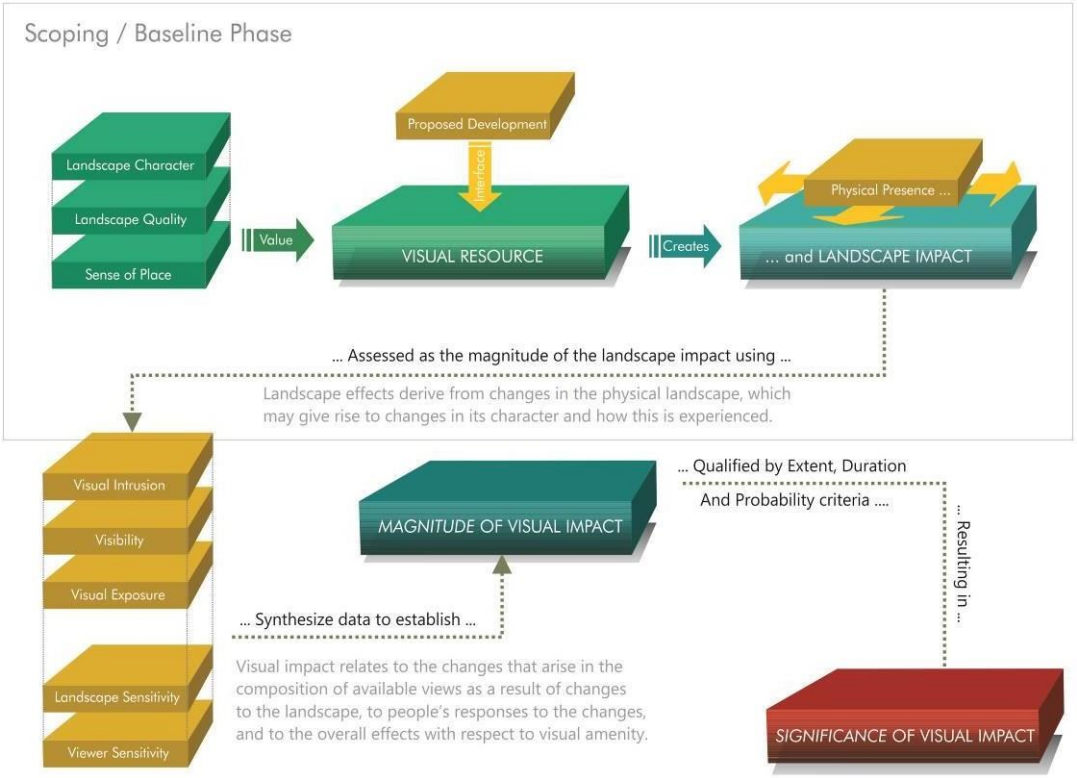

Figure 2: VIA Process

3.2. Methodology

The following method was used:

- Site visit: A field survey was undertaken so the extent of the receiving environment could be documented and adequately described. The climate conditions were mostly sunny with some cloud cover.
- Project components: The physical characteristics of the Project components were described and illustrated based on information supplied by Savannah Environmental.
- General landscape characterization: The visual resource (i.e., receiving environment) was mapped using the field survey, Google Earth imagery, and Mucina and Rutherford's (2006) reference book, The Vegetation of South Africa, Lesotho, and Swaziland. The description of the landscape focused on the nature of the land rather than the response of a viewer (refer to Appendix A).
- The character of the landscape was described and rated in terms of its aesthetic appeal using recognized contemporary research in perceptual psychology as the basis, and its sensitivity as a landscape receptor.
- The sense of place of the study area was described as to its uniqueness and distinctiveness. The primary informant of these qualities was the spatial form and character of the natural landscape together with the cultural transformations associated with the historic/current use of the land.

- The creation of viewshed analyses from the proposed Project site in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses consider the dimensions of the proposed structures and activities
- The potential impact on the visual environment of the proposed Projects were identified; and rated according to Savannah's significance rating criteria.
- Measures to mitigate the negative impacts of the proposed Project were recommended.

4. DESCRIPTION OF THE PROJECT

4.1. Project Phases and Activities

Activities to be undertaken during each of the phases are described in the following sections:

4.1.1. Site Preparation Phase

This phase would include the clearance of vegetation, installation of perimeter fencing and levelling of the site and preliminary earthworks. Thereafter the Project site will be marked out, a construction camp set up and the access road to the site is constructed. The clearance of vegetation is not anticipated to be site wide and will depend on the detailed layout of the proposed Project.

4.1.2. Construction Phase

The construction phase of the proposed Project will be initiated following the completion of the site preparation activities. The construction phase will include the following:

- Excavation of cable trenches;
- Ramming or drilling of the mounting structure frames;
- Installation of the PV modules onto the frames;
- Installation of measuring equipment;
- Laying of cables between the module rows to the inverter stations;
- Optionally laying of gravel or aggregate from nearby quarries placed in the rows between the PV panel array for enhanced reflection onto the panels, assisting in vegetation control and drainage;
- Construction of foundations for the inverter stations and installation of the inverters;
- Construction of operations and maintenance buildings;
- Undertaking of rehabilitation on cleared areas where required;
- Testing and commissioning; and
- Removal of equipment and disassembly of construction camp.

The construction phase of the proposed Project will be for a period of up to 12 – 18 months.

4.1.3. Operational Phase

The proposed Project will be operated on a 24 hour, 7 days a week basis. The operation phase of the proposed Project will comprise the following activities:

- Regular cleaning of the PV modules by trained personnel;
- Vegetation management under and around the PV modules and within the transmission line servitude to allow maintenance and operation at full capacity;
- Office management and maintenance of operations and maintenance of buildings;
- Supervision of the solar PV facility operations; and
- Site security monitoring.

4.1.4. Decommissioning Phase

The proposed Project is expected to operate for up to 25 years. Once the solar PV facility reaches the end of its life, the facility and the grid connection infrastructure will be decommissioned or continue to operate following the issuance of a new Power Purchase Agreement (PPA) by Eskom. If decommissioned, all components will be removed, and the site rehabilitated. Where possible all materials will be recycled, otherwise they will be disposed of in accordance with local regulations and international best practice.

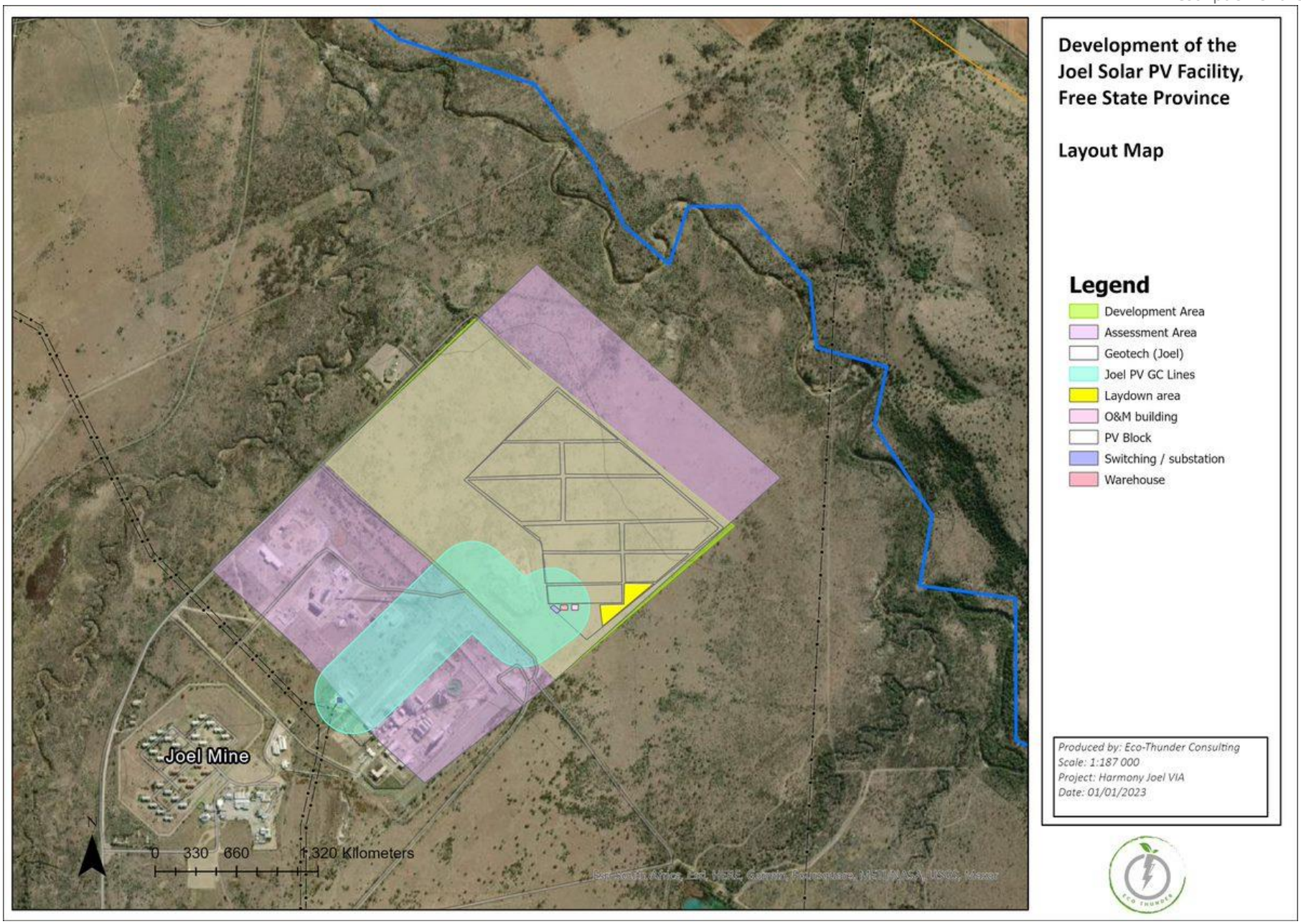

Figure 3: Facility layout map

5. ENVIROMENTAL SETTING

5.1. Landscape Character

The study area lies completely within the Middle Vaal Water Management Area (WMA) and entirely within the Highveld ecoregion (Kleynhans et al., 2005). The topography is characterised by slightly undulating plains with wetlands and / or drainage channels bisecting the area. Most properties situated within a 5km radius of the site is being used for livestock and crop cultivation.

The main characteristics of the study area includes mining, crop and livestock farming. Tourist attractions mostly occur on the outer edges of the study area, 20km radius, with the closest being the Allemanskraal Dam, approximately 16km South-East of the study area. The residential component of the study area includes farmsteads with associated workers housing as well as the towns of Virginia and Ventersburg and the townships of Meloding and Mmamahabane.

According to Mucina and Rutherford (2006) the site is situated in a summer-rainfall seasonal precipitation region, with Mean Annual Precipitation (MAP) of 560mm. Much of the rainfall is of convectional origin and peaks in December to January. The overall Mean Annual Temperature (MAT) is around 15ºC. Incidences of frost are relatively high (43 days on average).

The Lejweleputswa District Municipality is located in the North-western part of the Free State and is one of five district municipalities in the Free State Province. The district covers an area of 31 686km² and is made up of five local municipalities, of which the Masilonyana Local Municipality (which covers the study area) is one. According to the Free State Provincial Growth and Development Strategy (FSPGDS) (2004-2014), Lejweleputswa District Municipality is the major contributor in the Free State Gross Geographic Product (GGP) and is also an important agricultural area. The district is predominantly known as the Free State Goldfield which forms a part of the larger Witwatersrand basin. The economy of the region is dominated by the gold mining industry and agriculture sectors in particular maize production.

The Masilonyana Local Municipality covers an area of 6 796km² and is located in the western part of the Free State Province within Lejweleputswa District Municipality. The Masilonyana Local Municipality consists of 5 Local Councils, Brandfort, Soutpan, Theunissen, Verkeerdevlei and Winburg. Theunissen is the administrative seat of the Masilonyana Local Municipality and is located approximately 102km north-east of Bloemfontein. The majority of the commercial and industrial activities in the Masilonyana Local Municipality are based in Theunissen and Winburg.

