ENVIRONMENTAL IMPACT ASSESSMENT FOR RE CAPITAL 13 PV, COPPERTON, NORTHERN CAPE PROVINCE

VISUAL STATEMENT
SPECIALIST REPORT

DRAFT: 20 August 2014

Document prepared on behalf of:
Cape Environmental Practitioners (Pty) Ltd
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GLOSSARY

Best Practicable Environmental Option (BPEO)
This is the option that provides the most benefit, or causes the least damage, to the environment as a whole, at a cost acceptable to society, in the long, as well as the short, term.

Cumulative Impact
The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

Impact (visual)
A description of the effect of an aspect of a development on a specified component of the visual, aesthetic or scenic environment, within a defined time and space.

Issue (visual)
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?"

Key Observation Points (KOPs)
KOPs refer to receptors (people affected by the visual influence of a project) located in the most critical locations 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.

Management Actions
Actions that enhance the benefits of a proposed development, or avoid, mitigate, restore or compensate for, negative impacts.

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.

Scoping
The process of determining the key issues, and the space and time boundaries, to be addressed in an environmental assessment.

Viewshed
The outer boundary defining a view catchment area, usually along crests and ridgelines. Similar to a watershed. This reflects the area in which, or the extent to which, the landscape modification is likely to be seen.

Zone of Visual Influence (ZVI)
The ZVI is defined as 'the area within which a proposed development may have an influence or effect on visual amenity.'

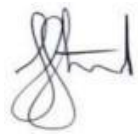
LIST OF ACRONYMS

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 and Development Planning (South Africa)
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
IDP	Infrastructure Development Plan
IEMA	Institute of Environmental Management and Assessment (United Kingdom)
IEMP	Integrated Environmental Management Plan
KOP	Key Observation Point
MET	Ministry of Environment and Tourism
MLA	Mine License Area
MME	Ministry of Mines and Energy
NNNP	Namib Naukluft National Park
MAMSL	Metres above mean sea level
NELPAG	New England Light Pollution Advisory Group
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

This document was completed by Silver Solutions 887 cc trading as VRM Africa, a Visual Impact Study and Mapping organisation located in George, South Africa. VRM Africa cc was appointed as an independent professional visual impact practitioner to facilitate this VIA.

This document was undertaken by the following team:

Stephen Stead	Director/ Visual Impact	APHP accredited VIA Practitioner
Lisa Schultz	Editing and Contrast Rating	Bachelor of Arts, Fine Art



Stephen Stead
APHP accredited VIA Specialist

1 INTRODUCTION

VRM Africa was appointed by RE Capital 13 (Pty) Ltd to undertake a Visual Statement of the proposed RE Capital 13: Solar Development. The site is situated near Copperton in the Northern Cape Province. A preliminary site visit was undertaken on the 5th August 2014.

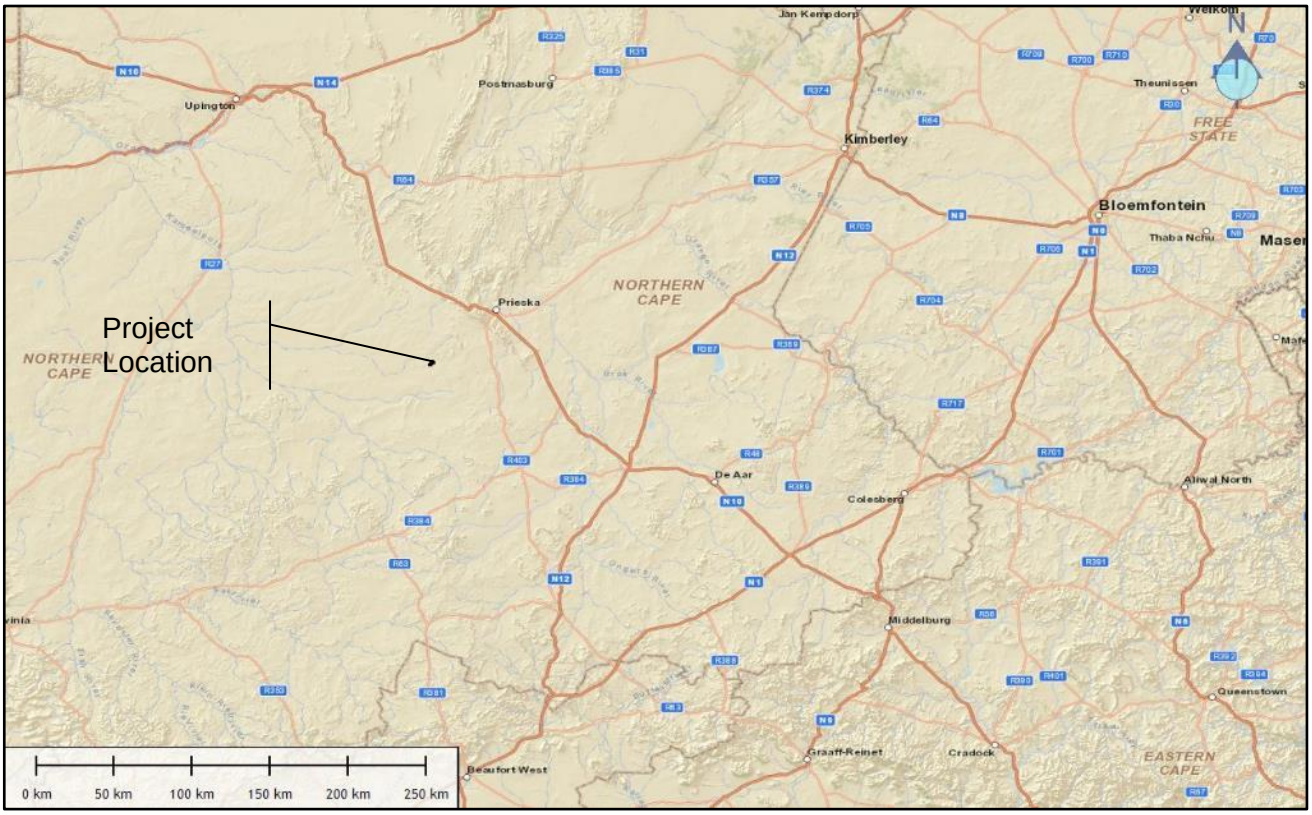


Figure 1: Regional locality map

1.1 Terms of Reference

Landscape significance is assessed by differentiating between those landscapes of recognized or potential significance or sensitivity to modification and landscapes that have low sensitivity and scenic value. Different levels of scenic values require different degrees 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. Assessing scenic values and determining visual impacts can be a subjective process. Objectivity and consistency can be greatly increased by using standard assessment criteria to describe and evaluate landscapes, and to also describe proposed projects.' *(USA Bureau of Land Management. 2004)*.

The scope of the study is to cover the entire proposed project area, and the terms of reference for the study are as follows:

- Quantifying and assessing existing scenic resources/visual characteristics on, and around, the proposed site.
- Determining visible extent, view corridors and important viewpoints in order to assess the probable visual impacts of the proposed project.
- Reviewing the legal framework that may have implications for visual/scenic resources.
- Assessing the visual significance of proposed project per phases of operation.

