Vrede Solar PV Facility

Northern Cape Province

EIA Report

May 2023

DFFE Reference: 14/12/16/3/3/2/2274

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PROJECT DETAILS

DFFE Reference	:	14/12/16/3/3/2/2274
Title	:	Vrede Solar PV Facility
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Client	:	Akuo Energy Afrique
Report Revision	:	Draft for public review
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When used as a reference this report should be cited as: Savannah Environmental (2023) Draft EIA Report Vrede Solar PV Facility, Northern Cape Province

PURPOSE OF THE EIA REPORT AND INVITATION TO COMMENT

Akuo Energy Afrique has appointed Savannah Environmental as the independent environmental consultant to undertake the Scoping and Environmental Impact Assessment Process for the Vrede Solar PV Facility. The EIA process is being undertaken in accordance with the requirements of the 2014 EIA Regulations promulgated in terms of the National Environmental Management Act (NEMA; Act No. 107 of 1998). This Scoping report has been compiled in accordance with Appendix 2 of the EIA Regulations, 2014 (as amended) and consists of the following sections:

This EIA Report consists of eight chapters, as follows:

- **Chapter 1** provides background to the Project and the EIA process.
- **Chapter 2** provides a description of the Project, including details of the technology, the site selection information and identified project alternatives.
- **Chapter 3** describes the need and desirability of the Project within the project site in the context of the strategic regulatory and legal context for energy planning in South Africa, and specifically for the proposed Project.
- **Chapter 4** outlines the process which was followed during the EIA process.
- **Chapter 5** describes the existing biophysical and socio-economic environment affected by the proposed Project.
- **Chapter 6** provides an assessment of the potential direct, indirect and cumulative impacts associated with the proposed Project.
- **Chapter 7** presents the conclusions and recommendations based on the findings of the EIA for The Project.
- **Chapter 8** provides references used in the compilation of the EIA Report.

The EIA Report is available for review and comment from **29 May to 29 June 2023**. All comments received and recorded during the 30-day review and comment period was included, considered, and addressed where possible within the final EIA report for the consideration of the DFFE.

Please submit your comments by **29 June 2023** to:
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Comments can be made as written submission via fax, post, or email.

EXECUTIVE SUMMARY

Vrede Solar Energy (Pty) Ltd (a consortium consisting of Akuo Energy Afrique, Africoast Investments and Golden Sunshine Trading) proposes to develop the Vrede Solar PV Facility and its associated electrical infrastructure on Portion 5 of the Farm Bas Berg 88 in the Renosterberg Local Municipality in the greater Pixley ka Seme District Municipality in the Northern Cape Province. The project site is located approximately 20km north of Philipstown and 30km west of Petrusville.

The Project (Vrede Solar PV Facility) is part of a cluster of solar facilities known as the Crossroads Green Energy Cluster. The Cluster entails the development of up to 21 solar energy facilities, each up to 240MW in capacity, and each including grid connection infrastructure connecting the facilities to the proposed Hydra B Substation (refer to Figure 1.2)[1]. Each solar energy facility will be constructed as a separate stand-alone project and therefore, separate Scoping and Environmental Impact Assessment (S&EIA) processes will be undertaken for each of the renewable energy facilities. The projects will be considered through the EIA process in batches, with Batch 1 consisting of 9 projects, Batch 2 consisting of 6 projects and Batch 3 consisting of 6 projects. Vrede Solar PV Facility forms part of the EIA process for Batch 1 consisting of 9 projects to be undertaken in 2023. A summary of the projects and EIA processes is listed in **Table 1** and displayed in **Figure 1**.

Table 1: EIA Processes to be undertaken for the Crossroads Green Energy Cluster

No	Project name	Farm Name and portion Number	Capacity	Project Batch
1	Tafelkop Solar PV Facility	Portion 3 of the Farm Grass Pan 40	240MW	Phase 1
2	Koppy Alleen Solar PV Facility	Portion 5 of the Farm Koppy Alleen 83	100MW	Phase 1
3	Vrede Solar PV Facility	Portion 5 of the Farm Bas Berg 88	150MW	Phase 1
4	Zionsheuvel Solar PV Facility	Remainder of Farm Leeuwberg 79	240MW	Phase 1
5	Amper Daar Solar PV Facility	Remainder of Farm Wolwe Kuil 44	100MW	Phase 1
6	Wag-'n-Bietjie Solar PV Facility	Portion 1 of the Farm Leeuwe Berg 45	100MW	Phase 1
7.1	Ruspoort 1 Solar PV Facility (**Option A)**	Portion 5 of the Farm Bokken Kraal 81 **(Option A)**	100MW	Phase 1
7.2	Ruspoort 1 Solar PV Facility (**Option B)**	Portion 4 on the Farm Knoffelfontein 74 Portion 1 on the Farm 78 Portion 2 on the Farm Leeuwberg 79 **(Option B)**	100MW	Phase 1
8	Ruspoort 2 Solar PV Facility	Portion 2 of the Farm Leeuwberg 79	100MW	Phase 1
9	Middelplaas Solar PV Facility	Portion 4 of the Farm Grass Pan 40	100MW	Phase 1
10	JW Solar PV Facility	Remainder of the Farm Plaas 196	240MW	Phase 2
11	Pro Deo Solar PV Facility	Portion 1 of the Farm Grass Pan 40	100MW	Phase 2
12	Uitkyk Solar PV Facility	Remainder of the Farm Plaas 197	100MW	Phase 2
13	Kareekloof Solar PV Facility	Remainder of the Farm Swart Koppies 86	100MW	Phase 2
14	JAN Solar PV Facility	Portion 1 of the Farm Schaap Kraal 38, Portion 1 of the Farm Annex Donker Hoek 89; and Remainder of Farm Kuhns Post 90	240MW	Phase 2
15	Driefontein Solar PV Facility	Portion 1 of the Farm Driefontein 87	100MW	Phase 2
16	Jagpoort Solar PV Facility	Portion 2 of the Farm Driefontein 87, Portion 3 of the Farm Driefontein 87, and Portion 2 of the Farm Kareekloof 85	150MW	Phase 3
17	Strydam Solar PV Facility	Portion 3 of the Farm Stryd Dam 107	240MW	Phase 3
18	Roodekraal Solar PV Facility	Remainder of the Farm Roode Kraal 106	150MW	Phase 3

No	Project name	Farm Name and portion Number	Capacity	Project Batch
19	Oosthuisfontein Solar PV Facility	Remainder of the Farm Oosthuisfontein 108	100MW	Phase 3
20	Bokkraal Solar PV Facility	Remainder of the Farm Bokken Kraal 81	100MW	Phase 3
21	HCA Solar PV Facility	Portion 4 of the Farm Koppy Alleen 83	100MW	Phase 3

The Vrede Solar PV Facility is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the Vrede Solar PV Facility in terms of a regulated power purchase procurement process (e.g., the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme) (or similar procurement programme) to evacuate the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP), with the Vrede Solar PV Facility set to inject up to 150MW into the national grid.

From a regional perspective, the Northern Cape Province, and particularly the area under investigation, is considered favourable for the development of a commercial solar facility by virtue of prevailing climatic conditions (i.e. solar irradiation), relief, the extent of the affected properties, the availability of a direct grid connection (i.e., a point of connection of the national grid) and the availability of land on which the development can take place.

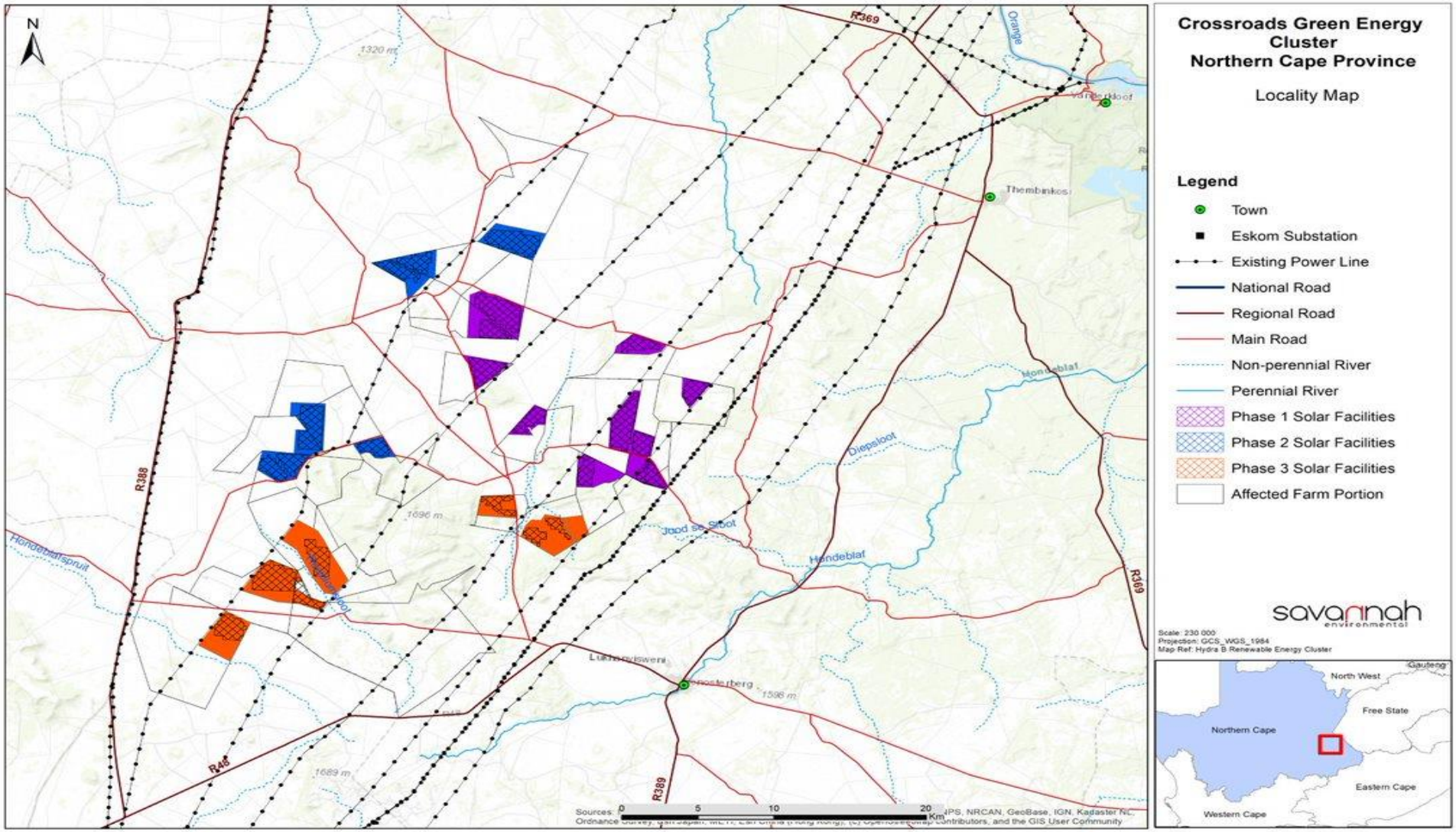

Figure 1: Visual Representation of the EIA Processes to be undertaken for the Crossroads Green Energy renewable energy cluster (Batch 1, Batch 2, and Batch 3).