The main source of income in the municipality is due to the agricultural and mining sector. The total population of Masilonyana Local Municipality which includes both male and female for all towns, that is, Theunissen/ Masilo, Brandfort/ Majwemasweu, Winburg/ Makeleketla, Soutpan/ Ikgomotseng, Verkeerdevlei/ Tshepong, Rural, Star Diamond Mine, Beatrix Mine and Joel Mine is estimated at 80 090. This population includes Blacks, Coloureds, Indians and Whites. The following 15 population groups constitute the following percentages out of the total population group of the entire municipality, that is, Blacks (91,2%), Coloureds (1,28%), Indians (0,03%), and Whites (7,49%) respectively. The population has grown slightly due to the reduction of infant mortality, less people dying of HIV/ AIDS and economic migration caused by opening of new shafts at the Beatrix Mine and more people having to stay in Brandfort.

Due to the fact that mines cannot absorb all unemployed people, of which the youth are in majority in terms of unemployment and population stats; more emphasis must be put on training of unemployed (including youth, women and the disabled people) for self-reliance and to avoid high and unrealistic dependence on grants and funding (IDP 2012- 2017).

The proposed development is located on a terrain unit of rolling or irregular plains with low hills at an altitude of between 1,370 and 1,410 meters. During the pre-mining period the land on which the mine is now situated was used for agricultural purpose and mainly for cultivation of crops and grazing purposes.

The built environment surrounding the proposed development area ranges from high density low-income housing and informal rural type settlements to large mining and agriculture developments. Developments located adjacent to the proposed settlement are informal settlement, with limited infrastructure that only meets RDP Standards. Social facilities within the area are lacking, with the nearest school being located some few kilometres from the site. No infrastructure is currently in place on site; however, electricity, sewer and water will be connected onto existing bulk infrastructure currently servicing the surrounding areas. One access route to the site is proposed, via existing roads. Access to the majority of the area will take place from Main road (where a 60 – 80 m length of 6 m wide tarred road surface is proposed).

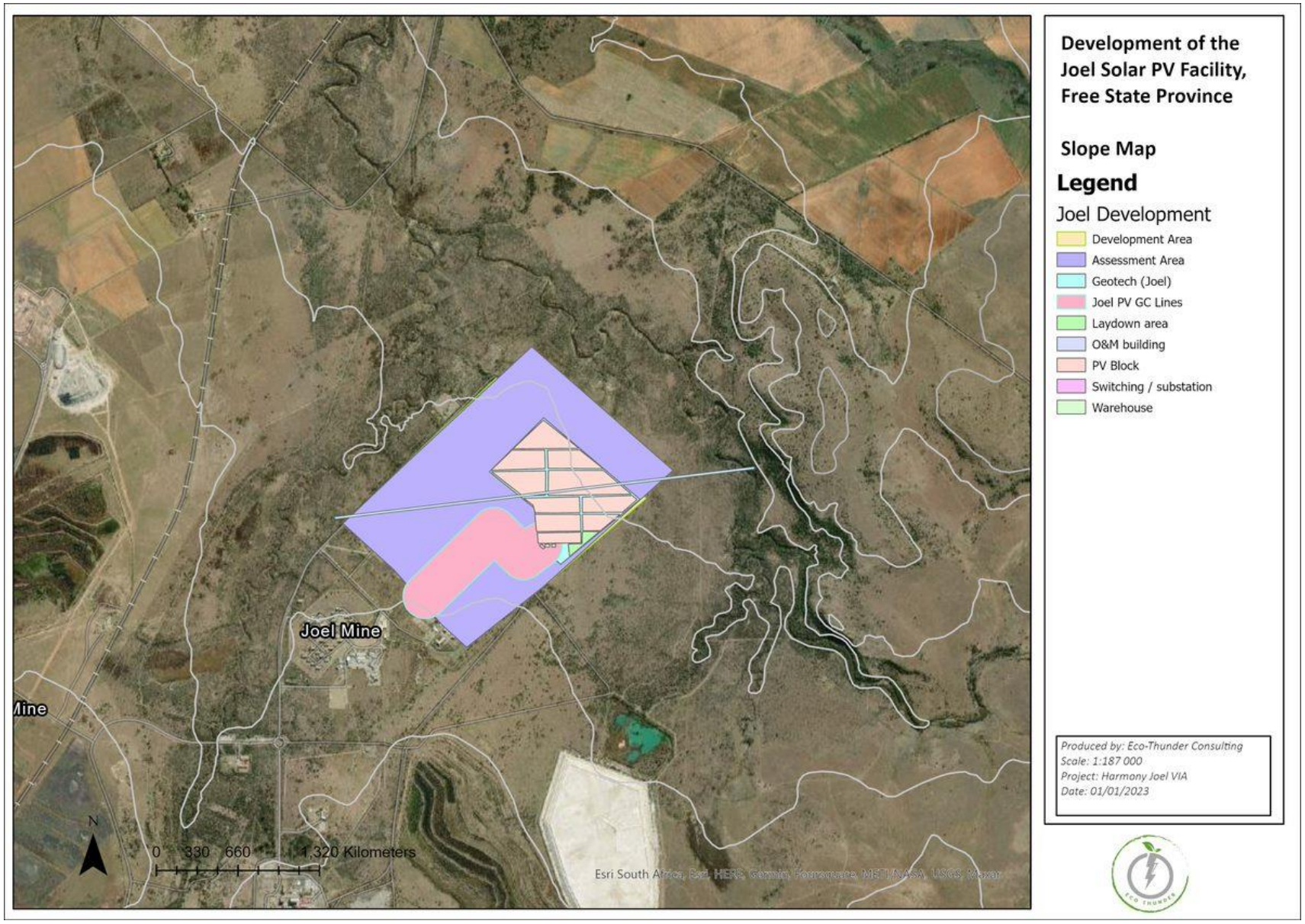

Figure 4: Slope and terrain of development

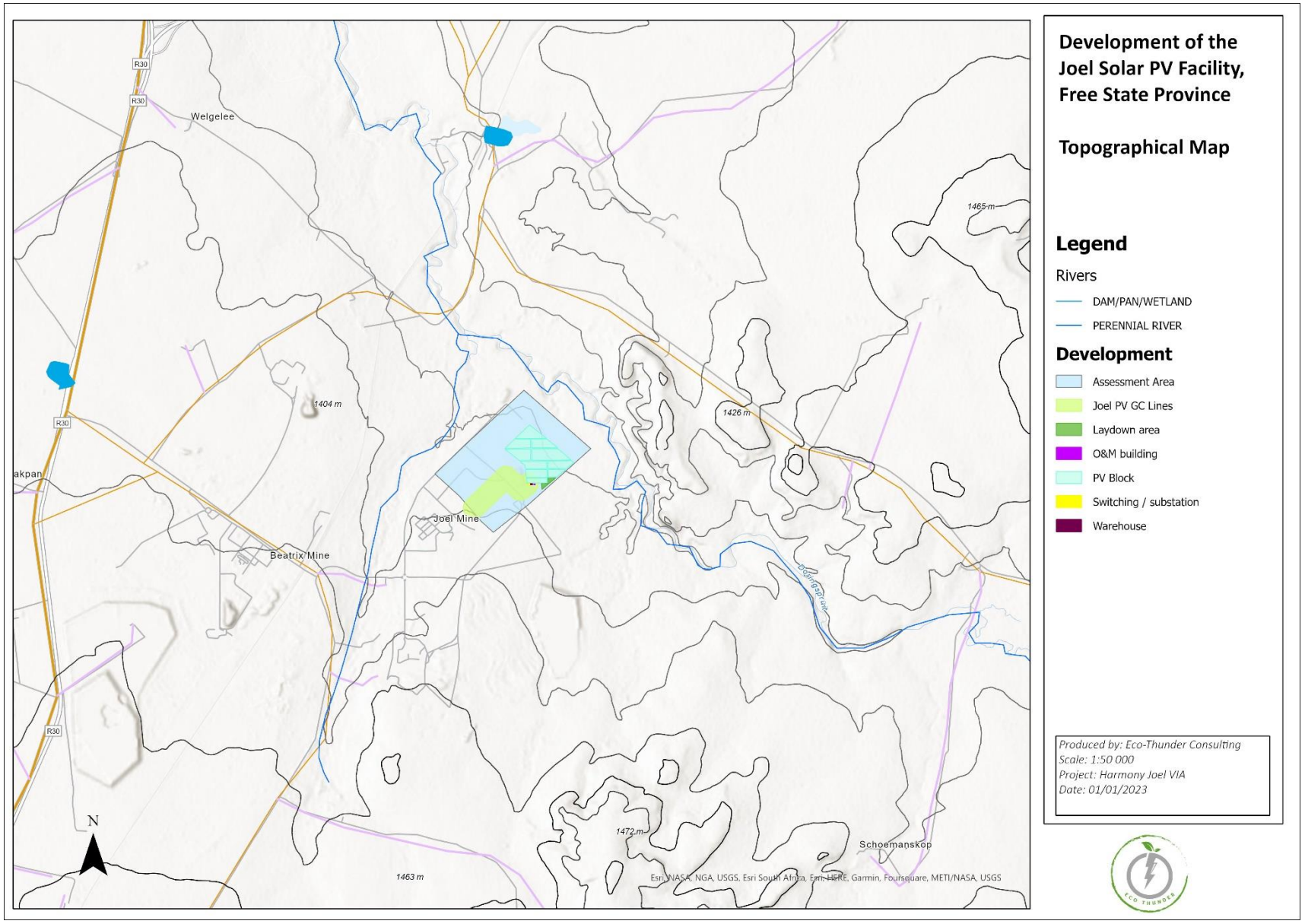

Figure 5: Topographical view of development

5.2. Land Use

Land use activities within the broader region are predominantly described as maize farming, with some mining activity evident towards the west (BEISA mine) of the proposed site. The mining activities intensify further north (beyond the study area boundary), towards Virginia and Welkom, where predominantly gold and uranium are mined. Farm settlements or residences occur at irregular intervals throughout the study area. Some of these, in close proximity to the proposed development site.

The population density of the region is indicated as approximately 200 people per km^2, predominantly concentrated within the town of Virginia. An existing Eskom power line runs diagonally across the selected site, enabling a short distance for grid connection with minimal possible impact on avifauna or ecology.

In terms of geology, the power line corridor is located in the central part of the Main Karoo Basin, east of the line of latitude 24°E that is important for the stratigraphy of the Karoo Basin. These old rocks are unconformably overlain by Quaternary sands and alluvium. The Main Karoo Basin covers a large proportion of South Africa and represents some 120 million years of deposition. At the base is the Carboniferous-Permian Dwyka Group, then the Permian aged Ecca Group, Permian-Triassic Beaufort Group, the Triassic-Jurassic Stormberg Group, all capped by the Drakensberg basalts.

Intruding through the Karoo rocks are volcanic dykes of Jurassic age, and they were emplaced when the major Drakensberg basalts poured out and capped the Karoo sediments. These dolerite dykes are common in the area and because they are harder than the Karoo sediments, they form ridges and hills.

The land type unit represented within the corridor include the Bd 20 and Dc16 land types. Bd20 is eutrophic; red soils not widespread upland duplex and margalitic soils rare. Dc16 is prismacutanic and/or pedocutanic diagnostic horizons dominant. In addition, one or more of vertic melanic red structured diagnostic horizons.

The A horizon is normally coarse textured, and the B horizon is fine textured. The coarse textured A horizon has a law water holding capacity and the structure is usually weak (Tekle, 2004). The slopes are typically covered by well weathered unstructured red or yellow soils, while the valleys have clay deposits washed down from the slopes.
Besides the mines and mining infrastructure within the study area, there are numerous power lines and substations, predominantly associated with the mines.