- If a detailed VIA is not required, motivating why further assessment is not required and making general recommendations regarding possible measures to reduce negative visual impacts for inclusion into the proposed project design, including input into the Environmental Management Plan (EMP).

1.2 Assumptions and Limitations

- Information pertaining to the specific heights of activities proposed for the development was limited and, where required, generic heights will be used to define the visibility of the project.
- Although every effort to maintain accuracy was undertaken, as a result of the Digital Elevation Model (DEM) being generated from satellite imagery and not being a true representation of the earth's surface, the viewshed mapping is approximate and may not represent an exact visibility incidence
- 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 (previously *Live Search Maps*, *Windows Live Maps*, *Windows Live Local*, and *MSN Virtual Earth*) and powered by the Enterprise framework
- The information for the terrain used in the 3D computer model on which the visibility analysis is based on is:
    - The Advanced Spaceborne Thermal Emission and Reflection (ASTER) Radiometer Data (ASTGTM_S2 3E014 and ASTGTM_S24E014 data set). ASTER GDEM is a product of Japan's Ministry of Economy, Trade and Industry (METI) and National Aeronautics and Space Administration (NASA) in USA. *(ASTER GDEM. METI / NASA. 2011)*
    - The ASTER DEM is utilised as a tool to determine broad-brush terrain variation and smaller scale terrain variations may not be reflected.
- Determining visual resources is a subjective process where absolute terms are not achievable. Evaluating a landscape's visual quality is complex, as assessment of the visual landscape applies mainly qualitative standards. Therefore, subjectivity cannot be excluded in the assessment procedure *(Lange 1994)*. 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. This study is based on assessment techniques and investigations that are limited by time and budgetary constraints applicable to the type and level of assessment undertaken. 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 proposed RE Capital 13 Solar Development will consist of a photovoltaic (PV) solar facility with a generation capacity of a 75 MW. The PV technology will consist of Photovoltaic (PV) panels, which will mounted on either fixed tilt or tracking structures (to be confirmed), orientated north. The Concentrated Photovoltaic facility (CPV) fixed-tilt solar mounting technology option would have a maximum height of 10m above ground level. *(Cape EAPrac. 2014).*

The key visual aspects of the project that the VIA will focus on include:

- **Solar energy plant:** A photovoltaic component comprising of numerous arrays of PV panels and associated PV module mountings to generate up to 75 MW.
- **Transmission lines:** 132 kV overhead transmission lines to connect each facility to the three central onsite substations
- **Substations:** There are three by substations onsite including the existing Eskom Kronos or Cuprum
- **Access Roads***:* There are 4 proposed access roads of 20 m, 40 m, 50 m and 100 m from the R357.

(Cape EAPrac. 2014).

Alternative Technologies

Alternatives proposed for the project include the use of the following activities and technologies:
There are two mounting alternatives:

- A fixed axis tracking system - the PV panels are installed at a set tilt and cannot move.
- A single axis tracking system - the panels follow the sun to ensure maximum exposure to sunlight. These have the highest efficiency level, the smallest footprint and lower development costs.

No Go Alternative

The No go alternative proposes that the status quo remains the same and that the proposed development does not go ahead. The No Go alternative is used to compare the proposed activities during the Impact Assessment phase of this process.

The photographs below show examples of existing solar energy photovoltaic (PV) projects.

Figure 2: Photograph example of solar panels
(Source: www.hawaiirenewableenergy.org/Villamesias2)

Figure 3: Example of tracking CPV solar panels
(Source: www. solar_tracker16 ecoforlife com au)

Figure 4: Example of solar power panels *(Source: Southern Califormia Gas* www.glenmosier.com*)*

Photograph of example of mounting *(Source: VRMA)*

Example of an existing 132 kV transmission line *(Source: VRMA)*

Substation with transformers at Sugarloaf Hill *(Source: www.grocotts.co.za)*

Figure 5: Examples of photographs of additional infrastructure

2.1 Planning

The proposed study site for the RE Capital 13 Solar Energy Project is approximately 475 ha in size (of which only 270ha will be developed) and is located approximately 48 km south west of Prieska and approximately 2 km east of Copperton. The town of Copperton falls within the SiyaThemba Local Municipality

SiyaThemba Local Municipality (LM) IDP

- The SiyaThemba LM has identified solar energy projects as one of their major economic activities.
- The area should develop a unique tourism brand of its own and be marketed on various platforms.

3 PROJECT LANDSCAPE CONTEXT

3.1 Project Visibility

The visible extent, or viewshed, is 'the outer boundary defining a view catchment area, usually along crests and ridgelines' *(Oberholzer, 2005).* This reflects the area, or extent, where a landscape modification of a specified height would probably be seen. In order to define the extent of the possible influence of the proposed project, a viewshed analysis is undertaken from the proposed sites at a specified height above ground level as indicated in the below table. The extent of the viewshed analysis was restricted to a defined distance that represents the approximate zone of visual influence (ZVI) of the proposed activities. The maps are informative only as visibility tends to diminish exponentially with distance, which is well recognised in visual analysis literature (*(Hull, R.B. and Bishop, I.E., 1988)*.

Table 1: Proposed Project Heights Table

Project Phase	Proposed Activity	Approx. Height (m)	Approx. ZVI (km)
Operation	PV and substation	10	8
Operation	Power line	20	2