1. Evaluation of The Project

No environmental fatal flaws or unacceptable impacts were identified in the detailed specialist studies conducted, provided that the recommended mitigation measures are implemented. These measures include, amongst others, the avoidance of sensitive features within the development footprint as specified by the specialists.

The potential environmental impacts associated with The Project assessed through the EIA process include:

- Impacts on terrestrial ecology (flora and fauna)
- Impacts on freshwater ecology
- Impacts on avifauna
- Impacts on soils and agricultural potential
- Heritage Impacts
- Visual impacts on the area imposed by the components of the facility
- Positive and negative social impacts
- Traffic impacts
- Risks associated with the BESS

The development footprint, as assessed in the EIA Report is presented in **Figure 2**.

i) Impacts on Terrestrial Ecology (including flora and fauna)

The project area is situated in the Northern Upper Karoo vegetation type according to SANBI (2018). The project area is homogenous in terms of vegetation with a low karroid scrub grassland occurring throughout. One vegetation community type can be found in the project area: Karoo Grassland, which approximates Northern Upper Karoo. The project area includes ESA. Development of this nature (i.e.: Solar PV facilities and associated infrastructure) may occur in an ESA area provided all mitigation measures are adhered to. No Species of Conservation Concern (SCC) were recorded from the project area.

The main impact to the vegetation and habitat types within and surrounding the project area is grazing. Much of the project area comprises large areas of intact indigenous vegetation with little to no existing degradation, making these areas suitable for a wide variety of plant species (not all of which could be identified as a result of the seasonality of the site visit) as well as suitable habitat for a suite of faunal species, most notably various mammals. Based on the ecological assessment, all habitats within the project area of the proposed development were allocated a sensitivity category or Site Ecological Importance (SEI), which is considered a combined SEI for Terrestrial Biodiversity, Animal Species and Plant Species Themes.

The main expected impacts of the proposed infrastructure will include the following:

- Habitat loss and fragmentation as well as degradation of surrounding habitat;
- Disturbance and displacement caused during the construction and maintenance phases; and
- Direct mortality during the construction phase.

The primary expected impacts of the proposed project will be the loss of habitat and emigration of fauna. Based on the outcomes of the SEI determination, the study area is considered to have a Medium SEI which indicates that minimisation mitigation must be applied to the site.

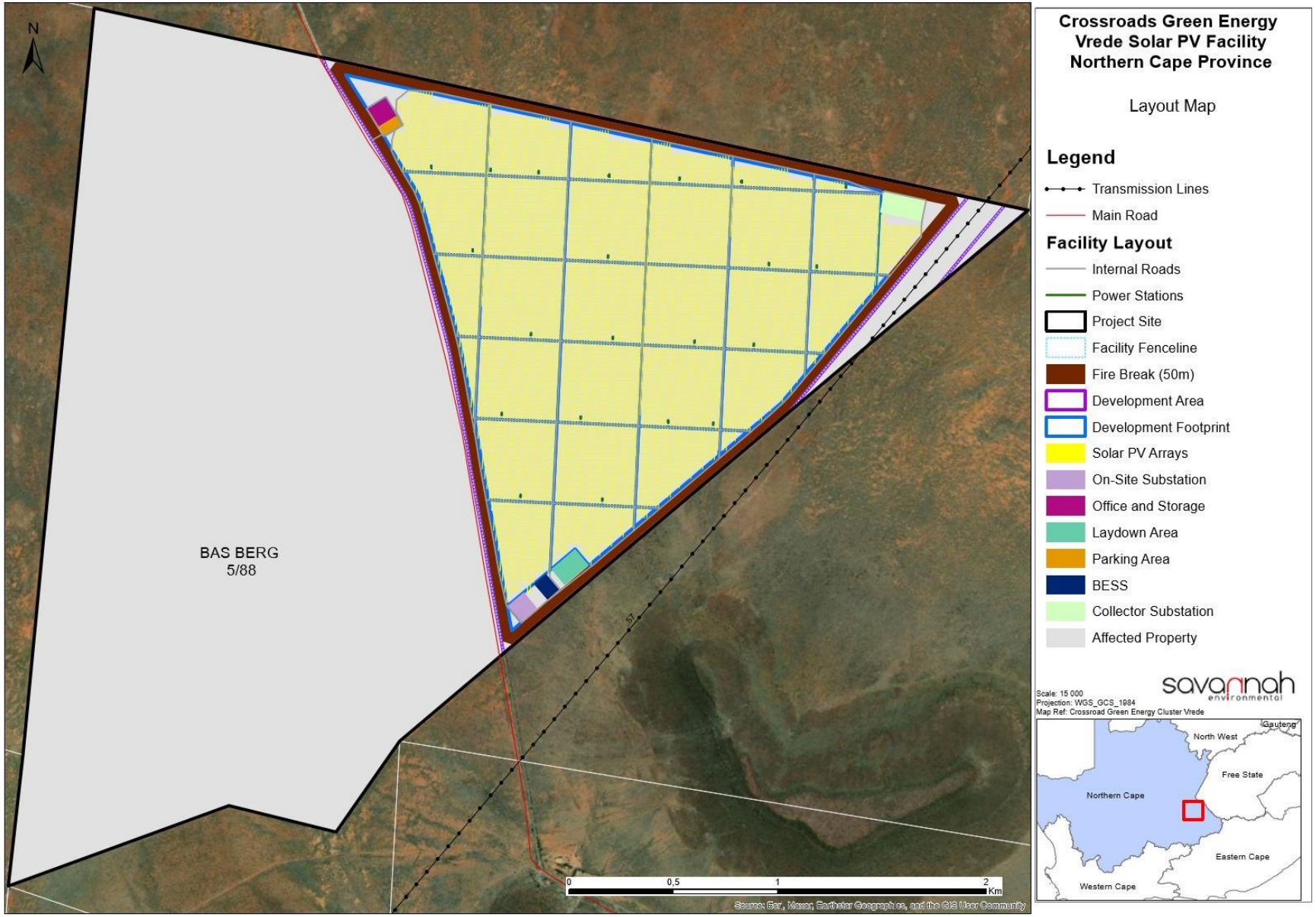

Figure 2: The development footprint of The Project, as assessed within the EIA Report

It must be noted, when taken into consideration in conjunction with the other Solar PV facilities planned for all three phases of the overall proposed development, that the cumulative fragmentation of the ESA is very high. The associated cumulative fragmentation impacts are expected to be high for the overall development. This project should ideally not be considered in insolation but rather as a part of the full proposed development when considering impacts to the ESA.

Considering that this area has been identified as being of significance for biodiversity maintenance and ecological processes (ESA), development may proceed but with caution and only with the implementation of mitigation measures. Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinion of the specialists that the project may be favourably considered, on condition that all prescribed mitigation measures and supporting recommendations are implemented.

ii) Impacts on Freshwater Ecology

One (1) form of a watercourse was identified and delineated within the regulated area. This includes an ephemeral river (watercourse). No natural wetland systems, or even cryptic wetlands were identified for the area. The proposed development area is more than 650 m south of the watercourse. A borrow bit with no drainage was identified within the project area, but this is not considered to be a natural water resource. The results of the habitat assessment indicates natural (class A) and largely natural (class B) instream and riparian conditions for the watercourse catchment respectively. The recommended buffer was calculated to be 20 m for the river.

A site sensitivity verification forms part of reporting requirements. In this regard, the allocated sensitivities of low for the general area and medium sensitivity for the drainage features agrees with the Environmental Screening Tool. The project must take cognisance of this and avoid any unnecessary disturbance of the drainage features and adjacent habitat. Therefore, the aforementioned post-mitigation buffer should be implemented and treated as 'no go areas'.

The development footprint is not located within 100 m of the delineated water resource [as per the National Water Act, 1998 (Act No. 36 of 1998) in accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i)]. However, the closest water resource (ephemeral river) is rated as Very High sensitivity, and no development activities should take place within the delineated buffer zone. Since the development footprint is outside of the regulation zone and buffer zone, no risks to the freshwater systems are foreseen for the proposed project. Therefore, no impacts or risks were anticipated to the freshwater systems and therefore not assessed in this report. A Compliance Statement was prepared by the specialist in accordance with the specialist protocols.

As a result of the absence of impacts or risks to freshwater systems, the contribution of the project to cumulative impacts in the region are expected to be low.

No fatal flaws were identified for the project, and the development may be favourably considered and all prescribed mitigation measures must be considered by the issuing authority. No monitoring measures are deemed necessary for the development.

iii) Impacts on Avifauna

The SABAP2 Data lists 234 avifauna species that could be expected to occur within the area. Eleven (11) of these expected species are regarded as SCC. One hundred and twenty-four (124) bird species were recorded across all properties within the Crossroads Green Energy Cluster in the first survey undertaken during 25 April- 6 May 2022, with Pied Crow, Red-billed Quelea, Spiked-heel Lark and Pink-billed Lark being the most abundant species. A number of species were found during the survey that would be regarded as 'high risk' species.

One hundred and two (102) bird species were recorded during the second survey across all properties within the Crossroads Green Energy Cluster in the second survey which was conducted from 1-10 July 2022. Nine of the species recorded were SCC on a national or international scale. They were found in varying degrees of frequency. During the second survey similar SCCs were recorded with the exception of the Karoo Korhaan and Lanner Falcon.

The assessment area overlaps is located within the Platberg–Karoo Conservancy IBA and includes with three habitat types namely, Grassland Karoo, Shrubland Karoo and Water Resources (Dams, drainage lines and river). These habitats were based on the species compositions in the various areas.

Three active Verreaux's Eagle nests were observed and an additional two inactive nests were also noted. Two active Secretarybird nests were also recorded (refer to Figure 6.9). As per the Species Environmental Assessment Guidelines (2020) a core area of 1km (core buffer) surrounding the nests must be treated as a no-go area, an additional area of 5.2km (seasonal buffer) was also placed around the nest as per the Birdlife Verreaux's Eagle and Wind Farms Guidelines (2021). This 5.2km area is based on the average home range of the Verreaux's Eagle during the breeding season, and as such this area must be avoided during the breeding season of the species which stretches from April to July to avoid disturbing the species. As per the guidelines, buffers were also placed around the inactive nests. For the Secretarybird nests a 4 km buffer was placed around the nests, of which 2km must be treated as no go (core buffer), while the other 2 km must be low impact development (low impact buffer) (pers comms Birdlife, 2022). Secretarybirds breeds year around therefore low impact development is required and a breeding season limitation will not suffice.