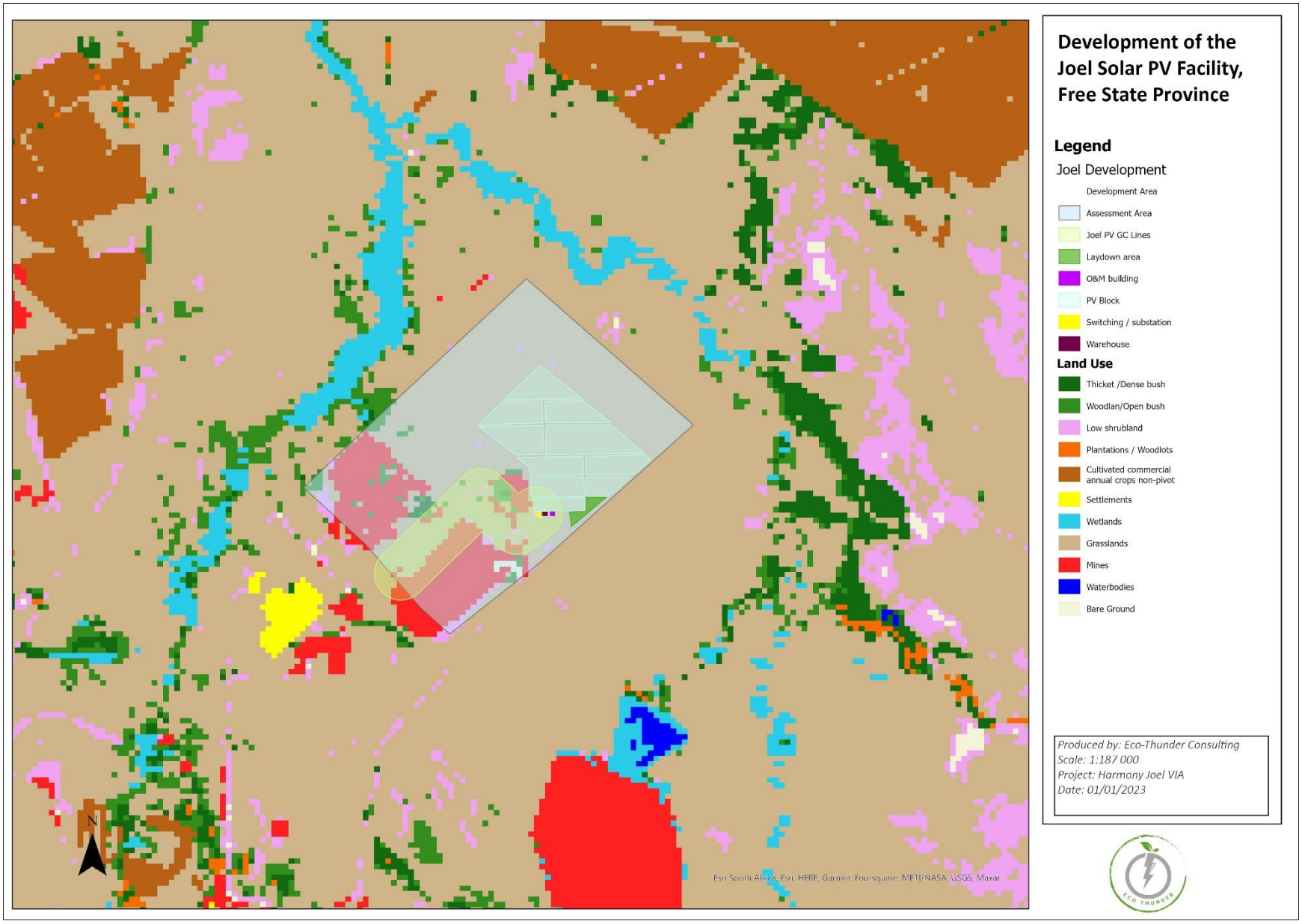

Figure 6: Surrounding Land use

5.3. Visual exposure and area of study

The result of the viewshed analyses for the proposed facility is shown on **Figure 9**. The viewshed analyses were undertaken from a number of vantage points within the proposed development area at an offset of 5m above average ground level. This was done in order to determine the general visual exposure (visibility) of the area under investigation, simulating the maximum height of the proposed structures (PV panels) associated with the facility.

Visual exposure as follow:

0 – 1 KM (**Very High sensitivity area**)

The main project components are anticipated to fall within this area, the anticipated visual exposure of the facility is contained to a core area on the site itself and within a 1 km radius thereof. There are no residences within this zone, however some farming development appears to be located within this area. Some of the northern portion is within the river buffer zone. The Joel mine lays South-west of the proposed facility within this observation zone. There some small mine roads located to the west of the proposed development, which is utilized by the mine. Observers travelling along this road will be exposed to the project infrastructure.

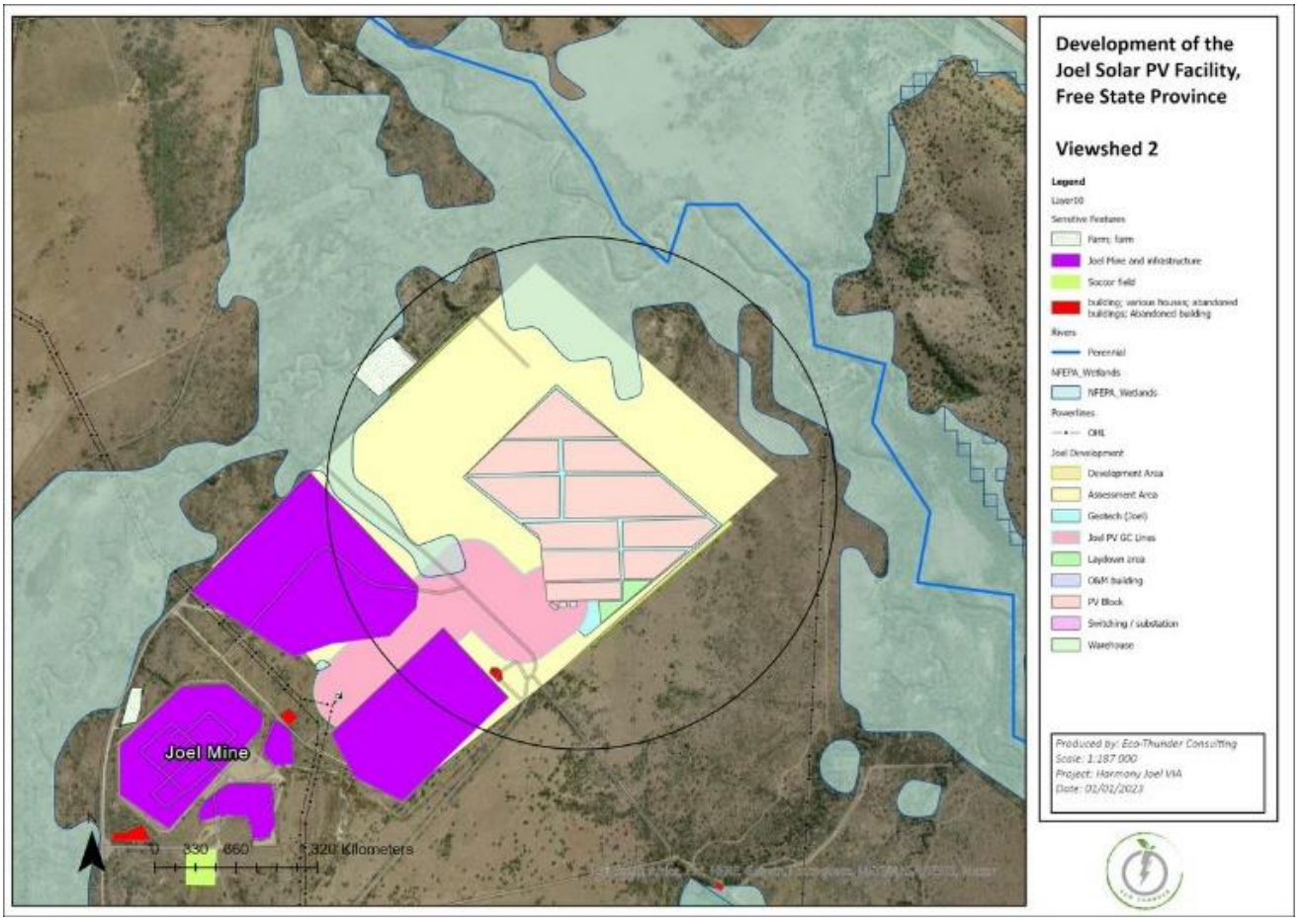

Figure 7: A- 1KM Visual exposure area

1 – 3 KM (**High Sensitivity**)

Potential visual exposure in the short to medium distance (i.e., between 1 and 3km), is largely contained to the south which has been noted as additional mining infrastructure and dumping facilities. There are some abandoned buildings and recreational sport fields within this zone, which is theorized to be used by the mine residence.

The majority of this area (towards the North and east) is agricultural or vacant land, vary few residence reside within this area indicating fewer visual receptors. These features, farms, buildings, recreational facilities and mines can be considered one of the more sensitivity areas in terms of the visual receptors, however there are large number of trees, mining infrastructure and other infrastructure between the proposed development and the receptors (as seen in figure 7:b) which is anticipated to largely reduce the visual impact on the facility.

Additionally, there are some road which are found within this observational area, such as the A169. It is expected that the PV facility would be clearly visible from these sections of road. There are some areas in which the topography is relatively flat with little to no tall vegetation. It is therefore recommended that in these areas the visual impact is mitigated from very high by use of things such as trees etc., as discussed in section 7.

The area has a lot of natural and artificially occurring wetland features surrounding the development, which must also be noted and may have an impact on the Terrestrial or Avifauna sensitivities.

Additionally, some key mining establishments are within this zone of observation, it is anticipated to have no negative impact on their landscape character as Harmony is a mining company who, as can be seen to the south of the development area (in brown) have extensively transformed the landscape.

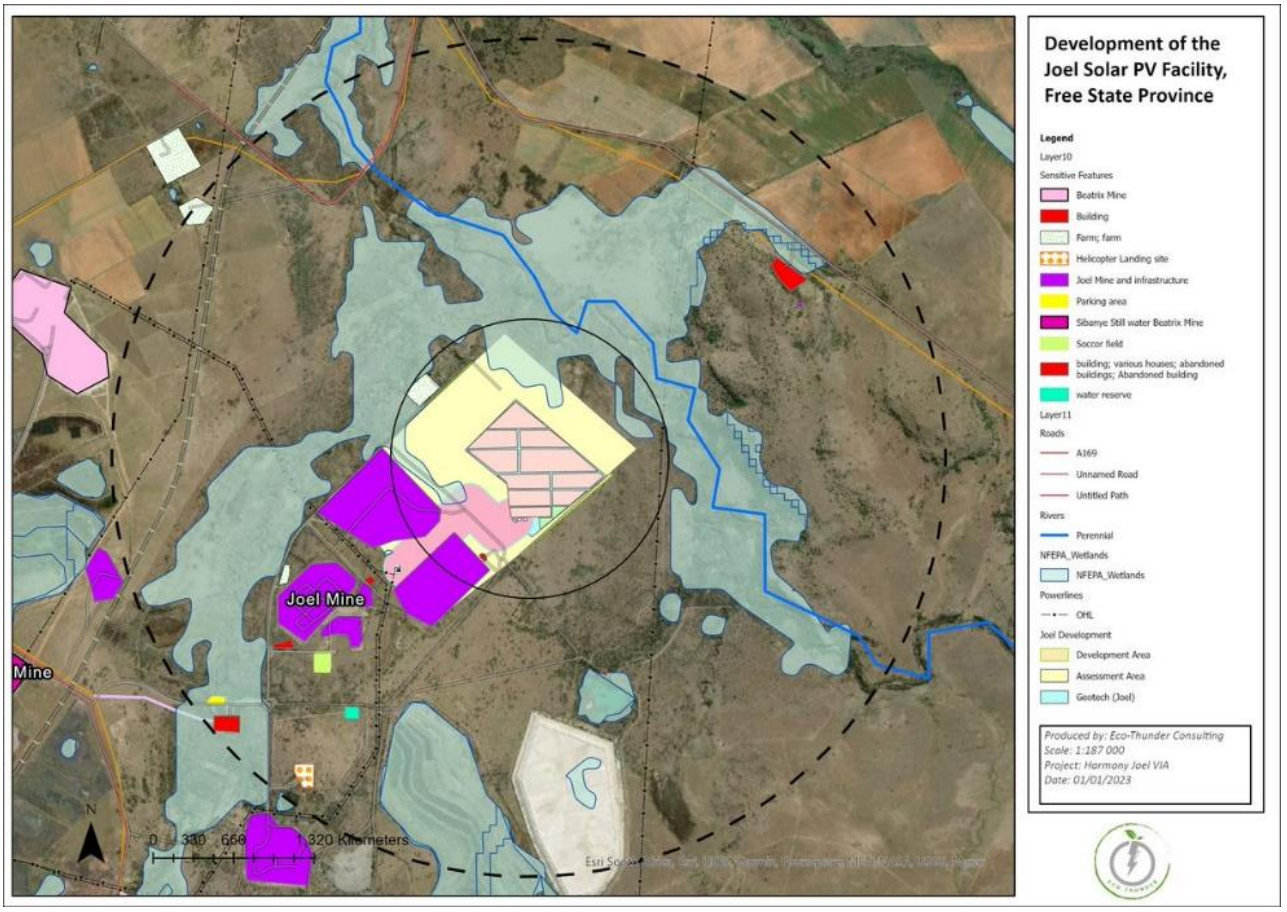

Figure 7: B- 3KM Visual exposure area

3 - 6KM (**Moderate Sensitivity**)

Within this observation the visual exposure becomes very scattered and interrupted due to the undulating nature of the topography as well as the surrounding features (mine heaps, buildings, roads, vegetation, etc.). Some agricultural holdings exist to the east and north of the proposed development.