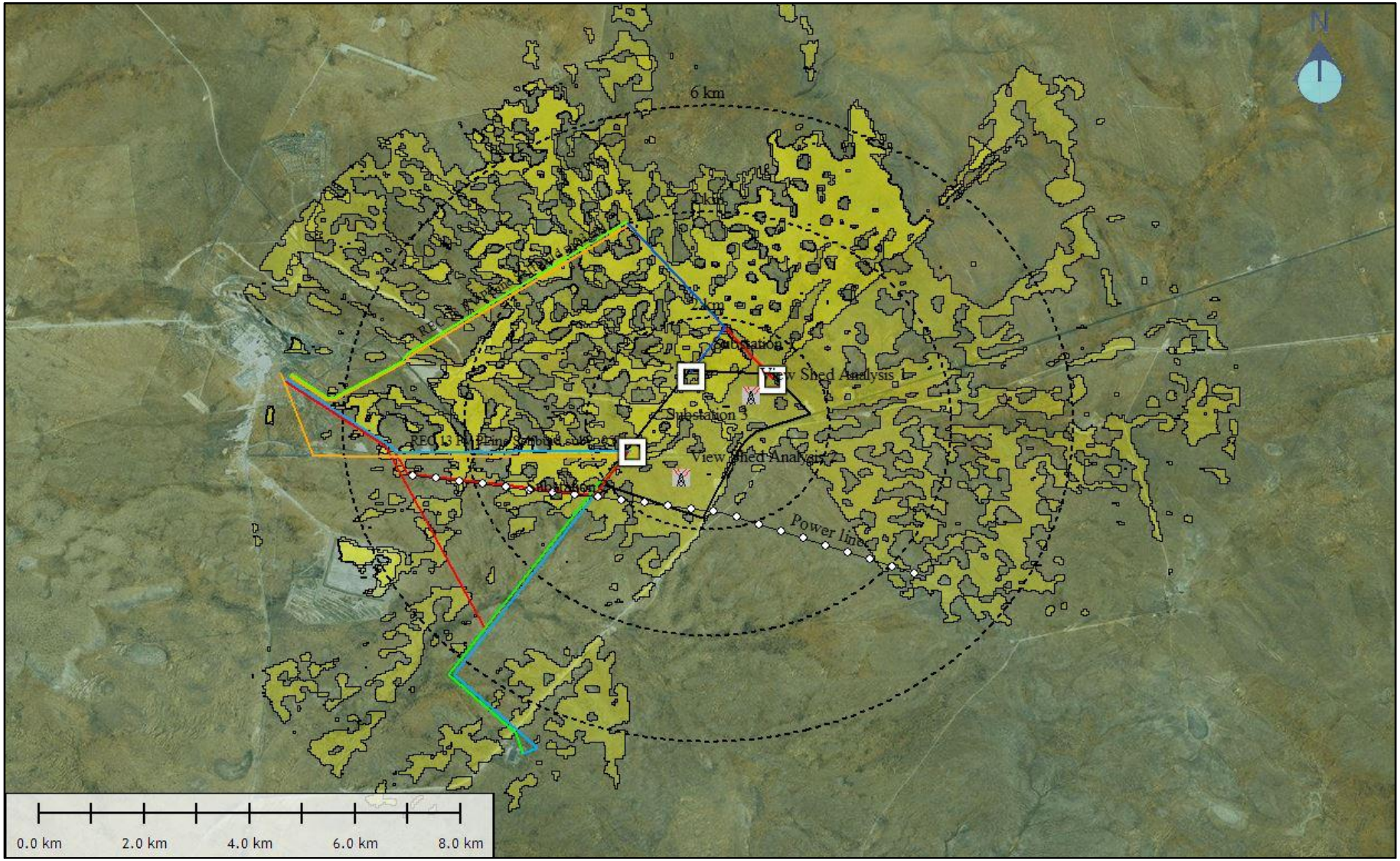


Figure 6: Proposed viewshed from site with offset 10m above ground level overlay onto satellite image map.

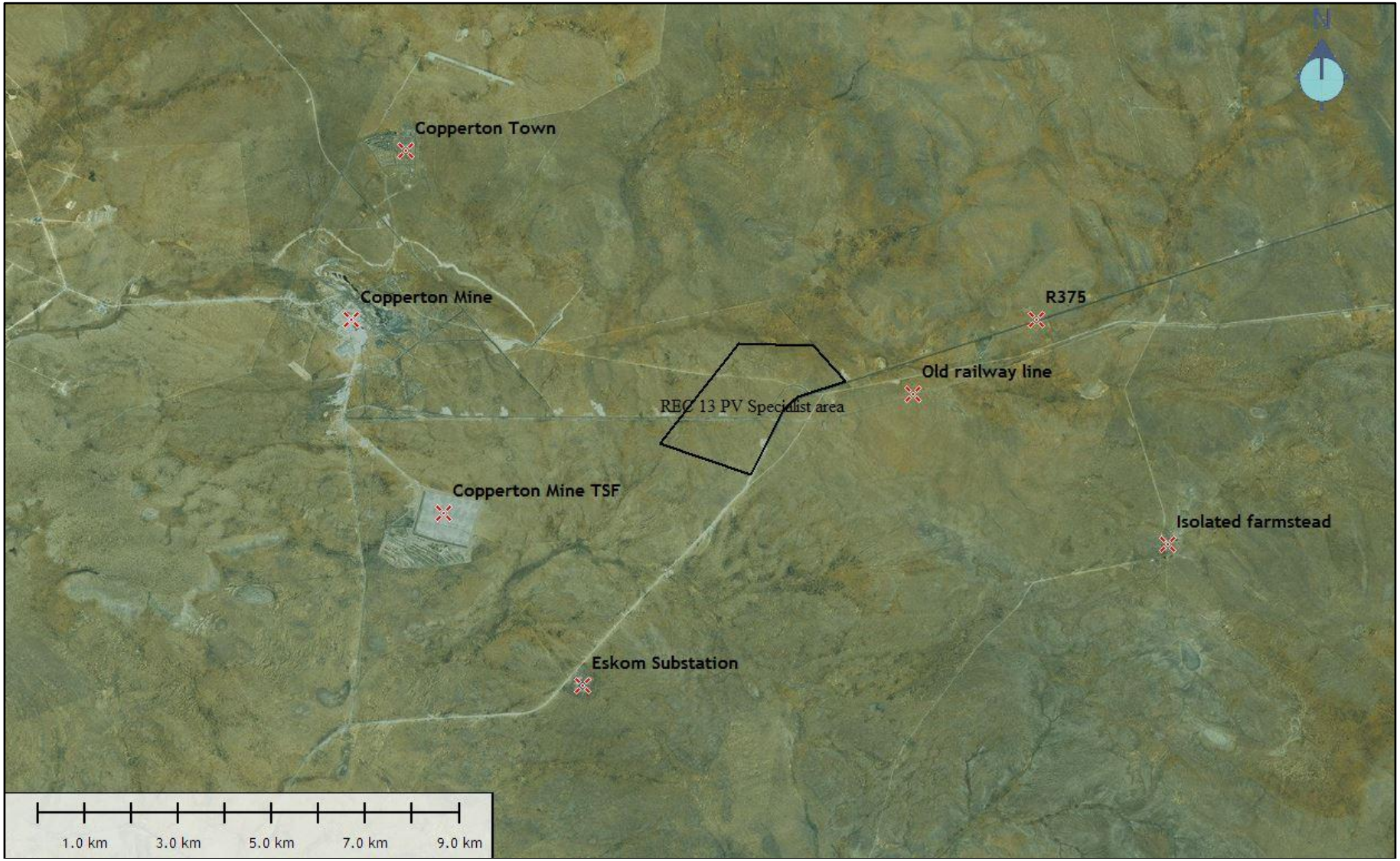


Figure 7: Locality of key landmarks located within the project approximate viewshed.

3.2 Landmarks

A broad brush regional landscape survey was undertaken to identify key features that define the landscape context within the project approximate viewshed area. The following landmarks were identified as significant in defining the surrounding areas characteristic landscape as indicated in the landmark locality map above:

- Copperton mine and tailing storage facility
- Eskom substation and powerlines
- Solar energy context
- R357 road
- Old railway line
- Isolated farmsteads

Copperton Mine

Figure 8: View of Copperton Mine headgear and Waste Rock Dumps as seen from the site

Figure 9: View of Copperton Mine Tailings Storage Facility as seen from the site

The nearest settlement to the site is Copperton, at a distance of 14.4 km, which was originally established for the workers of Copperton Mine. The mine opened in 1972 and closed in 1991 when the majority of the houses were demolished. Copperton was then sold to a private owner after the closing of the mine. The town is currently on a long-term lease by the Request Trust *(SiyaThemba Municipality IDP).* Although there are some trees and shrubs present, the sense of place is one of a derelict, small settlement. The resident population is approximately 70 people. The remaining built structures include the mineshaft, an adjacent concrete shed and large concrete storage tanks, as well as unused lighting pylons. A key features in the landscape is the Copperton Tailings Storage Facility (TSF) which is located to the west of the proposed site. The steep sided walls and light colour of the oxidised sands increases visual contrast, resulting in the TSF dominating the views of any casual observers.

