PROPOSED BATTERY ENERGY STORAGE SYSTEMS (BESS): RE CAPITAL 3C SOLAR ENERGY FACILITY, UPINGTON, SOUTH AFRICA

Visual Statement Report

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Document prepared for Cape EAPrac (Pty) Ltd
on behalf of RE Capital 3C (Pty) Ltd

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LIST OF ACRONYMS

APHP	Association of Professional Heritage Practitioners
BLM	Bureau of Land Management (United States)
BPEO	Best Practicable Environmental Option
CALP	Collaborative for Advanced Landscape Planning
DEA&DP	Department of Environmental Affairs & Development Planning (SA)
DEM	Digital Elevation Model
DoC	Degree of Contrast
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GIS	Geographic Information System
I&APs	Interested and Affected Parties
IEMA	Institute of Environmental Management and Assessment (UK)
EMPr	Environmental Management Programme
KOP	Key Observation Point
MAMSL	Metres above mean sea level
NELPAG	New England Light Pollution Advisory Group
NEMWA	National Environmental Management Waste Act (South Africa)
PSDF	Provincial Spatial Development Framework
ROD	Record of Decision
SAHRA	South African National Heritage Resources Agency
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment
VRM	Visual Resource Management
ZVI	Zone of Visual Influence

GLOSSARY OF TECHNICAL TERMS

Technical Terms	**Definition** (Oberholzer, 2005)
Degree of Contrast	The measure in terms of the form, line, colour and texture of the existing landscape in relation to the proposed landscape modification in relation to the defined visual resource management objectives.
Visual intrusion	Issues are concerns related to the proposed development, generally phrased as questions, taking the form of "what will the impact of some activity be on some element of the visual, aesthetic or scenic environment".
Receptors	Individuals, groups or communities who would be subject to the visual influence of a particular project.
Sense of place	The unique quality or character of a place, whether natural, rural or urban.
Scenic corridor	A linear geographic area that contains scenic resources, usually, but not necessarily, defined by a route.
Viewshed	The outer boundary defining a view catchment area, usually along crests and ridgelines. Similar to a watershed. This reflects the area, or the extent thereof, where the landscape modification would probably be seen.
Visual Absorption Capacity	The potential of the landscape to conceal the proposed project.

Technical Term	**Definition** (USDI., 2004).
Key Observation Point	Receptors refer to the people located in the most critical locations, or key observation points, surrounding the landscape modification, who make consistent use of the views associated with the site where the landscape modifications are proposed. KOPs can either be a single point of view that an observer/evaluator uses to rate an area or panorama, or a linear view along a roadway, trail, or river corridor.
Visual Resource Management	A map based landscape and visual impact assessment method development by the Bureau of Land Management (USA).
Zone of Visual Influence	The ZVI is defined as 'the area within which a proposed development may have an influence or effect on visual amenity.'

1 INTRODUCTION

1.1 Terms of Reference

In 2015, Cape Environmental Practitioners (Pty) Ltd. was appointed by RE Capital 3C (Pty) Ltd. as independent environmental assessment practitioners (EAP) to conduct an Environmental Impact Assessment (EIA) for the proposed RE Capital 3C Solar Energy Facility (SEF), a commercial PV energy facility and associated infrastructure near Upington in the Northern Cape Province (EIA Ref No:). The project was granted Environmental Authorisation (EA) on. Subsequently, Part 1 amendments have been authorised to extend the EA validity and to increase the authorized generation capacity.

Visual Resource Management Africa CC (VRMA) was appointed by Cape EAPrac (Pty) Ltd, on behalf of RE Capital 3C (Pty) Ltd, to undertake a ***Visual Statement*** for the proposed Battery Energy Storage System (BESS) located in the North Cape Province, South Africa.

RE Capital 3C Solar Energy Facility (Pty) Ltd. now wish to include a Battery Energy Storage System (BESS), which will cover up to 4ha, adjacent to the western boundary within the approved project footprint (**Error! Reference source not found.**). In terms of Regulation 31 and 32 of the 2014 National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations, RE Capital 3C Solar Energy Facility (Pty) Ltd. wishes to apply for an amendment to the EA issued. Cape Environmental Practitioners (Pty) Ltd. have now been appointed as the EAP to conduct the amendment assessment.

One of the potential environmental issues identified during the former EIA process was the potential visual impacts caused by the construction and operation activities. A Visual Impact Assessment (VIA), conducted Visual Resource Management Africa CC (VRMA) in 2015, was therefore included as one of the specialist studies.

Based on the requirements of Regulation 32 of the EIA Regulations, specialist input regarding the proposed amendments is required to enable the DEA to make an informed decision on whether to grant or reject the amendment application.

1.2 Study Team

Contributors to this study are summarised in Table 1 below.

Table 1: Authors and Contributors to this Report.

Aspect	Person	Organisation / Company	Qualifications
Landscape and Visual Assessment (author of this report)	Stephen Stead B.A (Hons) Human Geography, 1991 (UKZN, Pietermaritzburg)	VRMA	• Accredited with the Association of Professional Heritage Practitioner and • 16 years of experience in visual assessments including renewable energy, powerlines, roads, dams across southern Africa.

1.3 Visual Assessment Approach

A detailed VIA was undertaken for the RE Capital 3C SEF in 2015. Therefore, this visual statement will provide specialist input to assess the proposed inclusion of a BESS in the context of the former 2015 VIA, to determine the visual impacts resulting from the proposed amendments. This visual statement is to be read in conjunction with the former 2015 VIA as it does not repeat information in that report that is still relevant to the current VIA.

In particular, this visual statement will provide further information on the following:

- The nature of the BESS within the landscape;
- Potential changes to the zone of visual influence of the PV project; and
- Potential impacts experienced by receptors.

Based on the above, a preliminary impact statement, including any mitigation measures, will be provided for the BESS.

1.4 Assumptions and Uncertainties

- The use of open source satellite imagery was utilised for base maps in the report;
- Some of the mapping in this document was created using Bing Maps, Open Source Map, ArcGIS Online and Google Earth Satellite imagery;
- The project deliverables, including electronic copies of reports, maps, data, shape files and photographs are based on the author's professional knowledge, as well as available information; VRM Africa reserves the right to modify aspects of the project deliverables if and when new/additional information may become available from research or further work in the applicable field of practice, or pertaining to this study.

2 PROJECT DESCRIPTION

The authorised project is located on the Farm RE Capital, approximately 20km west of Upington along the N14 in the Kai! Garib Local Municipality of ZF Mgcawu District Municipality, Northern Cape Province of South Africa. The proposed amendment is to include aBattery Energy Storage System (BESS), which will cover up to 4ha, adjacent to the on-site substation within the approved project footprint (see Figure 1 below).