Sensitivities were compiled by the specialist for the avifauna study based on the field results and desktop information. The Water resources and Nest buffers were given a very high sensitivity based on the low receptor resilience these areas and species will have to change. The Karoo scrubland and Karoo Grasslands all support a large number of SCCs (9 species), the biodiversity importance of these areas are thus high.

Apart from the disruption of the nests, habitat loss, collisions and electrocutions are regarded as the main impacts. Should the mitigations, monitoring and avoidance guidelines be followed the impacts can be reduced to a Moderate-Low level.

The following is concluded by the specialist:

- The development within the area of the nest core buffers is regarded as a fatal flaw and no development is to be allowed in these areas.
- Construction is permitted In the seasonal/low impact buffer areas, however must be considered with caution based on the high number of species of conservation concern and 'risk' species present. It is recommended that should development take place in the seasonal/ low impact buffers that the rest of the property remain undeveloped.

The Vrede PV facility development footprint falls outside of the identified core buffers and a small portion of the PV facility falls within the seasonal/low impact buffer areas. With the implementation of the recommended mitigation measures, the project is considered to be acceptable as proposed.

iv) Impacts on Soils and Agricultural Potential

The developable area is located in the Ae138 land type. The Ae land types are characterized with Hutton, Oakleaf and Mispah soil forms according to the Soil Classification Working Group, (1991) with the possibility of other soils and bare rocky areas. The Ae land type consists of red to yellow apedal soils which are freely drained. The soils tend to have a high base status and are deeper than 300 mm.

Fifteen land capabilities have been digitised by (DAFF, 2017) across South Africa, of which two are located within the proposed development area, including:

» Land Capability 1 to 5 (Very Low to Low Sensitivity); and
» Land Capability 6 to 8 (Low/Moderate to Moderate Sensitivity).

It is the specialist's opinion that the baseline findings concur with the land capabilities identified by means of the DAFF (2017) desktop findings regarding land capability sensitivities. No "High" land capability sensitivities were identified within the developable area. Considering the relatively medium to low sensitivities, it is the specialist's opinion that the proposed activities will have an acceptable level of impact on agricultural productivity for the area. Furthermore, no measures regarding moving components in their micro-setting are required to avoid or minimise fragmentation and disturbances of agricultural activities.

No fatal flaws were identified for the project. It is the specialist's opinion that the proposed activities may proceed as have been planned without the concern of loss of high sensitivity land capabilities or agricultural productivity for the developable area.

v) Heritage Impacts

The overall archaeological sensitivity of the development area with regard to the preservation of Early, Middle and Later Stone Age archaeology as well as Khoe and San heritage, early colonial settlement is regarded as very high. Despite this, the field assessment conducted for this project has demonstrated that the specific areas proposed for development have an overall low sensitivity for impacts to significant archaeological heritage.

The results of this assessment align with the findings of other specialists such as Morris (2011) who notes that ephemeral MSA and LSA scatters are the dominant archaeological signature of the area and are therefore not archaeologically significant. Specific mitigation measures are proposed for the few sensitive sites identified. Often, rock engravings and some archaeological sites from this area are associated with dolerite outcrops as these outcrops provide the raw material resource for rock engravings. The dolerite outcrops that are present within the areas proposed for development therefore have high levels of archaeological sensitivity and impacts to these outcrops must be avoided. No archaeological resources of significance were identified within the area proposed for the Vrede Solar PV Facility.

Based on previous surveys in the area, the land use (for grazing by sheep), the presence of superficial deposits (probable Pleistocene to Recent age) covering the fossiliferous sediments (probably Ecca and

Beaufort Groups), as well as the extensive network of intrusive dolerite dykes and sills that bake (thermally metamorphose) adjacent mudrocks, it is anticipated that the impact of the development will mainly be low to moderate. However, any excavations > 1m could disrupt Ecca and Beaufort Group sediments which are highly fossiliferous and would increase the impact of the development to moderate to high. There are no objections on palaeontological heritage grounds, granted the excavations do not exceed 1m in depth. Any fossil finds, most likely in the superficial Quaternary sediments, are to be reported by the developer. Should important fossil material be found during excavations, a Fossil Finds Procedure must be implemented.

In terms of cultural landscape, the following recommendations are adapted from Winter and Wilson (2021) in terms of Solar PV placement ("where" and "how"). The following general principles apply to the PV layout:

» Avoid steep slopes.
» Avoid proximity to historic corridors.
» Avoid placement within viewshed of farmsteads.

The layout provided comply with the above general principles. The impact tables for this impact are fully addressed in the VIA.

There is no objection to the proposed development in terms of impacts to heritage resources on condition that:

» There are no objections on palaeontological heritage grounds, granted the excavations do not exceed 1m in depth. Any fossil finds, most likely in the superficial Quaternary sediments, are to be reported by the developer. Should important fossil material be found during excavations, an appropriate Fossil Finds Procedure must be implemented.
» A 100m Buffer is implemented around site TK001 (which is located outside of the development footprint)
» Should any buried archaeological resources or human remains or burials be uncovered during the course of development activities, work must cease in the vicinity of these finds. The South African Heritage Resources Agency (SAHRA) must be contacted immediately in order to determine an appropriate way forward.

vi) Visual Impacts

Despite the significant industrial type infrastructure which is present in the area, the greater landscape of the study area is characterised by wide-open spaces and otherwise very limited development. The study area is sparsely populated outside of the Philipstown (i.e. less than two people per km^2 within the district municipality). A number of isolated homesteads occur throughout the study area. The study area is characterised by wide-open spaces and otherwise very limited development. It should however be noted that there are a number of authorised (and current) renewable energy applications within the study area and the greater region, that may change the landscape to some degree in the future. There are no formally protected or conservation areas within the study area. Sensitive visual receptors include residents or visitors to the area and users of local roads. Potential impacts include:

» The proposed development could change the character and sense of place of the landscape setting;
» The proposed development could change the character of the landscape as seen from the local roads;
» The proposed development could change the character of the landscape as seen from local agricultural homesteads;

- The proposed development could change the character of the landscape as seen from private nature reserves;
- Solar glare and glare impacts; and
- Lighting impacts.

The findings of the Visual Impact Assessment undertaken for the proposed Vrede Solar PV Facility is that the visual environment surrounding the site, especially within a 1km radius (and potentially up to a radius of 3km) of the proposed facility, may be visually impacted during the anticipated operational lifespan of the facility (i.e. a minimum of 20 years).

The following is a summary of impacts remaining:

- Construction activities may potentially result in a high temporary visual impact, that may be mitigated to moderate
- The operation of the proposed PV facility is expected to have a high visual impact pre-mitigation and a moderate visual impact post mitigation on the residents of Jakobsrus and observers/visitors travelling along the secondary roads within a 1km radius of the PV facility.
- The operational facility could have a high visual impact which may be mitigated to moderate on residents/visitors to the homestead of Middelplaas and observers travelling along the various secondary roads within 1 – 3km radius of the facility.
- The operational facility could have a moderate visual impact which may be mitigated to low on residents/visitors to the homestead of Wolwekuil and an unknown residence as well as observers travelling along the various secondary roads within 3 – 6km radius of the facility.
- The operational facility could have a low visual impact both pre and post mitigation on residents/visitors to various homesteads as well as observers travelling along the various secondary roads beyond the 6km radius of the facility.
- This anticipated lighting impact is likely to be of high significance and may be mitigated to moderate especially within 0-3 km radius of the PV facility.
- The potential visual impact related to solar glint and glare as a road travel hazard is therefore expected to be of low significance. No mitigation of this impact is required since the solar reflection is predicted towards a local/secondary road.
- There is a single affected residence, Jakobsrus, within a 1km radius of the proposed PV facility. The potential visual impact related to solar glint and glare on static ground-based receptors (residents of homesteads) is therefore expected to be of moderate significance before mitigation and low post mitigation.
- The anticipated visual impact resulting from ancillary infrastructure is likely to be of low significance both before and after mitigation.
- Decommissioning activities may potentially result in a high, temporary visual impact that may be mitigated to moderate.
- The anticipated significance of the visual impacts on the sense of place within the region (i.e. beyond a 6 km radius of the development and within the greater region) is expected to be of Moderate significance.
- The anticipated cumulative visual impact of the proposed facility is expected to be of high significance.

The anticipated visual impacts listed above (i.e. post mitigation impacts) range from prominently moderate to low significance. One visual impact of high is anticipated in terms of the cumulative visual impact of the proposed Phase 1 of the Crossroads Green Energy Cluster. Anticipated visual impacts on sensitive visual

receptors (if and where present) in close proximity to the proposed Vrede Solar PV Facility are not considered to be fatal flaws for the proposed PV facility.

A number of mitigation measures have been proposed. Regardless of whether or not mitigation measures will reduce the significance of the anticipated visual impacts, they are considered to be good practice and should all be implemented and maintained throughout the construction, operation and decommissioning phases of the proposed facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. As such, the Vrede Solar PV facility would be considered to be acceptable from a visual impact perspective and can therefore be authorised.

vii) Social Impacts

The development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all refer to and support renewable energy. The PKSDM SDF and IDP also support the development of renewable energy. The development of the proposed PV facility is therefore supported by key policy and planning documents.

The findings of the SIA indicate that the proposed Vrede PV SEF will result in several social and socio-economic benefits, including creation of employment and business opportunities during both the construction and operational phases. The project will also create economic development opportunities for the local community. The enhancement measures listed in the report should be implemented in order to maximise the potential benefits. The significance of this impact is rated as High Positive. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the negative environmental and socio-economic impacts associated a coal-based energy economy and the challenges created by climate change, represents a significant positive social benefit for society as a whole. The Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits, both at a national level and at a local, community level. These benefits are linked to foreign Direct Investment, local employment and procurement and investment in local community initiatives.

The findings also indicate that the potential negative impacts associated with both the construction and operational phase are likely to be Low Negative with mitigation. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented.

On the basis of the above conclusion, the establishment of the proposed Vrede PV SEF and associated infrastructure is supported.

viii) Traffic Impacts

The Traffic Impact Assessment concluded the following regarding key issues and alternatives to be considered for the proposed Vrede Solar PV Facility:

- The preferred Port of Entry for imported components is the Port of Ngqura.
- The proposed access road located off the R48 is deemed a suitable access road as it is an existing gravel road i.e., less expensive to upgrade.

- It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will hence need to be maintained during the additional loading of the construction phase and then reinstated after construction is completed. The gravel roads will require grading with a grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage.
- The construction phase traffic, although significant, will be temporary and can be mitigated to an acceptable level.
- During operation, it is expected that staff and security will periodically visit the facility. The traffic generated during this phase will be minimal and will not have an impact on the surrounding road network.
- The construction and decommissioning phases of a development is the only significant traffic generator and therefore noise and dust pollution will be higher during this phase. The duration of this phase is short term i.e., the impact of the traffic on the surrounding road network is temporary and solar facilities, when operational, do not add any significant traffic to the road network.