Copperton Substation

Figure 10: View of existing Cuprum substation

The Cuprum Substation was built to serve Copperton Mine and still operates together with Kronos substation, which lies several kilometres to the south. There are existing powerlines that run through the area.

Local Solar Energy Context

As a result of the substation and the suitable conditions for solar energy generation, many solar energy projects are proposed in the surrounding areas. There are existing proposed renewable energy projects in the surrounding area. There would be new transmission lines, substations and new access roads associated with all the new developments

- A 10 MW PV has been approved close to the closed mine.
- There are a number of additional proposed PV facility sites currently being assessed; at Hoekplaas Dam Farm, at Struisbult (Portion 1 of Farm 104) and on Farm Hoekplaas (Remainder of Farm No. 146).
- There is an approved 190 turbine development which will occupy two sites between the R357 and the R386 to Carnarvon.
- A proposed 56 turbine wind energy farm is being considered on a site to the north of the Struisbult PV facility site.

As a result of the visual massing effect of the combined solar energy facilities, it is likely that the landscape will become highly modified and a change in the current sense of place is most likely.

Transport Infrastructure

Figure 11: View of the old railway line with the Copperton mine in the background

Figure 12: View east of the tarred section of the R357 road

The R357 links the N10 to the east to the small town of Vanwyksvlei in the west. The section between the N10 and the Copperton mine has been tarred. There are numerous minor gravel roads that divert off the main road to access isolated farming areas and farmsteads. Also evident in the landscape is the old railway line. The rails have been lifted but the flat support and cuttings are still apparent.

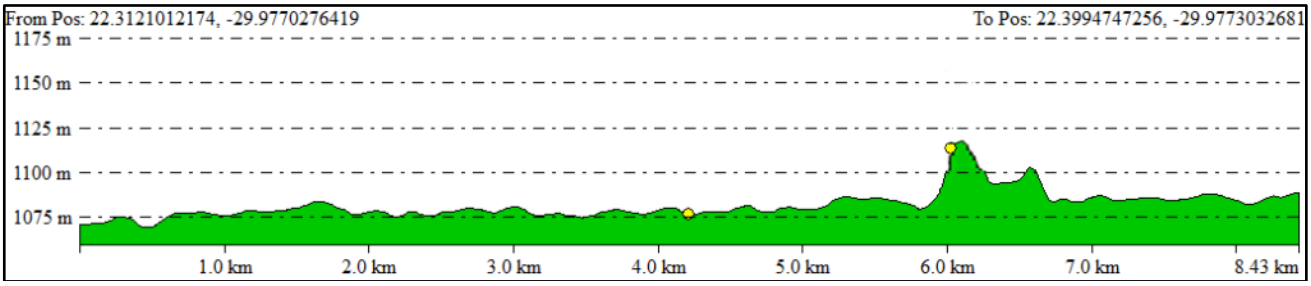
Isolated Farmsteads

Other than the mine, the landuse in the area is predominantly sheep farming which a few isolated farmsteads located in more sheltered topographic locations. Receptors residing at these areas would be more sensitive to landscape change, unless they were involved with other PV projects. There are no residential receptors living in any of the high visual exposure areas to the proposed project.

4 SITE REVIEW

The site is characterised by flat open terrain covered with Karoo scrub vegetation. As indicated in the profiles below, the west to east profile reflects little topographic undulation with the small spike representing the bridge that crosses over the old railway line. The north to south profile reflects more variation with the site north facing and the southern extents of the site situated on a shallow ridgeline. A slopes analysis indicated that there were a few steep slopes but these are associated with man-made modifications such as the bridge and borrow pits.

West to East



North to South

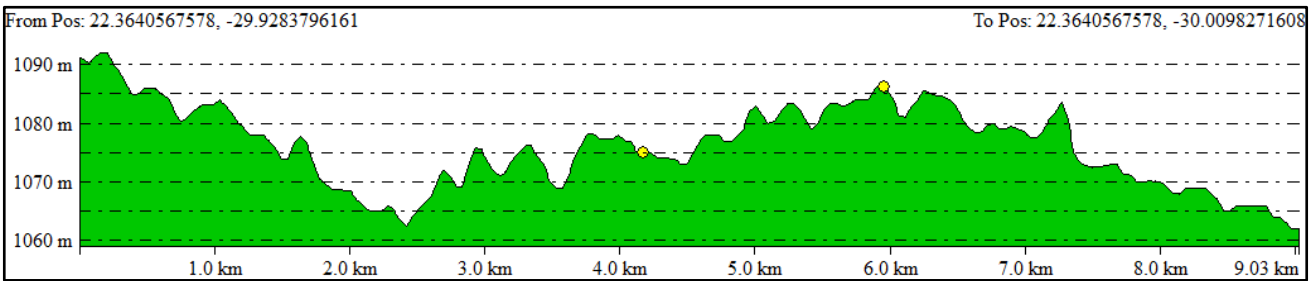


Figure 13: West-east and north-south profile lines which run though the proposed site

As indicated on Figure 14 below, landscape modifications on the site are limited to the old railway line, the road access to Copperton and some powerline infrastructure. Along the access road there are numerous borrow pits which degrade the immediate vicinity.

