

# APPENDIX J

## Ecosystem Services Assessment



May 2016

ACWA POWER AFRICA HOLDINGS (PTY)  
LTD

# Ecosystem Services Review and Impact Assessment: Proposed 75 MW PV1 Solar Power Development on the Remaining Extent of Farm Bokpoort 390, Northern Cape

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REPORT

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## Executive Summary

This report consists of an Ecosystem Services Review and Impact Assessment for the proposed Photovoltaic Facility 1 (PV1) of the Bokpoort II Solar Photovoltaic development, which ACWA Power intends to develop (the Project). The Project is located on the north-eastern portion of the Remaining Extent (RE) of the Farm Bokpoort 390, which is 20 km north-west of the town of Groblershoop within the !Kheis Local Municipality in the ZF Mgcawu District Municipality, Northern Cape Province. The total Bokpoort II project area designated for the development is approximately 1 500 ha. The Orange River is located approximately 12 km south-west of the site; water for the solar energy facility will be pumped from the Orange River to the facility via an underground pipeline.

Two principal natural vegetation types are predicted for the Study Area (Mucina & Rutherford 2006); Kalahari Karroid Shrubland and Gordonia Duneveld. The Orange River flows through the study area. Ecosystem services typically supplied by these habitats in the region include grazing for livestock (shrubland, duneveld and arid grassland), agricultural cultivation (Orange River floodplain), flood frequency regulation (Lower Gariep Alluvial Vegetation) and fresh water supply (Orange River). Other ecosystem services associated with the Orange River include provision of irrigation water for crop production, and water-based recreation and ecotourism activities, such as canoeing, fishing, nature appreciation (e.g. at Augrabies Falls National Park) and bird watching. The beneficiaries who use those services supplied by the ecosystems that could be affected by the Project were identified, and fall into the following categories: the local community, businesses, tourists, crop producers, and game farm owners.

The presence of the Project infrastructure will cause land cover changes and associated loss of supply of ecosystem services; it will also change the physical landscape of the area which lends itself to the visual amenity value of the landscape to local communities and tourists, which may result in impacts to tourism businesses. The abstraction of water for the Project will contribute to water demand in the Orange River, albeit on a relatively low scale.

Four priority Type I ecosystem services that may be impacted by the Project were identified:

- 1) **Fresh water supply:** The Project will contribute to cumulative effects on water balance, which may be negative by 2050, affecting water users reliant on Orange River for supply.
- 2) **Soil stability & erosion control:** Droughts and future effects of climate change could increase the likelihood of desertification encroachment in this region. Vegetation removal for site clearance will contribute, creating a 'nick point' for erosion to take hold.
- 3) **Recreation and ecotourism:**
  - The 60 000 ha Kalahari Oryx game farm to the immediate north of the site is a well-established commercial operation that markets high-end exclusive hunting packages to an international clientele. The contribution of the landscape to clients' 'wilderness experience' will be affected by the proposed PV1 facility, which could ultimately affect the livelihood of the game farm owner; and
  - The Project contribution to cumulative impacts on water quantity in the Orange River, in combination with other major water users, may affect its capacity to support tourism activities downstream such as fly fishing, canoe tours and white water rafting in the future.
- 4) **Ethical and spiritual values:** The view of the landscape and its contribution to people's (residents, tourists, road users) sense of place may become diminished by the presence of the PV1 facility development.

The presence of the Project infrastructure will cause land cover changes and reductions in the visual amenity value of the landscape, resulting in associated loss of supply of ecosystem services; it will also change the physical landscape of the area which lends itself to the cultural heritage and recreational and tourism value of the landscape to local communities.



In addition, the Project will also contribute to cumulative impacts on beneficiaries of priority ecosystem services that are also located within the viewshed of other solar energy developments in the region, as well as cumulative impacts on water quantity in the Orange River in the medium-long term.

Other than the actual direct and indirect effects of Project infrastructure and activities, maintenance of the Project's social licence to operate from affected beneficiaries is critical. It is therefore crucial that the mitigation hierarchy is followed and all efforts to avoid and minimise impacts on Orange River water quantity, soil stability and landscape viewsheds are made. In particular, implementation of the recommended measures to manage and prevent soil erosion, and reductions in the amount of process water being abstracted are key mitigation measures in reducing the Project's contribution to cumulative impacts within the study area, maintaining the Project's social license to operate in the area, and assisting the Project in maintaining operational performance.

The impacts on the visual amenity value of the landscape, users sense of place and consequent effects on recreation and tourism, and ethical and spiritual values cannot be mitigated as the benefits conferred by the landscape in its natural state are irreplaceable. The possibility of compensating the owners of the Kalahari Oryx Game Farm should be considered to compensate for potential loss of livelihood as a result of the changed landscape and effects on users sense of place. Where significant Project impacts on the landscape and associated effects on ecosystem service beneficiaries are unavoidable, the Project may need to obtain the free, prior and informed consent (FPIC) of the Affected Communities, as per IFC PS8 and PS1 requirements.



## DEFINITIONS

Term	Definition
<b>Assimilative capacity</b>	The capacity of the ambient environment, typically a body of water, to accept and dissipate pollutant discharges without exceeding environmental limits
<b>Carrying capacity</b>	The maximum population size of cattle that can be sustained indefinitely, given the amount of grass available in a given area.
<b>Cultural ecosystem service</b>	The nonmaterial contributions of ecosystems to human well-being, such as recreation, spiritual values, and aesthetic enjoyment.
<b>Ecosystem Integrity</b>	The structure, composition, and function of an ecosystem operating within the bounds of natural or historic range of variation.
<b>Ecosystem Resilience</b>	The capacity of an ecosystem to respond to a disturbance by resisting damage and recovering quickly.
<b>Ecosystem Function</b>	Refers to all of the natural ecological processes that occur within an ecosystem, and is dependent on the composition and extent of a particular habitat or combination of habitats; their integrity or intactness, and their resilience.
<b>Irreplaceability</b>	Relates to rarity or uniqueness of an ecosystem in the landscape.
<b>Study Area</b>	The spatial context for the study.
<b>Priority Ecosystem Services</b>	Those services on which project impacts affect the livelihoods, health, safety, or culture of the ecosystem service beneficiaries, and those services that could prevent the project from achieving planned operational performance.
<b>Project Area of Influence</b>	The area relevant to the assessment of project impacts and dependencies on priority ecosystem services; it includes the ecosystems that supply the priority ecosystem services, and the locations where the Project and affected stakeholders access priority ecosystem services.
<b>Provisioning Ecosystem Services</b>	The goods or products obtained from ecosystems, such as food, timber, fibre, and freshwater.
<b>Regulating Ecosystem Services</b>	The contributions to human well-being arising from an ecosystem's control of natural processes, such as climate regulation, disease control, erosion prevention, water flow regulation, and protection from natural hazards.
<b>Social Licence to Operate</b>	Social Licence to Operate (SLO) refers to the acceptance within local communities of both companies and their projects. In order to obtain an SLO it is necessary to develop good relationships with all stakeholders, especially with local communities.
<b>Supporting Ecosystem Services</b>	The natural processes such as nutrient cycling and primary production, which maintain the other services.
<b>Spiritual ecosystem services</b>	Sacred, religious, or other forms of spiritual inspiration derived from ecosystems.
<b>Vulnerability</b>	Refers to degree of threat to an ecosystem or species.



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**APPENDIX A**

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## 1.0 INTRODUCTION

This report consists of a desk-based Ecosystem Services Review and Impact Assessment for the proposed Photovoltaic Facility 1 (PV1) of the Bokpoort II Solar Photovoltaic development, which ACWA Power intends to develop (the Project). The Project is located on the north-eastern portion of the Remaining Extent (RE) of the Farm Bokpoort 390, which is 20 km north-west of the town of Groblershoop within the !Kheis Local Municipality in the ZF Mgcawu District Municipality, Northern Cape Province. The total Bokpoort II project area designated for the development is approximately 1 500 ha. The Orange River is located approximately 12 km south-west of the site; water for the solar energy facility will be pumped from the Orange River to the facility via an underground pipeline.

The report describes the ecosystem services supplied by the various land cover types in the Study Area, and the benefits that the local community gains from them under existing conditions. The services that the Project may impact are identified, and the beneficiaries of those ecosystem services identified. The potential impacts of the Project on Priority<sup>1</sup> Ecosystem Services (Landsberg, *et al.*, 2013) are assessed, and mitigation measures proposed for any adverse impacts on identified Priority Ecosystem Services.

### 1.1 The Concept of Ecosystem Services

Ecosystem services consist of all the natural products and processes that contribute to human well-being, as well as the personal and social enjoyment derived from nature (Landsberg, *et al.*, 2013). For example, riparian floodplains provide grazing for livestock, foraging opportunities for wading and water birds, and play a role in the regulation of flooding frequency and intensity downstream (Macfarlane, *et al.*, 2008).

- The benefits of ecosystems are passed on at many levels, and to many different beneficiaries. Examples of the benefits provided at different scales include:
- Local scale: Ecosystem services may be the basis for rural livelihoods and subsistence; particularly for the poor; for example, grasses and shrubland in an otherwise arid landscape are an important grazing resource for livestock, which provides both cash income and food for low-income families;
- Regional scale: Prevention of erosion and desertification through maintenance of natural vegetation conditions; and
- Global scale: Ecosystems regulate climate and act as a reservoir of biodiversity that underpins biological production of all types, including agriculture.

### 1.2 Ecosystem Services and the International Finance Corporation

The International Finance Corporation's (IFC) Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources (PS6) (IFC, 2012a), and its Guidance Notes (IFC, 2012b) - defines ecosystem services as **the benefits that people, including businesses, derive from ecosystems**. The IFC define two types of ecosystem services:

- **Type I Ecosystem Services:** Ecosystem Services on which the Project operations are most likely to have an impact and, therefore, which result in adverse impacts to affected communities (beneficiaries); and
- **Type II Ecosystem Services:** Ecosystem Services on which the Project is directly dependent for its operations, for example, water.

Although ecosystem services are largely addressed by IFC PS 6, the assessment of ecosystem services is spread throughout the environmental and social Performance Standards (PS) because the potential effects of a project on ecosystem services relates to all aspects of peoples' relationship with the environment, including health and safety risks, land ownership or usage, and cultural heritage.

<sup>1</sup> Priority ecosystem services are those where the significance of the project impact on the ecosystem services is considered likely to be high



The specific PS that contain provisions for ecosystem services assessment are Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts; Performance Standard 3: Resource Efficiency and Pollution Prevention; Performance Standard 4: Community Health, Safety, and Security; Performance Standard 5: Land Acquisition and Involuntary Resettlement; Performance Standard 7: Indigenous Peoples and Performance Standard 8: Cultural Heritage. These are described in section 5.6.

### 1.3 Regional Ecosystem Services Overview

The Project is located in a transitional area that includes elements of both the Savanna Biome and the Nama Karoo Biome. The Savanna Biome is defined by the co-dominance of grasses and trees (Sankaran *et al.* 2005), and is the largest biome in South Africa, covering approximately 35% of the country's land surface (Scholes & Walker 1993). Savannas are described as a patch-mosaic landscapes, comprising patches of grassland, scattered trees or closed woodlands, the relative proportions of which vary both spatially and temporally (Bond, 2008). The Nama Karoo Biome, the second largest biome in Southern Africa, is characterised by plains of dwarf shrubs and grasses, dotted with characteristic 'koppies' (rocky outcrop). It is essentially a grassy, dwarf shrubland; the ratio of grasses to shrubs increases progressively until the Nama Karoo merges with the Savanna Biome (Mucina & Rutherford, 2006).

Two principal natural vegetation types are predicted for the Study Area (Mucina & Rutherford 2006); Kalahari Karroid Shrubland and Gordonia Duneveld. The Orange River flows through the study area. Ecosystem services typically supplied by these ecosystems in the region include grazing for livestock (shrubland, duneveld and arid grassland), agricultural cultivation (Orange River floodplain), flood frequency regulation (Lower Gariep Alluvial Vegetation) and fresh water supply (Orange River). Other ecosystem services associated with the Orange River include provision of irrigation water for crop production, and water-based recreation and ecotourism activities, such as canoeing, fishing, nature appreciation (e.g. at Augrabies Falls National park) and bird watching.

### 1.4 Report Structure

The report is structured sequentially:

- The terms of reference are introduced in section 2.0 which provide the context for the study;
- Relevant international and national legislation and policy in terms of the Project's obligations to take ecosystem services into account are summarised in section 4.0;
- The methods used in the determination of the Study Area, identification of ecosystem services and beneficiaries within the Study Area, prioritisation of ecosystem services and impact assessment of those priority ecosystem services are detailed in section 3.0.
- Section 5.0 provides a summary of the baseline biodiversity, land cover, surface water and social context of the Study Area in order to identify ecosystem services and beneficiaries within the Study Area;
- Section 6.0 provides the process and results of the ecosystem service review for the Study Area, and the prioritisation of ecosystem services exercise;
- Section 7.0 describes the assessment of Project impact on Priority ecosystem services;
- Recommended mitigation measures are outlined in section 8.0;
- Cumulative impacts are discussed in section 9.0;
- Study conclusions are drawn in section 10.0; and
- References for the study are given in section 11.0.



## 2.0 TERMS OF REFERENCE

In determining the requirements of the Ecosystem Service Review and Impact Assessment for the Project, reference was made to the international guidance document 'Weaving Ecosystem Services into Impact Assessment' (Landsberg *et al.*, 2013), appropriate South African legislation and guidelines, as well as international standards and guidelines. National policy and international standards pertaining to the Project are detailed in section 4.0.

### 2.1 Objectives

The aim of this Ecosystem Services Review and Impact Assessment is to:

- Identify priority ecosystem services and goods currently supplied in the context of the area in which the Project will be located;
- Qualify the relationship between ecosystem services, the ecosystems that provide them, and the condition of those systems, and the current drivers of change of those systems;
- Identify beneficiaries of the services, that is, the Project and/or the people who benefit from the goods and services supplied, and their level of dependence on the ecosystem services;
- Identify potential impacts on priority ecosystem services arising from the Project and propose mitigation measures; and
- Identify any necessary additional areas of investigation.

### 2.2 Scope

In order to address the above objectives, and in line with the Scoping Report (Golder Associates Africa, 2015), a description and regional contextualisation of the baseline ecosystem services supplied and utilised within the Project area of influence was undertaken.

Using available regional data on ecosystem services in the Northern Cape, and pertinent data gathered from the biodiversity, socioeconomic, surface water and cultural heritage baseline studies, an assessment of the predicted Project effects on ecosystem services was conducted to meet the requirements of IFC PS6.

### 2.3 Assumptions and Limitations

- This assessment is a desk-based study, informed only by the data gathered as part of the biodiversity, cultural heritage, socioeconomic, landscape and visual baseline studies and economic cost benefit analysis;
- No assessment of the functionality of land cover types within the study, and thus their specific capacity to deliver ecosystem services, was conducted as part of the assessment;
- No ecosystem service supply and demand modelling was done for this study; and
- No specific stakeholder engagement processes were undertaken as part of the baseline data gathering for the ecosystem service review, the socioeconomic baseline or the cultural heritage baseline.