Impacts are expected to occur with the development of the project during the construction and operation phases.

Impacts during construction include:
- Construction related traffic
- The construction traffic would also lead to noise and dust pollution.
- This phase also includes the construction of roads, excavations, trenching for electrical cables and other ancillary construction works that will temporarily generate the most traffic.

Impacts during the operation phase include:
- During operation, it is expected that staff and security will visit the facility.
- Maintenance vehicles are expected on site at times.
- Should municipal water not be available, water will have to be transported to the site.

Cumulative Impacts
- Traffic congestion/delays on the surrounding road network.
- Noise and dust pollution

The construction and decommissioning phases of a development is the only significant traffic generator and therefore noise and dust pollution will be higher during this phase. The duration of this phase is short term i.e., the impact of the traffic on the surrounding road network is temporary and solar facilities, when operational, do not add any significant traffic to the road network.

The development is supported from a transport perspective provided that the recommendations and mitigations contained in this report are adhered to.

The impacts associated with the facility are acceptable with the implementation of the recommended mitigation measures and can therefore be authorised.

ix) Risks Associated with the BESS

All types of batteries can be hazardous and can pose a safety risk. The risks associated with battery technologies are generally well understood and researched. The primary risks for all BESS technologies relate to fire hazards and the potential for a condition known as 'thermal runaway'. Thermal runaway occurs in situations where an increase in temperature changes the conditions in a way that causes a further increase in temperature, often leading to fires and/or explosions. Lithium-ion batteries and flow batteries in fire scenarios may generate toxic gas from the combustion of hydrocarbons, plastics, or acidic electrolytes. Physical damage to the battery can also lead to problems as this can allow the electrolyte inside to leak potentially resulting in toxic chemical exposure or pollution.

Flow batteries are generally considered the safer technology because they do not contain flammable materials, and the materials that they do contain, such as vanadium, are often environmentally friendly. However, lithium-ion batteries are easier to install (i.e. usually housed within containers as opposed to formal building structures) and require fewer staff to operate.

Liquid metal batteries are a good alternative battery solution to Lithium Ion and Redox. Liquid metal batteries are safe to transport, being in a solid state when not in use. This new technology utilises environmentally friendly materials which are recyclable after decommissioning and do no emit any toxic gases when operating. Because of the abundance of materials used in liquid metal batteries, the costs are also generally lower than lithium-ion and are much better equipped for stressed environments especially considering that liquid metal batteries can be exposed to harsh overcharging and discharging cycles without impacting on their capacities[1].

All of the listed battery technologies will require strict adherence to supplier Standard Operating Procedures to minimise risks to workers.

The Vrede Solar PV Facility development site is not located in close proximity to residences or water resources. The development of the BESS (regardless of technology selected) is therefore not expected to raise any unacceptably high-risk issues, i.e. the BESS facility of either technology type is not a No-Go option and **all technologies are considered acceptable**.

x) Assessment of Cumulative Impacts

Cumulative impacts are expected to occur with the development of the project throughout all phases of the project life cycle and within all areas of study considered as part of this EIA report. The main aim for the assessment of cumulative impacts considering the Project is to test and determine whether the development will be acceptable within the landscape proposed for the development, and whether the loss, from an environmental and social perspective, will be acceptable without whole-scale change.

The following conclusions can be drawn regarding the cumulative impacts associated with the project when considered together with impacts of similar industrial-type projects in the area:

» There will be no unacceptable loss or impact on ecological aspects (vegetation types, species and ecological processes), provided the recommended mitigation measures are implemented. This is due to the moderate sensitivity of the site and the acceptability of solar development within an ESA.

[1] https://www.energy-storage.news/ambri-gets-ul-1973-safety-certification-for-liquid-metal-battery-storage-tech/

- There will be no significant loss of sensitive and significant aquatic features as the project is located outside of any freshwater resources.
- There will be no unacceptable loss or impact to avifauna or avifaunal habitats, provided the recommended mitigation measures are implemented. This is due to the location of the project infrastructure outside of identified no-go areas and the fact that solar development is considered to be low impact in terms of the BirdLife species specific guidelines.
- The project will not impact on any high potential agricultural land and will therefore not contribute to impacts on this resource or food security.
- Change to the sense of place and character of the area is expected with the development of the proposed Vrede Solar Energy Facility and other renewable energy facilities within a 30km radius of the site. Other industrial type infrastructure in the region include numerous power lines and substations. Whilst the proposed project will create a new large scale industrial operation and change the character of an area of rural landscape, this is not entirely out of character with the region. The cumulative impact is therefore considered to be acceptable.
- There will be no loss of heritage resources of significance due to the absence of any areas of sensitivity from the development footprint.
- No unacceptable social impacts are expected to occur.

A summary of the cumulative impacts is included in **Table 7.1** below.

Table 7.1: Summary of the cumulative impact significance for the project.

Specialist assessment	Overall significance of impact of the proposed project considered in isolation	Cumulative significance of impact of the project and other projects in the area
Terrestrial Ecology	Low	High
Freshwater Ecology	None	Low
Avifauna	Medium	Medium
Soils and Agricultural Potential	Low	Low
Heritage	None	Medium
Visual	Moderate	High
Social	Low to Medium (positive and negative)	Medium to High (positive and negative)
Traffic	Low	Medium

Based on the specialist cumulative assessment and findings, the development of the Vrede Solar PV Facility and its contribution to the overall impact of all renewable energy projects to be developed within a 30km radius, it can be concluded that the cumulative impacts associated with the project will be of a low to high significance depending on the impact being considered. Based on all areas of study considered as part of this EIA report, the development of Vrede Solar PV Facility will not result in unacceptable, high cumulative impacts and will not result in a whole-scale change of the environment.

2. Assessment of Alternatives

As per the approved Plan of Study for EIA, and described in Chapter 2 of this report, the following alternatives were considered within this EIA Report

Type of Alternatives Considered	Description of the Alternative relating to the Vrede Solar PV facility
Site-specific Alternatives	Privately owned farm portions have been identified for the development of the Vrede Solar PV facility, taking advantage of the site-specific characteristics such as the solar irradiation. The study area which is ~1101 ha in extent and in which a development area (~400ha) has been identified, is considered to be large enough for the development of a PV facility with a contracted capacity of up to 150MW, while allowing for avoidance of environmental sensitivities, as may be required in line with the mitigation hierarchy.
Layout Footprint Design Alternatives	The layout for the development of the Vrede Solar PV facility will be designed taking cognisance of the environmental sensitivities identified during the scoping phase. The detailed facility layout will be made available for assessment and ground-truthing by the independent specialists in the EIA phase. Where further conflicts are predicted, a mitigation strategy will be developed to meet the objectives of the mitigation hierarchy (avoid, minimise, mitigate).
Technology Alternatives	Consideration of the following technology alternatives: » PV Technology: ∗ Bifacial PV panels ∗ Monofacial PV panels ∗ Fixed mounted PV systems (static / fixed-tilt panels). ∗ Single-axis tracking or double-axis tracking systems (with solar panels that rotate around a defined axis to follow the sun's movement). » BESS Technology: ∗ Lithium-Ion technology (e.g. Lithium Ferrophosphate (LFP), Nickel Manganese Cobalt Oxide (NMC) or similar technology and chemistries); and ∗ Redox-flow technology (e.g. vanadium flow battery, or similar technology and chemistries).
'Do-nothing' Alternative	The option to not construct the Vrede Solar PV facility. The 'do-nothing' alternative assumes that the site remains in its current state, that is status quo, and that the current land use practises only continue.

i) Assessment of the Facility Layout

The facility layout/development footprint assessed within this EIA Report (**Figure 3**) was designed by the project developer in order to respond to and avoid the sensitive environmental and social features located within the project site, which were identified by the specialists during the Scoping Phase of the EIA process. This approach ensured the application of the mitigation hierarchy (i.e., avoid, minimise, mitigate, and offset) to the proposed project, which ultimately ensures that the development is appropriate from an environmental perspective and is suitable for development within the project site.

Based on the findings as documented in this EIA report, it was concluded that this layout avoids areas of sensitivity and recommended no-go areas, and therefore no further optimisation was recommended. As such, the impact of this proposed Facility Layout is considered to be acceptable and the layout is recommended for approval. Final micro-siting must however be undertaken prior to construction considering all mitigation measures recommended within this EIA Report and associated specialist studies.