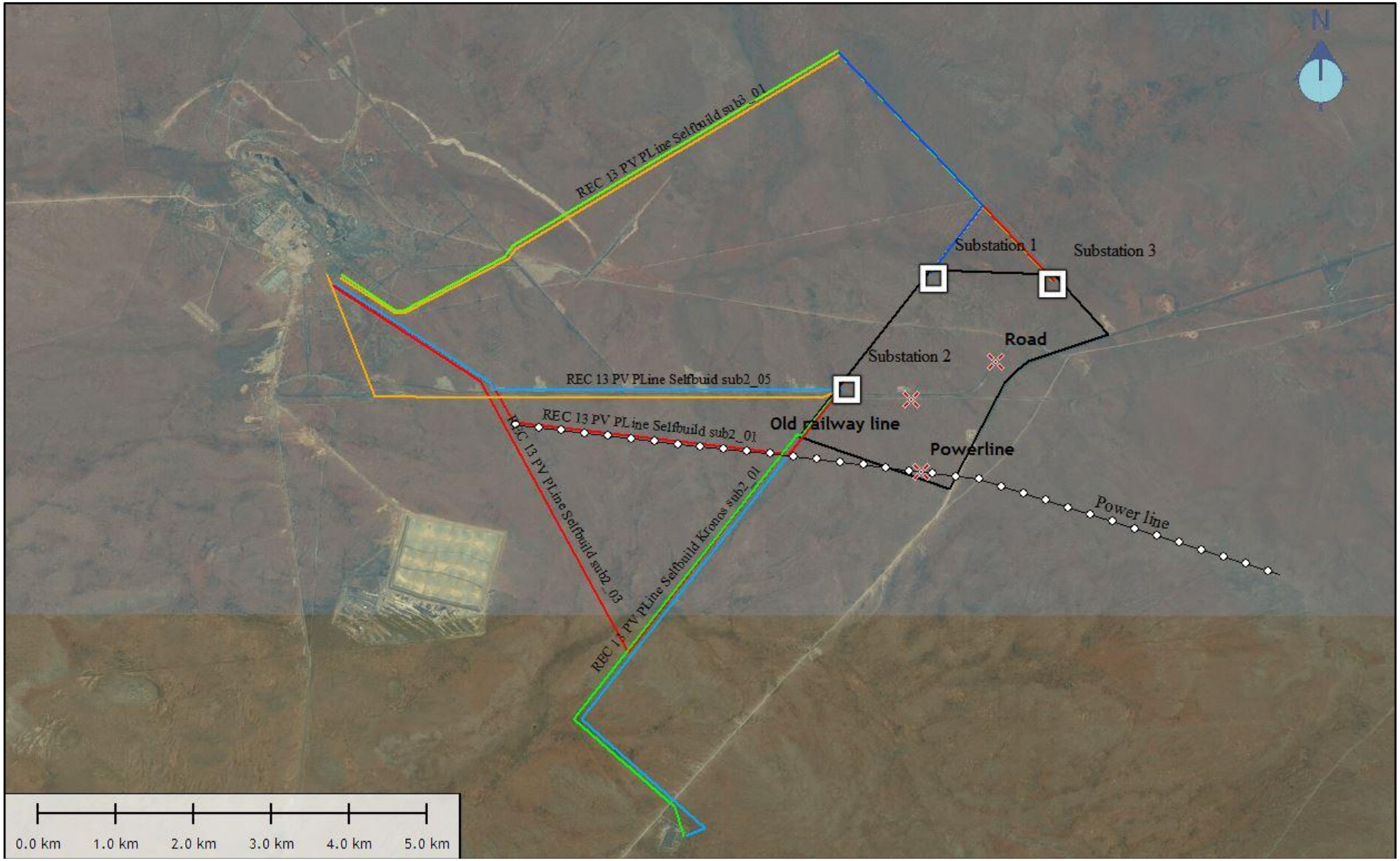


Figure 14: Proposed project and site features overlay onto satellite image map

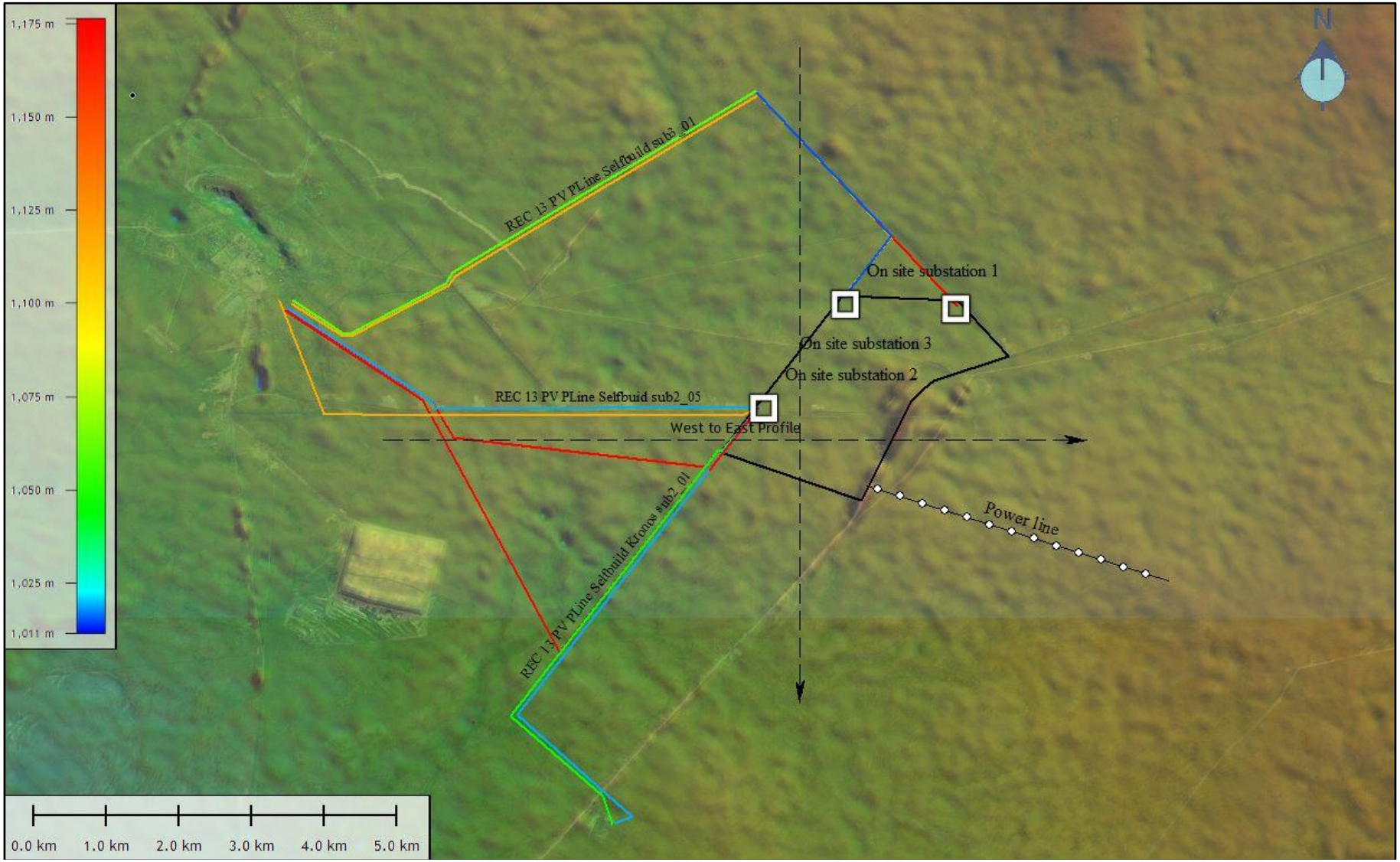


Figure 15: Broad-brush elevation model generated from ASTER data map

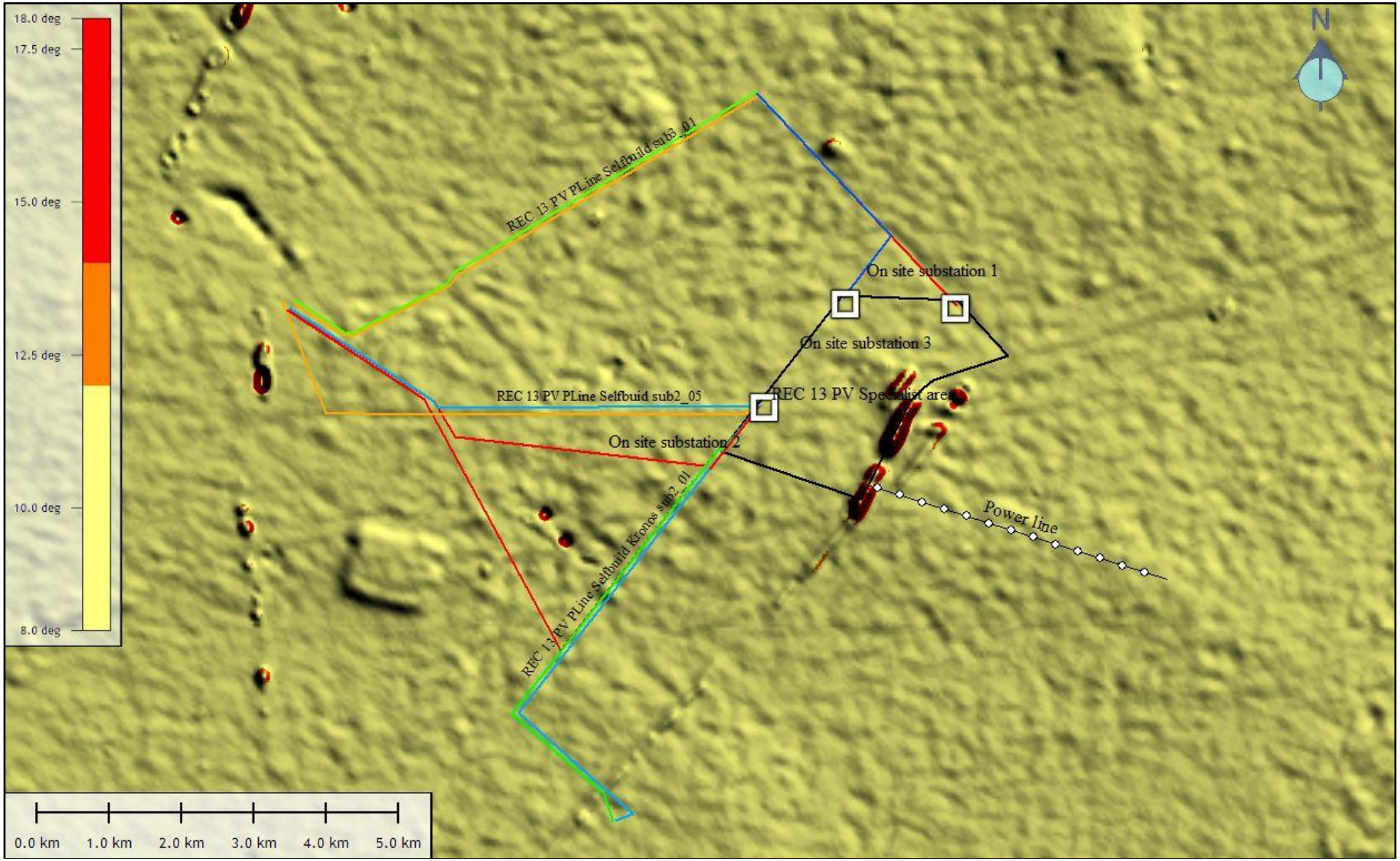


Figure 16: Broad-brush slopes analysis generated from ASTER Digital Elevation Model Map

Figure 17: View of existing transmission lines crossing the site.

Figure 18: View to north of site showing local sense of place with the railway line cutting and the Copperton mine in the distant background.

5 PRELIMINARY FINDINGS

A visual statement was requested by Cape Environmental Practitioners (Pty) Ltd on behalf of RE Capital 14 PV. A site visit to the area and surrounds was made on the 5th August 2014.

A viewshed analysis was undertaken for the photovoltaic technology options and transmission lines alternatives. Due to the flat terrain and the location of the southern extent of the proposed site on a shallow watershed, the visibility would cover most of the Foreground distance areas (up to 6km from site). The only receptor identified within the viewshed with high exposure was the R357 which is located adjacent to the proposed site.

A broad brush regional landscape survey was undertaken to identify key features that define the landscape context within the project approximate viewshed area. The following landmarks were identified as significant in defining the surrounding areas characteristic landscape:

- Copperton mine and tailing storage facility
- Eskom substation and powerlines
- Solar energy context
- R357 road
- Old railway line
- Isolated farmsteads

It was found that the proposed alternatives would not constitute a significant visual impact to the characteristic landscape and further detailed visual assessment is not necessary for the following reasons:

- The proposed project's close proximity to the Copperton mine and TSF.
- The old railway line and borrow pits degrade the landscape in the immediate vicinity.
- The area is an unofficial node for Solar Energy development with adjacent sites already having authorization.
- The alignment of the proposed project with municipal planning.

To assist in reducing the massing and crowing effects of the proposed PV structures the following is recommended:

- That a 75m No-Go buffer from the main roads (and Copperton access road) is implemented.
- To reduce visual intrusion from the possible multiple power lines linking up to different proposed PV projects in the vicinity, it is recommended that the power lines as much as possible follow existing transmission line corridors.
- Transmission lines are not routed within 50m of the roads.
- The lay down should be located away from the main roads.
- Dust control measures should be implemented.
- Lights at night have the potential to significantly increase the visual exposure of the proposed project. It is recommended that mitigations are implemented to reduce light spillage (refer to Addendum for general guidelines).
- There is a strong preference for Power Line 2_01 as it is further away from the roads.