## 3.0 APPROACH AND METHODS

Ecosystem services are **the benefits that people and/or a project (the beneficiaries) obtain from ecosystems**. In the strictest sense, without beneficiaries, there are no ecosystem services. The benefits gained can be either physical or psychological, and can be obtained actively or passively, directly or indirectly. For the purposes of this assessment, the definitions of ecosystem services were based on those developed by the *Millennium Ecosystem Assessment* (MA, 2005), (Table 1). These definitions were chosen to keep consistency with the IFC's Performance Standards, and because they are widely recognised.



**Table 1: Ecosystems services categories (MA, 2005)**

Broad categories	Definition
Supporting services	Natural processes essential to resilience, and functioning of ecosystems. e.g., primary production.
Regulating services	Control of the natural environment, e.g., maintenance of key ecological processes, protected areas, habitat of special value, groundwater recharge, catchments.
Provisioning services	Supporting human needs, e.g., traditional hunting grounds, medicinal plants and minerals, water sources, fishing grounds, fire wood.
Cultural services	Aesthetic, spiritual, recreational, and other cultural values, e.g., sacred sites, recreation, sense of place.

As mentioned, without the beneficiaries (that is, the local community (Type I) and the Project (Type II)), there are no ecosystem services. In terms of a project's location, an understanding of the ecosystem processes occurring in the area is important, as it enables an understanding of how those processes affect the supply and demand of the ecosystem services arising from such processes, and the value the ecosystem services eventually offer to beneficiaries (i.e. ecosystem service **supply**). A conceptual ecosystem services flow path illustrating these supply linkages, using the photosynthesis process and the functions, services and benefits that flow from it as an example, is shown in Figure 1.



*Figure 1: The flow of ecosystem services to beneficiaries*

Given the above, and given that the assessment of ecosystem services is also concerned with the social aspects of the benefits of services (i.e. ecosystem service demand), the assessment of ecosystem services relied upon data gathered as part of the socio-economic baseline study (Golder Associates Africa, 2016a) and the cultural heritage baseline study (RHDHV, 2014). No stakeholder engagement processes were undertaken as part of the project. Other information for the ecosystem services assessment was gathered from the various specialist inputs to the baseline for the ESIA, during the Desktop Review (section 3.3).

### **3.1 Study Area**

As determined in the biodiversity impact assessment for PV1, one of the major effect on ecosystems supplying ecosystem services will be loss in extent due to site clearance and groundworks. These works are unlikely to be limited to the exact footprint of PV1 in isolation, therefore these impacts are instead considered as occurring within the extent of the Bokpoort II boundary. The scale at which effects on ethical and spiritual ecosystem services and recreation and tourism are expected to reach beyond the Project footprint, given the project visibility of the PV1 facility from distances up to 40 km, and potential effects on downstream recreational users of the Orange River. The scale of effect of water abstraction is also considered in the regional context for other water uses, such as commercial crop production, industry, and municipal use.

The focus of this assessment is therefore on ecosystem services at the regional and local scale to the Project, specifically, the Bokpoort II boundary within which the main PV1 project footprint will be located and site clearance works will take place, the area lying within the 40 km viewshed of PV1, and downstream users of the water resource provided by the Orange River.



This ecosystem services Study Area generally aligns with the study areas used for the socio-economic baseline assessment (Golder Associates Africa, 2016a) the biodiversity baseline assessment (Golder Associates Africa, 2016b), the surface water assessment (Golder Associates Africa, 2016c) and landscape and visual assessment (Golder Associates Africa, 2016d), and is illustrated on Figure 2.



# ECOSYSTEM SERVICES REVIEW AND IMPACT ASSESSMENT - 75 MW PV1 SOLAR DEVELOPMENT

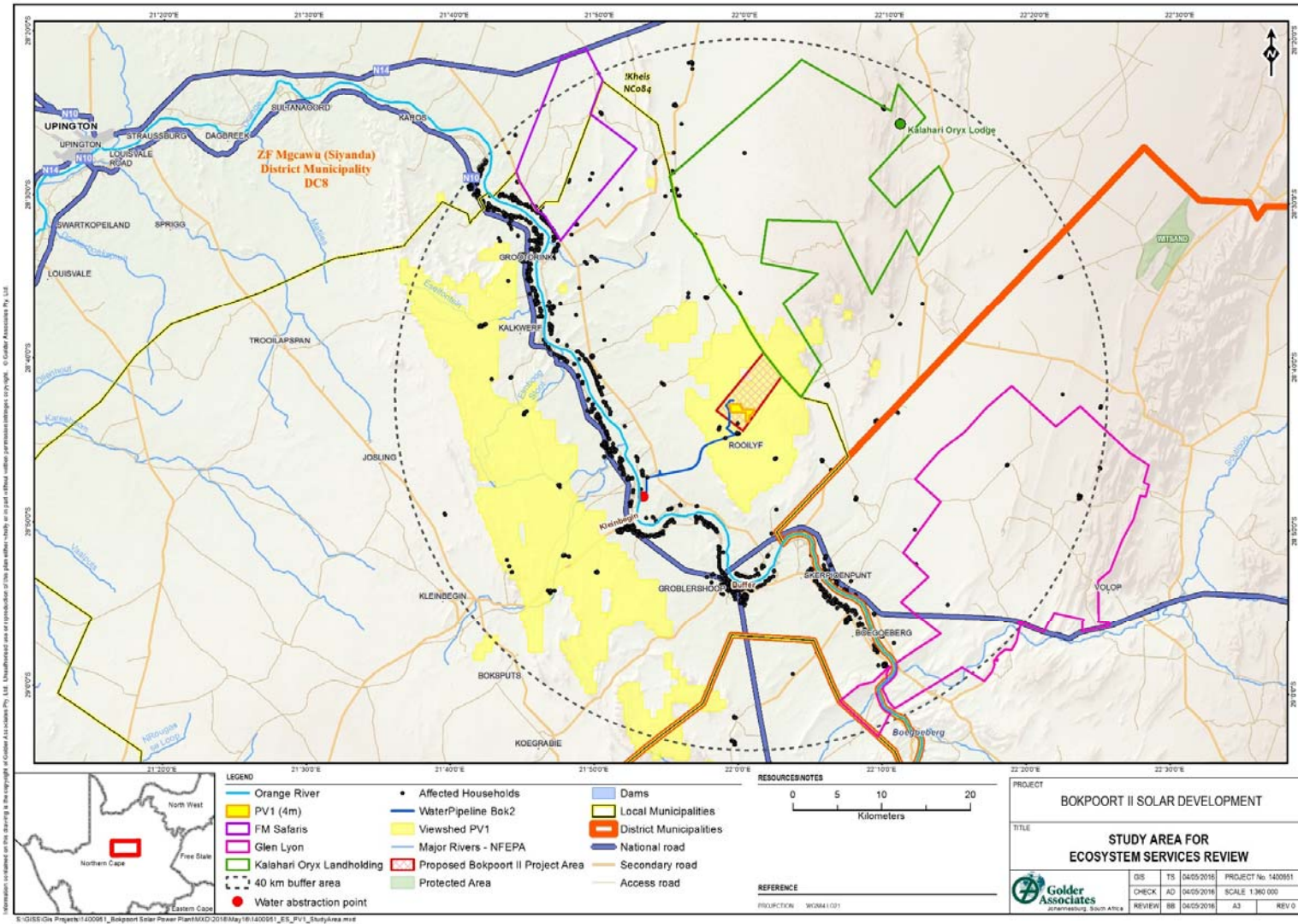


Figure 2: Study Area for Ecosystem Services Review



## 3.2 Approach

The approach taken to conducting the ecosystem services review is based on the method put forward by Landsberg *et al.* (2013). Given that this report is an entirely desk-based study, the method was adapted to preclude additional baseline data gathering for priority ecosystem services once the initial list of relevant ecosystem services list was refined to focus on priority ecosystem services only.

The approach to impact assessment consisted of a combination of the Project impact assessment on priority ecosystem services method described in Landsberg *et al.* (2013), and the prescribed impact assessment method being used for the ESIA (ref. section 3.6).

## 3.3 Step 1: Identification of Ecosystem Services Relevant to the Project

The ecosystem services that that Project could impact (Type I) were identified by first defining which ecosystems could be affected, determining the ecosystem services supplied by and demanded from those ecosystems, and identifying the beneficiaries who use those services supplied by the ecosystems that could be affected, as per Step 1 of the guidance provided in (Landsberg, *et al.*, 2013).

This was done by means of reviewing a variety of social, ecological and biophysical assessments to obtain data for identifying which ecosystem services are relevant to the Project. These included;

- Vegetation mapping and assessment of the Bokpoort II area previously carried out (BEC, 2010; RHDHV 2014);
- Land cover mapping (Figure 4);
- Agriculture and soils assessment (Lanz, 2016);
- Cultural Heritage assessment (Dreyer, 2015);
- Socioeconomic assessment (Golder Associates Africa, 2016a);
- Biodiversity assessment (Golder Associates Africa, 2016b);
- Surface water assessment (Golder Associates Africa, 2016c);
- Landscape and visual impact assessment (Golder Associates Africa, 2016d); and
- Economic cost-benefit analysis and land trade-off assessment (Conningarth Economists, 2016).

The ecosystem services that the Project depends upon (Type II) were also identified. As Type II ecosystem services relate to Project *operational performance*, but not Project impact, these are listed in section 6.1.2 for reference, but are not included in the impact assessment.

## 3.4 Step 2: Prioritisation of Ecosystem Services

Priority ecosystem services, upon which the impact assessment was focused, were selected from the list of relevant ecosystem services generated in Step 1. Priority ecosystem services are:

- Services for which Project impacts could affect beneficiaries' livelihoods, health, safety or culture (Type I); and
- Services that could prevent the Project from achieving operational performance (i.e. impact the Project) (Type II).

The ecosystem service prioritisation exercise was carried out systematically, using the WRI Impact and Dependence Scoping tools, and current guidance regarding conducting an Ecosystem Services Review (Landsberg *et al.*, 2013).



### 3.5 Step 3: Establishment of the baseline for priority ecosystem services

As mentioned previously, Landsberg *et al.*'s (2013) ecosystem service review method was adapted to preclude additional baseline data gathering for priority ecosystem services once the initial ecosystem services list was refined. Instead, data on the use of priority ecosystem services was collated from the baseline social, biodiversity and surface water studies and the Project description, to determine how ecosystem services currently contribute to beneficiaries' livelihoods, health, safety or culture.

### 3.6 Step 4: Assessing Project Impacts on Priority Ecosystem Services

The impact assessment process was aligned with the World Resources Institute (WRI) approach (Landsberg *et al.*, 2013), consisting of a combination of the WRI approach to assessment of Project impact on priority ecosystem services and thereby assessment of impact on beneficiaries (Figure 3; and the prescribed impact assessment method being used for the ESIA (ref. section 3.6.1).

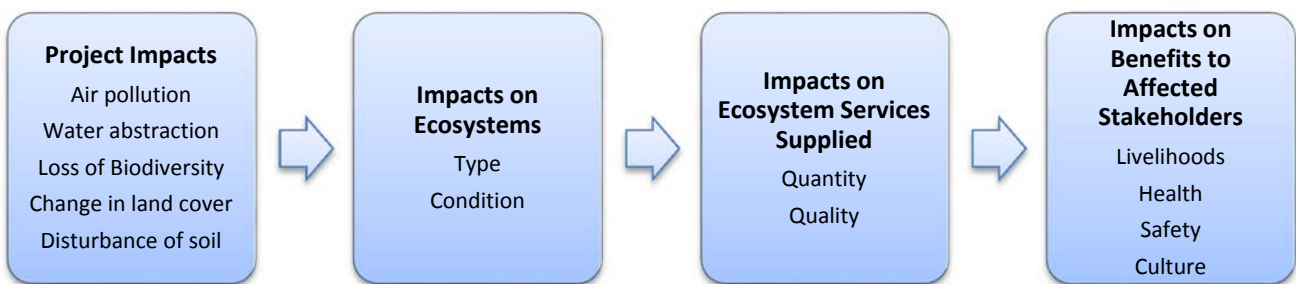


Figure 3: How assessment of Project impacts on ecosystems leads to assessing impacts on beneficiaries of ecosystem services (Landsberg *et al.*, 2013)

The types of potential Project impacts considered appropriate for the ecosystem services assessment are summarised in Table 2.

**Table 2: Types of ecosystem service impact**

Impact	Description
<b>Direct Impact</b>	Impacts that result from a direct interaction between a planned Project activity and the receiving environment/receptors (e.g. reduction of an ecosystem's capacity to supply grazing for livestock due to reduction in extent from vegetation clearance).
<b>Indirect impact</b>	Secondary impacts that result from project activity and affect the environment in which the receiving receptor is experienced (e.g. the introduction of alien invasive species into areas where vegetation has been cleared, and concurrent change in vegetation community and capacity to supply ecosystem services).
<b>Cumulative impact</b>	Impacts that act together with other impacts (including those from concurrent or planned activities from other projects) to affect the same resources and/or receptors as the Project (e.g. effects on Orange River).

#### 3.6.1 Assessing significance of Project impacts on affected Priority Ecosystem Services

The significance of the identified impacts will be determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely probability of occurrence and severity, which are further sub-divided as follows:





## ECOSYSTEM SERVICES REVIEW AND IMPACT ASSESSMENT - 75 MW PV1 SOLAR DEVELOPMENT

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:

Probability	Duration
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8 - 15 years)
2 - Low probability	2 - Short-term (0 - 7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 - Immediate
0 - None	

Scale	Magnitude
5 - International	10 - Very high/don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	

Once these factors are ranked for each impact, the significance of the two aspects, occurrence and severity, is assessed using the following formula:

- **SP (significance points) = (magnitude + duration + scale) x probability.**

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows:

**Table 3: Impact significance categories**

Significance	Description
SP >75	Indicates high environmental significance An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate environmental significance An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact An impact that constitutes an improvement over pre-project conditions.



## **4.0 LEGISLATIVE AND POLICY CONTEXT**

### **4.1 Applicable South African Legislation and Policy**

#### **4.1.1 National Environmental Management Act: Biodiversity Act (2004)**

The over-arching government policy on natural resource conservation in South Africa is provided for in the National Environmental Management Act: Biodiversity Act (Act No. 10 of 2004). The relevant constitutional provisions in the Act include the following:

- Chapter 3 - Biodiversity Planning and Monitoring: Provides for integrated and coordinated biodiversity planning, including the National Biodiversity Framework (see section 4.1.1.1); Bioregional plans, Biodiversity management plans and agreements, monitoring of the conservation status of various components of South Africa's biodiversity, and promotion of research on biodiversity conservation including the sustainable use, protection and conservation of indigenous biological resources; and
- Chapter 4 - Threatened or Protected Ecosystems and Species: Provides for the protection of ecosystems and species that are threatened or in need of protection; gives effect to South Africa's obligations under international agreements regulating trade in endangered species; and ensures that utilisation of biodiversity is managed in an ecologically sustainable way.