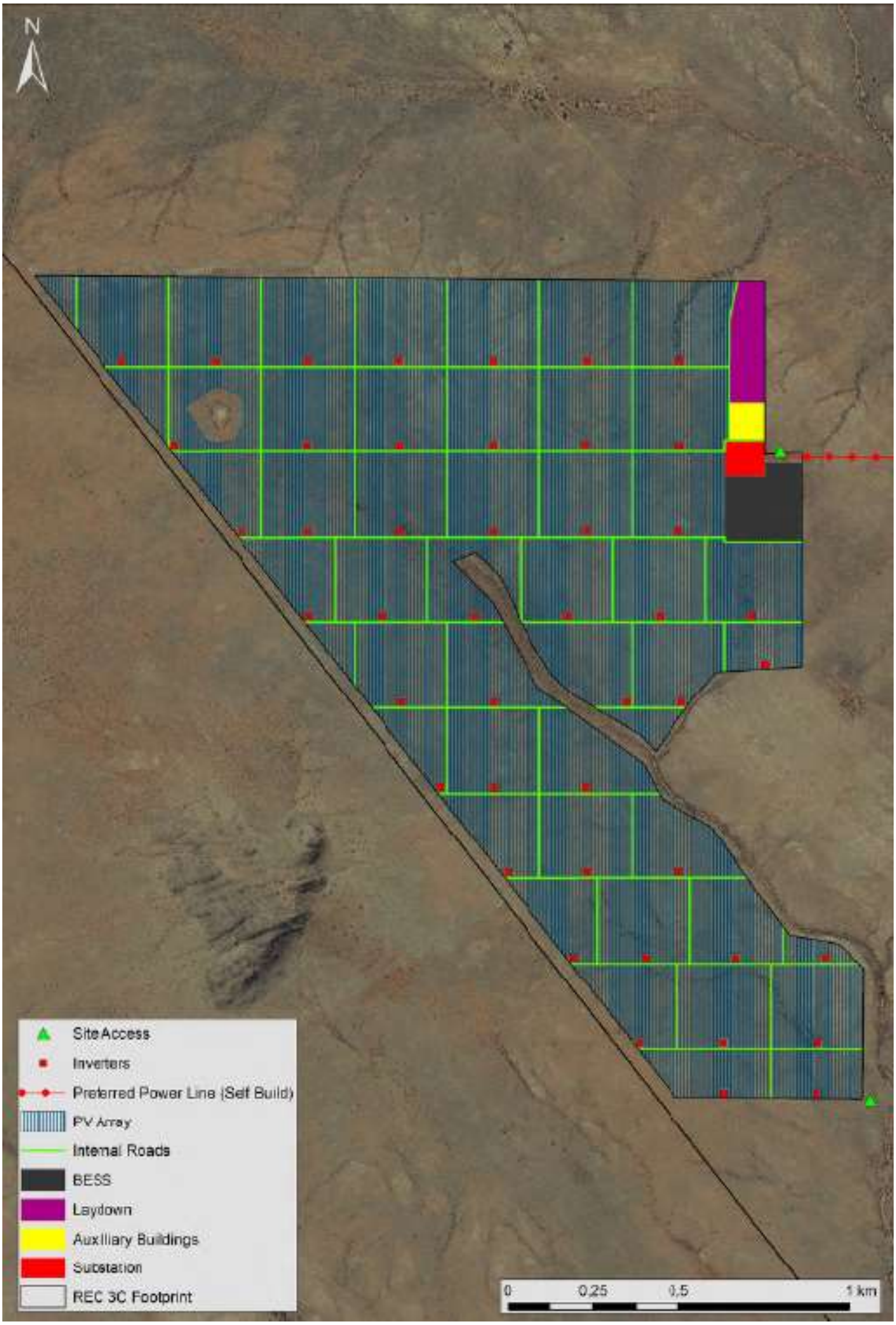

Figure 1. Proposed site layout plan for preferred development option (RE Capital 3C)

The exact design of the BESS will depend on the specific manufacturer. It is customary to develop the final detailed design of the facility only once an Independent Power Producer (IPP) is awarded a successful bid under the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), after which major contracts are negotiated and final equipment suppliers identified. Therefore, at this stage the exact supplier/ manufacturer has not yet been identified. However, a BESS typically includes batteries that have been assembled in containerised/modular enclosures. While each manufacturer has slightly different individual battery container/module dimensions, they all typically fall within the following ranges:

- Length: 6m – 12m
- Width: 1.5m – 2.5m
- Height: maximum of 3m

As a proposed specific manufacturer for the proposed Battery Energy Storage Systems has not been identified, the following information and diagrams are taken from a manufacturer, Tesla, as “utility-scale energy storage products, suitable for power stations and utility companies. The proposed BESS are designed to store energy that can be later used during periods of surplus demand. For example the Tesla Megapack is a large-scale lithium-ion battery storage product manufactured and can be used to store energy generated by intermittent renewable power sources, such as solar and wind. The energy stored can be used by the grid as required, for example during periods of peak electricity demand”. (Tesla, 2020)

“BESS are used to improve the reliability of intermittent renewable energy sources such as solar and wind. Large-scale battery storage solutions such as the Tesla Megapack are becoming more economically viable for utility companies to implement due to the declining price of lithium-ion battery technology. Demand for energy storage is also increasing in some jurisdictions due to transitions towards renewable energy sources.” (Stevens, 2019)

Renewable energy sources must be stored in order to improve peak-period demand in South Africa. “Lithium ion storage batteries are a cost effective way to meet the peak demand and regional spikes in demand….South Africa has an opportunity to improve grid reliability and reduce costs. Lithium ion storage’s ability to quickly improve reliability, reduce costs, and create options, necessitates immediate consideration in every area where it can provide value.” (Tesla, The Value of Lithium Ion Storage - South Africa)

Battery storage is an increasingly important element of the world’s transition to sustainable energy. Each Megapack can store up to 3 megawatt-hours (MWh) of electricity. The proposed Megapack is 7.1m wide, 2.5m in height and 1.6m in diameter. (Tesla, 2020)

The following image depicts the nature of the Tesla battery storage units.

MECHANICAL AND MOUNTING

Ingress Ratings	IP66/NEMA 3R (Main enclosure) IP20 (Thermal system)
Unit Dimensions	W: 7125 mm (23 ft 5 in) D: 1600 mm (5 ft 3 in) H: 2516 mm (8 ft 3 in)

Figure 2. Example of a similar proposed structure and approximate heights (Tesla, 2020)

Figure 3. Example of a Photomontage of Tesla BESS in landscape

3 Legal Framework

In order to comply with the Visual Resource Management requirements, it is necessary to evaluate the proposed amendment in terms of 'policy fit'. This requires a review of National and Regional policy and planning for the area to ensure that the scale, density and nature of activities or developments are harmonious and in keeping with the planned sense of place and character of the area. The following maps provide the spatial context to the provincial and local context:

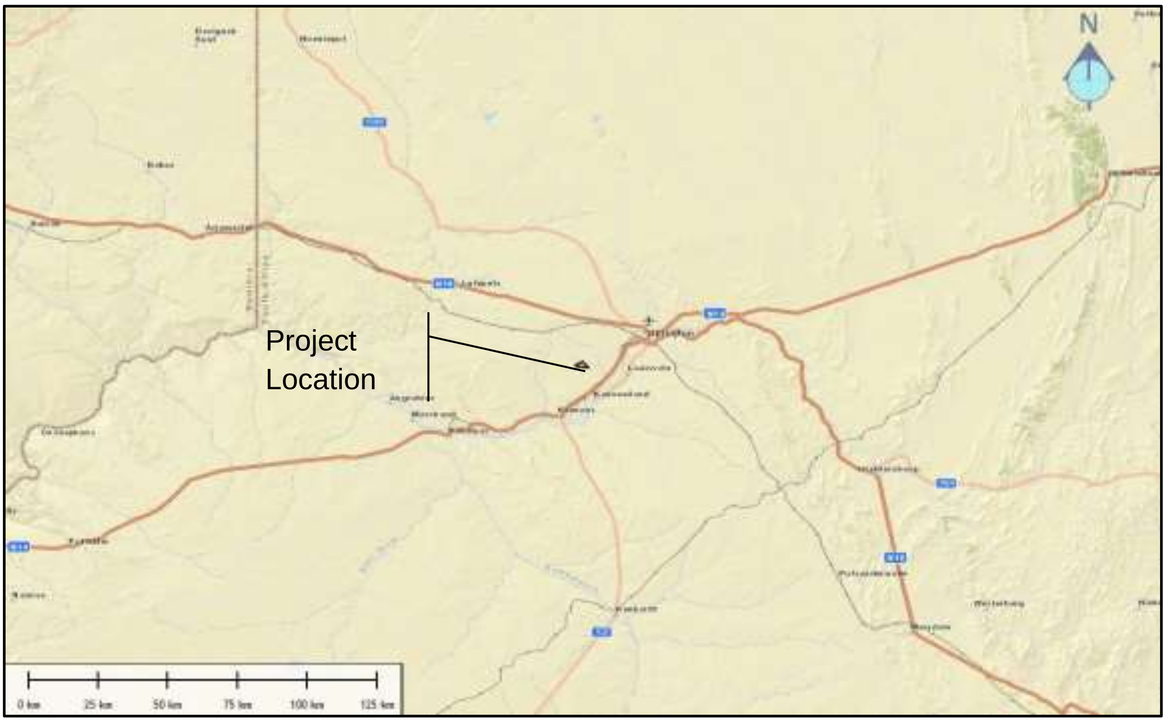

Figure 4. Project Locality Map

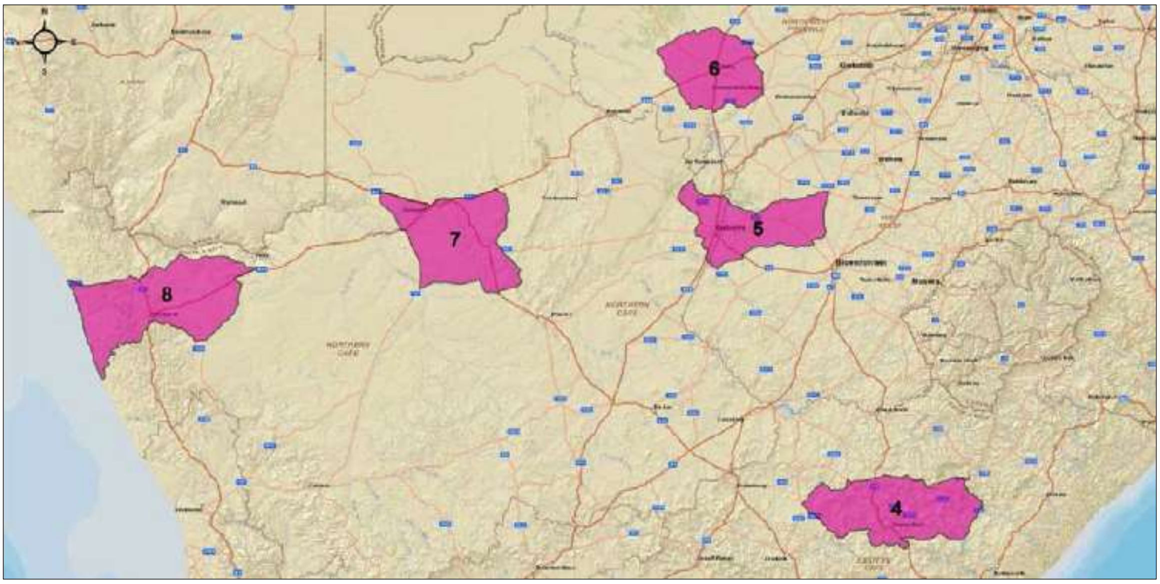

Figure 5. Renewable Energy Development Zones Map with coloured areas indicating the REDZ areas

3.1 Local Government Legislation and Planning Policy Fit Statement

No IDP or Spatial Planning documentation could be found in the Kai! Garib website, however, tourism is strongly emphasised. Considering that the property falls within the Renewable Energy Development Zones (REDZ) 7 strategic area, and many other solar renewable energy projects are located in the area, it is likely that solar energy projects are supported at a District and Local Municipal planning level.

4 METHODOLOGY

The process that VRMA followed when determining landscape significance is based on the United States Bureau of Land Management's (BLM) Visual Resource Management method (USDI., 2004). This mapping and GIS-based method of assessing landscape modifications allows for increased objectivity and consistency by using standard assessment criteria. The following key factors determine the suitability of landscape change:

- "Different levels of scenic values require different levels of management. For example, management of an area with high scenic value might be focused on preserving the existing character of the landscape, and management of an area with little scenic value might allow for major modifications to the landscape. Determining how an area should be managed first requires an assessment of the area's scenic values".
- "Assessing scenic values and determining visual impacts can be a subjective process. Objectivity and consistency can be greatly increased by using the basic design elements of form, line, colour, and texture, which have often been used to describe and evaluate landscapes, to also describe proposed projects. Projects that repeat these design elements are usually in harmony with their surroundings; those that don't create contrast. By adjusting project designs so the elements are repeated, visual impacts can be minimized" (USDI., 2004).

As a baseline assessment to define the landscape significance of the greater area has already been undertaken, the visual statement will not review the baseline, but rather focus on the review of the BESS zone of visual influence, and a review of the impacts and mitigations.

The following Visual impact significance criteria were used in the previous PV VIA, and the statement will make reference to these criteria used of the DEA&DP Guideline for involving Visual and Aesthetic Specialists in EIA processes (Oberholzer, 2005).

Table 2: Visual Impact Criteria Table

Extent	Geographical area of influence. **Site Related (S):** extending only as far as the activity **Local (L):** limited to i*mmediate surroundings.* **Regional (R):** affecting a larger metropolitan or regional area **National (N):** affecting large parts of the country **International (I):** affecting areas across international boundaries
Duration	Predicted lifespan **Short term (S):** duration of the construction phase. **Medium term (M):** duration for screening vegetation to mature. **Long term (L):** lifespan of the project. **Permanent (P):** where time will not mitigate the visual impact.
Magnitude	Magnitude of impact on views, scenic or cultural resources **Low (L):** where visual and scenic resources are not affected. **Moderate (M)**: where visual and scenic resources are affected **High (H)**: where scenic and cultural resources are significantly affected.
Probability	Degree of possible visual impact: **Improbable (I):** possibility of the impact occurring is very low. **Probable (P):** distinct possibility that the impact will occur. **Highly probable (HP):** most likely that the impact will occur. **Definite (D):** impact will occur regardless of any prevention measures.
Significance	A synthesis of nature, duration, intensity, extent and probability **Low (L):** will not have an influence on the decision. **Moderate (M):** should have an influence on the decision unless it is mitigated. **High (H):** would influence the decision regardless of any possible mitigation.
Confidence	Key uncertainties and risks in the VIA process, which may influence the accuracy of, and confidence in, the VIA process.

5 BASELINE FINDING SUMMARY

Landscape character is defined by the U.K. Institute of Environmental Management and Assessment (IEMA) as the ‘distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement’. It creates the specific sense of place or essential character and ‘spirit of the place’ (IEMA, 2002). This section of the VIA identified the main landscape features that define the landscape character, as well as the key receptors that make use of the visual resources created by the landscape.

5.1 Landscape Investigation

A field survey was not undertaken for the BESS, but a full site survey was undertaken for the PV visual assessment. The photographs for the surrounding landscape can be viewed on the Cape EAPrac website. (CapeEAPrac)

5.2 Landscape Context

The following key landmarks, falling within the proposed project viewshed, were identified during the desktop assessment:

- Rural agricultural / viticulture landscape associated with the Orange River Valley.
- The N14 National Road.
- The Khi Solar One Concentrated Solar Power facility.
- Sand dune features and rocky hills.

A factor that is increasingly influencing the regional landscape character is the recognition of the area around Upington as an important solar renewable energy location. The property is situated within visual proximity to the Khi Solar One Concentrated Solar Power (CSP) tower project, located 6km to the east of the property. This creates a large vertical feature in the landscape. It is likely that the area will become a solar energy hub as this area falls within the REDZ 7 renewable energy development zone. Other Solar PV projects are also located to the east of the property, as well as on the southern portions of the property.