- From a cumulative perspective, power lines should not be route on either side of the road i.e. one side of the road should be kept open with a preference for keeping eastern views away from the mine open.

6 REFERENCES

1. ASTER GDEM. METI / NASA. 2009. Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model Version 2 (GDEM V2 2011). Ministry of Economy, Trade, and Industry (METI) of Japan and United States National Aeronautics and Space Administration (NASA) Source: https://lpdaac.usgs.gov.
2. Cape EAPrac. Background Information Document for Kimbratrax Solar Project. Cape EAPrac. George. May 2013.
3. Cape EAPrac. 2014. Draft Environmental Impact Report for Capital 3: Solar Development. Cape EAPrac. George. Report Reference: KAI231/10.

7 ANNEXURE 1: SPECIALIST INFORMATION

7.1 Specialist Declaration of Independence

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

Specialist:	VRM AFRICA CC		
Contact person:	STEPHEN STEAD		
Postal address:	P.O BOX 7233, BLANCO		
Postal code:	6531	Cell:	083 560 9911
Telephone:	044 874 0020	Fax:	086 653 3738
E-mail:	steve@vrma.co.za		
Professional affiliation(s) (if any)	Association of Professional Heritage Practitioners South Africa (APHP)		

The specialist appointed in terms of the Regulations

I, **STEPHEN STEAD**, declare that ---

General declaration:

- I act as the independent specialist in this application
  I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct;
  and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SILVER SOLUTIONS TRADING AS VRM AFRICA

Name of company (if applicable):

23 JANUARY 2013

Date:

7.2 Curriculum Vitae

Curriculum Vitae (CV)

1. **Position**: Owner / Director
2. **Name of Firm**: Visual Resource Management Africa cc *(www.vrma.co.za)*
3. **Name of Staff**: Stephen Stead
4. **Date of Birth**: 9 June 1967
5. **Nationality:** South African
6. **Contact Details:** **Tel: +27 (0) 44 876 0020**
   Cell: +27 (0) 83 560 9911
   Email: steve@vrma.co.za

7. **Educational qualifications**:
   - University of Natal (Pietermaritzburg):
   - Bachelor of Arts: Psychology and Geography
   - Bachelor of Arts (Hons): Human Geography and Geographic Information Management Systems

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

9. **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)

10. **Conferences Attended:**
    - IAIAsa 2012
    - IAIAsa 2011
    - IAIA International 2011 (Mexico)
    - IAIAsa 2010
    - IAIAsa 2009
    - IAIAsa 2007

11. **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)

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

13. **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 which 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. In association with ILASA qualified landscape architect Liesel Stokes, he has assessed of over 100 major landscape modifications through-out 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, Mellium Challenge Account (USA), Pretoria Portland Cement (Pty) Ltd

14. Languages:

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

15. 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).