#### **Project Relevance**

The Project must demonstrate that it has taken appropriate measures to avoid/minimise any potential impacts on biodiversity and areas of ecosystem service supply within the Study Area, and where necessary, implement an invasive species management plan as part of the mitigation actions for potential effects on biodiversity. In addition, it should avoid significant effects on areas identified as Endangered within the Study Area.

#### **4.1.1.1 South Africa's National Biodiversity Framework (2008)**

South Africa's National Biodiversity Framework (NBF) is a requirement of the National Environmental Management Act: Biodiversity Act, 2004 (ref. section 4.1.1). The NBF is informed by the National Biodiversity Strategy and Action Plan (NBSAP) (ref. section 4.1.1.2) and the National Spatial Biodiversity Assessment (NSBA) (ref section 4.1.1.3), and provides a framework for implementation of the conservation and development objectives of the NBSAP and the NSBA.

#### **Project Relevance**

The NBF defines five major pressures on South Africa's biodiversity, including loss and degradation of natural habitat, spread of invasive alien species, over-harvesting of species, over-abstraction of water and climate change. Solar power is an industrial sector whose activities could contribute to over-abstraction of water and invasive species spread, which could affect the capacity of habitats to supply ecosystem services. The Project must therefore demonstrate that it has taken appropriate measures to avoid/minimise any potential impacts on baseline water quality and quantity in the Orange River, and where necessary, implement appropriate mitigation measures including an invasive species management plan to reduce potential effects on vegetation communities and their capacity to supply ecosystem services within the Study Area.

#### **4.1.1.2 South Africa's National Biodiversity Strategy and Action Plan (2005)**

The NBSAP is a long-term (20 year) strategy for the conservation and sustainable use of South Africa's biodiversity. The overall goal of the NBSAP is to conserve and manage terrestrial and aquatic biodiversity to ensure sustainable and equitable benefits to the people of South Africa. It identifies five Strategic Objectives that are required to achieve that goal, of which Strategic Objectives 3, 4 and 5 directly relate to the supply of ecosystem services:

- Strategic Objectives 3: Integrated terrestrial and aquatic management across the country minimises the impacts of threatening processes on biodiversity, enhances ecosystem services and improves social and economic security
- Strategic Objectives 4: Human development and well-being is enhanced through sustainable use of biological resources and equitable sharing of the benefits; and



- Strategic Objectives 5: A network of conservation areas conserves a representative sample of biodiversity and maintains key ecological process across the landscape.

The NBSAP is a useful policy guide for addressing South Africa's concerns in biodiversity conservation and the utilisation of its components, as well as for implementation of the requirements of the Convention on Biological Diversity (see section 4.2).

### **Project Relevance**

The NBSAP promotes integrated terrestrial and aquatic management in order to minimise the impacts of threatening processes on biodiversity, enhance ecosystem services and improve social and economic security. It also addressed the sustainable use of biological resources, and upkeep of a network of conservation areas to conserve a representative sample of biodiversity and maintain key ecological process across the landscape. Through appropriate management of ecosystem integrity and therefore the services that ecosystems supply, the Project can contribute to achieving the National ecosystem service maintenance and delivery aims outlined in the NBSAP.

#### **4.1.1.3 National Spatial Biodiversity Assessment (2004)**

The NSBA was the first comprehensive spatial assessment of biodiversity throughout South Africa, intended to inform policies and plans of both public and private-sector bodies with reference to biodiversity issues. It focusses on mainstreaming biodiversity priorities throughout the economy and making links between biodiversity and socio-economic development; with the intention of enabling these to reinforce each other so that conserving biodiversity strengthens the economy and contributes to social development.

### **Project Relevance**

The spatial assessment generated several map products including terrestrial ecosystem status, priority conservation areas and protected areas. These maps will be viewed in the context of the Project to determine any potential impacts the Project may have on terrestrial and riparian ecosystems and ensuing effects on ecosystem service supply by those systems.

#### **4.1.2 National Heritage Resources Act (1999)**

The National Heritage Resources Act (NHRA) aims to enable and encourage communities to nurture and conserve their legacy so that it may be passed on to future generations. It notes that cultural heritage is unique and irreplaceable, helping to define cultural identity and lying at the heart of people's spiritual well-being; all of which are cultural ecosystem services that may be gained by communities from cultural resources including objects, practises and landscapes.

The Act makes provision for the protection and management of heritage resources, including 'living heritage' i.e. the intangible aspects of inherited culture, such as cultural traditions, oral history, rituals, indigenous knowledge systems and the holistic approach to nature, society and social relationships; and landscapes and natural features of cultural significance.

### **Project Relevance**

The Project will need to demonstrate alignment with the provisions of the National Heritage Resources Act, through identifying and protecting intangible cultural heritage and cultural practices by ensuring that internationally recognised practices for the protection, field-based study, and documentation of cultural heritage are implemented.

## **4.2 Conventions and International Agreements**

South Africa is a signatory to the following international conventions and agreements:

- Convention on Biological Diversity: Under the convention, each contracting party is expected to develop national strategies, plans or programs for the conservation and sustainable use of Biological diversity (see NBSAP – section 4.1.1.2);
- Convention on International Trade in Endangered Species (CITES);



- Convention on the Conservation of Migratory Species of Wild Animals, (the Bonn Convention):
  - South Africa is a Contracting Party to the African-Eurasian Water-bird Agreement (AEWA).
- Convention on Wetlands of International Importance (the Ramsar Convention); and
- UNESCO World Heritage Commission.

### **Project Relevance**

The Project will need to demonstrate alignment with the provisions of the conventions and agreements in order to satisfy Government obligations as a signatory to these. This can be achieved through identifying biodiversity value of the Study Area, restricting impacts on biodiversity features and ecosystem service supply value, and by ensuring that internationally recognised practices for the protection, field-based study, and documentation of these biodiversity and ecosystem service components are implemented throughout the ESIA and the lifetime of the Project.

### **4.3 IFC Performance Standards 2012**

At the project financing level, the assessment and management of ecosystem services is largely dealt with in PS 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources (IFC, 2012); however, elements of PS 1, 3, 4, 5, 7 and 8 are also relevant to ES assessment. Relevant parts of the PS are briefly summarised as follows.

#### **PS 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources**

PS 6 directly relates to the four types of ecosystem services, as one of the three major objectives of PS 6 is to maintain the benefits of ecosystem services. It establishes objectives and requirements to avoid, minimise and, where residual impacts remain, compensate/offset for risks and impacts to ecosystem services within a project's area of influence. It puts an onus on project developers (the 'client') to carry out a systematic review (including participation of beneficiaries) of all ecosystem services a project will impact, or is dependent upon, to identify priority ecosystem services, and avoid, minimise, and mitigate impacts on priority ecosystem services for which a client has direct management control or significant influence.

#### **PS 1 – Assessment and Management of Environmental and Social Risks and Impacts**

This PS requires that all reasonably expected risks and impacts related to ecosystem services are identified, and broader definition of a project's area of influence be used. Indirect project impacts on ecosystem services upon which beneficiaries' livelihoods are dependent should be included in the assessment.

#### **PS 4 – Community Health, Safety and Security**

This PS establishes the requirement for the assessment of impacts on priority ecosystem services that may result in adverse health and safety risks to beneficiaries.

#### **PS 5 – Land Acquisition and Involuntary Resettlement**

PS5 relates to project situations where restrictions on land use, access to natural resources, and use of natural resources, such as aquatic resources, timber products and fresh water, impact affected beneficiaries of ecosystem services. The client must assess impacts on, and compensate for, loss of provisioning ecosystem services resulting from land acquisition and involuntary resettlement.

#### **PS 7 – Indigenous Peoples**

PS7 addresses impacts on lands and natural resources that may be subject to traditional ownership, or under customary use. Such use may be seasonal/cyclical, and may be ceremonial, cultural, or economic in nature. PS7 requires that adverse impacts on affected Communities of Indigenous Peoples should be avoided where possible; or otherwise be subject to appropriate application of the mitigation hierarchy to minimise adverse impacts.



## **PS8 – Cultural Heritage**

PS8 deals with the protection of tangible and intangible Cultural Heritage, and sets out requirements for avoidance, or the application of an appropriate mitigation hierarchy to minimise adverse impacts. When replicable cultural heritage is removed and avoidance is not possible, restoration measures including the maintenance of ecosystem services required to support the cultural heritage must be taken, either in situ or in a different location. Non-replicable cultural heritage should not be removed unless several specific conditions are met. The Project should not remove or significantly alter or damage critical cultural heritage.

### **Project Relevance**

In the case of its direct investments (including project and corporate finance provided through financial intermediaries), the IFC requires its clients to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced. Together, the Performance Standards establish standards that the Project is to meet throughout the life of an investment by IFC. As stated above, Performance Standards 1, 4, 5, 6, 7 and 8 have components that directly relate to ecosystem services and maintenance of their supply despite project impact. Therefore, in order to secure Project funding from IFC, the Project must demonstrate that it is in compliance with the requirements of each of the above-mentioned performance standards.

## **5.0 OVERVIEW OF BASELINE ENVIRONMENT WITHIN THE STUDY AREA**

This section presents a description of the existing environment within the Study Area. In particular, it presents a summary of the relevant information on ecosystem *condition* distilled from the biodiversity, surface water, socioeconomic, cultural heritage, landscape and visual, agricultural and soil baseline reports, and land cover mapping, in order to put the proposed Project area's **capacity** to supply provisioning, supporting, regulating and cultural and spiritual ecosystem services in context.

### **5.1 Vegetation Communities within the Bokpoort II footprint**

The Bokpoort II area largely comprises arid grassland, with an area of rocky outcrop at the north-eastern extent of the boundary, whilst the proposed water pipeline will be laid in parallel to the existing railway line and access road corridor. No additional natural vegetation clearance for the proposed pipeline is anticipated. As the pipeline approaches the Orange River, it diverts south along an existing access track, finally crossing approximately 200 m of agricultural cultivation and riparian fringe vegetation (within the existing Bokpoort I servitude), to the proposed water abstraction point.

Surveys of flora and fauna were previously conducted in the Bokpoort II footprint and along the pipeline route (RHDV, 2014a; RHDV, 2014b; BEC, 2010; EnviRoss, 2010), from which data was used for the biodiversity impact assessment for Bokpoort II (Golder Associates Africa, 2016). Relevant data gathered on vegetation communities and fauna is presented below and in section 5.3.

#### **Rocky Outcrops/Foothills**

Part of the Korannaberg foothills are located in the northern corner of the study area, characterised by boulders, high slopes and mountainous topography. Soils in this unit are characteristically shallow and poor in nutrients. The species composition compares well to the Koranna-Langeberg Mountain Bushveld described by Mucina and Rutherford (2006). The vegetation consists of an open tall shrubveld; a prominent herbaceous layer with interspersed tall shrubs, bushes and low trees. This area was found to be in **pristine** condition and thus is considered to be of a **high** ecological integrity/status.

#### **Open Shrub Duneveld**

This vegetation unit is characterised by the presence of low dunes with crests, slopes and streets, with a vegetation composition that largely conforms to an open tree savanna. The presence of the grass species *Schmidtia kalahariensis* is generally accepted as an indicator of high utilisation pressure. This habitat type is representative of the Gordonia Duneveld vegetation type (Mucina & Rutherford, 2006) and is in a relatively untransformed condition. However, due to grazing pressures evident throughout the Bokpoort II footprint including in this vegetation community, a **moderate** ecological integrity status is ascribed to this unit.



### Open Shrub Plains

Open shrub plains occupy the majority of the Study Area. Biophysical attributes include open plains (flat or slightly undulating) with high shrubs and scattered trees on deep sandy, red soils or gravel plains and a well-developed herbaceous layer. The species diversity is relatively low with only 24 species observed during the 2010 survey (BEC, 2010). This habitat type is representative of the regional vegetation type Kalahari Karroid Shrubland (Mucina & Rutherford, 2006), which typically forms bands alternating with bands of *Gordonia* Duneveld. Due to grazing pressures in this vegetation community, a **moderate** ecological integrity status is ascribed to this unit within the Bokpoort II footprint.

### Calcareous Low Shrub Plains

The vegetation is characterised by low shrubs and grasses; tall shrubs and trees are generally absent from this unit, or occur infrequently. The status of these areas appears to be relatively degraded due to grazing pressure from sheep and other livestock; a **moderate** ecological integrity status is ascribed to this vegetation within the Bokpoort II footprint (BEC, 2010).

### Riparian Vegetation

Riparian vegetation within the Study Area consists of dense thickets of trees and shrubs with a dense understorey (*Vachellia (Acacia) karroo*, *Ziziphus mucronata*, *Rhus lancea*, *Diospyros ramulosa* and *Lycium cinereum*), as well as stands of reeds *Phragmites australis* at the edge of the Orange River. The invasive species *Prosopis glandulosa* was recorded throughout the *Phragmites* reed bed. The presence of invasive plant species within this vegetation unit reduces the ecological integrity status to a **moderately modified** status.

## 5.2 Land Cover within the Study Area

The various land cover types within the Study Area are summarised on Table 4 and Figure 4, and indicated on Figure 5.