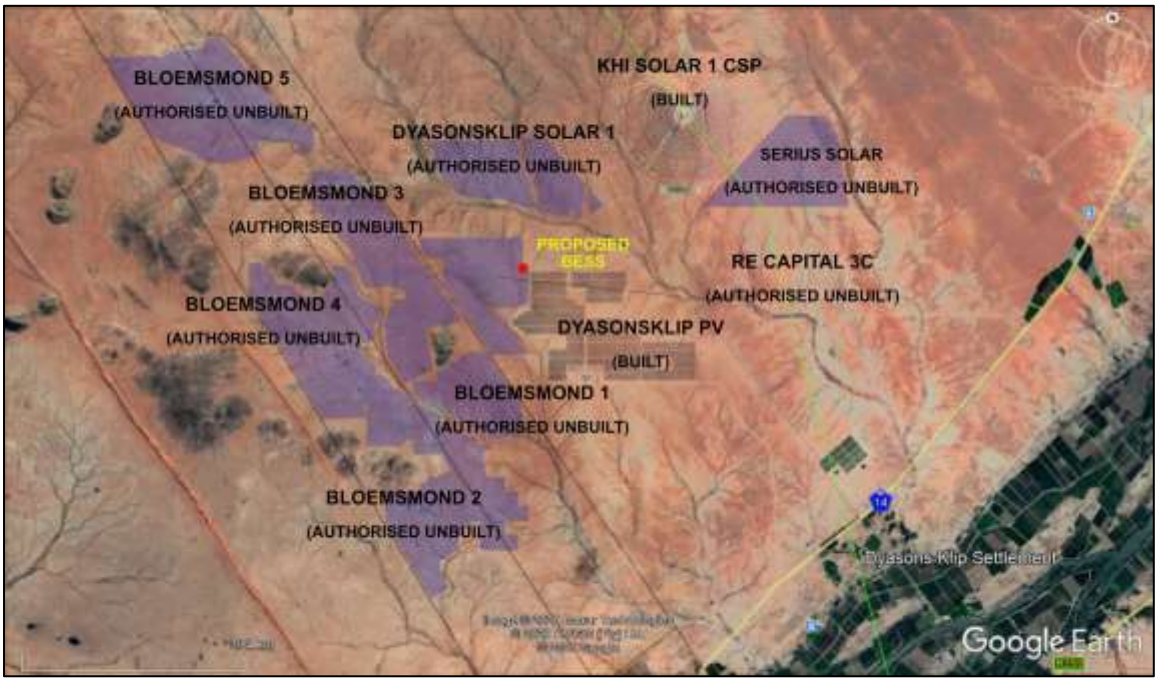

Figure 6. Renewable Energy Cumulative Projects maps with the RE Capital 3C BESS SEF location indicated as a red node.

5.2.1 Protected Areas

No protected areas are located within the Foreground / Mid-ground areas within the expected Zone of Visual Influence (ZVI) of the project. The nearest protected area is Augrabies National Park located approximately 60km to the west of the property.

5.2.2 Regional Topography

The regional terrain is predominantly flat around the site, but with some small rocky outcrops to the west of the site which do add value to the local landscape. No significant landscape features are located within direct influence of the BESS ZVI.

5.3 Project Zone of Visual Influence

A viewshed analysis was undertaken from the proposed site at a specified height above ground level to define the extent of the possible visual influence of the proposed landscape modification (refer to the Table below). The Google Earth viewshed function was used to generate the expected visual incidence. The maps are informative only as visibility tends to diminish exponentially with distance, which is well recognised in visual analysis literature (Hull & Bishop, 1988). It is important to note that the terrain model ***excludes vegetation and structural screening*** which could influence the extent of the visibility.

Table 3: Proposed Project Heights Table

Proposed Activity	Approx. Maximum Height above ground level (m)	Viewshed Extent (km)
BESS Structures	3 m	10

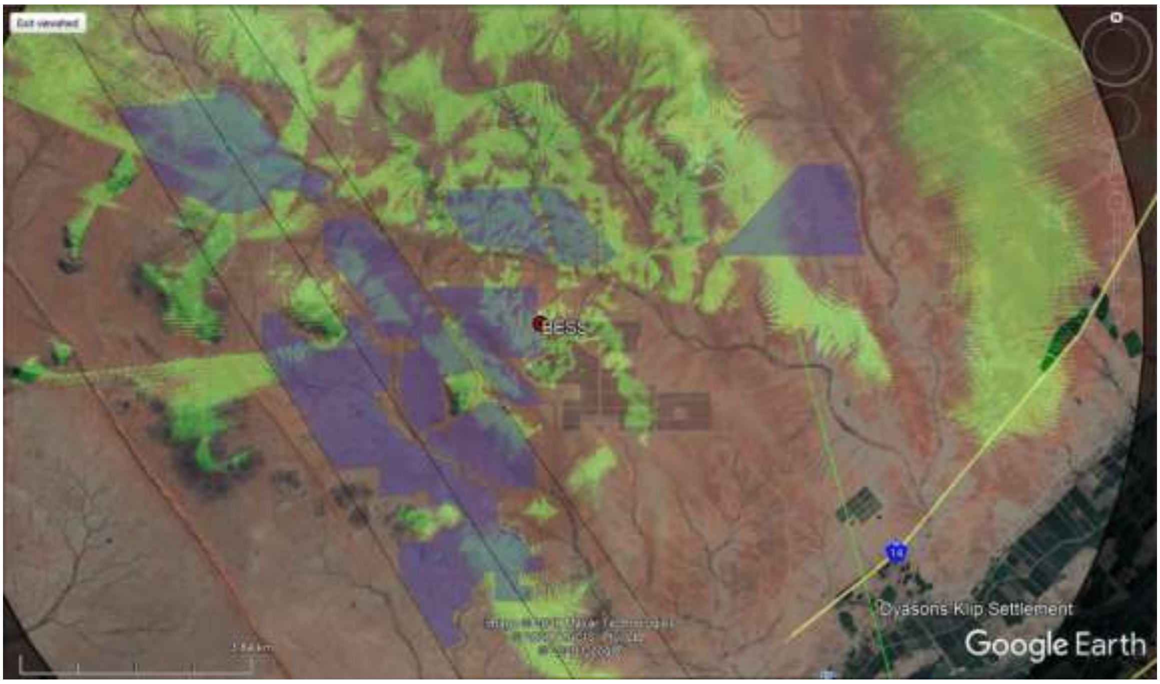

Figure 7. Google Earth Bloemsmond PV 1 BESS Viewshed Map (Green area depicting visual incidence)

As can be seen from the viewshed, the outer extent where the project is likely to be visible is 10km, but with only higher vantage point with this localised ZVI having visibility of the BESS. These areas are mainly located to the north, and although there is a possibility of visual incidence to the N14 National Highway, clear visibility is unlikely to take place due to the 7.5km distance from this receptors. The location of the RE Capital 3C PV in close proximity to the BESS site, will further visually obscure the BESS structures once the 3.5m high PV panels are constructed.

5.4 Receptors and Key Observation Points

As defined in the methodology, KOPs are defined by the Bureau of Land Management as the people (receptors) located in strategic locations surrounding the property that make consistent use of the views associated with the site where the landscape modifications are proposed.

As identified in the viewshed mapping exercise, the proposed development zones of visual influence does not include sensitive receptors. This is due to the remoteness of the site, as well as the slight undulation of the terrain that topographically screens the 3m high BESS structures.

6 VISUAL RESOURCE MANAGEMENT

In terms of the VRM methodology, landscape character is derived from a combination of scenic quality, receptor sensitivity to landscape change, and distance of the proposed landscape modification from key receptor points. Making use of the key landscape elements defined in the landscape contextualisation sections above, landscape units are defined which are then rated to derive their intrinsic scenic value, as well as how sensitive people living in the area would be to changes taking place in these landscapes.

6.1 Physiographic Rating Units

The Physiographic Rating Units are the areas within the project development area that reflect specific physical and graphic elements that define a particular landscape character. These unique landscapes within the project development areas are rated to assess the scenic quality and receptor sensitivity to landscape change, which is then used to define a Visual Resource Management Class for each of the site’s unique landscape/s. The exception are Class I areas, where the rating is determined based on national and international policy / best practice and landscape significance and as such are not rated for scenic quality and receptor sensitivity to landscape change. The mapping of the portions of the property visible from sensitive receptors, and associated Physiographic Rating Units can be viewed in the following maps:

During the initial site visit, two main broad-brush landscapes were identified, these being Bushmanland Arid Grassland and the Shallow Drainage Lines. As can be seen on the map on the following page depicting the footprint overlaid onto Google Earth satellite imagery, the majority of the proposed development site is flat and covered with Bushmanland Grassland with no defined drainage lines within the footprint area.