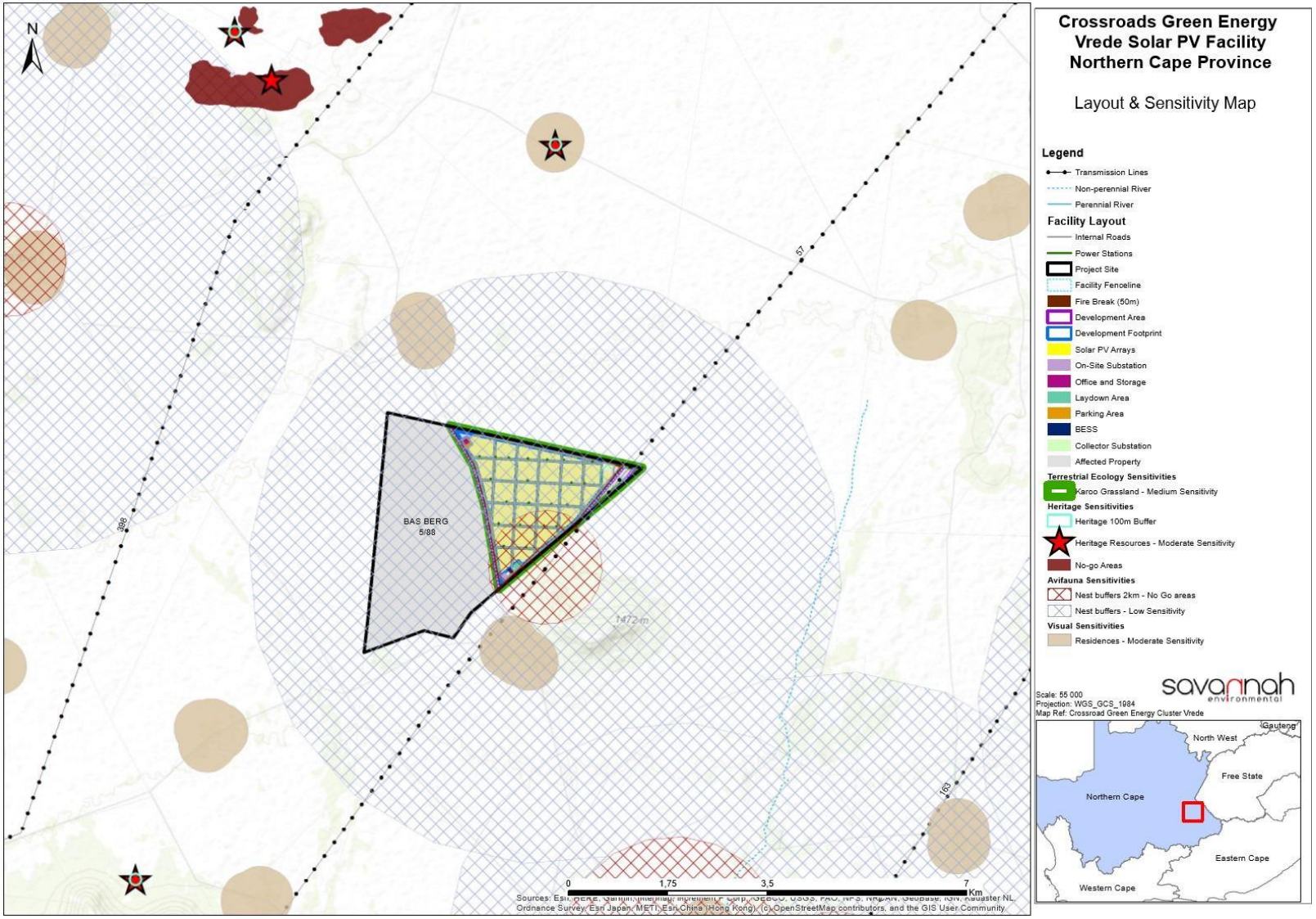

Figure 3: The development footprint of Vrede Solar PV Facility, as assessed within this EIA Report, overlain on the identified sensitive environmental features (also refer to **Appendix L**)

ii) Assessment of Technology Alternatives

i) PV Technology

The primary difference between PV technologies available relate to the extent of the facility, as well as the height of the facility (visual impacts), however the potential for environmental impacts remains similar in magnitude. Fixed mounted PV systems are able to occupy a smaller extent and have a lower height when compared to tracking PV systems, which require both a larger extent of land, and are taller in height. However, both options are considered to be acceptable for implementation from an environmental perspective. Regardless of the technology implemented, the development will be restricted to the footprint considered within this EIA report and the impacts assessed will not differ. Therefore, there is no preference regarding the technology to be implemented.

ii) BESS Technology

The development site is not located in close proximity to residences or water resources. The development of the BESS (regardless of technology selected) is therefore not expected to raise any unacceptably high-risk issues, i.e. the BESS facility of either technology type is not a No-Go option and either technology is considered acceptable.

iii) Assessment of 'Do nothing' Alternative

The no-go is the continuation of the existing land use, i.e. maintain the status quo. There would be no environmental impacts on the site or to the surrounding local area due to the construction and operation activities of a solar farm with the implementation of this alternative. All negative impacts, specifically related to the development of the solar facility, discussed in this report will not materialise.

The 'do-nothing' alternative will do little to influence the renewable energy targets set by government. However, as the project site experiences ample solar resource and optimal grid connection opportunities, not developing the Vrede Solar PV Facility would see such an opportunity being lost. In addition, the Northern Cape Province will not benefit from additional generated power being evacuated directly into the Province's grid. As current land use activities can continue on the site once the project is operational, the loss of the land to this project during the operation phase is not considered significant. Therefore, from a regional perspective, the 'do-nothing' alternative is not preferred as there is a perceived loss of benefits for the regional area.

From the specialist studies undertaken, no environmental fatal flaws were identified to be associated with the Vrede Solar PV Facility subject to implementation of the recommended mitigation measures. All impacts associated with the project can be mitigated to acceptable levels. If the solar energy facility is not developed, the following positive impacts will not be realised:

- Job creation from the construction and operation phases.
- Economic benefit to participating landowners due to the revenue that will be gained from leasing the land to the developer.
- Meeting of energy generation mix in a most economic and rapid manner.
- Provision of clean, renewable energy in an area where it is optimally available.

As detailed above, the 'do-nothing' alternative will result in a number of lost opportunities. The 'do nothing' alternative is therefore not preferred and not proposed to be implemented for the development of the Vrede Solar PV Facility.

3. Environmental Costs versus Benefits of The Project

Environmental costs (including those to the natural environment, economic and social environment) can be anticipated at a local and site-specific level and are considered acceptable provided the mitigation measures as outlined in the EIA Report and the EMPr are implemented and adhered to. No fatal flaws have been identified. These environmental costs could include:

- *Loss of biodiversity, flora and fauna due to the clearing of land for the construction and utilisation of land for the solar facility* – The cost of loss of biodiversity have been minimised through the location of the project infrastructure outside of areas of high sensitivity. Costs can be further reduced through the implementation of the recommended mitigation measures.
- *Impacts on freshwater resources* – As a result of the proposed Facility Layout avoiding direct impacts on aquatic resources, the establishment of the proposed project will not pose a significant threat to local watercourses. All anticipated impacts have a Low residual risk rating.
- *Impacts on birds*– loss of bird species due to collision with infrastructure and disturbance associated with construction and operation of the facility has been minimised through the location of the facility outside of identified no-go areas. Mitigation measures as described in this report can be implemented to reduce the significance of the risk but there is still a possibility of impacts.
- *Visual Impacts* – Overall, the significance of the visual impacts is expected to range from moderate to low, as a result of the very low occurrence of sensitive visual receptors. Cumulative impacts is however anticipated to be of high significance. It should be noted that of the receptors located within a 6km radius of the proposed site, a number of the homesteads are located on farms that already have authorization to construct renewable energy developments or where processes are underway for such facilities.

Benefits of the project include the following:

- The project will result in important economic benefits at the local and regional scale through job creation, income and other associated downstream economic development, supporting the Just Energy Transition in the region. These will persist during the pre-construction, construction, operation and decommissioning phases of the project.
- The project provides an opportunity for a new land use on the affected properties which would result in additional financial benefits to the directly affected landowners through compensation. It is important to note that the construction and operation of a solar facility can occur in tandem with crop production.
- The project contributes towards the Provincial and Local goals for the development of renewable energy as outlined in the respective IDPs.
- The project serves to diversify the economy and electricity generation mix of South Africa through the addition of solar energy, in line with national policy regarding energy generation.
- The water requirement for a solar facility is negligible compared to the levels of water used by coal-based technologies. This generation technology is therefore supported in dry climatic areas.
- South Africa's per capita greenhouse gas emissions are amongst the highest in the world due to the reliance on fossil fuels. The Vrede Solar PV Facility will contribute to achieving goals for implementation of renewable energy and sustaining a 'green' economy within South Africa.

The benefits of the project are expected to occur at a national, regional and local level. As the costs to the environment at a site-specific level can be appropriately managed and minimised, the benefits of the project are expected to partially offset the localised environmental costs of the solar facility, provided that the mitigation measures, as recommended by the specialists are adhered to.

4. Overall Conclusion (Impact Statement)

The preferred activity was determined by the developer to be the development of a renewable energy facility on site using solar as the preferred technology, due to the availability of a strong solar resource, land availability, available grid capacity, benign topography, and good access. A technically viable development footprint was proposed by the developer considering environmental sensitivities identified in the scoping study and assessed as part of the EIA process. The assessment of the development footprint within the project site was undertaken by independent specialists and their findings have informed the results of this EIA Report.

From a review of the relevant policy and planning framework, it was concluded that the project is well aligned with the policy framework, and a clear need for the project is seen from a policy perspective at a local, provincial and National level.

The specialist findings from the EIA studies undertaken have indicated that there are no identified fatal flaws associated with the implementation of the development footprint within the project site subject to implementation of the recommended mitigation measures. The developer has designed a project development footprint in response to the identified sensitive environmental features and areas present within the project site. This approach is in line with the application of the mitigation hierarchy, where all the sensitive areas which could be impacted by the development have been avoided (i.e., tier 1 of the mitigation hierarchy). The impacts that are expected to remain after the avoidance of the sensitive areas by the facility layout have been reduced to acceptable levels through the recommendation of specific mitigation measures by the specialists. The minimisation of the significance of the impacts is in line with tier 2 of the mitigation hierarchy. Therefore, impacts can be mitigated to acceptable levels or enhanced through the implementation of the recommended mitigation or enhancement measures. The layout for the PV facility assessed within this EIA Report is located outside of the very high sensitivity areas and features regarded to be no-go for development and is therefore considered to be acceptable for implementation.

As detailed in the cost-benefit analysis, the benefits of the Vrede Solar PV Facility are expected to occur at a national, regional and local level. As the costs to the environment at a site-specific level can be appropriately managed and minimised, the benefits of the project are expected to partially offset the localised environmental costs of the solar facility. From a social perspective, both positive and negative impacts are expected. The implementation of the 'do-nothing' alternative will result in a number of lost opportunities. The 'do nothing' alternative is therefore not preferred and not proposed to be implemented for the development of The Project.

Through the assessment of the development footprint within the project site, it can be concluded that the development of the Vrede Solar PV Facility will not result in unacceptable environmental impacts (subject to the implementation of the recommended mitigation measures).

5. Overall Recommendation

Considering the findings of the independent specialist studies, the impacts identified, the development footprint proposed by the developer and the potential to minimise the impacts to acceptable levels through mitigation, it is the reasoned opinion of the EAP that the Vrede Solar PV Facility is acceptable within the landscape and can reasonably be authorised subject to implementation of the avoidance of the sensitive areas identified through the EIA process and the implementation of mitigation and enhancement measures recommended by the specialists. The following project details should be included within the EA for the Project:

» The Vrede Solar PV Facility with a contracted capacity of up to 150MW, to be located on ortion 5 of the Farm Bas Berg 88 in the Renosterberg Local Municipality in the greater Pixley ka Seme District Municipality in the Northern Cape Province. The project site is located approximately 20km north of Philipstown and 30km west of Petrusville.