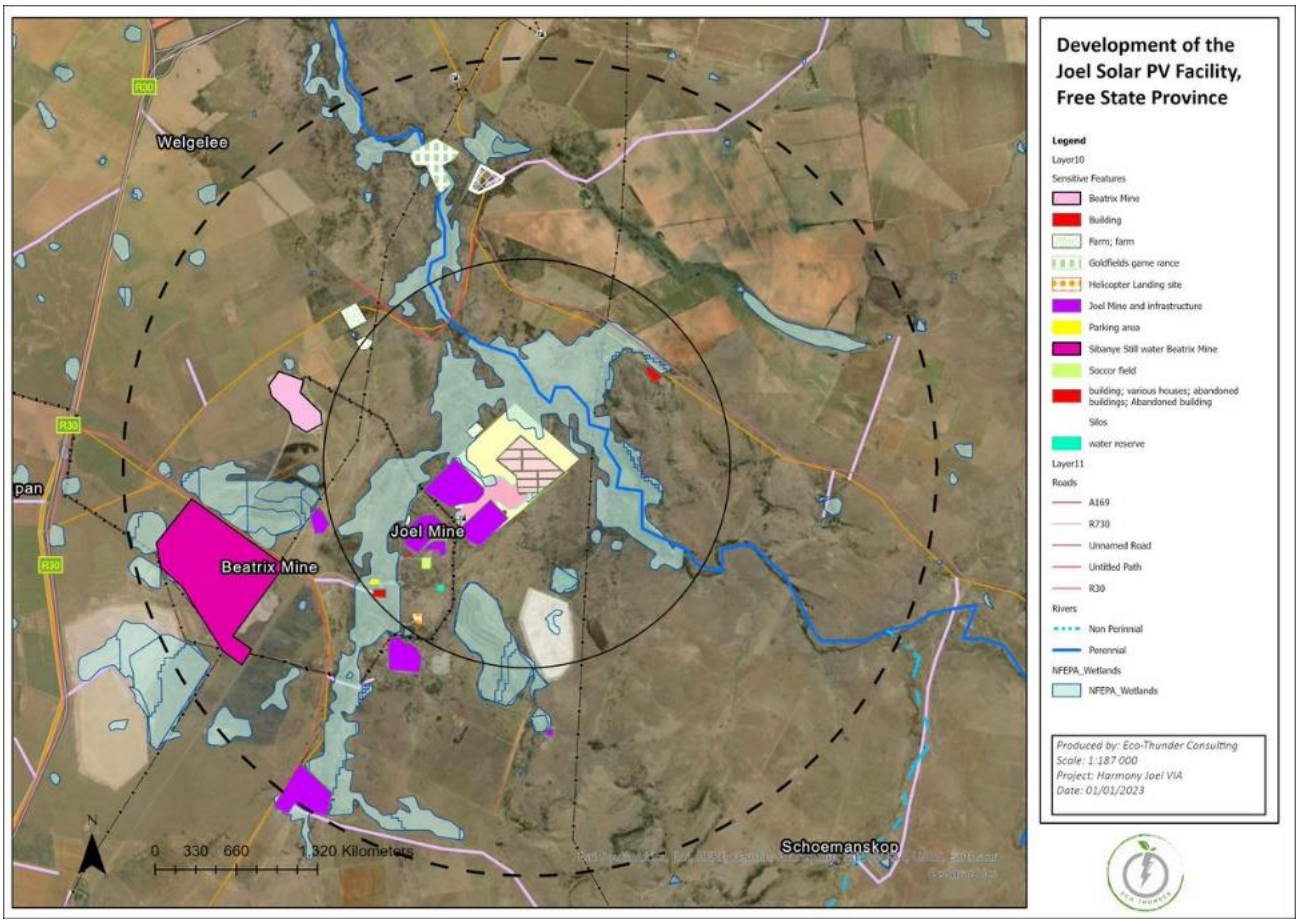

Figure 7: C- 6KM Visual exposure area

6 – 10 KM (**Very Low Sensitivity**)

At distances exceeding 6km the intensity of visual exposure is expected to be very low and highly unlikely due to the distance between the object (development) and the observer.

It is clear that the relatively constrained dimensions of the PV facility would amount to a fairly limited area of potential visual exposure. The visual exposure would largely be contained within a 6km radius of the proposed development site, with the predominant exposure to the north and east of the development.