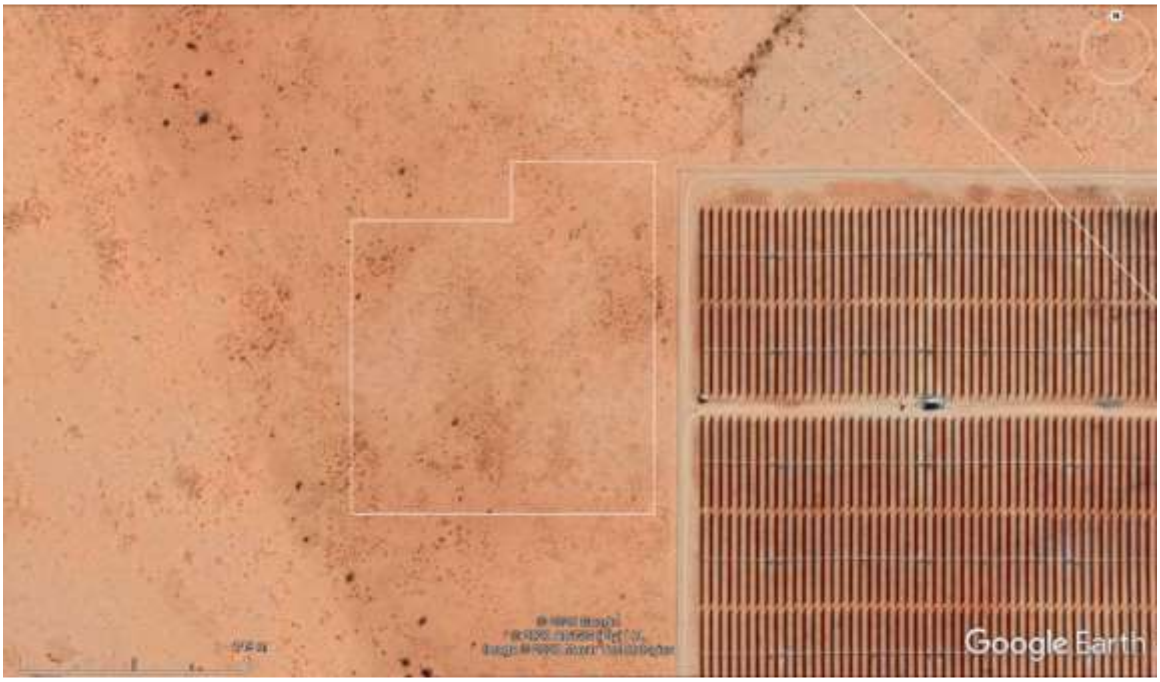

Figure 8. Proposed BESS footprint map

6.2 Visual Resources Management Classes

The BLM methodology defines four Classes that represent the relative value of the visual resources of an area and are defined making use of the VRM Matrix:

- **Classes I and II** are the most valued
- **Class III** represent a moderate value
- **Class IV** is of least value

The Classes are not prescriptive and are utilised as a guideline to determine the carrying capacity of a visually preferred landscape that is utilised to assess the suitability of the landscape change associated with the proposed project.

Due to the seldom seen nature of the proposed development site, with limited scenic resources and the REDZ7 planning for the area, a Class IV visual objective was assigned to the grassland portions of the proposed PV development area. As the proposed BESS falls within this area, the Class IV visual objective was assigned to this area. The Class IV objective is to provide for management activities that major modifications of the existing character of the landscape but working within international best practice for landscape modification management and restoration.

7 IMPACT ASSESSMENT REVIEW

As indicated in the methodology, the contrast rating is undertaken to determine if the VRM Class Objectives are met. This informs the impact ratings for Visual Impacts. The suitability of landscape modification is assessed by comparing and contrasting existing receiving landscape to the expected contrast that the proposed landscape change will generate. This is done by evaluating the level of change to the existing landscape by assessing the line, colour, texture and form, in relation to the visual objectives defined for the area. Due to the remoteness of the locality, no significant receptors were identified within the project Zone of Visual Influence. As such, a contrast rating exercise was not undertaken, and ***only Landscape impacts will be assessed***.

7.1 BESS Landscape and Visual Impacts

The following impacts were identified as having a likelihood of occurring during the construction and operation of the proposed BESS. These have the potential to change the local landscape character and will be collectively assessed under the heading of change to landscape resources.

- Construction Phase
  - Loss of site landscape character from the removal of vegetation and the construction of the BESS structures and associated infrastructure;
  - Wind-blown dust due to the removal of large areas of vegetation;
  - Windblown litter from the laydown and construction sites.
- Operation Phase
  - Light spillage making a glow effect that would be clearly noticeable to the surrounding dark sky night landscapes to the north of the proposed site;
  - Massing effect on the landscape from a large-scale modification;
- Decommissioning Phase
  - Movement of vehicles and associated dust;
  - Windblown dust from the disturbance of cover vegetation / gravel.
- Cumulative Impacts
  - A long-term change in land use setting a precedent for other similar types of solar and wind energy projects.
  - Loss of scenic resources located on the adjacent property to the west that could influence future eco-tourism opportunities in this area.

The visual impact of the construction of the proposed 3m high structures was reviewed in the Table below.

Table 4: BESS Impacts Ratings Review Table.

Nature: Change of local and surrounds visual resources due to the construction and operation of the proposed **(3**m high) structures, and buildings.		
	Without mitigation	**With mitigation**
Extent	Local	Local
Duration	Long-term	Long-term
Magnitude	Medium	Low
Probability	Probable	Probable
Significance	**Medium to Low**	**Low**
Status (positive or negative)	Negative	Negative
Reversibility	Possible	Possible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Impact Motivation • The proposed BESS development footprint area does not contain any significant visual resources or topographic prominence. • The area is remote with limited receptors and is located adjacent to the already authorized PV projects that clearly define the area as a renewable energy zone.
Mitigation: • To reduce colour contrast, if permitted by the Original Equipment Manufacturer, the container structure should preferably be painted a grey-brown colour so as to blend with the surrounding arid region landscapes. • Light spillage reduction management should be implemented (refer to Annexure E).
Cumulative impacts: • Excessive lights at night could reduce the current dark sky sense of place that could detract from tourism opportunities in the area. • From a cumulative perspective, the area is already well established as a renewable energy zone. Therefore, it is unlikely that the addition of the BESS will degrade the regional landscape character.
Residual Risks: • Residual risks post mitigation are rated Low. On decommissioning, the limited earthworks required for the construction of the BESS plant would allow for effective rehabilitation of the impacted area back to the current agricultural land use and associated rural sense of place.

8 ENVIRONMENTAL MANAGEMENT PLAN RECOMMENDATIONS

The original environmental mitigations submitted for the initial PV EIA needs to be incorporated. The only addendum regarding the BESS mitigation is:

- To reduce colour contrast, if permitted by the Original Equipment Manufacturer, the container structure should preferably be painted a grey-brown colour so as to blend with the surrounding arid region landscapes.

9 CONCLUSION

Due to the relative remoteness of the locality and some topographic screening, no sensitive receptors were identified for the site, and as such Visual Exposure and Sensitivity to landscape change for the BESS project is defined as ***Low***. Based on the VRM methodology, the Scenic Quality of the area is defined as ***Low***.

There is a good policy fit for the RE Capital 3C Solar Energy Facility project (located within the REDZ7), and the region already depicts a number of large-scaled renewable energy projects that define the sense of place.

Thus, the findings of this visual statement are that ***the BESS development is unlikely to result in the loss of significant visual and scenic resources, and as such should be allowed to proceed with mitigation***. The landscape context is already strongly defined as a renewable energy node, and the inclusion of the BESS structures into the landscape would be incorporated into the existing visual absorption capacity created by the receiving landscape.