**Table 4: Landcover within the Study Area and loss to PV1 development**

Landcover type	Total Area in Study Area (Ha)	Proportion cover of total Study Area	Area lost to PV1 (Ha)	Area lost to PV1 footprint as proportion of total in Study Area
Bare	22892.50	4.52%	-	-
Commercial/Industrial	33.64	0.01%	-	-
Cultivated	6584.43	1.30%	-	-
Grassland	36468.53	7.21%	5.58	0.02%
Low shrubland	407474.46	80.53%	221.39	0.05%
Mines	241.40	0.05%	-	-
Plantation	1.89	0.00%	-	-
Residential	262.40	0.05%	-	-
Thicket /Dense bush	10207.02	2.02%	-	-
Water Bodies	1428.37	0.28%	-	-
Woodland/Open bush	20426.75	4.04%	-	-

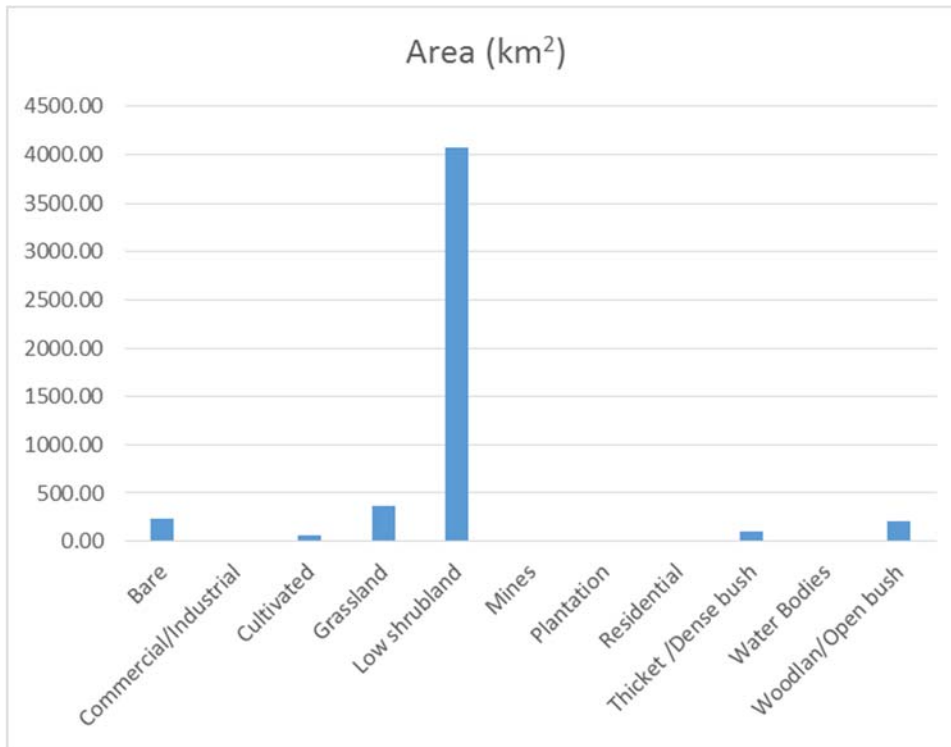


Figure 4: Land cover proportions within the Study Area

The following important points can be deduced from Table 4 and the land cover map of the study area (Figure 5):

- Low shrubland is the dominant land cover in the Study Area, accounting for 80.53% of the entire study area;
- Natural habitat within the study area is contained within the categories Grassland, Low Shrubland, Thicket/Dense Bush, Waterbodies and Woodland/Open bush, amounting to approximately 94% of the study area;
- Transformed land cover categories including Commercial/industrial, cultivated, mines, residential cover only 0.11% of the study area; and
- Although only a small proportion of transformed lands are present within the Study Area, the open shrub duneveld and open shrub plains vegetation communities within the Bokpoort II footprint have been found to be of moderate ecological integrity due to grazing pressure from livestock. Similar grazing pressure may be experienced in other parts of the study area, particularly where water supply for livestock is feasible. The capacity of natural habitats within the Study Area to supply ecosystem services is thus assumed to range from moderate-high, depending on the extent of livestock grazing pressure experienced across the various farm portions.



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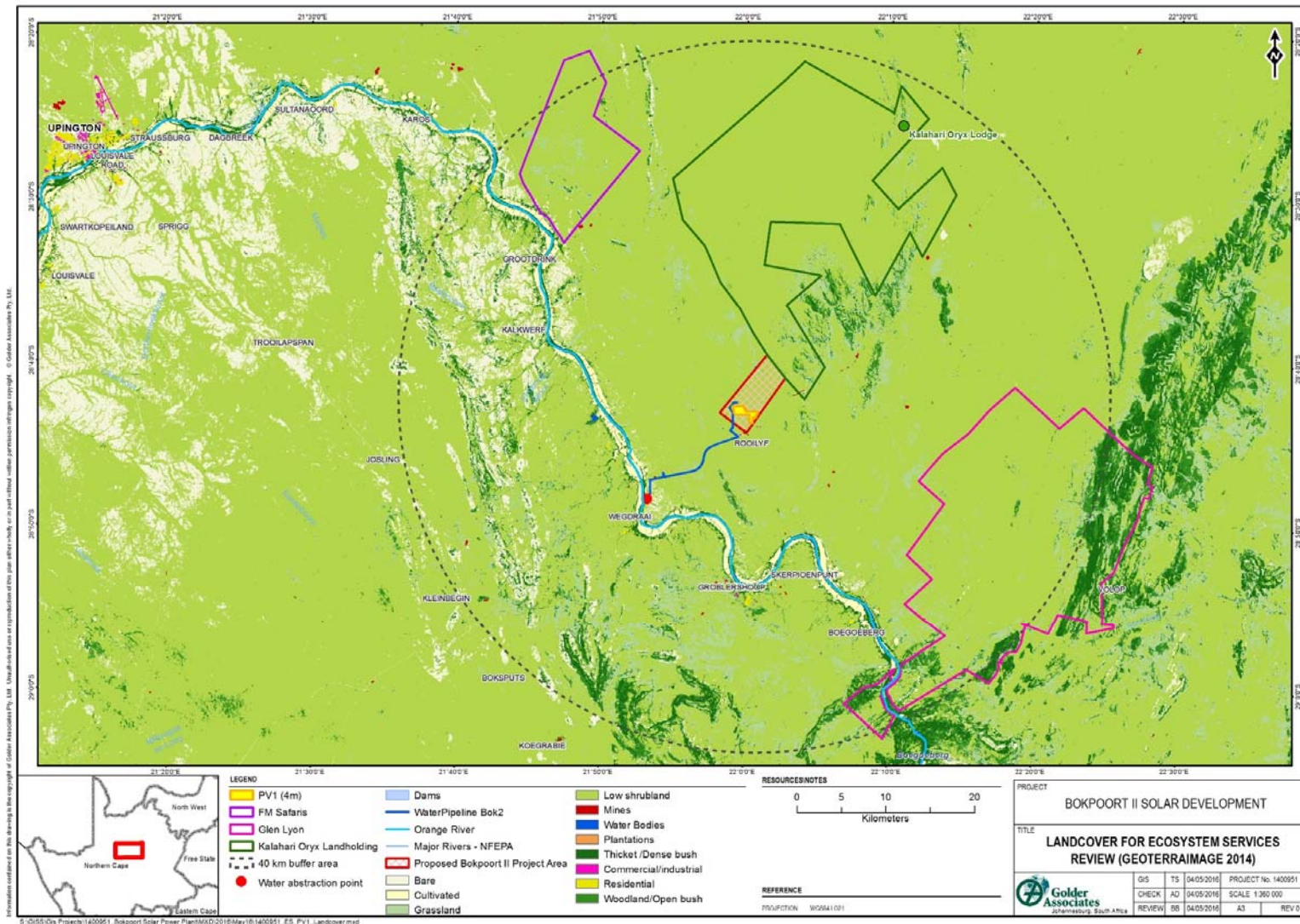


Figure 5: Land Cover Classification of the Study Area





### 5.3 Faunal Communities

Due to the arid nature of the Study Area, vegetation cover is sparse and the potential of the area to support terrestrial mammal species is considered to be relatively limited; however, a few medium sized mammals were recorded during the biodiversity baseline studies. These tended to be carnivorous species such as Black-backed Jackal, Bat-Eared Fox and Caracal (Golder Associates Africa, 2016), which specialize in preying upon the small mammals and reptiles that are supported by the arid conditions.

Bird fauna within the Study Area is diverse, and surveys conducted for the Project have recorded several South African near-endemic species, regionally red-listed species and various charismatic species, including Fiscal Flycatcher, Black-eared Sparrow-lark, Ludwig's Bustard, Karoo Korhaan and Martial Eagle (ARCUS 2016). The presence of charismatic, endemic and red-listed bird species is likely to attract birders to the region, contributing to the supply of recreation and ecotourism services.

None of the typical 'target' species for subsistence hunting for food have been recorded within the Study Area, although like in many parts of South Africa, species like Cape Hare and Scrub Hare may be hunted with dogs by beneficiaries, as an occasional supplement to the staple diet. However, no evidence of systematic hunting of wild animals for food supply was apparent either from the literature review or evident over the course of the previous baseline studies and the site visit conducted in September 2015.

Recreational hunting does occur within the Study Area; notably on three large entities on the same side of the Orange River as the proposed Project (Figure 2). These include:

- FM Safaris (Pty) Ltd;
- Kalahari Oryx Game Reserve; and
- Glen Lyon Kalahari Nature Reserve.

Hunting at these reserves includes trophy hunting, and 'biltong' hunting. The farms also produce surplus live game which is then sold at either game auctions or through private transactions. Game farm owners who derive their livelihoods from these enterprises are reliant on the continued presence of grazing for livestock, as well as maintenance of the 'wilderness' sense of place in order to attract international hunting guests.

### 5.4 Surface Water Resources

The Orange River located west and southwest of the Project area is the predominant perennial surface water feature in the vicinity of the proposed development. This section of the river falls in the Lower Orange Water Management Area (LOWMA). The Orange River is the main source of water for the ZF Mgcawu (previously referred to as Siyanda) District and !Kheis Local Municipality. The ZF Mgcawu District Environmental Management Framework cited that the evaporation rate in the LOWMA is estimated at 3000 mm which is much higher than the Mean Annual Rainfall. The banks of the Orange River are heavily used for irrigated agriculture.

The hydrological assessment conducted for the Bokpoort II EIA (Golder Associates Africa, 2016c) and satellite imagery review, indicate that there are no areas of permanent surface water present on the Project site. Satellite imagery indicates some ephemeral drainage lines in the southern part of the proposed site, but these areas are only expected to contain flowing water during periods of exceptionally high rainfall. There are no significant wetlands, estuaries, Ramsar Sites or major dams present within the immediate vicinity of the study site. One seasonal pan occurs approximately 3 km north of the Garona Substation and the Bokpoort I EIA indicates a 200 m 'no development area' buffer demarcated around the pan. The smaller riparian systems in the region are impacted by livestock where natural habitats are grazed intensively.

The Orange River's water quality is categorised as Moderately Transformed (Class C) due to existing agricultural activities along the river banks (Nel *et al.*, 2011). The Orange River's major inflow of water is from the Vaal River which has high nutrient levels which sometimes result in algal blooms. Slow water flow rates also cause siltation and turbidity of the water which leads to water quality degradation within the river. A water pump will be installed in the Orange River to extract water for the proposed Bokpoort II development.



The area of quaternary D73D is 4291 km<sup>2</sup> (gross area). The area of the Bokpoort II development is 24 km<sup>2</sup>, 0.56% of the catchment.

### 5.4.1 Project Water Demand

Once constructed, the Bokpoort II Solar Development will have specific water demands for cleaning of the proposed 75 MW PV1 solar facility. The water requirements for the PV1 facility are shown in Table 5.

**Table 5: 75 MW PVI Facility (Bokpoort II Solar Development) Requirement**

Description	Water Demand (million m <sup>3</sup> /a)
PV1	0.025

Table 6 indicates the cumulative requirements for the entire Bokpoort II Solar Development.

**Table 6: Bokpoort II Solar Development Requirements**

Description	Water Demand (million m <sup>3</sup> /a)
Bokpoort II Solar Development Requirement	0.300

The Project water demand is lower than the major water users in the Study Area (see Table 6, Table 7). Future scenarios predict that the water balance for the Orange River in 2050 may be negative (Table 11), which would affect supply of freshwater to both the Project and to other water users.

### 5.4.2 Other Water Users

The Orange River is the primary source of freshwater in the Study Area. The majority of residential water use within the Study Area arises from the !Kheis LM and the Ward 3 municipalities. Major commercial users largely consist of agricultural and mining enterprises.

#### Crop Production

The water in the Orange River is to a very large extent allocated to irrigation. Irrigation in the Northern Cape is a large consumer of the local water resources (Department of Water Affairs, 2013). Table 7 shows the total irrigation water volume estimates for the Lower Orange Catchment Management Areas. There is a base assumption that water demand for irrigation farming will not increase per annum (Golder Associates Africa, 2016c).

**Table 7: Total Irrigation Water Volume estimates (Department of Water Affairs, 2013)**

Catchment	Field Requirement (million m <sup>3</sup> /a)	Irrigated Area (ha)
Lower Orange Tributaries	19.8	132

Areas of intensive agricultural cultivation have been developed on both banks of the Orange River, within the naturally occurring floodplain zone (Figure 6). The Orange River plays a crucial economic role in the ZF Mgcawu DM, with most of the economic activities linked to or located along the river, including delivery of a major part of South Africa's table grape production (section 5.5). There are approximately 1 600 farm land units, which belong to 890 owners, in ZF Mgcawu DM.

The readily available water supply from the Orange River is critical to the viability of agricultural production within the Study Area. In addition, sediment trapped by the floodplains during periods of flood contributes to the soil quality and cultivation potential of the lands within the Orange River floodplain.



Figure 6: Agricultural fields in the Orange River floodplains

### Municipal Fresh Water Supply and Sanitation

A third of the population of the !Kheis LM and half of Ward 3 have access to a flush toilet (connected to sewerage system); the next most available sanitation system are flush toilets (with a septic tank) (Table 8). A fourth (25%) of !Kheis LM and 7% of Ward 3 do not have access to any sanitation system. There is a lack of proper and sufficient sanitation and sewerage systems to all residents within Ward 3 and the !Kheis LM.

Table 8: Sanitation systems

Locality	Flush toilet (connected to sewerage system)	Flush toilet (with septic tank)	Chemical toilet	Pit toilet with ventilation (VIP)	Pit toilet without ventilation	Bucket toilet	Other	None
ZF Mgcauwu DM	64%	8%	0%	5%	6%	5%	1%	10%
!Kheis LM	27%	21%	1%	12%	9%	2%	3%	25%
Ward 3	55%	30%	0%	4%	1%	0%	2%	7%

Source: Census Stats 2011

Formal dwellings (66.3%) dominate the types of dwellings found in the local municipality, however only 27% have flush toilets connected to a reticulated sewerage system and 16.7% have piped water inside their dwellings.

Other major urban water demand from the Lower Orange comes from the towns of Prieska, Boegoeberg, Karos Geelkoppaan, Upington, Kakamas, and Pelladriфт and Namakwa Water Boards (Table 9).

The Orange River therefore plays a crucial role in supply of freshwater to communities within the Study Area, as well as water purification and waste treatment, and regulation of water-borne diseases.

### Mining

Major mining water demands from the Lower Orange main stem arise from Black Mountain Mine, Alexander Bay Transhex Small mines in South Africa, and Haib Mine and Rosh Pinah, Aughas and Skorpion mines in Namibia. These water requirements are expected to increase in future years (Table 9).

Table 9: Estimated Water Requirements of current major water users in the Lower Orange Main Stem (million m<sup>3</sup>/a) (Department of Water Affairs, 2013)

Description	Area	2012	2015	2020	2025	2030	2035	2050
RSA Mining	Black Mountain Mine	1.916	13.916	13.916	13.916	13.916	13.916	13.916
RSA Mining	Alexander Bay Transhex Small Mines	5.047	5.214	2.869	3.026	3.184	3.342	3.500



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Description	Area	2012	2015	2020	2025	2030	2035	2050
RSA Urban	Prieska Urban Demand	1.657	1.753	1.875	2.002	2.131	2.260	2.389
RSA Urban	Boegoeberg Small users	0.600	0.600	0.600	0.600	0.600	0.600	0.600
RSA Urban	Karos Geelkoppan	0.040	0.040	0.040	0.040	0.040	0.040	0.040
RSA Urban	Upington and Others	15.966	17.517	18.687	19.890	21.217	22.363	23.600
RSA Urban	Kakamas Urban Demand	2.327	2.536	2.758	2.974	3.199	3.424	3.649
RSA Urban	Pelladrift Water Board	2.035	2.078	2.118	2.163	2.209	2.255	2.302
RSA Urban	Namakwa Water Board	10.294	10.294	10.294	10.294	10.294	10.294	10.294
Namibia Mining	Haib Mine	0.000	3.000	3.000	3.000	3.000	3.000	3.000
Namibia Mining	Mines Rosh Pinah, Auchas, Skorpion	7.642	7.745	7.973	8.224	8.474	8.725	8.975
Namibia Urban	Aussenkehr Noordoewer	0.286	0.359	0.577	0.645	0.713	0.781	0.849
Namibia Urban	Urban Rosh Pinah, Skorpion, Oranjemund	8.482	8.581	8.802	8.829	8.857	8.884	8.911

### Other Solar Developments

DWS has recognised the potential for other projects in the area and have listed new projects and approved water use licenses. Table 10 represents the water requirements of new users and licenses which may impact the total water requirements in the Lower Orange Main Stem (DWAF, 2013).