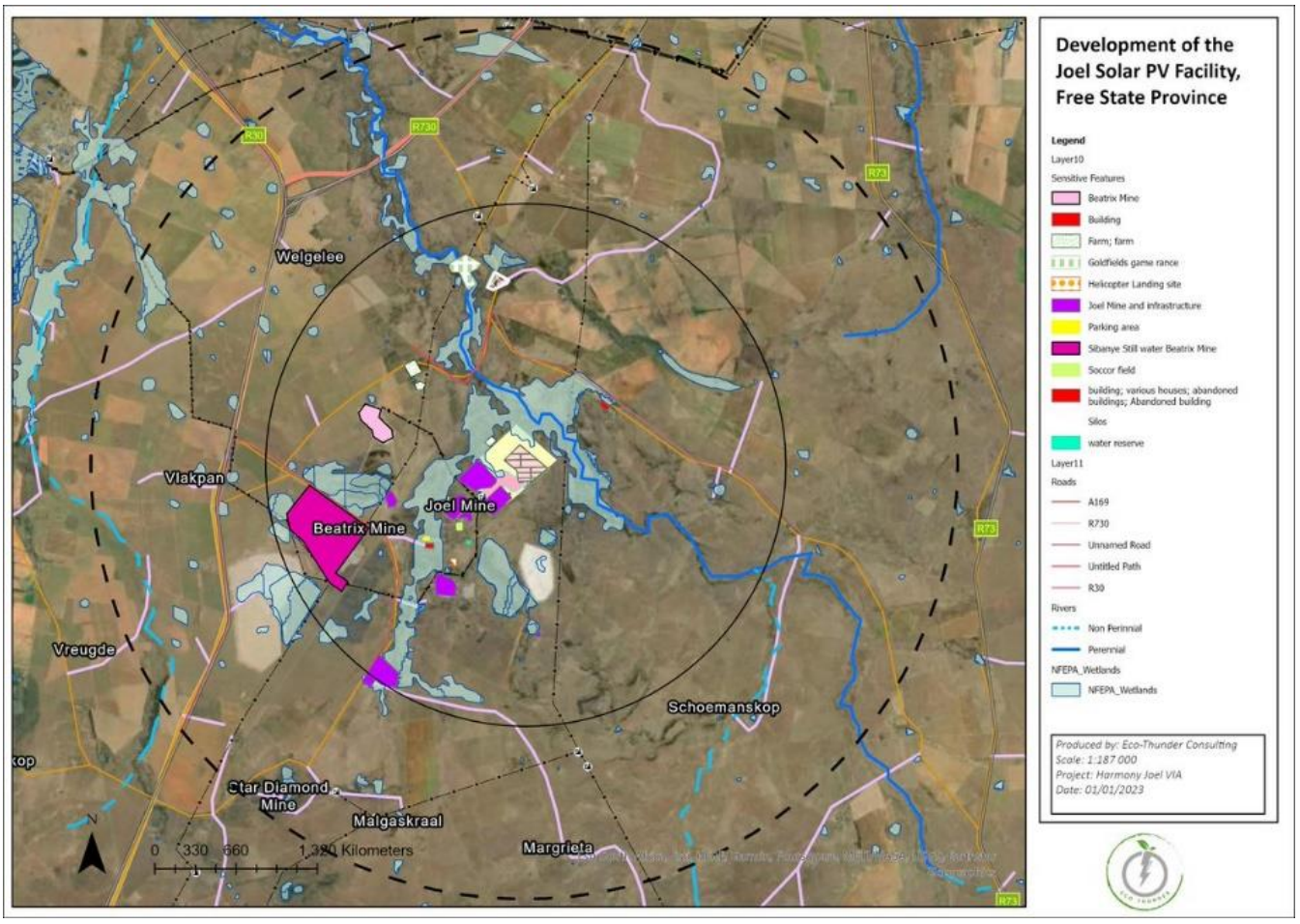

Figure 7: D- 10KM Visual exposure area

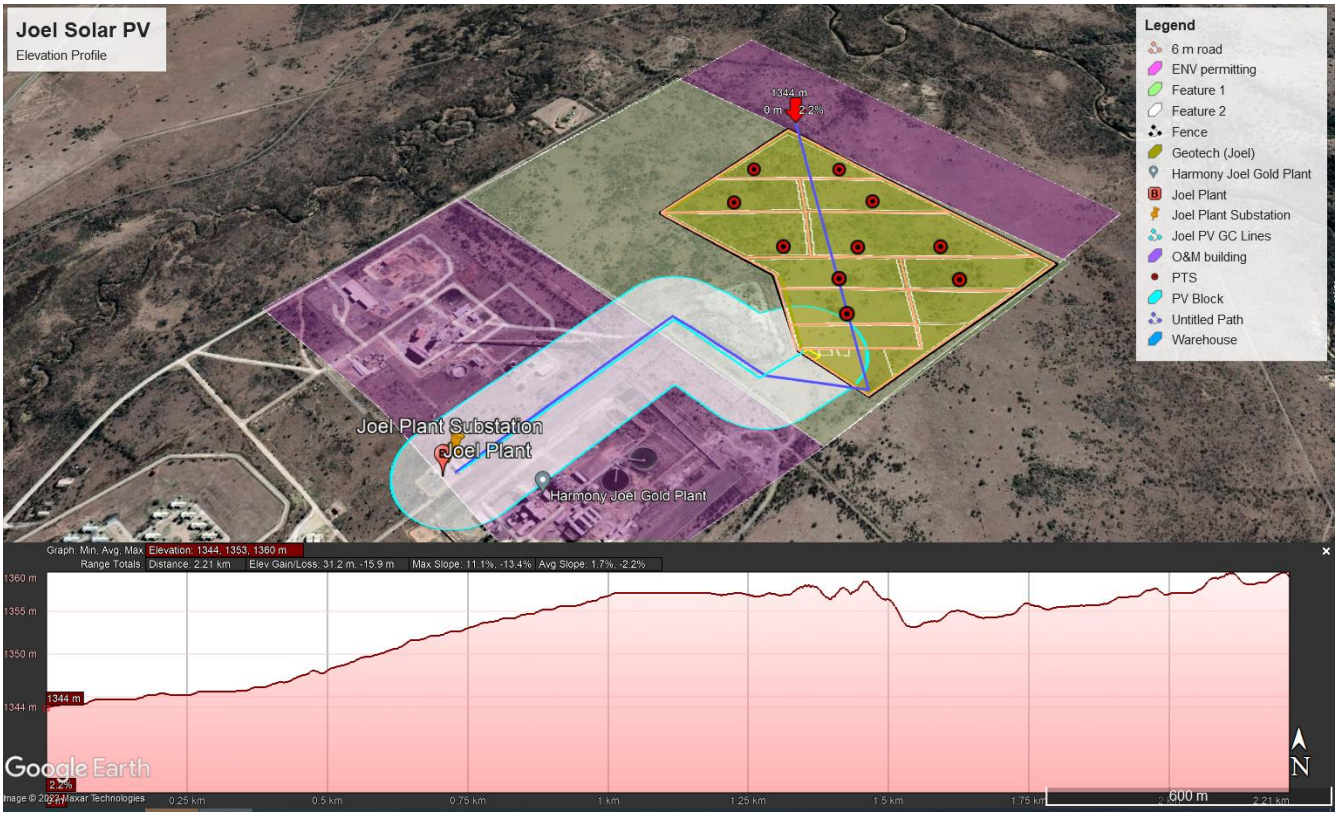

Figure 8: Elevation Profile of the development

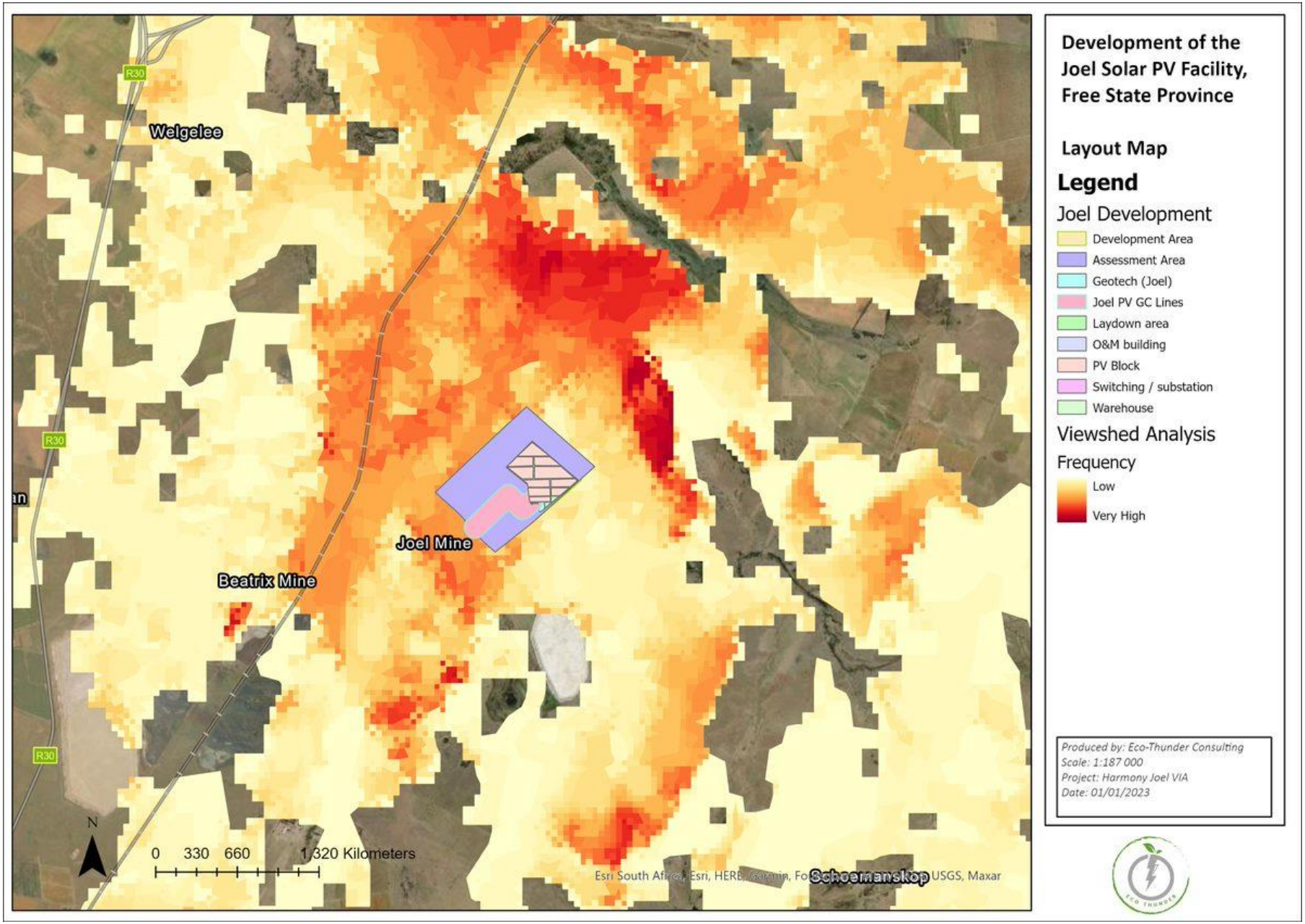

Figure 9: Viewshed Analysis

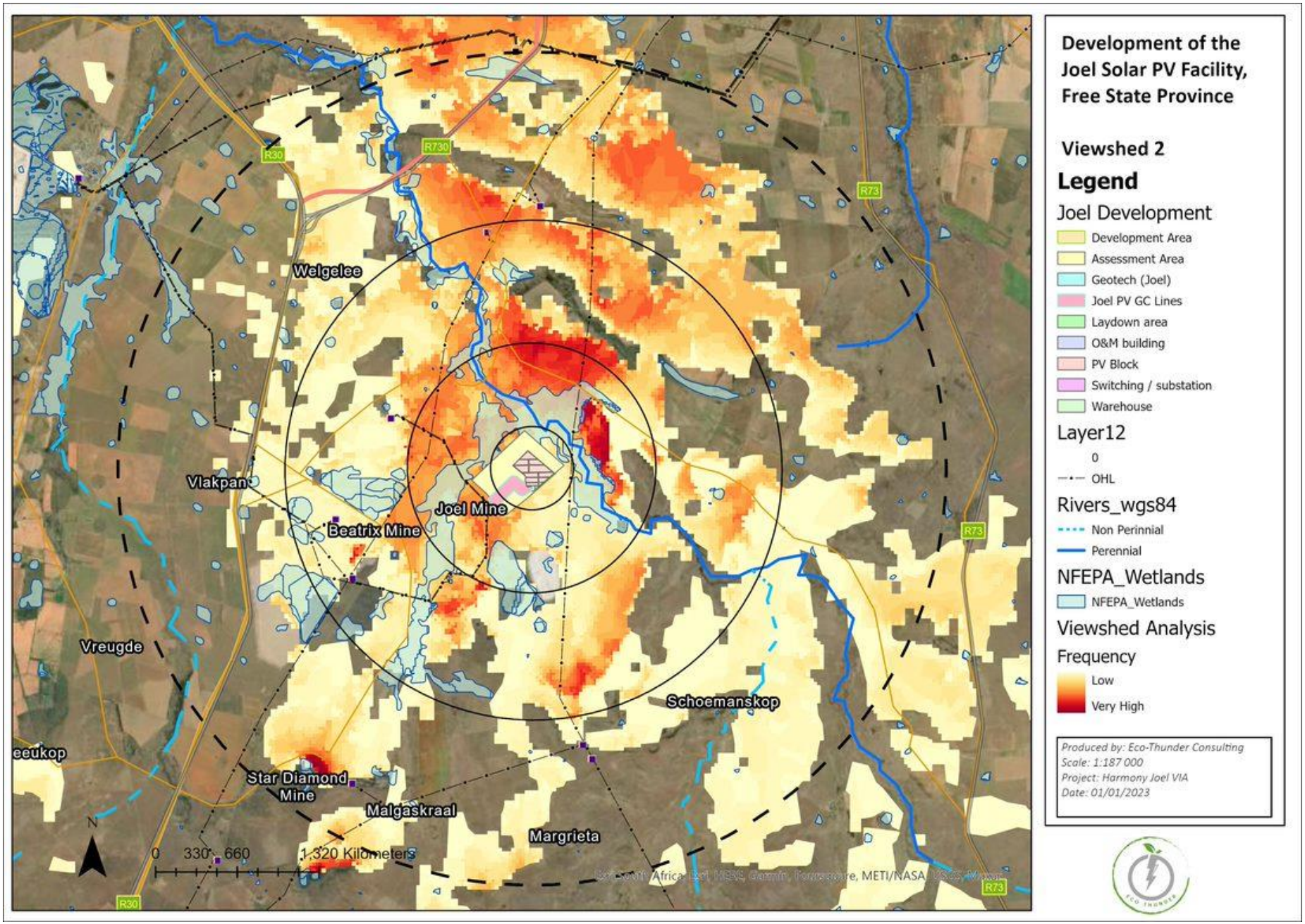

Figure 10: Viewshed and zone of observation

6. VISUAL RESOURCE

6.1. Visual Resource Value, Scenic Quality and Landscape Sensitivity

The value of the visual resource and its associated scenic quality are primarily derived from the combination of land-uses described above overlaid onto an open rolling topography. These are the primary features that give the area its general characteristics and a sense of place.

The sensitivity of the study area's landscape can be defined as high, medium, or low (as indicated below), and is dependent on the Character – does it contribute to the area's sense of place and distinctiveness; Quality – in what condition is the existing landscape; Value – is the landscape valued by people, local community, visitors, and is the landscape recognised, locally, regionally, or nationally; and Capacity – what scope is there for change (either negative or positive) in the existing landscape character?

When the criteria are considered and understood within the context of the sub-region, a visual resource value of *low* (power utility and mining areas), *moderate* (drainage lines, open farmland, and urban recreation development), and *high* (bush-covered low hills), is allocated.

Table 1: Value of the Visual Resource
(After: LiEMA 2013)

High	Moderate	Low
This landscape type is considered to have a *high* value because it is a: Distinct landscape that exhibits an extremely positive character with valued features that combine to give the experience of unity, richness, and harmony. It is a landscape that may be of particular importance to conserve, and which has a strong sense of place. Sensitivity: It is sensitive to change in general and will be detrimentally affected if change is inappropriately dealt with.	This landscape type is considered to have a *moderate* value because it is a: Common landscape that exhibits some positive character, but which has evidence of alteration / degradation / erosion of features resulting in areas of more mixed character. Sensitivity: It is potentially sensitive to change in general and change may be detrimental if inappropriately dealt with.	This landscape type is considered to have a *low* value because it is a: Minimal landscape generally negative in character with few, if any, valued features. Sensitivity: It is not sensitive to change in general and change may be detrimental if inappropriately dealt with.

The Project sites occur within a landscape type rated moderate, with nearby power infrastructure and mines rated low. Generally, because most of the areas surrounding the site is rated moderate to moderately high in scenic value, the area is potentially sensitive to change if the change is inappropriately dealt with.

6.2. Sense of Place

According to Lynch (1992), a sense of place is the extent to which a person can recognize or recall a place as being distinct from other places - as having a vivid, unique, or at least particular character of its own. The sense of place for the study area derives from a combination of the local landscape types described above, their relative 'intactness', and their impact on the senses.

The sub-region is recognised as a major agricultural area. The combination of the mining land and farming activities, along with the distinctiveness of the rolling open land, gives the study area a mixed sense of place. One, in which new development needs to be carefully managed such that the combination of development activities associated with the Project and the landscape are not at odds with each other.

The Zone of Visibility reflects the visibility rating in term of proximity of viewers to the power line. The distances were calculated using satellite imagery, but the impact magnitude was determined by using previous experiences, assumptions and opinions, it is therefore theoretical.

Figure 10 will give a clearer understanding of areas susceptible to line of sight which means, an imaginary line from the eye to a perceived object, in this case the power line and PV facility. The assessment did not take into account existing screening such as buildings, mining heaps and vegetation cover but rather the terrain's above mean sea level (AMSL) which indicates line of sight. The receptors which were identified were subject to an impact assessment, the findings of therefore largely impacted by the onsite findings which impacts the direct line of sight.

Aesthetic issues are subjective, and some people find solar farms and power line infrastructure pleasant and optimistic changes whilst others may find it visually invasive; it is mostly perceived as symbols of energy independence; and local prosperity.

6.3. Aerospace

Any communications structure, building or other structure, whether temporary or permanent, which has the potential to endanger aviation in navigable airspace, or has the potential to interfere with the operation of navigation or surveillance systems or Instrument Landing Systems, including meteorological systems for aeronautical purposes, is considered an obstacle and shall be submitted to the Commissioner for Civil Aviation for evaluation (refer to SA-CAR Part 139.01.33).