YEAR	NAME	DESCRIPTION	LOCATION
2014	Joram Solar	Solar Energy	Northern Cape
2014	RERE PV Postmasberg	Solar Energy	Northern Cape
2014	RERE CPV Upington	Solar Energy	Northern Cape
2014	Rio Tinto RUL Desalinisation Plant	Industrial	Namibia
2014	NamPower PV	Solar Energy	Namibia
2014	Pemba Oil and Gas Port Expansion	Industrial	Mozambique
2014	Brightsource CSP Upington	Solar Energy	Northern Cape
2013	Cape Winelands DM Regional Landfill	Industrial	Western Cape
2013	Drennan PV Solar Park	PV Solar Energy	Eastern Cape
2013	Eastern Cape Mari-culture	Mari-culture	Eastern Cape
2013	Eskom Pantom Pass Substation	Substation /Tx lines	Knysna
2013	Frankfort Paper Mill	Plant	Free State
2013	Gibson Bay Wind Farm Transmission lines	Tranmission lines	Eastern Cape
2013	Houhoek Eskom Substation	Substation /Tx lines	Western Cape
2013	Mulilo PV Solar Energy Sites (x4)	PV Solar Energy	Northern Cape
2013	Namies Wind Farm	Wind Energy	Northern Cape
2013	Rossing Z20 Pit and WRD	Mining	Namibia
2013	SAPPI Boiler Upgrade	Plant	Mpumalanga
2013	Tumela WRD	Mine	North West
2013	Weskusfleur Substation (Koeburg)	Substation /Tx lines	Western Cape
2013	Yzermyn coal mine	Mine	Mpumalanga
2012	Afrisam	Mine	Saldana
2012	Bitterfontein	PV Energy	N Cape
2012	Bitterfontein slopes	Slopes Analysis	N Cape
2012	Kangnas PV	Energy	N Cape
2012	Kangnas Wind	Energy	N Cape
2012	Kathu CSP Tower	Solar Power	Northern Cape

2012	Kobong Hydro	Hydro & Powerline	Lesotho
2012	Letseng Diamond Mine Upgrade	Mine	Lesotho
2012	Lunsklip Windfarm	Windfarm	Stilbaai
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
2012	Sasol Upington CSP Tower	Solar Power	Northern Cape
2011	Beaufort West PV Solar Power Station	Power Station	Beaufort West
2011	Beaufort West Wind Farm	Wind Energy	Beaufort West
2011	De Bakke Cell Phone Mast	Mast	Western Cape
2011	ERF 7288 PV	PV	Beaufort West
2011	Gecko Industrial park	Industrial	Namibia
2011	Green View Estates	Residential	Mossel Bay
2011	Hoodia Solar	PV expansion	Beaufort West
2011	Kalahari Solar Power Project	Solar Power	Northern Cape
2011	Khanyisa Power Station	Power Station	Western Cape
2011	Laingsburg Windfarm	Level 4	Mpumalanga
2011	Olvyn Kolk PV	Solar Power	Northern Cape
2011	Otjikoto Gold Mine	Mining	Namibia
2011	PPC Rheebieck West Upgrade	Industrial	
2011	Slopes analysis Erf 7288 Beaufort West	Slopes	Beaufort West
2011	Southern Arterial	Road	George
2010	Bannerman Etango Uranium Mine	Mining	Namibia
2010	Bantamsklip Transmission Revision	Transmission	Eastern Cape
2010	Beaufort West Urban Edge	Mapping	Beaufort West
2010	Bon Accord Nickel Mine	Mine	Barbeton
2010	Herolds Bay N2 Development Baseline	Residential	George
2010	MTN Lattice Hub Tower	Structure	George
2010	N2 Herolds Bay Residental	Residential	Herolds Bay
2010	Onifin(Pty) Ltd Hartenbos Quarry Extension	Mining	Mossel Bay
2010	Rossing South Board Meeting	Mining	Namibia
2010	Still Bay East	Mapping	SA, WC
2010	Vale Moatize Coal Mine and Railwayline	Mining_rail	Mozambique
2010	Vodacom Mast	Structure	Reichterbosch
2010	Wadrif Dam	Dam	Beaufort West
2009	Asazani Zinyoka UISP Housing	Residential Infill	Mossel Bay
2009	Bantamsklip GIS Mapping	Mappig	Western Cape
2009	Eden Telecommunication Tower	Structure Tower	George
2009	George Landscape Characterisation	George SDF	George
2009	George Western Bypass	Structure Road	George
2009	Rossing Uranium Mine Phase 2	Mining	Namibia
2009	Sun Ray Wind Farm	Wind Energy	Still Bay
2008	Bantamsklip Transmission Lines Scoping	Transmission	Western Cape

2008	Erf 251 Damage Assessment	Residential VIA	Great Brak
2008	Erongo Uranium Rush SEA	SEA	Namibia
2008	Evander South Gold Mine Preliminary VIA	Mining	Mpumalanga
2008	George Open Spaces System	George SDF	George
2008	GrooteSchuur Heritage Mapping	Mapping	Cape Town
2008	Hartenbos River Park	Residential VIA	Hartenbos
2008	Kaaimans Project	Residential	Wilderness
2008	Lagoon Garden Estate	Residential VIA	Great Brak
2008	Moquini Beach Hotel	Resort	Mossel Bay
2008	NamPower Coal fired Power Station	Power Station	Namibia
2008	Oasis Development	Residential VIA	Plettenberg Bay
2008	RUL Sulpher Handling Facility	Mining	Walvis Bay
2008	Stonehouse Development	Residential VIA	Plettenberg Bay
2008	Walvis Bay Power Station	Structure	Namibia.
2007	Calitzdorp Retirement Village	Residential VIA	Calitzdorp
2007	Calitzdorp Visualisation	Visualisation	Calitzdorp
2007	Camdeboo Estate	Residential VIA	Graaff Reinet
2007	Destiny Africa	Residential	George
2007	Droogfontein Farm 245	Residential VIA	Danabaai
2007	Floating Liquified Natural Gas Facility	Structure tanker	Mossel Bay
2007	George Municipality Densification	George SDF	George
2007	George Municipality SDF	George SDF	George
2007	Kloofsig Development	Residential VIA	Vleesbaai
2007	OCGT Power Plant Extension	Structure Power Plant	Mossel Bay
2007	Oudtshoorn Municipality SDF	Mapping	Oudtshoorn
2007	Oudtshoorn Shopping Complex	Structure Mall	Oudtshoorn
2007	Pezula Infill (Noetzie)	Residential VIA	Knysna
2007	Pierpoint Nature Reserve	Residential VIA	Knysna
2007	Pinnacle Point Golf Estate	Golf/Residential	Mossel Bay
2007	Rheebok Development Erf 252 Apeal	Residential VIA	Great Brak
2007	Rossing Uranium Mine Phase 1	Mining	Namibia
2007	Ryst Kuil/Riet Kuil Uranium Mine	Mining	Beaufort West
2007	Sedgefield Water Works	Structure	Sedgefield
2007	Sulpher Handling Station Walvis Bay Port	Industrial	Namibia
2007	Trekkopje Uranium Mine	Mining	Namibia
2007	Weldon Kaya	Residential VIA	Plettenberg Bay
2006	Fancourt Visualisation Modelling	Visualisation	George
2006	Farm Dwarsweg 260	Residential VIA	Great Brak
2006	Fynboskruin Extention	Residential VIA	Sedgefield
2006	Hanglip Golf and Residential Estate	Golf/Residential	Plettenberg Bay
2006	Hansmoeskraal	Slopes Analysis	George
2006	Hartenbos Landgoed Phase 2	Residential VIA	Hartenbos
2006	Hersham Security Village	Residential VIA	Great Brak