**Table 10: New water user requirements (million m<sup>3</sup>/a) (Department of Water Affairs, 2013)**

Project	2012	2015	2020	2025	2030
Olyvenhoutsdrift Solar park (Assumed dry cooling)	0.01	0.249	0.488	1.716	2.907
Konkoonsies Solar (License)	0.013	0.013	0.013	0.013	0.013
Aries Solar (License)	0.013	0.013	0.013	0.013	0.013
Solafrica (License)	0.875	0.875	0.875	0.875	0.875
Eskom Distribution division (License)	1.430	1.430	1.430	1.430	1.430
KaXu CSP (License)	0.011	0.011	0.011	0.011	0.011
Khi CSP (License)	0.022	0.022	0.022	0.022	0.022
Solar Capital (License)	0.028	0.028	0.028	0.028	0.028

### Tourism

The Orange River is a popular tourist destination, with activities including canoeing tours, fly fishing and white water rafting on offer. The majority of these activities start at Augrabies Falls National Park, approximately 180 km downstream of the Study Area.



### 5.4.3 Future Water Demand in Orange River

Based on gathered information from DWA (Department of Water Affairs, 2013), the projected increase in water user demands could result in the unavailability of water in the medium to long term (2030 onwards) (Table 11). The Project abstraction volume will contribute to cumulative effects on the water balance.

**Table 11: Water Balance for the Lower Orange WMA (Department of Water Affairs, 2013)**

Description	2020 (million m <sup>3</sup> /a)	2025 (million m <sup>3</sup> /a)	2030 (million m <sup>3</sup> /a)
Total Inflows	141.5	141.95	142.32
Total User Demands	136.04	139.37	142.70
<b>Net Balance PV1</b>	5.47	2.58	-0.38
<b>Net Balance with PV2 and CSP implementation</b>	5.19	2.31	-0.65

## 5.5 Socio-economic Setting

The project area is sparsely populated and the nearest settlements are Groblershoop (~22 km south) and Wegdraai (~21 km southwest). Other main towns in the vicinity are Boegoeberg (~40 km south-southeast) and Upington (~77 km west-northwest). There is one settlement (~14 km southwest) from the centre point of the project site. Additionally, the Bokpoort I solar development has recently been completed and is located in the southern portion of the remaining extent of the farm Bokpoort 390.

In the wider Study Area, several small towns occur intermittently along the N10 national road between Groblershoop and Upington. Farmsteads occur in a distinct linear pattern alongside the Orange River.

Residential settlements include:

- The town of Groblershoop is located approximately 22 km south-east of the eastern boundary of the farm Bokpoort;
- The urban settlement (township) of Wegdraai, which is situated on the western side of the Orange River on the farm Boegoeberg 48;
- Numerous farmhouses and farm labourer houses on the northern and southern banks of the Orange River. These are residences related mainly to the sultana grape farms;
- The main farmhouse on Bokpoort is situated on a hill in the central portion of the farm; and
- The main farmhouse on the farm La Gratitude is situated 5.2 km east of the north-eastern corner boundary of Bokpoort.

Land use in the study area consists predominantly of agricultural activities within the Orange River floodplain. The majority of households within the municipality are involved in Poultry production followed by livestock production (Figure 7). Poultry production of this nature is most likely for home use as opposed to commercial reasons.

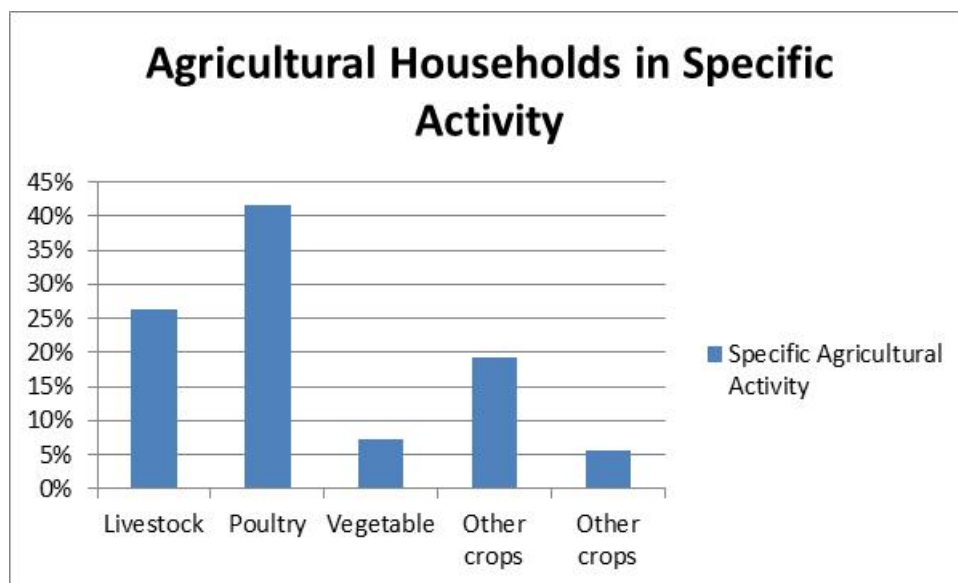


Figure 7: Percentage of Agricultural Households in each particular activity within the !Kheis LM (Stats SA, 2011)

### **Table Grape and Sultana Production and Processing**

Sultana production and processing is a major economic driver within the locality. The Orange River Producers Alliance is a table grape industry that is renowned as a supplier of fresh table grapes to Europe with an output of more than 20 million cartons (!Kheis LM IDP, 2012-2017). More than 90% of Africa's total dried vine fruit production is produced through 1 250 sultana grape growers in the Northern Cape who produced more than 50,000 tons in 2010. The sultanas produced here comprise more than 80% of that which is exported primarily to Europe and other eastern countries (ZF Mgcawu DM IDP, 2016-2017).

SAD Vine Fruit Pty (Ltd) is located in Upington and owns the largest dried vine fruit processing and packaging plant in South Africa, employing more than 350 persons. It has intakes at Groblershoop, Mylpaal, Louisvaleweg, Keimoes, Kakamas and Vredendal (ZF Mgcawu DM IDP, 2016-2017).

The Orange River Wine Cellars Co-Op, also based in Upington, is the second largest winemaking cooperative in the world and has wine cellars at Groblershoop, Grootdrink, Upington, Keimoes and Kakamas. This Co-Op has more than 740 members who produce wine grapes and 445 farmers who produce grape juice (ZF Mgcawu DM IDP, 2016-2017).

Irrigation to supplement natural rainfall is a requirement for consistent, successful grape production (DAFF, 2012); therefore consistent freshwater supply is key in maintenance of this industry.

### **Livestock Farming**

In the ZF Mgcawu DM, there are approximately 1 600 farm land units, which belong to 890 owners. Because of variation in carrying capacity, there are relatively large differences in the sizes of the farms. The carrying capacity of a field in this area can differ considerably between (for instance) a 10 ha stock unit and 65 ha stock unit further westwards (ZF Mgcawu DM IDP, 2016-2017).

The central parts of the region consist mainly of semi-desert areas and are, therefore, with a few exceptions, mainly suitable for livestock farming. Livestock farming occurs mainly on large farms where lands are extensive. The majority of these farms are privately owned.

### **Game Farms**

The 60 000 hectare Kalahari Oryx game farm to the immediate north of the site is a well-established commercial operation that markets high-end exclusive hunting packages to an international clientele. The accommodation and most of the game viewing routes and hunting areas on this property lie between the Bokpoort farm boundary and the hills to the north.



Other nearby game farming enterprises include Glen Lyon Nature Reserve and FM Safaris (Figure 2), all of which are game hunting facilities. The facilities attract two main groups of hunters; the middle-income, largely South African hunters that generally hunt non-trophy animals, and the high-income hunters, typically a mix of South African and international guests, attracted by the trophy hunting trade (Conningarth Economists, 2016). The high-income hunters in particular are expected to stay longer at these reserves, and value more highly the privacy and sense of place that these wilderness experiences offer (Conningarth Economists, 2016).

### **Renewable Energy**

The renewable energy sector is recognised as a key developing sector throughout the Northern Cape, particularly solar energy production facilities. In addition, there is currently an application to construct a Hydropower project on the Boegoeberg Dam on Orange River. This project also falls within the local municipality and would contribute to the local economy (e.g. job creation) particularly during the construction phase. All such facilities have an associated water demand, as highlighted in section 5.4.2.

#### **5.5.1 Land Tenure and Ownership**

The landowners for the Project area where the proposed infrastructure is planned are ACWA Power SolAfrica Bokpoort CSP. The lands are currently being leased for grazing sheep and goats (Figure 8).



*Figure 8: Sheep and goats within the Project Area*

### **5.6 Cultural Heritage Context**

A study of cultural heritage context of the proposed water pipeline (RHDHV, 2014) made no significant archaeological observations along the proposed route, with some stone artefact finds being generally low to very low 'background' density of 'off-site' Stone Age traces. The material observed appeared to be consistently of Pleistocene age, mainly Middle Stone Age, and mostly utilizing jaspilite as raw material (probably derived from the Orange River gravels). No artefacts were noted on the dunes in the valleys between the eroded spurs and ridges.



### ***Landscape and Sense of Place***

The landscape in the study area is uniquely characterised by open plains and mountain ridges within a semi-arid region. Shrubland and thickets with occasional views of the Orange River and high mountain ridges in the distance dominate views of the landscape from various vantage points. A quiet and peaceful sense of place is brought about by these landscape views (MetroGIS, 2010).

Tourists are attracted by the Orange River Wine Route along the N10 between Groblershoop and Upington, as well as other tourist destinations such as the Au-grabies National Park and private game reserves/hunting concessions. The Korannaberg foothills in the extreme northern section of the study area forms part of the Koranna Mountain Range extending into the eastern Free State and leading up to Lesotho. This range consists of sandstone ravines and rolling grasslands which are frequented by tourists due to its high scenic appeal.

The unique combination of visual resources such as plains, mountain ridges and the Orange River valley creates a landscape which reflects a high visual coherence and compositional harmony, which is largely free of encroaching elements (MetroGIS, 2010). Such landscapes are sensitive to the introduction of industrial-type activities.

## **6.0 ECOSYSTEM SERVICE REVIEW FOR IMPACT ASSESSMENT**

### **6.1 Step 1: Identification of Relevant Ecosystem Services**

The Project's area of influence hosts a wide range of ecosystem services. The following sections characterise the supply of ecosystem services within the Project's area of influence, their quality, and their level of use or value to beneficiaries.

Beneficiaries considered most likely to be affected are farmer(s) currently leasing of the Project area for grazing livestock; people living within the viewshed of PV1 and tourists visiting areas within the viewshed of PV1 whose sense of place may be affected by the proposed development; and local businesses, particularly game farms offering hunting and wilderness experiences, whose livelihood may be affected due to changes in sense of place and 'wilderness experiences offered, as a result of the visibility of the Project in the landscape.

#### **6.1.1 Which Ecosystem Services could the Project impact? Which Beneficiaries are potentially affected?**

The ecosystem services supplied within the Study Area are listed according to landcover type in Table 12. These ecosystem services are supplied by ecosystems that will have a loss in extent and/or condition as a result of the Project, and thus could potentially be impacted by the Project. The beneficiaries who use those services supplied by the ecosystems that could be affected by the Project were identified (Table 12), and fall into the following categories:

Local (Type I):

- The livestock farmer who is currently leasing the Project area for grazing;
- The owners of the Kalahari Oryx Game Reserve; and
- The clientele of the Kalahari Oryx Game Reserve.

Regional (Type I):

- Residents of the !Kheis local municipality;
- The owners of FM Safaris;
- The clientele of FM Safaris;
- Residents of the ZF Mgcawu District municipality that use river water for domestic use;
- Commercial crop farmers downstream of Project; and
- Solar developments downstream of Project.





Beyond regional (provincial, national, international):

- Tourists;
- Accommodation providers;
- Bars, cafes, restaurant owners;
- Tourism activity operators; and
- Mining industry.