To guarantee that the airspace stays operational, navigable airspace must be maintained, and any obstacle that may interfere with this must be considered. The main reason is to control or prevent structures that could jeopardize aviation safety, particularly near an airfield. It seems to reason that knowing where the impediments are will improve aviation safety. The South African Civil Aviation Authority (SACAA) should therefore be engaged with as part of the EIA Process.

The development is located 26 km north of the closest airfield and relatively close to a decommissioned helicopter landing pad and should not impact any Civil Aviation, however they should be consulted.

7. VISUAL IMPACT ASSESSMENT

The *intensity* of impact is assessed through a synthesis of visual intrusion, visibility, visual exposure, and viewer sensitivity criteria. Once the intensity of impact has been established this value is further qualified with spatial, duration and probability criteria to determine the *significance* of the visual impact.

In assessing the intensity of visual impact, the study assumes the worst-case scenario, i.e., that the facility (PV and Grid Connections) will be built at the same time. Figure 3 shows that the facilities and grid connection infrastructure are located immediately adjacent to each other, resulting in all Project components being observed within the same visual envelope (to a greater or lesser degree) from the sensitive viewing areas.

It is anticipated that visual impacts will result from the activities and infrastructure in all Project phases i.e., construction, operational, and closure. Activities associated with the Project will be visible, to varying degrees from varying distances around the Project site. During the establishment phase, the Project's visibility will be influenced due to the preparatory activities, primarily earthworks and infrastructure establishment. During the operation phase, the visibility of the Project will be the result of the established PV arrays, the substation, and associated powerline infrastructure (grid connections).

Typical issues associated with solar PV Projects are:

- Who will be able to see the new development?
- What will it look like, and will it contrast with the receiving environment?
- Will the development affect sensitive views in the area and if so, how?
- What will be the impact of the development during the day and at night?
- What will the cumulative impact be if any?

These potential impacts will be considered and rated in the following sections.

7.1. VIA Rating Methodology

This section will attempt to quantify the potential visual impacts in their respective geographical locations and in terms of the identified issues related to the visual impact.

The methodology for the assessment of potential visual impacts states the **nature** of the potential visual impact (e.g., the visual impact on users of major roads in the vicinity of the proposed power line alignment) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent** - long distance (very low = 1), medium to longer distance (low = 2), short distance (medium = 3) and very short distance (high = 4)[5].
- **Duration** - very short (0 – 1yrs. = 1), short (2 – 5yrs. = 2), medium (5 – 15yrs. = 3), long (>15 yrs. = 4), and permanent (= 5).
- **Magnitude** - None (= 0), minor (= 2), low (= 4), medium / moderate (= 6), high (= 8) and very high (= 10)[6].
- **Probability** – very improbable (= 1), improbable (= 2), probable (= 3), highly probable (= 4) and definite (= 5).
- **Status** (positive, negative or neutral).
- **Reversibility** - reversible (= 1), recoverable (= 3) and irreversible (= 5).
- **Significance** - low, medium or high.

[5] Long distance = > 3km. Medium to longer distance = 1.5 – 3km. Short distance = 0.5 – 1.5km. Very short distance = < 0.5km (refer to Section 6.3. Visual distance / observer proximity to the grid connection infrastructure).
[6] This value is read from the visual impact index. Where more than one value is applicable, the higher of these will be used as a worst-case scenario.

The *significance* of the potential visual impact is equal to the *consequence* multiplied by the *probability* of the impact occurring, where the consequence is determined by the sum of the individual scores for magnitude, duration and extent (i.e., *significance = consequence (magnitude + duration + extent) x probability*).

The significance weighting for each potential visual impact (as calculated above) is as follows:

- <30 points: Low (where the impact would not have a direct influence on the decision to develop in the area)
- 31-60 points: Medium / moderate (where the impact could influence the decision to develop in the area)
- >60: High (where the impact must have an influence on the decision to develop in the area)

7.2. Visual Impact Assessment

The combined results of the visual exposure, viewer perception and visual distance of the proposed solar PV facility are used to determine the impacts to the surrounding landscape. Typically, a location with close proximity to the proposed facility, a high viewer incidence, a predominantly negative perception and high visual exposure would have a high value on the index, thereby signifying a high visual impact.

The identification and assessment of environmental impacts is a multi-faceted process, using a combination of quantitative and qualitative descriptions and evaluations. It involves applying scientific measurements and professional judgement to determine the significance of environmental impacts associated with the proposed project. The process involves consideration of, inter alia: the purpose and need for the Project; views and concerns of interested and affected parties (I&APs); social and political norms, and the public's interest.

The following tables summarise the consequence and significance of the visual impact of the Project. These results are based on worst-case scenario when the impacts of all aspects of the Project are taken together (PV facilities, grid connection and battery systems). Consequence of impact is a function of intensity, duration, and spatial extent (SLR 2020). Intensity of impact is taken from the worst-case situation. These facilities are rated together, from a visual impact perspective, as the one would not exist without the other and they must be understood as the collective / cumulative.

The Nature of the Visual Impact of the PV facility is rated Negative. The proposed PV landscape has the potential to generate strong levels of color, form, texture and line contrast to the existing rural landscape. The following visual impacts could take place during the lifetime of the proposed PV facility:

Construction Phase:

- Impact on landscape character and sense of place due to the removal of vegetation and the construction of the PV structures and associated infrastructure.
- Impact on Roads
- Impact on Businesses, homes, or facilities in close proximity
- Visual impact from vegetation removal, dust generation and litter

7.2.1. Construction Phase

Table 2: Impact on landscape character and sense of place due to the removal of vegetation and the construction of the PV structures and associated infrastructure.
Solar PV Facilities and associated powerlines and substations are generally experienced as having a negative impact on landscape aesthetics as it will introduce an industrial aspect to a landscape. This area is however dominated by mining activities and has industrial features present, thus the visual intrusion of the proposed solar PV facility will be moderately low after mitigation. It is important to note that renewable energy structures are becoming increasingly important features in the South African landscapes and an important source of electricity for the growing population of South Africa. The significance of the impact is assessed in the table below.

	Rating	Motivation	Significance
Prior to Mitigation			
Duration	Short (2)	Construction is estimated to last or 12 -18 months	**Low (30)**
Extent	Short Distance (3)	The visual intrusion will only potentially be experienced by receptors within the immediate vicinity and in areas with flat topography and little vegetation	
Magnitude	Moderate (5)	The visual environment during the construction phase, may lead to moderate levels of visual intrusion, this will however be a temporary impact as the proposed construction activities are estimated to be one year	
Probability	Probable (3)	If development is approved there is a high probability the landscape will be impacted	
Mitigation/Enhancement Measures			
Mitigation: • Avoid complete clearing of parts of the construction site that will be cleared of vegetation, and only clear vegetation in a phased manner. • Regular dust suppression must be applied on the construction site where earth is exposed, and along unsurfaced access roads to the construction site. • Construction vehicle speed limits must be strictly adhered to avoid the creation of excessive dust. • Retain and maintain natural vegetation immediately adjacent to the development footprint. • Plan the placement of laydown areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e., in already disturbed areas) where possible. • Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads. • Reduce construction activities between 07:00 and 18:00, where possible, in order to reduce the impacts of construction lighting. • Rehabilitate all disturbed areas (if present / if required) immediately after the completion of construction works.			
Post Mitigation/Enhancement Measures			
Duration	Short (2)	Construction is estimated to last or 12 -18 months	**Low (27)**
Extent	Short Distance (3)	The visual intrusion will only potentially be experienced by receptors within the immediate vicinity, however mitigation will serve as buffer to decrease the impact	
Magnitude	Moderate (4)	The visual environment during the construction phase, may lead to moderate levels of visual intrusion, this will however be a temporary impact as the proposed construction activities are estimated to be one year	
Probability	Probable (3)	If development is approved there is a high probability the landscape will be impacted	
Residual Risks: • Land will no longer be able to be utilized for agricultural purposes.			

Table 3: Impact of PV facility on the Roads in Close Proximity
The Harmony Joel PV has two unnamed roads which is in close proximity to the development and will be a major visual receptor if constructed. These roads are however expected to be frequented primarily by local users going about their daily business (i.e., not sight-seeing), These roads are predominantly used by the mine as it grants access to the Target Facility

therefore potentially lessening the probability of the impact significance as the power generation is a benefit for the mining development.

Traffic on the outer roads such as the R30 and other access roads may also be impacted by traffic, however these roads are often utilized by the mine for transporting of goods or large vehicles, this may add to the deterioration of the roads and increased upkeep.

	Rating	Motivation	Significance
Prior to Mitigation			
Duration	Long term (4)	Development of the PV facility will be visible for its entire lifespan	**Moderate (45)**
Extent	Local (3)	Only road users in the area will be subjected to the impact	
Magnitude	High (8)	The development will impact the traffic on the road during development	
Probability	Probable (3)	Road users will most likely be able to see the PV Development when using the roads	

Mitigation/Enhancement Measures

Mitigation:

Mitigation of this impact is possible and both specific measures as well as general "best practice" measures are recommended in order ensure that a lower moderate impact is achieved.

The table below illustrates this impact assessment.

General mitigation / management:

Planning:

- Retain and maintain natural vegetation in all areas outside of the development footprint.
- Ensure the proper road traffic signage and measures are in place to ensure the safety of pedestrians.
- Ensure that the delivery vehicles are visible and well maintained.

Operations:

- Maintain the general appearance of the facility as a whole.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use of the facility.
- Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.
- Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Post Mitigation/Enhancement Measures			
Duration	Local (4)	Development of the PV facility will be visible for its entire lifespan	**Low (30)**
Extent	local (2)	Only road users in the area will be subjected to the impact	
Magnitude	Low (4)	The development will impact the traffic on the road during development	
Probability	Probable (3)	Road users will most likely be able to see the PV Development when using the roads	

Residual Risks:

- The visual impact will be removed after decommissioning, provided the development infrastructure is removed and the site is rehabilitated to its original (current) status. Failing this, the visual impact will remain.

Table 4: Visual Impact on Impact on Businesses, homes or facilities in close proximity

The proposed land use is not expected to create high levels of discord between the project and its surroundings, since various mining activities, disturbed areas, infrastructure development and powerlines are already present in the region. The perceived overall compatibility of the proposed project with the surrounding land uses and existing infrastructure is therefore considered to be acceptable.

Considering the above it must be noted that some places of high sensitive receptors were identified during the visual analysis

within the 1 to 6km observation zone.

In addition to physical infrastructure, impacts from clearing of vegetation, potential erosion as a result of bare soils, maintenance activities and the alteration of local topography will also create contrast in the landscape and may be visible to receptors. It is however important to note, that although the long term, operational visual impact of the Project is unlikely to be highly significant due to power lines being common features of South African landscapes.

These impacts associated may achieve lower moderate significance levels through the implementation of mitigation measures and provided that progressive revegetation of impacted areas take place.

	Rating	Motivation	Significance
Prior to Mitigation			
Duration	Long term (5)	The residence and road users in the surrounding area will be able to see the Solar PV facility as well as be subjected to the development impacts	**Moderate (45)**
Extent	Local (3)	The development is proposed to only disrupt local visual receptors	
Magnitude	Moderate (7)	The visual receptors in the area are limited and are predicted to be naturally mitigated by the existing mining development, however, features of high significance do exist	
Probability	Probable (3)	The Topography is very flat, and some areas are not subjected to protection from vegetation or mine heaps	
Mitigation/Enhancement Measures			
Mitigation: **General mitigation/management:** Planning: • Retain and maintain natural vegetation in all areas outside of the development footprint. Operations: • Maintain the general appearance of the facility as a whole. Decommissioning: • Remove infrastructure not required for the post-decommissioning use of the facility. • Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications. • Monitor rehabilitated areas post-decommissioning and implement remedial actions. **Site specific mitigation measures:** • Plant vegetation barriers along the western borders of the PV development in order to shield the structures from observers residing at the above-mentioned homesteads and residential settlements (The lifestyle farm).			
Post Mitigation/Enhancement Measures			
Duration	Long term (4)	The residence surrounding the development will be able to see the Solar PV facility	**Moderate (39)**
Extent	Local (4)	The development is proposed to only disrupt local visual receptors	
Magnitude	Moderate (5)	The visual receptors in the area are limited and are predicted to be naturally mitigated by the existing mining development, however, features of high significance do exist	
Probability	Probable (3)	The Topography is very flat, and some areas are not subjected to protection from vegetation or mine heaps	
Residual Risks: • Some businesses may draw a negative connotation with the development of Solar PV facilities.			