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11 Annexure A: Specialist Information

Curriculum Vitae (CV)

- Position: Owner / Director
- Name of Firm: Visual Resource Management Africa cc *(www.vrma.co.za)*
- Name of Staff: Stephen Stead
- Date of Birth: 9 June 1967
- Nationality: South African
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  Cell: +27 (0) 83 560 9911
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- Educational qualifications:
  - University of Natal (Pietermaritzburg):
  - Bachelor of Arts: Psychology and Geography
  - Bachelor of Arts (Hons): Human Geography and Geographic Information Management Systems

- Professional Accreditation
  - Association of Professional Heritage Practitioners (APHP) Western Cape
  - Accredited VIA practitioner member of the Association (2011)

- Association involvement:
  - International Association of Impact Assessment (IAIA) South African Affiliate
  - Past President (2012 - 2013)
  - President (2012)
  - President-Elect (2011)
  - Conference Co-ordinator (2010)
  - National Executive Committee member (2009)
  - Southern Cape Chairperson (2008)

- Conferences Attended:
  1. IAIAsa 2012
  2. IAIAsa 2011
  3. IAIA International 2011 (Mexico)

iv. IAIAsa 2010
v. IAIAsa 2009
vi. IAIAsa 2007

- Continued Professional Development:
    - Integrating Sustainability with Environment Assessment in South Africa (IAIAsa Conference, 1 day)
    - Achieving the full potential of SIA (Mexico, IAIA Conference, 2 days 2011)
    - Researching and Assessing Heritage Resources Course (University of Cape Town, 5 days, 2009)

- Countries of Work Experience:
    - South Africa, Mozambique, Malawi, Lesotho, Kenya and Namibia

- Relevant Experience:

  Stephen gained six years of experience in the field of Geographic Information Systems mapping and spatial analysis working as a consultant for the KwaZulu-Natal Department of Health and then with an Environmental Impact Assessment company based in the Western Cape. In 2004 he set up the company Visual Resource Management Africa that specializes in visual resource management and visual impact assessments in Africa. The company makes use of the well-documented Visual Resource Management methodology developed by the Bureau of Land Management (USA) for assessing the suitability of landscape modifications. Stephen has assessed of over 150 major landscape modifications throughout southern and eastern Africa. The business has been operating for eight years and has successfully established and retained a large client base throughout Southern Africa which include amongst other, Rio Tinto (Pty) Ltd, Bannerman (Pty) Ltd, Anglo Coal (Pty) Ltd, Eskom (Pty) Ltd, NamPower and Vale (Pty) Ltd, Ariva (Pty) Ltd, Harmony Gold (Pty) Ltd, Millennium Challenge Account (USA), Pretoria Portland Cement (Pty) Ltd.

- Languages:
    - English – First Language
    - Afrikaans – fair in speaking, reading and writing

- Projects:

  A list of ***some*** of the large scale projects that VRMA has assessed has been attached below with the client list indicated per project (Refer to www.vrma.co.za for a full list of projects undertaken).

Table 5: VRM Africa Projects Assessments Table

YEAR	NAME	DESCRIPTION	LOCATION
2018	Mogara PV	Solar Energy	Northern Cape (SA)
2018	Gaetsewe PV	Solar Energy	Northern Cape (SA)
2017	Kalungwishi Hydroelectric (2) and power line	Hydroelectric	Zambia
2017	Mossel Bay UISP (Kwanoqaba)	Settlement	Western Cape (SA)
2017	Pavua Dam and HEP	Hydroelectric	Mozambique (SA)
2017	Penhill UISP Settlement (Cape Town)	Settlement	Western Cape (SA)
2016	Kokerboom WEF * 3	Renewable Wind Energy	Northern Cape (SA)
2016	Hotazel PV	Solar Energy	Northern Cape (SA)
2016	Eskom Sekgame Bulkop Power Line	Infrastructure	Northern Cape (SA)
2016	Ngonye Hydroelectric	Hydroelectric	Zambia
2016	Levensdal Infill	Settlement	Western Cape (SA)
2016	Arandis CSP	Solar Energy	Namibia
2016	Bonnievale PV	Solar Energy	Western Cape (SA)
2015	Noblesfontein 2 & 3 WEF (Scoping)	Renewable Wind Energy	Eastern Cape (SA)
2015	Ephraim Sun SEF	Solar Energy	Northern Cape (SA)
2015	Dyasonsklip and Sirius Grid TX	Solar Energy	Northern Cape (SA)
2015	Dyasonsklip PV	Solar Energy	Northern Cape (SA)
2015	Zeerust PV and transmission line	Solar Energy	North West (SA)
2015	Bloemsmond SEF	Solar Energy	Northern Cape (SA)
2015	Juwi Copperton PV	Solar Energy	Northern Cape (SA)
2015	Humansrus Capital 14 PV	Solar Energy	Northern Cape (SA)
2015	Humansrus Capital 13 PV	Solar Energy	Northern Cape (SA)
2015	Spitzkop East WEF (Scoping)	Solar Energy	Western Cape (SA)
2015	Lofdal Rare Earth Mine and Infrastructure	Mining	Namibia
2015	AEP Kathu PV	Solar Energy	Northern Cape (SA)
2014	AEP Mogobe SEF	Solar Energy	Northern Cape (SA)
2014	Bonnievale SEF	Solar Energy	Western Cape (SA)
2014	AEP Legoko SEF	Solar Energy	Northern Cape (SA)
2014	Postmasburg PV	Solar Energy	Northern Cape (SA)
2014	Joram Solar	Solar Energy	Northern Cape (SA)
2014	RERE PV Postmasberg	Solar Energy	Northern Cape (SA)
2014	RERE CPV Upington	Solar Energy	Northern Cape (SA)
2014	Rio Tinto RUL Desalinisation Plant	Industrial	Namibia
2014	NamPower PV * 3	Solar Energy	Namibia
2014	Pemba Oil and Gas Port Expansion	Industrial	Mozambique
2014	Brightsource CSP Upington	Solar Energy	Northern Cape (SA)

2014	Witsand WEF (Scoping)	Renewable Wind Energy	Western Cape (SA)
2014	Kangnas WEF	Renewable Wind Energy	Western Cape (SA)
2013	Cape Winelands DM Regional Landfill	Industrial	Western Cape (SA)
2013	Drennan PV Solar Park	Solar Energy	Eastern Cape (SA)
2013	Eastern Cape Mari-culture	Mari-culture	Eastern Cape (SA)
2013	Eskom Pantom Pass Substation	Substation /Tx lines	Western Cape (SA)
2013	Frankfort Paper Mill	Plant	Free State (SA)
2013	Gibson Bay Farm Transmission lines	Transmission lines	Eastern Cape (SA)
2013	Houhoek Eskom Substation	Substation /Tx lines	Western Cape (SA)
2013	Mulilo PV Solar Energy Sites (x4)	Solar Energy	Northern Cape (SA)
2013	Namies Wind Energy Facility	Renewable Wind Energy	Northern Cape (SA)
2013	Rossing Z20 Pit and WRD	Mining	Namibia
2013	SAPPI Boiler Upgrade	Plant	Mpumalanga (SA)
2013	Tumela WRD	Mine	North West (SA)
2013	Weskusfleur Substation (Koeburg)	Substation /Tx lines	Western Cape (SA)
2013	Yzermyn coal mine	Mining	Mpumalanga (SA)
2012	Afrisam	Mining	Western Cape (SA)
2012	Bitterfontein	Solar Energy	Northern Cape (SA)
2012	Kangnas PV	Solar Energy	Northern Cape (SA)
2012	Kangnas Wind Farm	Renewable Wind Energy	Northern Cape (SA)
2012	Kathu CSP Tower	Solar Energy	Northern Cape (SA)
2012	Kobong Hydro	Hydro & Powerline	Lesotho
2012	Letseng Diamond Mine Upgrade	Mining	Lesotho
2012	Lunsklip Wind Farm	Renewable Wind Energy	Western Cape (SA)
2012	Mozambique Gas Engine Power Plant	Plant	Mozambique
2012	Ncondezi Thermal Power Station	Substation /Tx lines	Mozambique
2012	Sasol CSP Tower	Solar Power	Free State (SA)
2012	Sasol Upington CSP Tower	Solar Power	Northern Cape (SA)
2011	Beaufort West PV Solar Power Station	Solar Energy	Western Cape (SA)
2011	Beaufort West Wind Farm	Renewable Wind Energy	Western Cape (SA)
2011	De Bakke Cell Phone Mast	Structure	Western Cape (SA)
2011	ERF 7288 PV	Solar Energy	Western Cape (SA)
2011	Gecko Industrial park	Industrial	Namibia
2011	Green View Estates	Residential	Western Cape (SA)
2011	Hoodia Solar	Solar Energy	Western Cape (SA)
2011	Kalahari Solar Power Project	Solar Energy	Northern Cape (SA)