The following infrastructure is to be included within an authorisation issued for the project:

» Solar PV array comprising PV modules and mounting structures (monofacial or bifacial and of fixed-tilt, single-axis tracking, and/or double-axis tracking PV technology)
» Inverters and transformers
» Cabling between the project components
» Battery Energy Storage System (BESS) (Lithium-ion or Redox Flow)
» On-site facility substation
» Site offices, Security office, operations and control, and maintenance and storage laydown areas
» Access roads, internal distribution roads

The following key conditions would be required to be included within an authorisation issued for The Project:

» All mitigation measures detailed within this EIA Report, as well as the specialist reports contained within **Appendices D to K** are to be implemented.
» The EMPrs (for the facility and onsite substation) as contained within **Appendices M and N** of this EIA Report should form part of the contract with the Contractors appointed to construct and maintain the solar facility in order to ensure compliance with environmental specifications and management measures. The implementation of these EMPrs for all life cycle phases of the Project is considered key in achieving the appropriate environmental management standards as detailed for this project.
» Micro-siting must be undertaken for the final facility layout and must take all recommended mitigation measures into consideration. No development is permitted within the identified no-go areas as detailed in **Figure 7.2**.
» An Environmental Site Officer (ESO) must form part of the on-site team to ensure that the EMPrs are implemented and enforced and an Environmental Control Officer (ECO) must be appointed to monitor compliance for the duration of the construction phase.
» Preconstruction walk-through of the final development footprint must be undertaken for protected species that would be affected and that can be translocated must be undertaken. The survey must also cover sensitive habitats and species that are required to be avoided. Permits from the relevant provincial authorities, will be required to relocate and/or disturb listed plant species.
» All other relevant environmental permits must be obtained prior to the construction of the facility.

A validity period of 10 years of the Environmental Authorisation is requested, should the project obtain approval from DFFE.

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CHAPTER 1: INTRODUCTION

Vrede Solar Energy (Pty) Ltd (a consortium consisting of Akuo Energy Afrique, Africoast Investments and Golden Sunshine Trading) proposed to develop the Vrede Solar PV Facility and its associated electrical infrastructure on Portion 5 of the Farm Bas Berg 88 in the Renosterberg Local Municipality in the greater Pixley ka Seme District Municipality in the Northern Cape Province. The project site is located approximately 20km north of Philipstown and 30km west of Petrusville.

The Project (Vrede Solar PV Facility) is part of a cluster of solar facilities known as the Crossroads Green Energy Cluster. The Cluster entails the development of up to 21 solar energy facilities, each up to 240MW in capacity, and each including grid connection infrastructure connecting the facilities to the proposed Hydra B Substation (refer to Figure 1.2)[2]. Each solar energy facility will be constructed as a separate stand-alone project and therefore, separate Scoping and Environmental Impact Assessment (S&EIA) processes will be undertaken for each of the renewable energy facilities. The projects will be considered through the EIA process in batches, with Batch 1 consisting of 9 projects, Batch 2 consisting of 6 projects and Batch 3 consisting of 6 projects. Vrede Solar PV Facility forms part of the EIA process for Batch 1 consisting of 9 projects to be undertaken in 2023. A summary of the projects and EIA processes is listed in **Table 1.1** and displayed in **Figure 1.2**.

Table 1.1: EIA Processes to be undertaken for the Crossroads Green Energy Cluster

No	Project name	Farm Name and portion Number	Capacity	Project Batch
1	Tafelkop Solar PV Facility	Portion 3 of the Farm Grass Pan 40	240MW	Phase 1
2	Koppy Alleen Solar PV Facility	Portion 5 of the Farm Koppy Alleen 83	100MW	Phase 1
3	Vrede Solar PV Facility	Portion 5 of the Farm Bas Berg 88	150MW	Phase 1
4	Zionsheuvel Solar PV Facility	Remainder of Farm Leeuwberg 79	240MW	Phase 1
5	Amper Daar Solar PV Facility	Remainder of Farm Wolwe Kuil 44	100MW	Phase 1
6	Wag-'n-Bietjie Solar PV Facility	Portion 1 of the Farm Leeuwe Berg 45	100MW	Phase 1
7.1	Ruspoort 1 Solar PV Facility (**Option A)**	Portion 5 of the Farm Bokken Kraal 81 **(Option A)**	100MW	Phase 1
7.2	Ruspoort 1 Solar PV Facility (**Option B)**	Portion 4 on the Farm Knoffelfontein 74 Portion 1 on the Farm 78 Portion 2 on the Farm Leeuwberg 79 **(Option B)**	100MW	Phase 1
8	Ruspoort 2 Solar PV Facility	Portion 2 of the Farm Leeuwberg 79	100MW	Phase 1
9	Middelplaas Solar PV Facility	Portion 4 of the Farm Grass Pan 40	100MW	Phase 1
10	JW Solar PV Facility	Remainder of the Farm Plaas 196	240MW	Phase 2
11	Pro Deo Solar PV Facility	Portion 1 of the Farm Grass Pan 40	100MW	Phase 2
12	Uitkyk Solar PV Facility	Remainder of the Farm Plaas 197	100MW	Phase 2
13	Kareekloof Solar PV Facility	Remainder of the Farm Swart Koppies 86	100MW	Phase 2
14	JAN Solar PV Facility	Portion 1 of the Farm Schaap Kraal 38, Portion 1 of the Farm Annex Donker Hoek 89; and Remainder of Farm Kuhns Post 90	240MW	Phase 2
15	Driefontein Solar PV Facility	Portion 1 of the Farm Driefontein 87	100MW	Phase 2
16	Jagpoort Solar PV Facility	Portion 2 of the Farm Driefontein 87, Portion 3 of the Farm Driefontein 87, and Portion 2 of the Farm Kareekloof 85	150MW	Phase 3

[2] The grid connection infrastructure is the subject of a separate Application for Authorisation and as such the Eskom Switching Station and overhead power line do not form part of this development.

No	Project name	Farm Name and portion Number	Capacity	Project Batch
17	Strydam Solar PV Facility	Portion 3 of the Farm Stryd Dam 107	240MW	Phase 3
18	Roodekraal Solar PV Facility	Remainder of the Farm Roode Kraal 106	150MW	Phase 3
19	Oosthuisfontein Solar PV Facility	Remainder of the Farm Oosthuisfontein 108	100MW	Phase 3
20	Bokkraal Solar PV Facility	Remainder of the Farm Bokken Kraal 81	100MW	Phase 3
21	HCA Solar PV Facility	Portion 4 of the Farm Koppy Alleen 83	100MW	Phase 3

The Vrede Solar PV Facility is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the Vrede Solar PV Facility in terms of a regulated power purchase procurement process (e.g., the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme) (or similar procurement programme) to evacuate the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP), with the Vrede Solar PV Facility set to inject up to 150MW into the national grid.

From a regional perspective, the Northern Cape Province, and particularly the area under investigation, is considered favourable for the development of a commercial solar facility by virtue of prevailing climatic conditions (i.e. solar irradiation), relief, the extent of the affected properties, the availability of a direct grid connection (i.e., a point of connection of the national grid) and the availability of land on which the development can take place.

1.1. Requirement for an Environmental Impact Assessment Process

Section 24 of South Africa's National Environmental Management Act (No. 107 of 1998) (NEMA) pertains to Environmental Authorisations (EA), and requires that the potential consequences for, or impacts of, listed or specified activities on the environment be considered, investigated, assessed, and reported on to the Competent Authority (CA). The 2014 Environmental Impact Assessment (EIA) Regulations, as amended (GNR 326) published under NEMA prescribe the process to be followed when applying for Environmental Authorisation (EA), while the Listing Notices (Listing Notice 1 (GNR 327), Listing Notice 2 (GNR 325), and Listing Notice 3 (GNR 324)) contain those activities which may not commence without EA from the CA.

As the project has the potential to impact on the environment, an Environmental Authorisation (EA) is required from the Department of Forestry, Fisheries and the Environment (DFFE), the CA for the project. As the project exceeds 20MW in capacity the Application for Authorisation is subject to the completion of a full Scoping and Environmental Impact Assessment (S&EIA), as prescribed in Regulations 21 to 24 of the 2014 EIA Regulations, as amended (GNR 326).

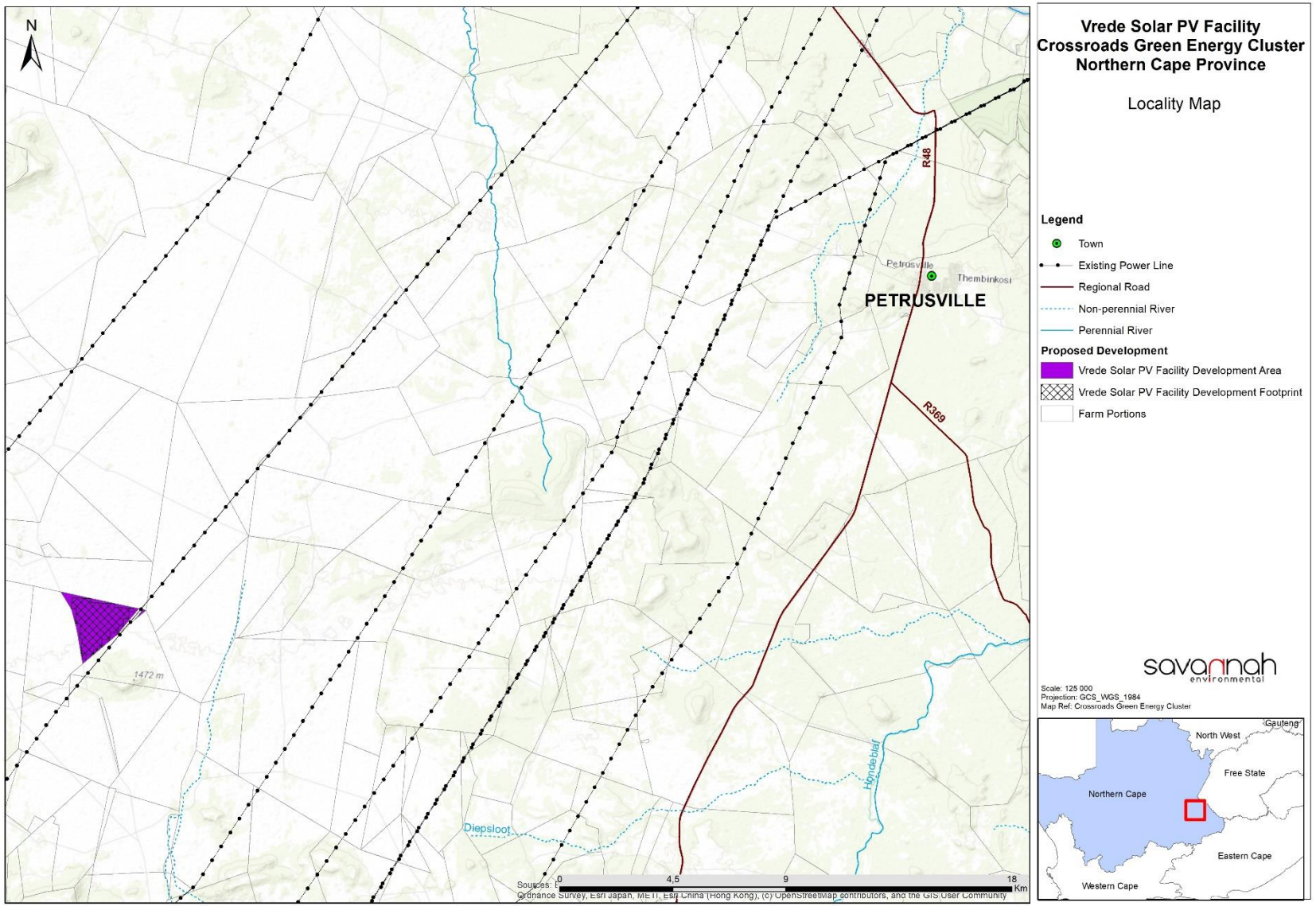

Figure 1.1: Locality map illustrating the location of the Vrede Solar PV Facility project site on Portion 5 of the Farm Bas Berg 88 (refer also to **Appendix L**).