7.2.2. Operational Phase

Operational Phase:

- Glint and Glare
- Visual Exposure and Intrusion
- Impact on Sense of Place

Table 5: Glint and Glare / Night and Daytime lighting

The visual impact of glint and glare relates to the potential it has to negatively affect sensitive visual receptors in relatively close proximity to the source (e.g., residents of neighbouring properties), or aviation safety risk for pilots (especially where the source interferes with the approach angle to the runway).

Lighting associated with the proposed project may be visible during both day and night, with lighting being more likely to have a visual impact during the night-time. Lighting may be visible for some distance and can be associated with indirect lighting impacts, such as sky glow (the scattering of light in the sky).

It is however important to note that the development area is situated within a suburban region and adjacent to the Harmony Joel, thus the area is currently already impacted by night-time lighting and although some level of cumulative impact is likely, the impact will not be highly significant.

With improved technology and design techniques, PV facilities are no longer associated with glare, however PV facilities can create increased visibility and contrast through the creation of geometric patterns of reflected light caused by simultaneous reflection of sunlight from regularly spaced metal surfaces in the collector array. The reflected light may not necessarily cause discomfort to the viewer, during the daytime, and may change dramatically as the observer moves.

It should be noted that the PV panels will not contribute to night-time light pollution in the area, since no reflection of the sun occurs at night.

No impacts are predicted towards pilots along any of the assessed approach paths and no ATC Tower was identified.

The potential visual impact related to solar glint and glare as an air / road travel hazard is expected to be of low significance. No mitigation of this impact is required since the PV facility is not expected to interfere with aircraft operations or impact the safety of road users.

	Rating	Motivation	Significance
Prior to Mitigation			
Duration	Long term (4)	This will be a possible risk for the entire life cycle of the development	**Low (24)**
Extent	Very short distance (4)	This will only be a problem from short distances and at sustain times of day	
Magnitude	Low (4)	The impact is not regarded to be of significance	
Probability	Improbable (2)	Reflection from sunlight, cars traveling on adjacent roads or night-time elimination will trigger this risk	
Mitigation/Enhancement Measures			
Mitigation: N/A			
Post Mitigation/Enhancement Measures			
Duration	N/A		
Extent	N/A		
Magnitude	N/A		
Probability	N/A		
Residual Risks: N/A			

Table 6: Visual Exposure

Visual exposure is determined by qualifying the visibility of an object, with a distance rating to indicate the degree of intrusion and visual acuity. As distance between the viewer and the object increases, the visual perception of the object reduces.

Since the Mines in the area has significantly altered the landscape of the area and is visible from various receptors in the surrounding region, it will aid in absorbing the impact on the visual environment caused by the proposed Harmony Joel PV.

The basic areas of concern are:

- The public roads including the unnamed road next to the site, and local roads generally servicing the farms, towns and mines throughout the study area.

	Rating	Motivation	Significance
Prior to Mitigation			
Duration	Long term (4)	The development will be visible for its life cycle duration	**Moderate (42)**
Extent	Local (4)	Visual receptors within the local area will be subjected to this impact	
Magnitude	Moderate (6)	The visual receptors in the area are limited and are predicted to be naturally mitigated by the existing mining development, however, features of high significance do exist	
Probability	Probable (3)	Without mitigation there is a high level of certainty that this impact will take place	
Mitigation/Enhancement Measures			
Mitigation: **General mitigation/management:** Planning: • Retain and maintain natural vegetation in all areas outside of the development footprint. Operations: • Maintain the general appearance of the facility as a whole. Decommissioning: • Remove infrastructure not required for the post-decommissioning use of the facility. • Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications. • Monitor rehabilitated areas post-decommissioning and implement remedial actions.			
Post Mitigation/Enhancement Measures			
Duration	Long term (4)	The development will be visible for its life cycle duration	**Moderate (36)**
Extent	Local (4)	Visual receptors within the local area will be subjected to this impact	
Magnitude	Low (4)	The visual receptors in the area are limited and are predicted to be naturally mitigated by the existing mining development, however, features of high significance do exist	
Probability	Probable (3)	With Mitigation this impact is likely to be significantly reduced	
Residual Risks: None			

Table 7: Sense of place

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria, specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc.), plays a significant role.

An impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the

environment differently, and more specifically, in a less appealing or less positive light. The environment surrounding the proposed PV is predominantly developed by mining activities represents existing visual disturbances.			
	Rating	**Motivation**	**Significance**
Prior to Mitigation			
Duration	Long term (4)	The development will be visible for its life cycle duration	**Low (22)**
Extent	Regional (3)	Visual receptors within the local area will be subjected to this impact	
Magnitude	Low (4)	The PV development will not infringe on the sense of place	
Probability	Improbable (2)	There is a small chance that this will impact visual receptors	
Mitigation/Enhancement Measures			
Mitigation: N/A			
Post Mitigation/Enhancement Measures			
Duration	N/A		
Extent	N/A		
Magnitude	N/A		
Probability	N/A		
Residual Risks: The visual impact will be removed after decommissioning, provided the PV facility infrastructure is removed. Failing this, the visual impact will remain			

7.2.3. Cumulative Effects

Cumulative landscape and visual effects (impacts) result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future. They may also affect how the landscape is experienced. Cumulative effects may be positive or negative. Where they comprise a range of benefits, they may be considered to form part of the mitigation measures.

Cumulative effects can also arise from the intervisibility of a range of developments and /or the combined effects of individual components of the proposed development occurring in different locations or over some time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effect on visual receptors within their combined visual envelopes. Intervisibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation, and distance as this affects visual acuity, which is also influenced by weather and light conditions (LI-IEMA (2013)).

Cumulative effect of the Project

The cumulative impact of the Project, the facilities and infrastructure taken together, is significant, along with the existing power infrastructure (ESKOM sub-station and transmission lines) that exists in the study area. Intervisibility for the proposed Project and the existing infrastructure would be evident.

Table 8: Cumulative Impact		
Nature of Impact: The potential cumulative visual impact of the PV facility on the visual quality of the landscape. The proposed Harmony Joel PV will increase the cumulative impact of electricity related infrastructure within the region. The cumulative impact of additional traffic on the local and regional roads as well as combined impacts from potential night-time lighting will also affect the sense of place of the larger region. The Development will however shift the development trend of away from mining creating different landscape features.		
	Overall impact of the proposed project considered in isolation (without mitigation)	***Cumulative impact of the project and other projects within the area (with mitigation)***
Extent	Very short distance **(4)**	Medium to longer distance **(2)**

Duration	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(6)**	Moderate **(6)**
Probability	Probable **(3)**	Probable **(3)**
Significance	**Moderate (42)**	**Moderate (36)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible **(1)**	Reversible **(1)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No, only best practise measures can be implemented	
Generic best practise mitigation/management measures: Planning: • Retain/re-establish and maintain natural vegetation (if present) immediately adjacent to the development footprint where possible. Operations: • Maintain the general appearance of the facility as a whole. Decommissioning: • Remove infrastructure not required for the post-decommissioning use. • Rehabilitate all affected areas. Consult an ecologist regarding rehabilitation specifications.		
Residual impacts: The visual impact will be removed after decommissioning, provided the PV facility infrastructure is removed. Failing this, the visual impact will remain.		

7.3. Impact Statement

The findings of the Visual Impact Assessment undertaken for the proposed 18MW PV facility is that the visual environment surrounding the site, especially within a 1 - 6km radius, may be visually impacted during the anticipated operational lifespan of the facility (i.e., a minimum of 25 years).

This impact is primarily applicable to the individual Harmony Joel PV Facility and the cumulative impact of the Project, and the existing infrastructure would be evident. The VAC for the study area is relatively low, and the combined effect over time of these developments would result in the study area being impacted upon in a moderate manner beyond the anticipated of the proposed Project alone.

- The anticipated **visual** impact is not considered to be a fatal flaw, considering the low incidence of visual receptors occurring within the region.

The anticipated visual impacts listed above (i.e., post mitigation impacts) range from **moderate** to **low** significance. **Anticipated visual impacts on sensitive visual receptors (if and where present) in close proximity to the proposed facility are not considered to be fatal flaws for the proposed PV facility.**

Considering all factors, it is recommended that the development of the facility as proposed be supported; subject to the implementation of the recommended mitigation measures (**Section 7.2.**) and management programme (**Section 9**).

8. CONCLUSION

The objective of this study was to provide sufficient information on the visual environment of the area, in order for the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. Based on the findings of the visual assessment, the proposed project is expected to be moderately visually intrusive in portions of the surrounding environment.

The following is evident from the viewshed analyses:

0 – 1 KM (**Very High sensitivity area**)
The main project components are anticipated to fall within this area, the anticipated visual exposure of the facility is contained to a core area on the site itself and within a 1 km radius thereof. There are no residences within this zone, however some farming development appears to be located within this area. Some of the northern portion is within the river buffer zone. The Joel mine lays South-west of the proposed facility within this observation zone. There some small mine roads located to the west of the proposed development, which is utilized by the mine. Observers travelling along this road will be exposed to the project infrastructure.

1 – 3 KM (**High Sensitivity**)
Potential visual exposure in the short to medium distance (i.e., between 1 and 3km), is largely contained to the south which has been noted as additional mining infrastructure and dumping facilities. There are some abandoned buildings and recreational sport fields within this zone, which is theorized to be used by the mine residence.

The majority of this area (towards the North and east) is agricultural or vacant land, very few residences reside within this area indicating fewer visual receptors. These features, farms, buildings, recreational facilities and mines can be considered one of the more sensitivity areas in terms of the visual receptors, however there are large number of trees, mining infrastructure and other infrastructure between the proposed development and the receptors (as seen in figure 7:b) which is anticipated to largely reduce the visual impact on the facility.

Additionally, there are some roads which are found within this observational area, such as the A169. It is expected that the PV facility would be clearly visible from these sections of road. There are some areas in which the topography is relatively flat with little to no tall vegetation. It is therefore recommended that in these areas the visual impact is mitigated from very high by use of things such as trees etc., as discussed in section 7.

The area has a lot of natural and artificially occurring wetland features surrounding the development, which must also be noted and may have an impact on the Terrestrial or Avifauna sensitivities.

Additionally, some key mining establishments are within this zone of observation, it is anticipated to have no negative impact on their landscape character as Harmony is a mining company who, as can be seen to the south of the development area (in brown) have extensively transformed the landscape.

3 - 6KM (**Moderate Sensitivity**)
Within this observation the visual exposure becomes very scattered and interrupted due to the undulating nature of the topography as well as the surrounding features (mine heaps, buildings, roads, vegetation, etc.). Some agricultural holdings exist to the east and north of the proposed development.
6 – 10 KM (**Very Low Sensitivity**)
At distances exceeding 6km the intensity of visual exposure is expected to be very low and highly unlikely due to the distance between the object (development) and the observer.

It is clear that the relatively constrained dimensions of the PV facility would amount to a fairly limited area of potential visual exposure. The visual exposure would largely be contained within a 6km radius of the proposed development site, with the predominant exposure to the north and east of the development.
It is believed that renewable energy resources are essential to the environmental well- being of the country and planet (WESSA, 2012). Taking into account all positive factors of such a development including economic factors, social factors

and sustainability factors, especially in an arid country, the visual impact of this proposed development will be insignificant and is suggested that the development commence, from a visual impact point of view.

The overall value and sense of place of the receiving environment is considered of low significance. It is the opinion of the specialist that the project be considered favourably from a visual resource management perspective, provided that the required mitigation and management measures be implemented and that it is ensured that the best long-term use of the resources in the project area will be made in support of the principle of sustainable development.

9. MITIGATION AND MANAGEMENT MEASURES

In considering mitigation measures three rules are considered - the measures should be feasible (economically), effective (how long will it take to implement and what provision is made for management / maintenance), and acceptable (within the framework of the existing landscape and land use policies for the area). To address these, the following principles have been established:

- Mitigation measures should be designed to suit the existing landscape character and needs of the locality.
- They should respect and build upon landscape distinctiveness.
- It should be recognized that many mitigation measures, especially the establishment of planted screens and rehabilitation, are not immediately effective.