2011	Khanyisa Power Station	Power Station	Western Cape (SA)
2011	Olvyn Kolk PV	Solar Energy	Northern Cape (SA)
2011	Otjikoto Gold Mine	Mining	Namibia
2011	PPC Rheebieck West Upgrade	Industrial	Western Cape (SA)
2011	George Southern Arterial	Road	Western Cape (SA)
2010	Bannerman Etango Uranium Mine	Mining	Namibia
2010	Bantamsklip Transmission	Transmission	Eastern Cape (SA)
2010	Beaufort West Urban Edge	Mapping	Western Cape (SA)
2010	Bon Accord Nickel Mine	Mining	Mpumalanga (SA)
2010	Etosha National Park Infrastructure	Housing	Namibia
2010	Herolds Bay N2 Development Baseline	Residential	Western Cape (SA)
2010	MET Housing Etosha	Residential	Namibia
2010	MET Housing Etosha Amended MCDM	Residential	Namibia
2010	MTN Lattice Hub Tower	Structure	Western Cape (SA)
2010	N2 Herolds Bay Residental	Residential	Western Cape (SA)
2010	Onifin(Pty) Ltd Hartenbos Quarry Extension	Mining	Western Cape (SA)
2010	Still Bay East	GIS Mapping	Western Cape (SA)
2010	Vale Moatize Coal Mine and Railway	Mining / Rail	Mozambique
2010	Vodacom Mast	Structure	Western Cape (SA)
2010	Wadrif Dam	Dam	Western Cape (SA)
2009	Asazani Zinyoka UISP Housing	Residential Infill	Western Cape (SA)
2009	Eden Telecommunication Tower	Structure	Western Cape (SA)
2009	George SDF Landscape Characterisation	GIS Mapping	Western Cape (SA)
2009	George SDF Visual Resource Management	GIS Mapping	Western Cape (SA)
2009	George Western Bypass	Road	Western Cape (SA)
2009	Knysna Affordable Housing Heidevallei	Residential Infill	Western Cape (SA)
2009	Knysna Affordable Housing Hornlee Project	Residential Infill	Western Cape (SA)
2009	Rossing Uranium Mine Phase 2	Mining	Namibia
2009	Sun Ray Renewable Energy Farm	Solar Energy	Western Cape (SA)
2008	Bantamsklip Transmission Lines Scoping	Transmission	Western Cape (SA)
2008	Erf 251 Damage Assessment	Residential	Western Cape (SA)
2008	Erongo Uranium Rush SEA	GIS Mapping	Namibia
2008	Evander South Gold Mine Preliminary VIA	Mining	Mpumalanga (SA)
2008	George SDF Open Spaces System	GIS Mapping	Western Cape (SA)
2008	Hartenbos River Park	Residential	Western Cape (SA)
2008	Kaaimans Project	Residential	Western Cape (SA)

2008	Lagoon Garden Estate	Residential	Western Cape (SA)
2008	Moquini Beach Hotel	Resort	Western Cape (SA)
2008	NamPower Coal fired Power Station	Power Station	Namibia
2008	Oasis Development	Residential	Western Cape (SA)
2008	RUL Sulpher Handling Facility Walvis Bay	Mining	Namibia
2008	Stonehouse Development	Residential	Western Cape (SA)
2008	Walvis Bay Power Station	Structure	Namibia
2007	Calitzdorp Retirement Village	Residential	Western Cape (SA)
2007	Calitzdorp Visualisation	Visualisation	Western Cape (SA)
2007	Camdeboo Estate	Residential	Western Cape (SA)
2007	Destiny Africa	Residential	Western Cape (SA)
2007	Droogfontein Farm 245	Residential	Western Cape (SA)
2007	Floating Liquified Natural Gas Facility	Structure tanker	Western Cape (SA)
2007	George SDF Municipality Densification	GIS Mapping	Western Cape (SA)
2007	Kloofsig Development	Residential	Western Cape (SA)
2007	OCGT Power Plant Extension	Structure Power Plant	Western Cape (SA)
2007	Oudtshoorn Municipality SDF	GIS Mapping	Western Cape (SA)
2007	Oudtshoorn Shopping Complex	Structure	Western Cape (SA)
2007	Pezula Infill (Noetzie)	Residential	Western Cape (SA)
2007	Pierpoint Nature Reserve	Residential	Western Cape (SA)
2007	Pinnacle Point Golf Estate	Golf/Residential	Western Cape (SA)
2007	Rheebok Development Erf 252 Apeal	Residential	Western Cape (SA)
2007	Rossing Uranium Mine Phase 1	Mining	Namibia
2007	Ryst Kuil/Riet Kuil Uranium Mine	Mining	Western Cape (SA)
2007	Sedgefield Water Works	Structure	Western Cape (SA)
2007	Sulpher Handling Station Walvis Bay Port	Industrial	Namibia
2007	Trekkopje Uranium Mine	Mining	Namibia
2007	Weldon Kaya	Residential	Western Cape (SA)
2006	Farm Dwarsweg 260	Residential	Western Cape (SA)
2006	Fynboskruin Extention	Residential	Western Cape (SA)
2006	Hanglip Golf and Residential Estate	Residential	Western Cape (SA)
2006	Hansmoeskraal	Slopes Analysis	Western Cape (SA)
2006	Hartenbos Landgoed Phase 2	Residential	Western Cape (SA)
2006	Hersham Security Village	Residential	Western Cape (SA)
2006	Ladywood Farm 437	Residential	Western Cape (SA)
2006	Le Grand Golf and Residential Estate	Residential	Western Cape (SA)
2006	Paradise Coast	Residential	Western Cape (SA)

2006	Paradyskloof Residential Estate	Residential	Western Cape (SA)
2006	Riverhill Residential Estate	Residential	Western Cape (SA)
2006	Wolwe Eiland Access Route	Road	Western Cape (SA)
2005	Harmony Gold Mine	Mining	Mpumalanga (SA)
2005	Knysna River Reserve	Residential	Western Cape (SA)
2005	Lagoon Bay Lifestyle Estate	Residential	Western Cape (SA)
2005	Outeniquabosch Safari Park	Residential	Western Cape (SA)
2005	Proposed Hotel Farm Gansevallei	Resort	Western Cape (SA)
2005	Uitzicht Development	Residential	Western Cape (SA)
2005	West Dunes	Residential	Western Cape (SA)
2005	Wilderness Erf 2278	Residential	Western Cape (SA)
2005	Wolwe Eiland Eco & Nature Estate	Residential	Western Cape (SA)
2005	Zebra Clay Mine	Mining	Western Cape (SA)
2004	Gansevallei Hotel	Residential	Western Cape (SA)
2004	Lakes Eco and Golf Estate	Residential	Western Cape (SA)
2004	Trekkopje Desalination Plant	Structure Plant	Namibia (SA)
1995	Greater Durban Informal Housing Analysis	Photogrametry	KwaZulu-Natal (SA)

12 ANNEXURE B: GENERAL LIGHTS AT NIGHT MITIGATIONS

Mitigation:

- Effective light management needs to be incorporated into the design of the lighting to ensure that the visual influence is limited to the mine, without jeopardising mine operational safety and security (See lighting mitigations by The New England Light Pollution Advisory Group (NELPAG) and Sky Publishing Corp in 14.2).
- Utilisation of specific frequency LED lighting with a green hue on perimeter security fencing.
- Directional lighting on the more exposed areas of operation, where point light source is an issue.
- No use of overhead lighting and, if possible, locate the light source closer to the operation.
- If possible, the existing overhead lighting method utilised at the mine should be phased out and replaced with an alternative lighting using closer to source, directed LED technology.