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**Table 12: ES supplied within the Project area of influence, and associated beneficiaries**

Ecosystem Service	Landcover Type	Definition of Service	Associated beneficiaries
<b>Provisioning</b>			
Food	<ul style="list-style-type: none"> <li>■ Cultivated.</li> </ul>	Large-scale commercial crops occur on the banks of the Orange River and will be traversed by the proposed pipeline. However, the pipeline will be constructed within the existing 50 m servitude for Bokpoort I therefore no additional direct loss of agricultural cropland is anticipated.	Commercial crop farmers whose livelihood depends on cultivated land availability.
	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	The lands of the Project area are currently being leased for livestock grazing.	Livestock farmers.
	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	Subsistence hunting for meat, and gathering of edible plants may occur within the Study Area.	Residents of the !Kheis local municipality.
Medicinal plants	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	Of the plants listed for the grid squares within the study area, cancer bush <i>Sutherlandia frutescens</i> is recorded. The level of harvesting of this species (or any other medicinal plant species) within the Study Area is unknown.	Residents of the !Kheis local municipality.
Biomass Fuel	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush; and</li> <li>■ Woodland/open bush.</li> </ul>	There is a strong reliance on wood fuel in the !Kheis Municipality (Census Stats, 2011).	Residents of the !Kheis local municipality.
Freshwater	<ul style="list-style-type: none"> <li>■ Orange River.</li> </ul>	Freshwater for consumption and irrigation is taken from the Orange River.	<ul style="list-style-type: none"> <li>■ Residents of the ZF Mgcawu District municipality that use river water for domestic use; and</li> <li>■ Commercial crop producers.</li> </ul>



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Ecosystem Service	Landcover Type	Definition of Service	Associated beneficiaries
		Freshwater for mining processes and renewable energy production is abstracted from the Orange River by several major mining enterprises, and existing and proposed solar power facilities.	<ul style="list-style-type: none"> <li>■ The Project;</li> <li>■ Other solar developments; and</li> <li>■ Mining operations downstream of the abstraction point (see Table 9).</li> </ul>
<b>Regulating</b>			
Regulation of air quality	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	Leaves of trees, shrubs and forbs trap air pollutants, especially near industrial and urban areas, and along roadsides.	<ul style="list-style-type: none"> <li>■ Residents of the !Kheis local municipality.</li> </ul>
Regulation of water flows and timing	<ul style="list-style-type: none"> <li>■ Orange River;</li> <li>■ Cultivated land; and</li> <li>■ Thicket and dense bush.</li> </ul>	Riparian vegetation and floodplains (including cultivated areas) retain water and contribute to reduced flooding frequency	<ul style="list-style-type: none"> <li>■ River-side residences and businesses downstream of floodplains in the ZF Mgcawu District municipality.</li> </ul>
Water purification and waste treatment	<ul style="list-style-type: none"> <li>■ Orange River.</li> </ul>	The Orange River has an important role in dilution, decomposition and assimilation of organic wastes in lieu of adequate provision of piped water and sanitation to households within the Study Area	<ul style="list-style-type: none"> <li>■ Residents of the ZF Mgcawu District municipality that use river water for domestic use.</li> </ul>
Regulation of disease	<ul style="list-style-type: none"> <li>■ Orange River.</li> </ul>	The Orange River's role in water purification and waste treatment contributes to reduced incidence of e.g. water-borne diseases	<ul style="list-style-type: none"> <li>■ Residents of the ZF Mgcawu District municipality that use river water for domestic use.</li> </ul>
Soil stability and erosion control	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	Vegetation cover within the study area reduces soil loss and prevents erosion.	<ul style="list-style-type: none"> <li>■ The Project.</li> <li>■ Livestock farmers. and</li> <li>■ Owners of adjacent game farms.</li> </ul>



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Ecosystem Service	Landcover Type	Definition of Service	Associated beneficiaries
Regulation of pests	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	Predatory animals from adjoining natural habitats (e.g. bats, snakes, Jackal, Bat-Eared Fox, Caracal) consume crop pests.	<ul style="list-style-type: none"> <li>■ Commercial crop farmers.</li> </ul>
Pollination	<ul style="list-style-type: none"> <li>■ Cultivated land;</li> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	Commercial agriculture is reliant on pollination by bees for fruit and vegetable growth.	<ul style="list-style-type: none"> <li>■ Commercial crop farmers.</li> </ul>
<b>Cultural</b>			
Recreation and ecotourism	<ul style="list-style-type: none"> <li>■ Orange River.</li> </ul>	Approx. 180 km downstream of the Project, the Orange River is a popular location for fly fishing, canoe tours and white water rafting.	<ul style="list-style-type: none"> <li>■ Tourists;</li> <li>■ Accommodation providers;</li> <li>■ Bars, cafes, restaurant owners; and</li> <li>■ Tourism activity operators.</li> </ul>
	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	The Kalahari Oryx game farm located to the immediate north of the Project site, and FM Safari game farm located approx. 30 km northwest of the Project, attracts high-end clientele for wilderness and hunting experiences. Glen Lyon reserve, located approx. 20 km southeast of the Project is not actively marketed to tourists currently (Conningarth Economists, 2016).	<ul style="list-style-type: none"> <li>■ Game farm owners; and</li> <li>■ Game farm clientele.</li> </ul>
Ethical and spiritual values	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	The contribution of the landscape to residents' and tourists' sense of place.	<ul style="list-style-type: none"> <li>■ Residents within the viewshed of PV1;</li> <li>■ Tourists partaking in wilderness experiences within the viewshed of PV1 and</li> <li>■ Road users.</li> </ul>



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Ecosystem Service	Landcover Type	Definition of Service	Associated beneficiaries
<b>Supporting</b>			
Habitat	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	<p>Orange River provides habitat for fish and waterfowl and contributes to landscape connectivity for terrestrial fauna through its role as a wildlife corridors.</p> <p>Terrestrial vegetation communities support faun, providing refugia for species moving in and out of neighbouring game farms as well as species of conservation concern moving in the surrounding landscape</p>	<ul style="list-style-type: none"> <li>■ Anglers;</li> <li>■ Bird watchers and nature lovers; and</li> <li>■ Game farm owners.</li> </ul>
Nutrient cycling	<ul style="list-style-type: none"> <li>■ Cultivated land.</li> </ul>	<p>Approximately 300 m of the pipeline route is surrounded by intensive agricultural crop production; however the existing cleared servitude will be used and no additional vegetation clearance and consequent reduction in food production will occur.</p>	<ul style="list-style-type: none"> <li>■ Commercial crop producers; and</li> <li>■ Crop consumers.</li> </ul>
Primary production	<ul style="list-style-type: none"> <li>■ Low shrubland;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	<p>These land covers within the Study Area provide grazing resources for livestock and game. The carrying capacity of the sparse grazing resource may be low, however it does support large herbivores in game farms, as well as goats and sheep in other areas.</p>	<ul style="list-style-type: none"> <li>■ Game farm owners; and</li> <li>■ Livestock farmers.</li> </ul>
Water cycling	<ul style="list-style-type: none"> <li>■ Orange River;</li> <li>■ Low shrubland;</li> <li>■ Thicket/dense bush;</li> <li>■ Woodland/open bush; and</li> <li>■ Grassland.</li> </ul>	<p>Although no permanent surface water systems occur within the Project footprint, a series of drainage liens direct surface water flow during times of high rainfall toward the Orange River.</p>	<ul style="list-style-type: none"> <li>■ Orange River water users.</li> </ul>



### 6.1.2 Which Ecosystem Services does the Project depend upon?

The Project itself is a **Type II** beneficiary of ecosystem services within the study area:

- Fresh water supply: The Project is reliant on the quality and quantity of freshwater remaining constant throughout its lifetime in order to maintain its operational feasibility. Cumulative impact of abstraction by other projects could limit water availability in future. The surface water report for this study (Golder Associates Africa, 2016b) shows that projected increase in water user demands could result in the unavailability of water in the medium to long term (2030 onwards);
- Soil stability & erosion control: Droughts and future effects of climate change could increase the likelihood of desertification encroachment in this region. Vegetation removal for site clearance could also contribute, creating a 'nick point' for erosion to take hold. Ongoing soil erosion around the Project infrastructure will be costly for the Project to maintain/address, which could affect the Project Performance;
- Recreation and ecotourism: The PV1 facility will be visible from part of the southern extent of the Kalahari Oryx game farm (Figure 2), which will affect sense of place enjoyed by tourists and may cause reduction/loss of business for the game farm owners. The Project is reliant on the game farm owners to grant a social license to operate, which could be eroded by the presence of the PV1 facility in the landscape and associated loss of business; and
- Ethical and Spiritual values: The PV1 infrastructure will be 95% visible in a 0 - 5 km radius, 60% visible in the 5 -10 km radius, and in the 40 km radius of the study area, the panels will be 35% visible in the south east quadrant of the study area around the project site. The additional solar panels and associated glare creates a high visibility which cannot be visually mitigated within the predominantly non-transformed environment (Golder Associates Africa, 2016d) The Project is reliant on the local residents, businesses and tourists to grant a social license to operate, which could be eroded by the presence of the PV1 facility in the landscape, affecting views and sense of place.

As mentioned previously (section 3.3), the ecosystem services on which the Project depends on are highlighted in this document and included for discussion, but are not included in the impact assessment, which deals with Type I ecosystem services, i.e. those that may be **impacted** by the Project, only.

## 6.2 Step 2: Ecosystem Service Prioritisation

Ecosystem services were prioritised according to project impact, by answering the three key questions put forward by (Landsberg, *et al.*, 2013):

- 1) Could the Project affect the ability of others to benefit from this ecosystem service?
- 2) Is the ecosystem service important to beneficiaries' livelihoods, health, safety or culture?
- 3) Do beneficiaries have viable alternatives to this ecosystem service?

The full results of the prioritisation exercise for Type I ecosystem services are detailed in Table 13. Five priority Type I ecosystem services according to Project Impact were identified:

- Fresh water supply: the Project will contribute to cumulative effects on water balance, which may be negative by 2050 (Table 11), affecting water users reliant on Orange River for supply;
- Soil stability & erosion control: Droughts and future effects of climate change could increase the likelihood of desertification encroachment in this region. Vegetation removal for site clearance will contribute, creating a 'nick point' for erosion to take hold;
- Recreation and ecotourism:
  - PV1 will be visible from the adjacent Kalahari Oryx game farm and this may affect the sense of place and 'wildlife experience' enjoyed by clients of the game farm. Ensuing effects on customers desire to come to the game farm may affect the livelihoods of the game farm owners; and



- The Project contribution to cumulative impacts on water quantity in the Orange River, in combination with other major water users, may affect its capacity to support tourism activities downstream such as fly fishing, canoe tours and white water rafting in the future.
- Ethical and spiritual values: The view of the landscape and its contribution to people's (residents, tourists, road users) sense of place may become diminished by the presence of the PV1 photovoltaic development.



**Prioritisation of Ecosystem Services according to Project Impact**

Following the method described in Landsberg *et al.* (2013), priority ecosystem services are those services for which the answers to both questions 1 and 2 are “Yes” or “Unknown”, **and** the answer to question 3 is “No” or “Unknown”. If the answer to question 1 is No, then no response to the remaining questions is applicable.

**Table 13: Priority ecosystem services according to Project Impact**

Ecosystem Service	Potentially affected beneficiaries	Potentially affected benefits	1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)	2. Is this ES important to beneficiaries' livelihoods, health, safety or culture? (Y/N/?)	3. Do beneficiaries have viable alternative to this ES? (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
<b>Provisioning</b>						
Food – Agricultural crops	Commercial crop producers.	Income, livelihoods, food intake.	N – No additional crop land will be lost. The pipeline will be constructed within the existing servitude.	n/a	n/a	0
Food - Grazing for Livestock	Livestock farmers.	Reduced grazing area due to Project land-take limit the ability of livestock farmers currently leasing the land to raise livestock for commercial/subsistence purposes.	Y	Y	Y – Extensive areas of similar grazing resources are available.	0
Food – subsistence hunting and edible plant gathering	Residents of the !Kheis local municipality.	Reduced habitat availability for hunted animal species, direct loss of edible plants within PV1 footprint.	Y	Y	Y – Extensive areas of similar vegetation types supporting edible plants and animals are available.	0
Medicinal Plants	Residents of the !Kheis local municipality.	Direct loss of medicinal plants within PV1 footprint.	Y	Y	Y – Extensive areas of similar vegetation types supporting medicinal plants are available.	0
Biomass fuel – wood and charcoal	Residents of the !Kheis local municipality.	Loss of low shrubland within PV1 footprint reduces available area for harvesting wood fuel.	Y – No evidence of wood fuel harvest was observed within the Study Area; however it may occur.	Y	Y – Numerous alternative energy sources (including electricity, alternative fuel wood harvest areas) are available.	0
Fresh water	Residents of the ZF Mgcawu District municipality that use river water for domestic use.	Availability and quality of fresh water for drinking may be compromised by abstraction from Orange River.	Y – The Project will contribute to cumulative effects on water balance, which may be negative by 2050.	Y	N	1
	<ul style="list-style-type: none"> <li>■ Commercial crop producers; and</li> <li>■ Industries whose water comes from Orange River.</li> </ul>	Availability of fresh water for irrigation may be compromised by abstraction from Orange River.	Y – The Project will contribute to cumulative effects on water balance, which may be negative by 2050.	Y	N	1
<b>Regulating</b>						
Regulation of air quality	Residents of the !Kheis local municipality.	Loss of 226 Ha of vegetation within PV1 footprint reduces available area for plants to take up air pollutants.	N – The loss of 226 Ha of vegetation to the Project footprint by comparison to that available within the 40 km buffer is low (4%).	n/a	n/a	0





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<b>Ecosystem Service</b>	<b>Potentially affected beneficiaries</b>	<b>Potentially affected benefits</b>	<b>1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)</b>	<b>2. Is this ES important to beneficiaries' livelihoods, health, safety or culture? (Y/N/?)</b>	<b>3. Do beneficiaries have viable alternative to this ES? (Y/N/?)</b>	<b>Priority ES 1 = Priority 0 = Non-priority</b>
Regulation of water flows and timing	River-side residences and businesses downstream of floodplains in the ZF Mgcawu District municipality.	The pipeline may intercept additional areas of riparian vegetation, requiring vegetation clearance.	N – Any required clearance would be minimal in the context of the service provision.	n/a	n/a	0
Water purification and waste treatment	Residents of the ZF Mgcawu District municipality that use river water for domestic use.	Quality of the water resource in the Orange River and its capacity to dilute and disperse organic pollutants may be compromised by abstraction from Orange River.	N – No impacts on surface water quality and therefore the Orange Rivers assimilative capacity in the Orange River as a result of proposed water abstraction are predicted.	n/a	n/a	0
Regulation of disease	Residents of the ZF Mgcawu District municipality that use river water for domestic use.	Quality of the water resource in the Orange River and its capacity to dilute and disperse disease-causing organisms may be compromised by abstraction from Orange River.	N – No impacts on surface water quality and therefore the Orange Rivers assimilative capacity in the Orange River as a result of proposed water abstraction are predicted.	n/a	n/a	0
Soil stability & erosion control	<ul style="list-style-type: none"> <li>■ Neighbouring Livestock farmers; and</li> <li>■ Owners of adjacent game farms.</li> </ul>	Vegetation clearance for PV1 construction may reduce the ability of the surrounding soils to withstand erosive forces of wind and drought.	Y	Y	N	1
Regulation of pests	Commercial crop farmers.	Reduction in vegetation cover on PV1 may affect predatory species habitat availability, which could reduce their effect on restricting pest populations.	N – The loss of 226 Ha of vegetation to the Project footprint by comparison to that available within the 40 km buffer is low (4%).	n/a	n/a	0
Pollination	Commercial crop farmers.	Reduced productivity of grape/sultana farms as a result in reduction of available wild vegetation types for bees.	N – The loss of 226 Ha of vegetation to the Project footprint by comparison to that available within the 40 km buffer is low (4%).	n/a	n/a	0
<b>Cultural</b>						
Recreation and ecotourism	Kalahari Oryx game farm owners.	PV1 will be visible from the adjacent Oryx game farm and this may affect the sense of place and 'wildlife experience' enjoyed by its clients. Ensuing effects on customers desire to come to the game farm may affect the livelihoods of the game farm owners.	Y – The solar PV panels will be visible from the southern extent of the Kalahari Oryx farm (Figure 2).	Y	N	1
	Kalahari Game farm clientele.	PV1 will be visible from the farm and this may affect the sense of place and 'wildlife experience' enjoyed by clients of the adjacent Oryx game farm. Clients may no longer wish to visit this game farm and look for alternatives.	N – It is anticipated that clients will be able to locate and use alternative facilities for hunting and wilderness experiences.	n/a	n/a	0
	Beyond regional: <ul style="list-style-type: none"> <li>■ Water sports enthusiasts;</li> <li>■ Accommodation providers;</li> <li>■ Bars, cafes, restaurant owners; and</li> <li>■ Tourism activity operators.</li> </ul>	Changes in water quantity in the Orange River may affect its capacity to support tourism activities downstream such as fly fishing, canoe tours and white water rafting.	Y – The Project will contribute to cumulative effects on water balance, in combination with other water users, particularly in the future (ref. Table 11).	Y	N	1