The primary visual impact, namely the appearance of the Solar PV Facility is not possible to mitigate. The functional design of the PV panels cannot be changed in order to reduce visual impacts. Mitigation is however possible if the recommended general actions are followed.

9.1. Preparatory Works and Construction Concerns

Mitigation of visual impacts associated with the construction phase, albeit temporary, would entail proper planning, management, and rehabilitation of the construction site. Recommended mitigation measures include the following:

- Ensure that vegetation is not unnecessarily cleared or removed during the construction period.
- Reduce the construction period through careful logistical planning and productive implementation of resources.
- Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing (i.e., in already disturbed areas) wherever possible.
- Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
- Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.
- Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e., whenever dust becomes apparent).
- Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
- Rehabilitate all disturbed areas, construction areas, roads, slopes, etc. immediately after the completion of construction works. If necessary, an ecologist should be consulted to assist or give input into rehabilitation specifications.
- With the preparation of the portions of land onto which activities will take place the minimum amount of existing vegetation and topsoil should be removed. Large trees should be saved were possible, specifically along the R30.
- Ensure, wherever possible, natural indigenous vegetation is retained and incorporated into the site rehabilitation.
- All topsoil that occurs within the proposed footprint of an activity must be removed and stockpiled for later use. The construction contract must include the stripping and stockpiling of topsoil. Topsoil would be used later during the rehabilitation phase of disturbed areas. The presence of degraded areas and disused construction roads, which are not rehabilitated, will increase the overall visual impact.
- Specifications with regards to the placement of construction camps, as well as a site plan of the construction camp, indicating waste areas, storage areas, and placement of ablution facilities should be included in the EMPr. These areas should either be screened or positioned in areas where they would be less visible from human settlements and main roads.
- Construction activities should be limited to between 08:00 and 17:00 or in conjunction with the ECO.
- Adopt responsible construction practices aimed at strictly containing the construction / establishment

activities to specifically demarcated areas.

- Building or waste material discarded should be undertaken at an authorised location, which should not be within any sensitive areas.

9.2. Earthworks

- Earthworks should be executed in such a way that only the footprint and a small 'construction buffer zone' around the proposed activities are exposed. In all other areas, the naturally occurring vegetation should be retained, especially along the periphery of the sites.
- All cut and fill slopes (if any) and areas affected by construction work should be progressively top soiled and re-vegetated as soon as possible.
- Any soil must be exposed for the minimum time possible once cleared of vegetation to avoid prolonged exposure to wind and water erosion and to minimise dust generation.

9.3. Landscaping and Ecological Approach

- It is recommended that the existing vegetation cover be maintained / established in all areas outside of the actual development footprint, both during construction and operation of the proposed facility. This will minimise visual impact as a result of cleared areas, power line servitudes and areas denuded of vegetation.
- Where new vegetation is proposed to be introduced to the site, an ecological approach to rehabilitation as opposed to a horticultural approach should be adopted. For example, communities of indigenous plants will enhance biodiversity, a desirable outcome for the area. This approach can significantly reduce long-term costs as less maintenance would be required over conventional landscaping methods as well as the introduced landscape being more sustainable.
- Progressive rehabilitation of all construction areas should be carried out immediately after they have been established.
- Undertake planting of screening vegetation along the eastern and southern boundaries of the Project sites.

9.4. Mounting Structures and Associated Infrastructure

- Paint the mounting structures with colours that reflect and compliment the colours of the surrounding landscape.
- Ensure the perimeter fence is of a 'see through' variety and that its colour blends with the environment.

9.5. Good housekeeping

- "Housekeeping" procedures should be developed for the Project to ensure that the Project site and lands adjacent to the Project site are kept clean of debris, garbage, graffiti, fugitive trash, or waste generated onsite; procedures should extend to control "track out" of dirt on vehicles leaving the active construction site and controlling sediment in stormwater runoff
- During construction, temporary fences surrounding the material storage yards and laydown areas should be covered with 'shack' cloth (khaki coloured).
- Operating facilities should be actively maintained during operation.

9.6. Operation Phase

- During operation, the maintenance of the PV panels, ancillary structures and infrastructure will ensure that the facility does not degrade, preventing aggravation of the visual impact. Roads must be maintained to forego erosion and to suppress dust, and rehabilitated areas must be monitored for rehabilitation failure. Remedial actions must be implemented as and when required. Once the facility has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated. An ecologist should be consulted to give input into rehabilitation specifications. All rehabilitated areas should be monitored for at least a year following decommissioning, and remedial actions implemented as and when required. Where sensitive

visual receptors are likely affected, it is recommended that the developer enter into negotiations regarding the potential screening of visual impacts, either at the receptor site or along the perimeter of the facility. This may entail the planting of vegetation or the construction of landscaped berms or screens.

9.7. Lighting

Light pollution is largely the result of bad lighting design, which allows artificial light to shine outward and upward into the sky, where it is not wanted, instead of focusing the light downward, where it is needed. Ill- designed lighting washes out the darkness of the night sky and radically alters the light levels in rural areas where light sources shine as 'beacons' against the dark sky and are generally not wanted.

Of all the pollutions faced, light pollution is perhaps the most easily remedied. Simple changes in lighting design and installation yield immediate changes in the amount of light spilled into the atmosphere. The following are measures that must be considered in the lighting design of the Project, particularly at the management and service platforms:

Mitigation measures include the following:

- Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself);
- Limiting mounting heights of lighting fixtures, or alternatively using footlights or bollard level lights;
- Making use of downward directional lighting fixtures;
- Making use of minimum lumen or wattage in fixtures;
- Making use of down-lighters, or shielded fixtures;
- Making use of Low Pressure Sodium lighting or other types of low impact lighting.
- Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.

In terms of ancillary infrastructure, it is recommended that access roads and other on-site infrastructure be planned so that the clearing of vegetation is minimised. Consolidate infrastructure as much as possible and make use of already disturbed areas rather than pristine sites, wherever possible. Mitigation of lighting impacts includes the pro-active design, planning and specification lighting for the facility. The correct specification and placement of lighting and light fixtures for the proposed Solar PV Facility and ancillary infrastructure will go far to contain rather than spread the light.

9.8. MANAGEMENT PROGRAMME

The following management plan tables aim to summarise the key findings of the visual impact report and suggest possible management actions in order to mitigate the potential visual impacts. Refer to the tables below.

Table 9: Management programme – Planning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the planning of the proposed PV facility.

Project Component/s	The Solar PV facility and ancillary infrastructure (i.e., PV panels, access roads, transformers, security lighting, workshop, power line, etc.).		
Potential Impact	Primary visual impact of the facility due to the presence of the PV panels and associated infrastructure as well as the visual impact of lighting at night.		
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site (i.e., within 1km of the site) as well as within the region.		
Mitigation: Target/Objective	Optimal planning of infrastructure to minimise the visual impact.		
Mitigation: Action/control		**Responsibility**	**Timeframe**
Plan the placement of laydown areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e., in already disturbed areas) wherever possible.		Project proponent / contractor	Early in the planning phase.

Retain and maintain natural vegetation (if present) immediately adjacent to the development footprint.	Project proponent/ design consultant	Early in the planning phase.
Make use of existing roads wherever possible and plan the layout and construction of roads and infrastructure with due cognisance of the topography to limit cut and fill requirements.	Project proponent/ design consultant	Early in the planning phase.
Plan all roads, ancillary buildings and ancillary infrastructure in such a way that clearing of vegetation is minimised. Consolidate infrastructure and make use of already disturbed sites rather than undisturbed areas.	Project proponent/ design consultant	Early in the planning phase.
Consult a lighting engineer in the design and planning of lighting to ensure the correct specification and placement of lighting and light fixtures for the PV Facility and the ancillary infrastructure. The following is recommended: ○ Shield the sources of light by physical barriers (walls, vegetation, or the structure itself). ○ Limit mounting heights of fixtures or use footlights or bollard lights. ○ Make use of minimum lumen or wattage in fixtures. ○ Making use of down-lighters or shielded fixtures. ○ Make use of Low-Pressure Sodium lighting or other low impact lighting. ○ Make use of motion detectors on security lighting, so allowing the site to remain in darkness until lighting is required for security or maintenance purposes.	Project proponent / design consultant	Early in the planning phase.
Performance Indicator	Minimal exposure (limited or no complaints from I&APs) of ancillary infrastructure and lighting at night to observers on or near the site (i.e., within 3km) and within the region.	
Monitoring	Monitor the resolution of complaints on an ongoing basis (i.e., during all phases of the project).	

Table 10: Management programme – Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the proposed Harmony Joel Solar Facility

Project Component/s	Construction site and activities	
Potential Impact	Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing and resulting erosion.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Minimal visual intrusion by construction activities and intact vegetation cover outside of immediate construction work areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Ensure that vegetation cover adjacent to the development footprint (if present) is not unnecessarily removed during the construction phase, where possible.	Project proponent / contractor	Early in the construction phase.

Reduce the construction phase through careful logistical planning and productive implementation of resources wherever possible.	Project proponent / contractor	Early in the construction phase.
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	Project proponent / contractor	Throughout the construction phase.
Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.	Project proponent / contractor	Throughout the construction phase.
Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e., whenever dust becomes apparent).	Project proponent / contractor	Throughout the construction phase.
Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting, where possible.	Project proponent / contractor	Throughout the construction phase.
Rehabilitate all disturbed areas (if present/if required) immediately after the completion of construction works.	Project proponent / contractor	Throughout and at the end of the construction phase.
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact (i.e., full cover as per natural vegetation present within the environment) with no evidence of degradation or erosion.	
Monitoring	Monitoring of vegetation clearing during construction (by contractor as part of construction contract). Monitoring of rehabilitated areas quarterly for at least a year following the end of construction (by contractor as part of construction contract).	

Table 11: Management programme – Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the proposed Harmony Joel Solar Facility

Project Component/s	The Solar PV facility and ancillary infrastructure (i.e., PV panels, access roads, workshop, etc.).	
Potential Impact	Visual impact of facility degradation and vegetation rehabilitation failure.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Well maintained and neat facility.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
If specific sensitive visual receptors are identified during operation, investigate screening at the receptor site.	Project proponent / operator	Throughout the operation phase.
Investigate the potential to screen the PV facility from the unnamed roads (located within 1km of the facility) with planted vegetation cover or solid fencing, where possible/if required.	Project proponent / operator	Throughout the operation phase.
Maintain the general appearance of the facility as a whole, including the PV panels, servitudes, and the ancillary structures.	Project proponent / operator	Throughout the operation phase.
Maintain roads and servitudes to forego erosion and to suppress dust.	Project proponent / operator	Throughout the operation phase.
Monitor rehabilitated areas and implement remedial action as and when required.	Project proponent / operator	Throughout the operation phase.

Investigate and implement (should it be required) the potential to screen visual impacts at affected receptor sites.	Project proponent / operator	Throughout the operation phase.
Performance Indicator	Well maintained and neat facility with intact vegetation on and in the vicinity of the facility.	
Monitoring	Monitoring of the entire site on an ongoing basis (by operator).	

Table 12: Management programme – Decommissioning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the decommissioning of the proposed Harmony Joel PV Facility

Project Component/s	The solar PV facility and ancillary infrastructure (i.e., PV panels, access roads, workshop, transformers, etc.).	
Potential Impact	Visual impact of residual visual scarring and vegetation rehabilitation failure.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Only the infrastructure required for post decommissioning use of the site retained and rehabilitated vegetation in all disturbed areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Remove infrastructure not required for the post-decommissioning use of the site.	Project proponent / operator	During the decommissioning phase.
Rehabilitate access roads and servitudes not required for the post-decommissioning use of the site. If necessary, an ecologist should be consulted to give input into rehabilitation specifications.	Project proponent / operator	During the decommissioning phase.
Monitor rehabilitated areas quarterly for at least a year following decommissioning and implement remedial action as and when required.	Project proponent / operator	Post decommissioning.
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact (i.e. full cover as per natural vegetation within the environment) with no evidence of degradation or erosion.	
Monitoring	Monitoring of rehabilitated areas quarterly for at least a year following decommissioning.	

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