2006	Ladywood Farm 437	Residential VIA	Plettenberg Bay
2006	Le Grand Golf and Residential Estate	Golf/Residential	George
2006	Paradise Coast	Residential VIA	Mossel Bay
2006	Paradyskloof Residential Estate	Residential VIA	Stellenbosch
2006	Riverhill Residential Estate	Residential VIA	Wilderness
2006	Wolwe Eiland Access Route	Road	Victoria Bay
2005	Harmony Gold Mine	Mining	Mpumalanga.
2005	Knysna River Reserve	Residential VIA	Knysna
2005	Kruisfontein Infill	Mapping	Knysna
2005	Lagoon Bay Lifestyle Estate	Residential VIA	Glentana
2005	Outeniquabosch Safari Park	Residential	Mossel Bay
2005	Proposed Hotel Farm Gansevallei	Resort	Plettenberg Bay
2005	Uitzicht Development	Residential VIA	Knysna
2005	West Dunes	Residential VIA	Knysna
2005	Wilderness Erf 2278	Residential VIA	Wilderness
2005	Wolwe Eiland Eco & Nature Estate	Residential VIA	Victoria Bay
2005	Zebra Clay Mine	Mining	Zebra
2004	Gansevallei Hotel	Residential VIA	Plettenberg Bay
2004	Lakes Eco and Golf Estate	Golf/Residential	Sedgefield
2004	Trekkopje Desalination Plant	Structure Plant	Namibia
1995	Greater Durban Informal Housing Analysis	Photogrametry	Durban

8 ANNEXURE 2: 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/).*

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.

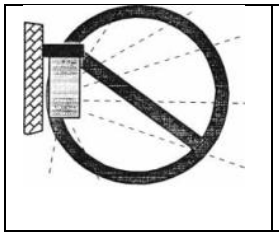
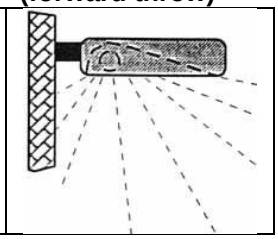
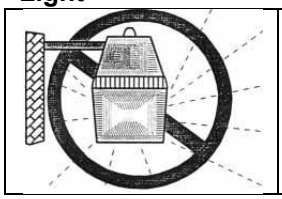
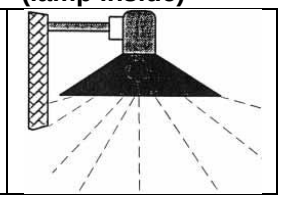
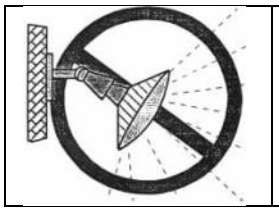
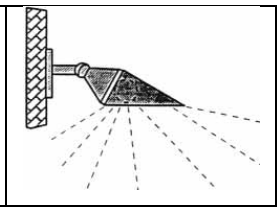
Glare Here’s the basic rule of thumb: If you can see the bright bulb from a distance, it’s a bad light. With a good light, you see lit ground instead of the dazzling bulb. “Glare” is light that beams directly from a bulb into your eye. It hampers the vision of pedestrians, cyclists, and drivers.

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”	**Typical “Shoe Box” (forward throw)**
	
BAD Waste light goes up and sideways	**GOOD** Directs all light down
Typical “Yard Light”	**Opaque Reflector (lamp inside)**
	
BAD Waste light goes up and sideways	**GOOD** Directs all light down
Area Flood Light	**Area Flood Light with Hood**
	
BAD Waste light goes up and sideways	**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.

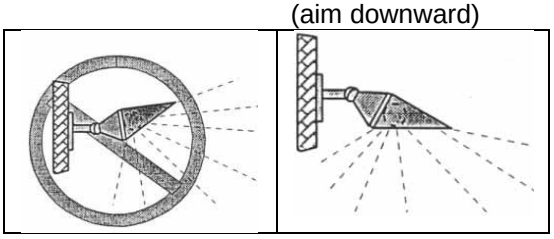
1. Aim lights down. Choose “full-cutoff shielded” fixtures that keep light from going uselessly up or sideways. Full-cutoff fixtures produce minimum glare. They create a pleasant-looking environment. They increase safety because you see illuminated people, cars, and terrain, not dazzling bulbs.

2. 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.

3. 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.

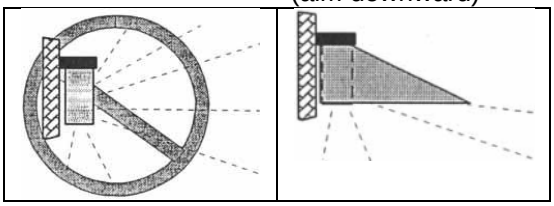
What You Can Do To Modify Existing Fixtures

Change this . . . to this (aim downward)



Floodlight:

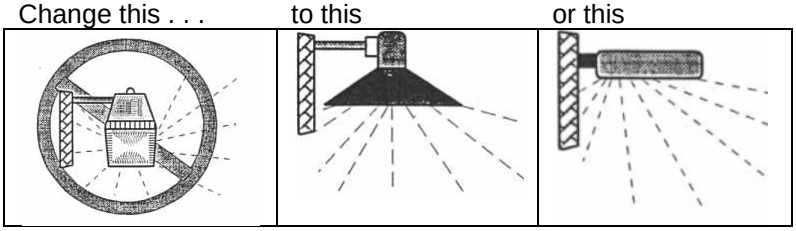
Change this . . . to this (aim downward)



Wall Pack

4. 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!

Change this . . . to this or this



Yard Light Opaque Reflecter 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.