Mesopic Lighting

Mesopic vision is a combination of photopic vision and scotopic vision in low, but not quite dark, lighting situations. The traditional method of measuring light assumes photopic vision and is often a poor predictor of how a person sees at night. The light spectrum optimized for mesopic vision contains a relatively high amount of bluish light and is therefore effective for peripheral visual tasks at mesopic light levels. *(CIE, 2012)*

The Mesopic Street Lighting Demonstration and Evaluation Report by the Lighting Research Centre (LRC) in New York found that the 'replacement of white light sources (induction and ceramic metal halide) were tuned to optimize human vision under low light levels while remaining in the white light spectrum. Therefore, outdoor electric light sources that are tuned to how humans see under mesopic lighting conditions can be used to reduce the luminance of the road surface while providing the same, or better, visibility. Light sources with shorter wavelengths, which produce a "cooler" (more blue and green) light, are needed to produce better mesopic vision. Based on this understanding, the LRC developed a means of predicting visual performance under low light conditions. This system is called the unified photometry system. Responses to surveys conducted on new installations revealed that area residents perceived higher levels of visibility, safety, security, brightness, and colour rendering with the new lighting systems than with the standard *High-Purity Standards* (HPS) systems. The new lighting systems used 30% to 50% less energy than the HPS systems. These positive results were achieved through tuning the light source to optimize mesopic vision. Using less wattage and photopic luminance also reduces the reflectance of the light off the road surface. Light reflectance is a major contributor to light pollution (sky glow).' *(Lighting Research Center. New York. 2008)*

‘Good Neighbour – Outdoor Lighting’

Presented by the New England Light Pollution Advisory Group (NELPAG) *(http://cfa/ www.harvard .edu /cfa/ps/nelpag.html)* and Sky & Telescope *(http://SkyandTelescope.com/).* NELPAG and Sky & Telescope support the International Dark-Sky Association (IDA) *(http://www.darksky.org/).*
(NELPAG)

What is good lighting? Good outdoor lights improve visibility, safety, and a sense of security, while minimizing energy use, operating costs, and ugly, dazzling glare.

Why should we be concerned? Many outdoor lights are poorly designed or improperly aimed. Such lights are costly, wasteful, and distractingly glary. They harm the night-time environment and neighbours’ property values. Light directed uselessly above the horizon creates murky skyglow — the “light pollution” that washes out our view of the stars.

Glare Here’s the basic rule of thumb: If you can see the bright bulb from a distance, it’s a bad light. With a good light, you see lit ground instead of the dazzling bulb. “Glare” is light that beams directly from a bulb into your eye. It hampers the vision of pedestrians, cyclists, and drivers.

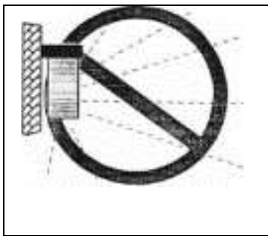
Light Trespass Poor outdoor lighting shines onto neighbours’ properties and into bedroom windows, reducing privacy, hindering sleep, and giving the area an unattractive, trashy look.

Energy Waste Many outdoor lights waste energy by spilling much of their light where it is not needed, such as up into the sky. This waste results in high operating costs. Each year we waste more than a billion dollars in the United States needlessly lighting the night sky.

Excess Lighting Some homes and businesses are flooded with much stronger light than is necessary for safety or security.

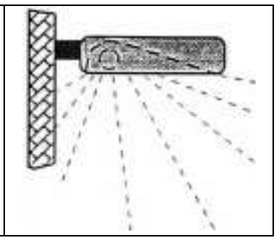
Good and Bad Light Fixtures

Typical “Wall Pack”



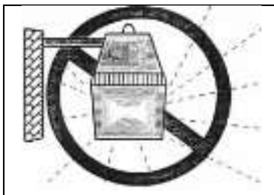
BAD
Waste light goes up and sideways

Typical “Shoe Box” (forward throw)



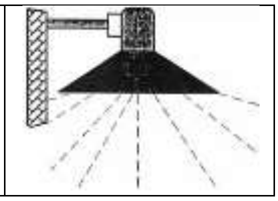
GOOD
Directs all light down

Typical “Yard Light”



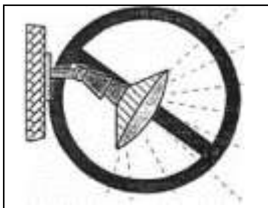
BAD
Waste light goes up and sideways

Opaque Reflector (lamp inside)



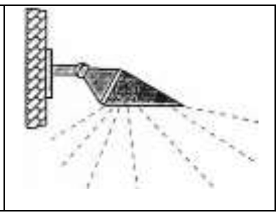
GOOD
Directs all light down

Area Flood Light



BAD
Waste light goes up and sideways

Area Flood Light with Hood



GOOD
Directs all light down

How do I switch to good lighting?

Provide only enough light for the task at hand; don’t over-light, and don’t spill light off your property. Specifying enough light for a job is sometimes hard to do on paper. Remember that a full Moon can make an area quite bright. Some lighting systems illuminate areas 100 times more brightly than the full Moon! More importantly, by choosing properly shielded lights, you can meet your needs without bothering neighbours or polluting the sky.

- Aim lights down. Choose “full-cutoff shielded” fixtures that keep light from going uselessly up or sideways. Full-cutoff fixtures produce minimum glare. They create a pleasant-looking environment. They increase safety because you see illuminated people, cars, and terrain, not dazzling bulbs.

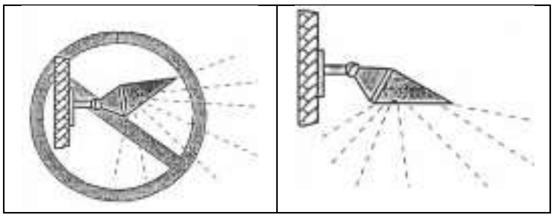
- Install fixtures carefully to maximize their effectiveness on the targeted area and minimize their impact elsewhere. Proper aiming of fixtures is crucial. Most are aimed too high. Try to install them at night, when you can see where all the rays actually go. Properly aimed and shielded lights may cost more initially, but they save you far more in the long run. They can illuminate your target with a low-wattage bulb just as well as a wasteful light does with a high-wattage bulb.

- If colour discrimination is not important, choose energy- efficient fixtures utilising yellowish high-pressure sodium (HPS) bulbs. If “white” light is needed, fixtures using compact fluorescent or metal-halide (MH) bulbs are more energy-efficient than those using incandescent, halogen, or mercury-vapour bulbs.

- Where feasible, put lights on timers to turn them off each night after they are no longer needed. Put home security lights on a motion-detector switch, which turns them on only when someone enters the area; this provides a great deterrent effect!

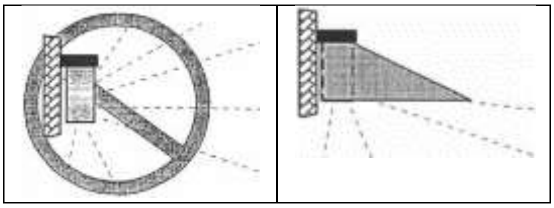
What You Can Do To Modify Existing Fixtures

Change this . . . | to this (aim downward)



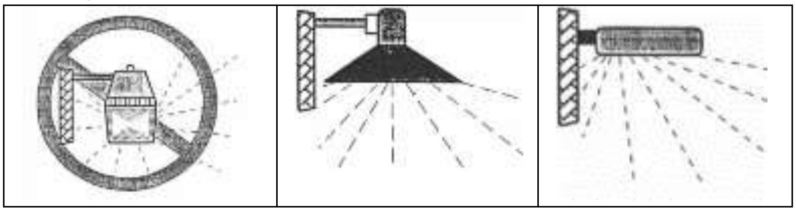
Floodlight:

Change this . . . | to this (aim downward)



Wall Pack

Change this . . . | to this | or this



Yard Light | Opaque Reflector | Show Box

Replace bad lights with good lights.

You’ll save energy and money. You’ll be a good neighbour. And you’ll help preserve our view of the stars.