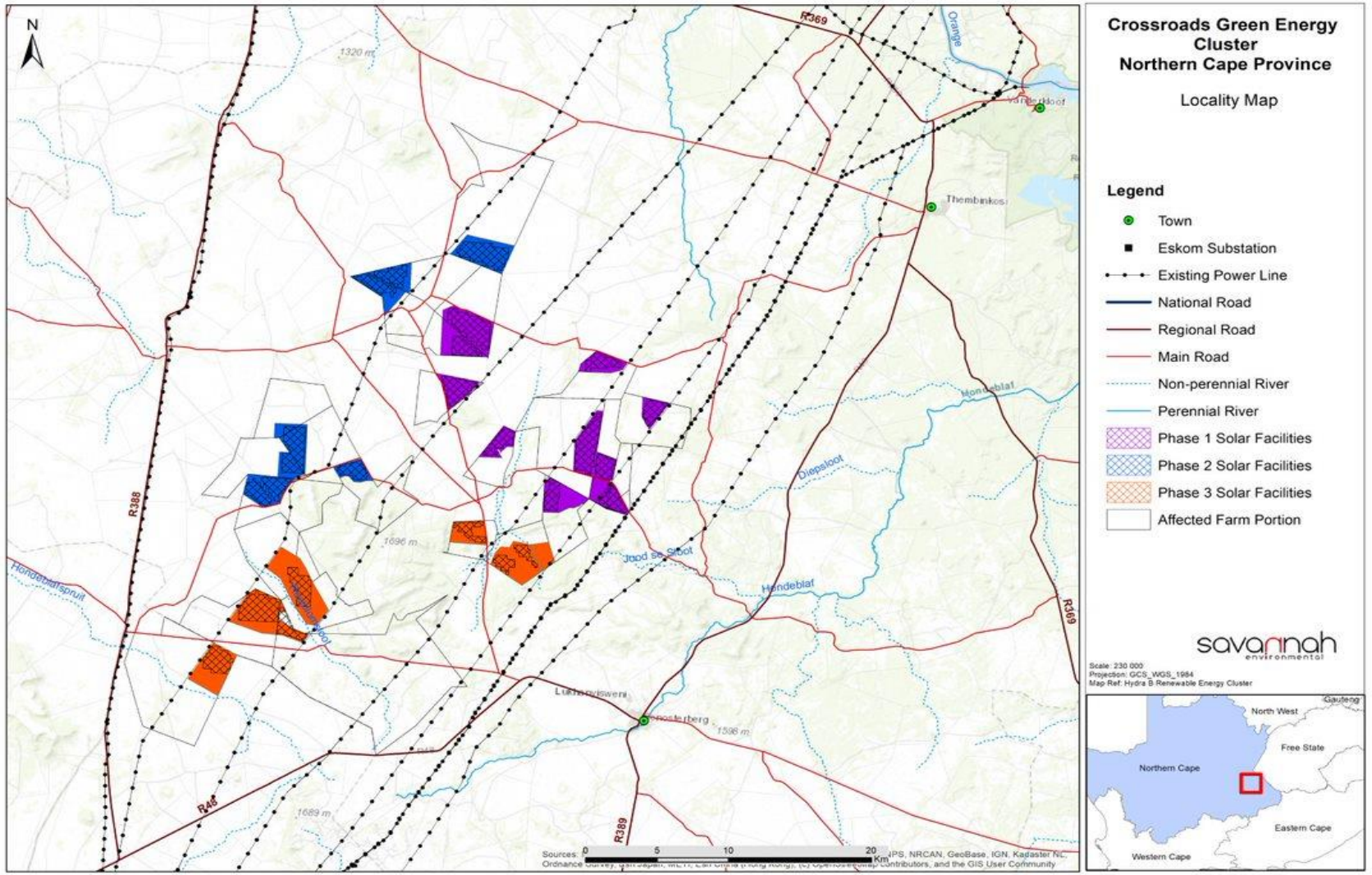

Figure 1.2: Visual Representation of the EIA Processes to be undertaken for the Crossroads Green Energy renewable energy cluster (Batch 1, Batch 2, and Batch 3) (refer also to **Appendix L**).

1.2. Legal Requirements as per the EIA Regulations, 2014 (as amended) for the undertaking of an Environmental Impact Assessment Report

This EIA Report has been prepared in accordance with the requirements of the EIA Regulations published on 08 December 2014 (and amended on 07 April 2017) promulgated in terms of Chapter 5 of the National Environmental Management Act (Act No 107 of 1998). This chapter of the EIA Report includes the following information required in terms of Appendix 3: Scope of Assessment and Content of Environmental Impact Assessment Reports:

Requirement	Relevant Section
3(1)(a) the details of (i) the EAP who prepared the report and (ii) the expertise of the EAP; including a curriculum vitae.	The details of the EAP and the relevant expertise have been included in **section 1.5**. The Curriculum vitae of the Savannah Environmental team and specialist consultants have been included as **Appendix A**.
3(1)(b) the location of the development footprint of the activity on the approved site as contemplated in the accepted scoping report, including (i) the 21-digit Surveyor General code of each cadastral land parcel; (ii) where available, the physical address and farm name and (iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties.	The location of the project site proposed for the development of the Project is included as **Figure 1.1**. The affected footprint is indicated in the Layout map which is provided in **Figure 7.1** of **Chapter 7** The details of the affected properties, including the property names and numbers, as well as the SG-codes are included in **Table 1.1**.
3(1)(c) a plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is (i) a linear activity, a description, and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or (ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken.	The locality of the project site is illustrated on a locality map included as **Figure 1.1**. The corner point co-ordinates of the project site are included in **Table 1.1**. The affected footprint including the location of all structures and infrastructure is provided in **Figure 7.1** of **Chapter 7**.

This EIA Report consists of eight (8) chapters, as follows:

- **Chapter 1** provides background to the Project and the EIA process.
- **Chapter 2** provides a description of the Project, including details of the technology, the site selection information and identified project alternatives.
- **Chapter 3** describes the need and desirability of the Project within the project site in the context of the strategic regulatory and legal context for energy planning in South Africa, and specifically for the proposed Project.
- **Chapter 4** outlines the process which was followed during the EIA process.
- **Chapter 5** describes the existing biophysical and socio-economic environment affected by the proposed Project.
- **Chapter 6** provides an assessment of the potential direct, indirect and cumulative impacts associated with the proposed Project.
- **Chapter 7** presents the conclusions and recommendations based on the findings of the EIA for The Project.
- **Chapter 8** provides references used in the compilation of the EIA Report.

1.3. Project Overview

The proposed facility will have a proposed contracted capacity of up to 150MW and will include the following infrastructure:

- Solar PV array comprising PV modules and mounting structures (monofacial or bifacial and of fixed-tilt, single-axis tracking, and/or double-axis tracking PV technology)
- Inverters and transformers
- Cabling between the project components
- Battery Energy Storage System (BESS)
- On-site facility substation and power lines between the solar PV facility and the Eskom substation (to be confirmed and assessed through a separate process)
- Site offices, Security office, operations and control, and maintenance and storage laydown areas
- Access roads, internal distribution roads

A technically suitable project site of ~1101ha has been identified by the Applicant for the establishment of the Vrede Solar PV Facility.

Table 1.1: Detailed description of the project site

Province	**Northern Cape Province**		
District Municipality	Pixley Ka Seme District Municipality		
Local Municipality	Renosterberg Local Municipality		
Ward Number (s)	Ward 4		
Nearest town(s)	Philipstown (20km north) and Petrusville (30km west)		
Farm name(s) and number(s) of properties affected by the Solar PV Facility	Portion 5 of the Farm Bas Berg 88		
SG 21 Digit Code (s) for all properties	N075C05700000000088000050		
Current zoning	Livestock Farming (mainly sheep farming)		
Current land use	Agriculture		
Site Extent (Study Area)	~1101ha		
PV Development Area	~400ha		
Site Coordinates (project site)		**Latitude:**	**Longitude:**
	Northern point	30°12'16.39"S	24°17'59.94"E
	Eastern point	30°12'42.04"S	24°20'46.71"E
	Western point	30°13'37.43"S	24°17'54.87"E
	Southern point	30°14'22.32"S	24°18'49.04"E
	Centre point	30°13'19.45"S	24°18'49.49"E

The overarching objective for the Vrede Solar PV Facility is to maximise electricity production through exposure to the available solar resource, while minimising infrastructure, operational and maintenance costs, as well as potential social and environmental impacts in accordance with the principles of sustainable development. The full extent of the development area were considered within the Scoping phase of the process through site-specific specialist studies with the aim of determining the suitability from an environmental and social perspective and identifying areas that should be avoided in development planning. The exact location of the development area within the project site for the Vrede Solar PV Facility

is defined within this EIA report (refer to **Figure 7.1** of **Chapter 7**). In order to assess the project, the following is considered through this S&EIA process:

Project site	Portion 5 of the Farm Bas Berg 88 (~1101ha in extent).
Development area	The identified area (to be located within the project site) where the Vrede Solar PV Facility is planned to be positioned. This area will be selected as a practicable location option for the facility, considering technical preference and environmental constraints. The development area is ~395ha in extent and will be demarcated as a result of the findings of the Scoping phase.
Development footprint (facility layout)	The defined area (located within the development area) where the PV panel array and other associated infrastructure for the Vrede Solar PV Facility is planned to be constructed. This is the facility footprint, and the area which would be disturbed by project-related infrastructure. The development footprint has been decided on and has an extent of ~350ha.

As is clear from the above, the development area is larger than the area needed for the development footprint of a 150MW PV facility, and therefore provides the opportunity for the optimal placement of the infrastructure, ensuring avoidance of environmental sensitivities or constraints identified through this Scoping and EIA process.

1.4. Overview of the Environmental Impact Assessment (EIA) Process

An EIA is an effective planning and decision-making tool for the project developer as it allows for the identification and management of potential environmental impacts. It provides the opportunity for the developer to be forewarned of potential environmental issues and allows for the resolution of the issues reported on in the Scoping and EIA Reports as well as dialogue with Interested and Affected Parties (I&APs).