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Ecosystem Service	Potentially affected beneficiaries	Potentially affected benefits	1. Could the project affect the ability of others to benefit from this ES? (Y/N/?)	2. Is this ES important to beneficiaries' livelihoods, health, safety or culture? (Y/N/?)	3. Do beneficiaries have viable alternative to this ES? (Y/N/?)	Priority ES 1 = Priority 0 = Non-priority
Ethical and spiritual values	<ul style="list-style-type: none"> <li>Residents within the viewshed of PV1;</li> <li>Tourists partaking in wilderness experiences within the viewshed of PV1; and</li> <li>Road users.</li> </ul>	The view of the landscape and its contribution to people's sense of place may become diminished by the presence of the PV1 photovoltaic development.	Y – PV1 infrastructure will be 95% visible in a 0 - 5 km radius, 60% visible in the 5 - 10 km radius, and In the 40 km radius of the study area, the panels will be 35% visible in the south east quadrant of the study area around the project site.	Y	N	1
<b>Supporting</b>						
Habitat	<ul style="list-style-type: none"> <li>Anglers; and</li> <li>Bird watchers and nature lovers.</li> </ul>	Changes in water quantity in Orange River may affect its capacity to provide habitat for fish and waterfowl and contribute to landscape connectivity for terrestrial fauna through its role as a wildlife corridor.	Y – The Project will contribute to cumulative effects on water balance, in combination with other water users, particularly in the future (Table 11).	N	Y	0
	<ul style="list-style-type: none"> <li>Bird watchers and nature lovers; and</li> <li>Game farm owners.</li> </ul>	Reduction in extent of vegetation communities as a result of clearance for PV1 may limit provision of refugia for species moving in and out of neighbouring game farms as well as species of conservation concern moving in the surrounding landscape.	N – The loss of 226 Ha of vegetation to the Project footprint by comparison to that available within the 40 km buffer is low (4%).	n/a	n/a	0
Nutrient cycling	<ul style="list-style-type: none"> <li>Commercial crop producers; and</li> <li>Crop consumers.</li> </ul>	Income, livelihoods, food intake.	N – No additional crop land will be lost. The pipeline will be constructed within the existing pipeline servitude for Bokpoort I.	n/a	n/a	0
Primary production	Livestock farmers.	Reduced grazing area due to Project land-take may limit the ability of the farmer currently using the land to raise livestock for commercial/subsistence purposes.	Y	Y	Y – Extensive areas of similar grazing resources are available.	0
Water cycling	<ul style="list-style-type: none"> <li>Orange River water users;</li> <li>Residents of the ZF Mgcawu District municipality that use river water for domestic use and industries whose water comes from Orange River; and</li> <li>Commercial crop producers.</li> </ul>	Changes in water quantity in the Orange River as a result of abstraction.	N – The volume being abstracted will not affect key components of water cycling, that is the transfer of water from soil to plants, plants to air, and air to rain.	n/a	n/a	0



## 7.0 ASSESSMENT OF PROJECT IMPACT ON TYPE I PRIORITY ECOSYSTEM SERVICES

### 7.1 Type I Priority Ecosystem Service Impacts

The predicted impacts on Type I Priority ecosystem services are outlined in Table 14.

The impact severity ratings presented in Table 14 are based on the anticipated impacts on ecosystem services, before specific mitigation measures have been applied. Specific mitigation measures relating to ecosystem services set out by relevant specialist studies are discussed in section 8.0. In cases where the specialist studies do not address mitigation of impacts on ecosystem services, or where residual impacts on ecosystem services remain following application of specialist recommendations, additional mitigation measures to address such impacts are also provided in section 8.0, Mitigation Measures.

**Table 14: Impact Severity on Type I Priority Ecosystem Services**

Impact	Priority Ecosystem Service Affected	Rating – Pre mitigation				Total Rating	Significance Points	Rating – Post mitigation				Total Rating	Significance Points
		Magnitude	Duration	Scale	Probability			Magnitude	Duration	Extent	Probability		
<b>Construction Phase</b>													
Vegetation clearance in advance of construction works	<b>Soil Stability and Erosion Control Type I:</b> Compromised soil stability and erosion control both within, and in the vicinity of the Project footprint, potentially affecting neighbouring game farms and livestock farmers.	6	5	2	5	65	Moderate	4	2	1	4	28	Low
<b>Operation Phase</b>													
Abstraction of water from Orange River	<b>Fresh Water Supply:</b> The proposed 75 MW PV1 facility's water requirements will have a minimal impact on the total water user demands in the Lower Orange Main stem in the short to medium term (until 2025).	2	4	3	5	45	Moderate	2	4	3	2	18	Low
	<b>Recreation and ecotourism:</b> Changes in water quantity in the Orange River may affect its capacity to support tourism activities downstream such as fly fishing, canoe tours and white water rafting.	2	4	3	5	45	Moderate	2	4	3	5	45	Moderate
Physical presence of solar power facility	<b>Soil Stability and Erosion Control Type II:</b> Ongoing reduced soil stability and erosion control both within, and in the vicinity of the Project footprint, potentially affecting neighbouring game farms and livestock farmers.	4	4	2	5	50	Moderate	2	2	2	2	12	Low



Impact	Priority Ecosystem Service Affected	Rating – Pre mitigation				Total Rating	Significance Points	Rating – Post mitigation				Total Rating	Significance Points
		Magnitude	Duration	Scale	Probability			Magnitude	Duration	Extent	Probability		
Physical presence of solar power facility	<b>Recreation and ecotourism:</b> PV1 will be visible from the farm and this may affect the sense of place and ‘wildlife experience’ enjoyed by clients of the adjacent Oryx game farm. Ensuing effects on customers desire to come to the game farm may affect the livelihoods of the game farm owners.	10	4	2	5	80	High	10	4	2	5	20	High
	<b>Ethical and Spiritual Values:</b> The view of the landscape and its contribution to people’s sense of place may become diminished by the presence of the PV1 photovoltaic development.	10	4	3	5	85	High	10	4	3	5	85	High

### 7.1.1 Construction Phase Impacts - Vegetation clearance in advance of construction works

#### Soil Stability and Erosion Control as a Type I Priority ES

Droughts and future effects of climate change could increase the likelihood of desertification encroachment in this region. Vegetation removal for site clearance for Project construction may contribute, creating a ‘nick point’ for erosion to take hold and spread from the Project footprint to adjacent areas, effects which would be permanent. The significance of effects on the supply of this ecosystem service are therefore considered to be of **moderate** significance prior to mitigation.

With the application of the recommended mitigation measures, the extent, magnitude and duration of impacts can be reduced, through increasing the supply of soil erosion control service, largely via restoration of the Project footprint’s vegetation cover and capacity to deliver the service. The impact post-mitigation is considered to be of **low** significance.

### 7.1.2 Operation Phase Impacts – Abstraction of Water from Orange River

#### Freshwater Supply

The proposed 75 MW PV1 facility’s water requirements will have a minimal impact on the total water user demands in the Lower Orange Main stem in the short to medium term (until 2025), and, should the remainder of the Bokpoort II Solar Development be implemented (proposed CSP and PV2), the total impact on water demand will remain similar (ref. Golder Associates Africa, 2016c). Therefore the magnitude of potential impacts as a result of the Project abstraction alone are considered minor. Predicted impacts will be long-term and occur at a regional scale, therefore the overall impact significance is moderate.

No specific mitigation measures have been put in place as part of the surface water impact assessment due to the relatively low levels of water being used by the Project. However, given that impacts on the ecosystem service are predicted to be long-term and at the regional scale, mitigation actions including re-use and recycling of water to minimise the amount of water being abstracted is recommended. The application of this mitigation measure could reduce the probability of impacts to low, thereby reducing the overall significance of impacts to low significance post-mitigation.

However, the projected increase in water user demands could result in the unavailability of water in the medium to long term (2030 onwards) based on gathered information from DWA (Department of Water Affairs, 2013).



The Project's contribution to cumulative impacts on water quantity in the Orange River, and potential means to address this, is discussed in section 9.0, Cumulative Impacts.

### **Recreation and Ecotourism**

As is the case for predicted effects on freshwater supply, the proposed amount of water abstraction required by PV1 will represent a minimal addition to the total water user demands in the Lower Orange Main stem in the short to medium term, with a moderate impact significance. Similarly, minimisation of the amount of water being abstracted through practising re-use and recycling of water on site could reduce overall impact significance to low post-mitigation.

## **7.1.3 Operation Phase Impacts – Physical Presence of PV1 in Landscape**

### **Recreation and Ecotourism**

PV1 will be visible from the southern extent of the adjacent Kalahari Oryx Game farm (Figure 2) and this is expected to affect the sense of place and 'wildlife experience' enjoyed by clients of the game farm. Ensuing effects on client's desire to come to the game farm, and loss of current customers, would affect the livelihoods of the game farm owners. The magnitude of impacts is potentially very high in terms of game farmer's livelihood, as the worst case scenario predicts that the farm would lose all of their current clientele, and shift focus to a lower-income-generating group of hunters (Conningarth Economists, 2016). The probability of this occurring is uncertain, therefore potential impacts on game farm owner's livelihoods are considered to be of high significance.

As a result of the visibility of PV1 and loss of 'wilderness' experience for high-end international clients, a changed marketing approach could shift customer focus to those less invested in 'wilderness experience' e.g. local (South African) biltong hunters; in addition game animals could still be produced and sold to other game farms. Nevertheless a shortfall in income would be still experienced. The impact of visibility of PV1 therefore remains high for the lifetime of the Project.

Potential compensation options (Conningarth Economists, 2016) could include acquiring the Kalahari Oryx enterprise or otherwise compensating the adjacent game farm, which could reduce impacts on the game farmer's livelihood due to loss of tourist potential to low significance.

### **Ethical and Spiritual Values**

The view of the landscape and its contribution to people's sense of place may become diminished by the presence of the PV1 photovoltaic development. The magnitude of effects on these ecosystem services in the landscape context is considered high, as it is irreplaceable. The effect will likely extend to beneficiaries in the Project viewshed (approx. 40 km), including the owners and users of the Oryx game farm adjacent to the project, and will last for at least the duration of the Project. The potential Project impact on the supply of this ecosystem service will be of **high** significance.

Mitigation options are very limited for the proposed 75 MW PV 1 solar facility as a result of the large footprint of the infrastructure, the flat, almost featureless topography as well as the functional/operational requirements of the installations, namely maximising unobstructed exposure to available sunlight.

Given the long expected operational lifespan of the installation, visual mitigation will therefore only be possible if and when the facility is decommissioned and dismantled, and the resultant footprint areas rehabilitated. Therefore impacts on the supply of this ecosystem service remain of high significance for the lifetime of the Project.

## **8.0 RECOMMENDED MITIGATION MEASURES**

Mitigation measures provided in the following sections include those from specialist studies that are specific to potential impacts on the supply of ecosystem services, and suggested additional mitigation measures based on guidance provided for major infrastructure project impacts and dependencies on ecosystem services (IPIECA, 2011). The recommended mitigation measures are presented in the following sections.



## **8.1 Mitigation measures for Construction Phase Impacts on Soil Stability and Erosion Control Ecosystem Services**

- New areas of surface disturbance and associated vegetation clearance should be minimised wherever possible. Areas proposed for vegetation clearance should be clearly marked and no heavy vehicles should travel beyond the marked works zone;
- The retention of a vegetated buffer zone between the edge of the proposed infrastructure footprint and the outer boundary of the facility, within which the existing vegetation is retained, is recommended. This will reduce disturbance associated with construction activity (presence of people and heavy machinery, disturbance of faunal species of conservation concern), and will also contribute to the conservation of natural vegetation within the project boundary, reducing the erosion vulnerability of the soil; and
- Collection of propagules including seeds, cuttings and seedlings of floral species of conservation concern should be conducted, to preserve genetic diversity and retain these species for specific conservation actions. Where possible, these should be replanted in areas of the Project footprint that have been cleared of vegetation once construction works are complete.

## **8.2 Mitigation measures for Operation Phase Impacts on Fresh Water Supply and Water-based Recreation and Tourism Ecosystem Services due to water abstraction from Orange River**

- Reduce water volumes needed by Project activities through treatment and re-use of process water and waste water; and
- Participation in water catchment management activities in the Lower Orange River water management unit in association with other Projects developments sourcing water from the Orange, to promote equitable sharing of fresh water resources and contribute to future planning.

## **8.3 Mitigation measures for Operation Phase Impacts on Recreation and Tourism, and Ethical and Spiritual Ecosystem Services as a result of the physical presence of the PV1 development in the landscape**

- Implement measures to reduce site light pollution at night:
  - Utilise security lighting (if feasible) that is movement activated rather than permanently switched on, to prevent unnecessary constant illumination during night-time;
  - Plan and optimise the lighting requirements of the facilities to ensure that lighting meets the need to keep the site secure and safe, without resulting in excessive illumination;
  - Reduce the height from which floodlights are fixed as much as possible while still maintaining the required levels of illumination;
  - Identify zones of high and low lighting requirements, focusing on only illuminating areas to the minimum extent possible to allow safe operations at night and for security surveillance;
  - Avoid up-lighting of structures by rather directing lighting downwards and focussed on the area to be illuminated; and
  - Fit all security lighting with 'blinkers' or specifically designed fixtures, to ensure light is directed downwards while preventing side spill. Light fixtures of this description are commonly available for a variety of uses and should be used to the greatest extent possible.



- Potential compensation options (Conningarth Economists, 2016) could include acquiring the Kalahari Oryx enterprise or otherwise compensating the owners of Kalahari Oryx Game Farm, FM Safaris and Glen Lyon Nature Reserve. This could reduce impacts on the respective game farm owner's livelihood due to loss of tourist potential to low significance; and
- Where significant Project impacts on the landscape and people's sense of place are unavoidable, the client will obtain the free, prior and informed consent (FPIC) of the Affected Communities, as per IFC PS8 and PS1 requirements, via a process of Informed Consultation and Participation of the affected communities.

## **9.0 CUMULATIVE IMPACTS**

The Project is located adjacent to the existing Bokpoort I development, and the proposed PV2 and CSP Tower also proposed for the Bokpoort II facility. In addition, the proposed SolAfrica Sanddraai 75 MW PV Project in !Kheis LM is situated on the farm directly adjacent to the Project (No. 19, Figure 9), and the proposed Kheis Solar Park 1 PV project (No. 14, ) is located in similar habitat approximately 20 km north of the Project.

The Bokpoort PV1 Project is expected to affect ecosystem services including soil stability and erosion control as a result of loss of areas of natural vegetation; fresh water supply, the quality and quantity of which may be reduced as a result of proposed abstraction for the Project; and view of the landscape and its contribution to people's sense of place, affecting the quality of supply of recreation and tourism ecosystem services affecting game farm owners livelihoods, as well as the supply of ethical and spiritual ecosystem services to local residents.

### ***Soil Stability and Erosion Control***

The application of the recommended mitigation measures is anticipated to reduce the potential effects on the supply of soil stability and erosion control ecosystem service to low significance, therefore the Project is not expected to significantly contribute to cumulative effects on the supply of this ecosystem service in the Study Area.

### ***Freshwater Supply and associated Recreation and Tourism Ecosystem Services***

Although the proposed 75 MW PV1 facility's water requirements will have a minimal impact on the total water user demands in the Lower Orange Main stem in the short to medium term (until 2025), the predicted impact on the supply of freshwater as an ecosystem service remains of moderate significance with the application of mitigation measures. Should the remainder of the Bokpoort II Solar Development be implemented (proposed CSP and PV2), the total impact on water demand will remain similar.

Potential impacts on freshwater supply may arise as a result of climate change, as well as the cumulative impact of abstraction by the existing Bokpoort I project, the adjacent SolAfrica Sanddraai 75 MW PV Project, the other components of the Bokpoort II project (CSP tower and PV2), as well as other major water users abstracting from the Orange River, which could limit water availability for Orange River water users and the Project in future. In addition, based on information from DWS (Department of Water Affairs, 2013), projected increases in water user demands could result in the unavailability of water in the medium to long term (2030 onwards). Therefore cumulative impacts on freshwater supply are predicted.

Reducing volumes of water intake through treatment and recycling, as well as participation in water catchment management activities in the Orange River management area can reduce significance of impacts on freshwater demand by the Project to low post-mitigation; however a catchment-wide strategy to address the cumulative impact of abstraction by the solar projects, as well as other major water users (commercial crop producers, municipal/urban, mining) should be investigated by the relevant authority, in partnership with the Department of Water Affairs.

### ***Ethical and Spiritual Values, and associated Recreation and Tourism Ecosystem Services***

The PV1 Project is expected to affect ecosystem services including ethical and spiritual values, and recreation and tourism due to changes in the landscape as a result of loss of areas of natural ecosystems, and the visual presence of the Project itself in these landscapes; both of which are expected to limit the beneficiaries' capability to benefit from this ecosystem services.



The magnitude of effects on these ecosystem services in the landscape context is considered high, as it is irreplaceable. The effect will extend to beneficiaries in the PV1 viewshed, including the owners and users of the Oryx game farm adjacent to the project, and will last for at least the duration of the Project.

Mitigation options for the construction and especially operation phases are very limited for the proposed PV1 facility as well as the potential additional Bokpoort II project facilities (75 MW PV 2 solar facility, 150 MW CSP Tower), as a result of the large footprint and/or vertical height of the infrastructure, the flat almost featureless topography as well as the functional/operational requirements of the installations, namely maximising unobstructed exposure to available sunlight.

The cumulative impact of the project in terms of visual intrusion is therefore expected to be moderate to high, as the project will introduce a larger amount of manmade infrastructure into a visual landscape that is relatively non-transformed. In terms of glare the project is expected to have a high cumulative impact, as the additional 250 ha of PV1 adjacent to the existing Bokpoort I facility will increase the intensity of the glare within the study area. The Project will therefore contribute to cumulative impacts on beneficiaries of priority ecosystem services. This is likely to further compromise the value the beneficiaries derive from the already impacted priority ecosystem services.

Given the long expected operational lifespan of the installation, visual mitigation and amelioration of cumulative impacts will therefore only be possible if and when the facility is ever decommissioned and dismantled, and the resultant footprint areas rehabilitated.

As suggested in the mitigation measures outlined in section 8.0, and where significant effects on the landscape and people's sense of place are unavoidable, a process of Informed Consultation and Participation of the affected communities should be undertaken, as per IFC PS8 and PS1 requirements.





# ECOSYSTEM SERVICES REVIEW AND IMPACT ASSESSMENT - 75 MW PV1 SOLAR DEVELOPMENT

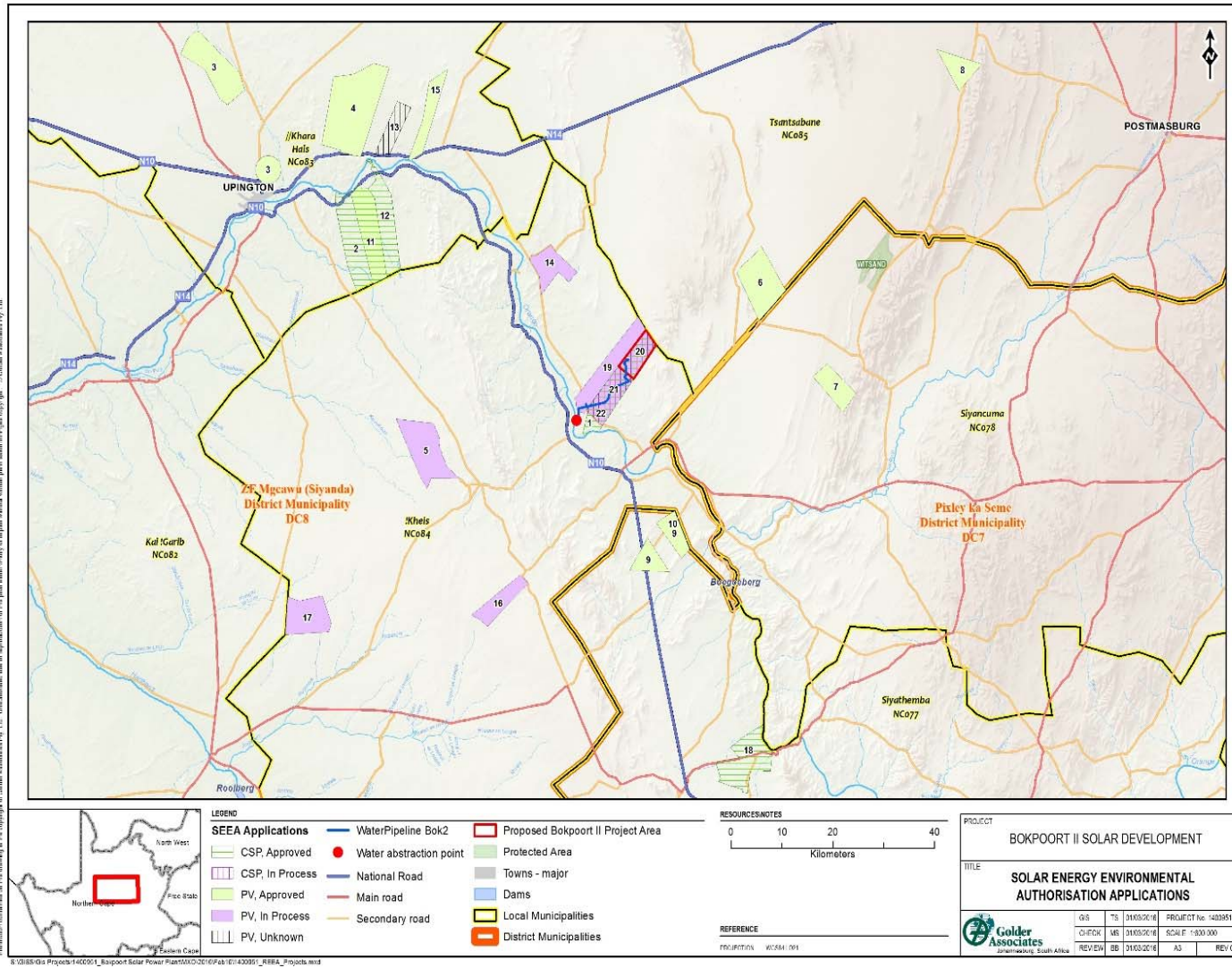


Figure 9: Approved and proposed solar developments that may pose cumulative impacts on the supply of ecosystem services, in combination with the Project



## 10.0 CONCLUSION

The Project will affect beneficiaries of priority ecosystem services in two main ways; changes in the landscape due to initial vegetation clearance for construction of the Project infrastructure and the physical presence of the Project infrastructure once constructed; and the contribution to cumulative impacts on the quantity of water in the Orange River in the future.

The presence of the Project infrastructure will cause land cover changes and reductions in the visual amenity value of the landscape, resulting in associated loss of supply of ecosystem services; it will also change the physical landscape of the area which lends itself to the cultural heritage and recreational and tourism value of the landscape to local communities. In addition, the Project will also contribute to cumulative impacts on beneficiaries of priority ecosystem services that are also located within the viewshed of other solar energy developments in the region.

Although the Project's effect on the supply of fresh water and provision of associated ecosystem services such as water-based recreation and crop irrigation in the Orange River is expected to be minimal, future scenarios predict that the cumulative demand on water from the Orange River is unsustainable in the long-term. Therefore, the Project should aim to minimise its reliance on abstraction from the Orange River through re-using and recycling water on site wherever possible.

Other than the actual direct and indirect effects of Project infrastructure and activities, maintenance of the Project's social licence to operate from affected beneficiaries is critical. It is therefore crucial that the mitigation hierarchy is followed and all efforts to avoid and minimise impacts on Orange River water quantity, soil stability and landscape viewsheds are made. In particular, implementation of the recommended measures to manage and prevent soil erosion, and reductions in the amount of process water being abstracted are key mitigation measures in reducing the Project's contribution to cumulative impacts within the study area, maintaining the Project's social license to operate in the area, and assisting the Project in maintaining operational performance.

The impacts on the visual amenity value of the landscape, users sense of place and consequent effects on recreation and tourism, and ethical and spiritual values cannot be mitigated as the benefits conferred by the landscape in its natural state are irreplaceable. The possibility of compensating the owners of the Kalahari Oryx Game Farm should be considered to compensate for potential loss of livelihood as a result of the changed landscape and effects on users sense of place. Where significant Project impacts on the landscape and associated effects on ecosystem service beneficiaries are unavoidable, the Project may need to obtain the free, prior and informed consent (FPIC) of the Affected Communities, as per IFC PS8 and PS1 requirements.

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# **APPENDIX A**

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NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

- (1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and
- (2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

### PROJECT TITLE

Proposed 75 MW Photovoltaic Development (PV1) on the Remaining Extent of the Farm Bokpoort 390 near Groblershoop in the !Kheis Local Municipality, Northern Cape.

Specialist:	Aisling Dower		
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16 May 2015

Dr Brent Baxter

Golder Associates (Africa)

Dear Dr Baxter

**RE: Review of Ecosystem Services Review and Impact Assessment: Proposed Development on the Remaining Extent of Farm Bokpoort**

I have reviewed the following three documents:

***Ecosystem Services Review and Impact Assessment: Proposed 150 MW CSP Tower Development on the Remaining Extent of Farm Bokpoort 390, Northern Cape***

***Ecosystem Services Review and Impact Assessment: Proposed 75 MW PV2 Solar Power Development on the Remaining Extent of Farm Bokpoort 390, Northern Cape***

***Ecosystem Services Review and Impact Assessment: Proposed 75 MW PV1 Solar Power Development on the Remaining Extent of Farm Bokpoort 390, Northern Cape***

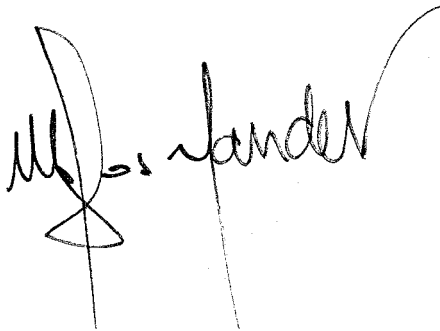
My comments are as follows:

1. The method used:
  - a. The method for the three assessments is acceptable given the level of land use and settlement density in the affected area.
2. The quality of the reporting:
  - a. There are some edits to be made. These are highlighted in CSP Tower report, and should be attended to in the two PV reports as well.
  - b. The quality of reporting is appropriate for the magnitude of the development proposed.
3. The identification of key ecosystem services impacted:
  - a. The key impacts identified and scored in all three reports appear to be adequate, with two exceptions:
    - i. Water quality needs to be included as a priority given that a small but significant water volume reduction is anticipated. A reduction in volume will lead to an elevation in pollution concentration. However, the impact on dilution capabilities is expected to be low. This is largely for completeness sake and will not change the overall outcome.
    - ii. Water cycling is identified as a priority, but water cycling is not an ecosystem service. As water supply is already covered as a priority, including water cycling is double counting. This needs to be removed.
4. The mitigation recommended:
  - a. The mitigation recommended is broadly appropriate but for two exceptions:
    - i. The mitigation action proposed for light pollution is weak, as it states that floodlights should be pointed down and shielded. I would propose stronger

wording that states floodlights should not be employed, and lighting will be minimised.

- ii. The question of compensation is a critical mitigating action in dealing with the loss of high value tourism and hunting. This is lightly dealt with in the assessment. The magnitude of the visual amenity impact on adjacent hunting farms has not been measured, and therefore the compensation value is unknown. This unknown places both the farmers and the developer at risk, as the question of affordability is critical. Can the developer afford the compensation which the mitigation proposes? Can the farmers afford not to be compensated? Should the development proceed without an estimation of this value?

Please call should you have any queries.



Myles Mander

4.2 The specialist appointed in terms of the Regulations\_

I, Aisling Dower , 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.



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Signature of the specialist:

Golder Associates Africa Pty Ltd

Name of company (if applicable):

18 April 2016

Date:

**DATE** 13 May 2016

**PROJECT No.** 1400951

**TO** Marie Schlechter

**CC** Brent Baxter, Myles Mander,

**FROM** Aisling Dower

**EMAIL** [adower@golder.com](mailto:adower@golder.com)

**PEER REVIEW OF ECOSYSTEM SERVICES REVIEW AND IMPACT ASSESSMENT: PROPOSED DEVELOPMENT ON THE REMAINING EXTENT OF FARM BOKPOORT**

Dear Marie

The comments contained in the peer review letter dated 16 May 2016 (Attachment A) have now been addressed in the respective reports. The responses are summarised in Table 1 below.

**Table 1: Responses to peer review comments received for ecosystem service review and impact assessment**

<b>Comment Reference No.</b>	<b>Response</b>
1a	Acknowledged.
2a	Reports have been updated accordingly.
2b	Acknowledged.
3a(i)	Water quality is addressed within the ecosystem services 'Freshwater Supply', 'Water Purification and Waste Treatment' and 'Regulation of Disease'. Ref. Table 13. No significant impacts on surface water quality as a result of proposed water abstraction are predicted in the surface water impact assessment report.
3a(ii)	Water cycling is considered a supporting ecosystem service according to the World Resources Institute method used for the assessment (Landsberg <i>et al.</i> , 2013). Its identification as a priority ecosystem service has been revised.
4a(i)	Mitigation is aligned with that proposed in the landscape and visual impact assessment.
4a(ii)	The matter of compensation was raised in the economic cost benefit analysis and land trade-off assessment for the Bokpoort CSP tower development (Conningarth Economists, 2016). No recommendation regarding specific compensation value was made in that report, only that it may be an option. The magnitude of visual amenity impact on adjacent hunting farms is addressed in the landscape and visual impact assessment report. As the ecosystem service review report is a desk-based review of existing information, no additional economic analysis was conducted or recommendations made.

Kind regards,

Aisling Dower  
Terrestrial Ecologist