The EIA process comprises of two (2) phases (i.e., Scoping and EIA) (refer to **Figure 1.3**) and involves the identification and assessment of potential environmental impacts through the undertaking of independent specialist studies, as well as public participation. The processes followed in these two phases is as follows:

» The **Scoping Phase** includes the identification of potential issues associated with the project through a desktop study (considering existing information), limited field work, and consultation with interested and affected parties and key stakeholders. This phase considers the broader project site in order to identify and delineate any environmental fatal flaws, no-go and / or sensitive areas. Following a public review period of the Scoping report, this phase culminates in the submission of a final Scoping Report and Plan of Study for the EIA to the Competent Authority (CA) for consideration and acceptance. The Scoping Report was accepted, and the Plan of Study for the EIA Phase approved by the DFFE on **06 April 2023.**

» The **EIA Phase** involves a detailed assessment of the potentially significant positive and negative impacts (direct, indirect, and cumulative) identified in the Scoping Phase. This phase considers a proposed development footprint within the project site and includes detailed specialist investigations as well as public consultation. Following a public review period of the EIA Report, this phase culminates in the submission of a final EIA Report and an Environmental Management Programme (EMPr), including recommendations of practical and achievable mitigation and management measures, to the CA for final review and decision-making.

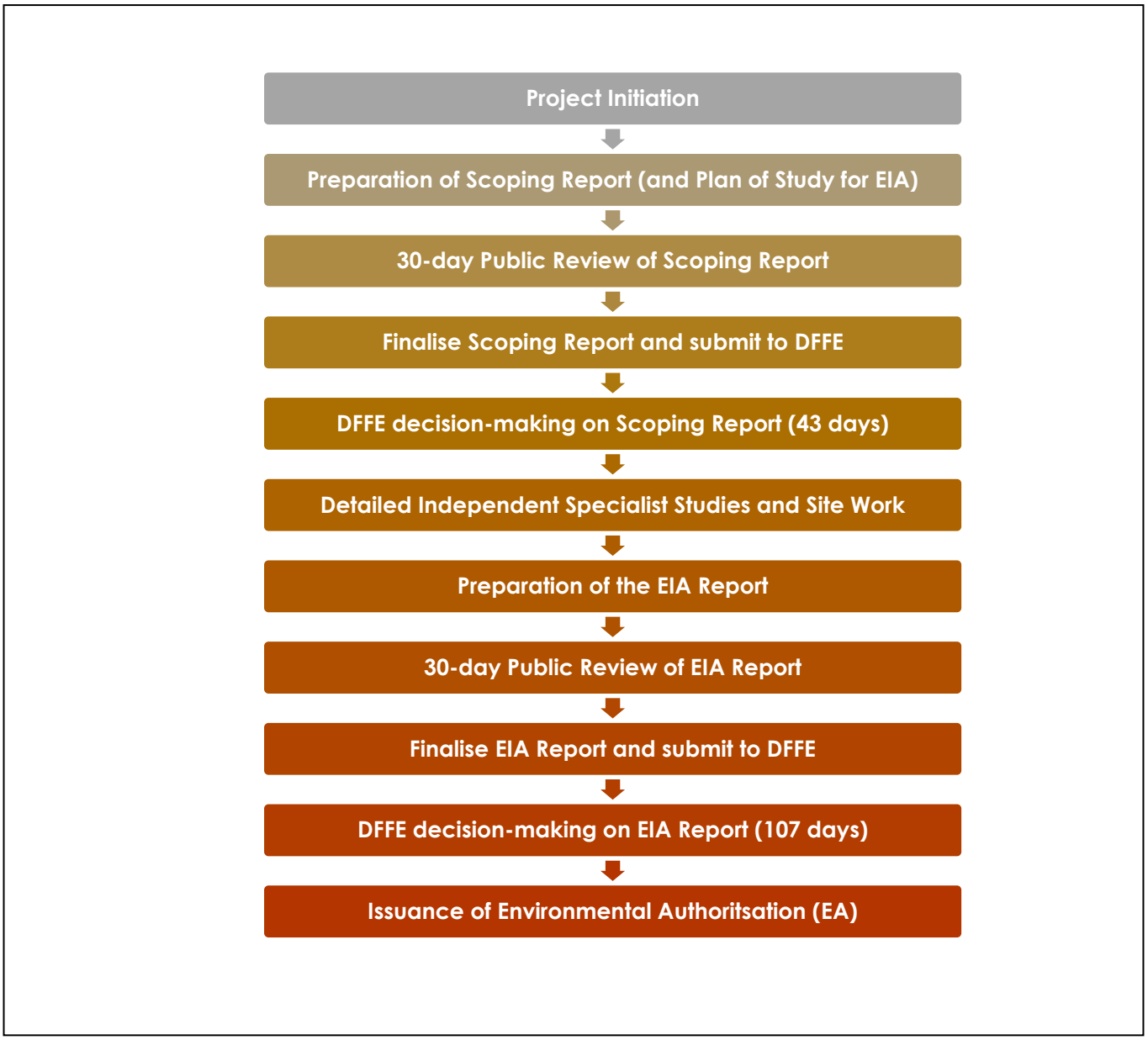

Figure 1.3: Regulated timeframe of an EIA Process

1.5. Details of Environmental Assessment Practitioner and Expertise to conduct the S&EIA Process

In accordance with Regulation 12 of the 2014 EIA Regulations (GNR 326), the Applicant has appointed Savannah Environmental (Pty) Ltd as the independent environmental consultant responsible for managing the Application for EA and supporting S&EIA process; inclusive of comprehensive, independent specialist studies. The application for EA and S&EIA process will be managed in accordance with the requirements of NEMA, the 2014 EIA Regulations (GNR 326), and all other relevant applicable legislation.

Neither Savannah Environmental nor any of its specialists are subsidiaries or are affiliated to the applicant. Furthermore, Savannah Environmental does not have any interests in secondary developments that may arise out of the authorisation of the proposed facility.

Savannah Environmental is a specialist environmental consulting company providing a holistic environmental management service, including environmental assessment, and planning to ensure

compliance and evaluate the risk of development, and the development and implementation of environmental management tools. Savannah Environmental benefits from the pooled resources, diverse skills and experience in the environmental field held by its team.

The Savannah Environmental team for this project includes:

» **Carina de Ornelas**, Environmental Consultant and author of this report has 9 months of experience in the environmental field. She holds a Bachelor of Arts in Environmental Management. She previously worked in retail as a supervisor for over 4 years and has over 8 months of experience as an Environmental Consultant whereby she has helped in drafting of scoping reports, basic assessment reports, EIAs, GIS mapping for reports, public participation administration and environmental management programmes. Her application for Candidate Environmental Assessment Practitioner (EAP) is under review by the Environmental Assessment Practitioners Association of South Africa (EAPASA).

» **Jo-Anne Thomas**, the principal EAP on this project, is a registered EAP with the Environmental Assessment Practitioners Association of South Africa (EAPASA - 2019/726) and a Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP). She provides technical input for projects in the environmental management field, specialising in Strategic Environmental Advice, Environmental Impact Assessment studies, environmental auditing and monitoring, environmental permitting, public participation, Environmental Management Plans and Programmes, environmental policy, strategy and guideline formulation, and integrated environmental management. Her key focus is on integration of the specialist environmental studies and findings into larger engineering-based projects, strategic assessment, and providing practical and achievable environmental management solutions and mitigation measures. Responsibilities for environmental studies include project management (including client and authority liaison and management of specialist teams); review and manipulation of data; identification and assessment of potential negative environmental impacts and benefits; review of specialist studies; and the identification of mitigation measures.

» **Nicolene Venter**. She is a Board Member of IAPSA (International Association for Public Participation South Africa). She holds a Higher Secretarial Diploma and has over 21 years of experience in public participation, stakeholder engagement, awareness creation processes and facilitation of various meetings (focus group, public meetings, workshops, etc.). She is responsible for project management of public participation processes for a wide range of environmental projects across South Africa and neighbouring countries.

In order to adequately identify and assess potential environmental impacts associated with the proposed Vrede Solar PV Facility, the following specialist consultants have provided input into this EIA report:

Company	Specialist Area of Expertise	Specialist Name
The Biodiversity Company	Terrestrial ecology (flora & fauna), avifauna (Regime 2 monitoring)	Andrew Husted Lindi Steyn
The Biodiversity Company	Freshwater	Dale Kindler and Andrew Husted
The Biodiversity Company	Soils and Agricultural Potential	Matthew Mamera and Andrew Husted
JG Africa	Traffic	Adrian Johnson
LOGIS	Visual	Lourens du Plessis

Company	Specialist Area of Expertise	Specialist Name
		Bryony van Niekerk Tosca de Villiers
CTS Heritage	Heritage and Palaeontology	Jenna Lavin Nicholas Wiltshire
Tony Barbour	Social	Tony Barbour

Appendix A includes the curricula vitae for the environmental assessment practitioners from Savannah Environmental and the specialist consultants.

CHAPTER 2: PROJECT DESCRIPTION

This chapter provides an overview of the Vrede Solar PV Facility and details the project scope which includes the planning/design, construction, operation, and decommissioning activities required for the development, and includes details of the proposed technology, the site selection information and identified project alternatives. It must be noted that the project description presented in this Chapter may change to some extent based on the outcomes and recommendations of detailed engineering and other technical studies, the findings and recommendations of the EIA and supporting specialist studies, and any licencing, permitting, and legislative requirements.

2.1 Legal Requirements as per the EIA Regulations, 2014 (as amended), for the undertaking of an Environmental Impact Assessment Report

This chapter of the EIA Report includes the following information required in terms of the EIA Regulations, 2014, as amended - Appendix 3: Scope of Assessment and Content of Environmental Impact Assessment Reports:

Requirement	Relevant Section
3(1)(b) the location of the development footprint of the activity on the approved site as contemplated in the accepted scoping report, including (i) the 21-digit Surveyor General code of each cadastral land parcel, (ii) where available the physical address and farm name and (iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties.	The location of the proposed project is detailed in **Chapter 1**, **Table 1.1**, as well as **Section 2.7**.
3(1)(d)(ii) a description of the scope of the proposed activity, including (ii) a description of the activities to be undertaken including associated structures and infrastructure related to the development.	A description of the activities to be undertaken with the development of the project is included in **Table 2.1** and **Table 2.2**.
3(1)(g) a motivation for the preferred development footprint within the approved site as contemplated in the accepted scoping report.	The identification and motivation for the preferred project site, the development footprint within the project site, the proposed activity and the proposed technology is included in **Section 2.3**.
3(1)(h)(i) details of the development footprint alternatives considered.	The details of all alternatives considered as part of the Project are included in **Section 2.5.**
3(1)(h)(ix) if no alternative development footprint for the activity were investigated, the motivation for not considering such.	Where no alternatives have been considered, motivation has been included. This is included in **Section 2.6.**

2.2 Nature and Extent of the Project

In responding to the growing electricity demand within South Africa, the need to promote renewable energy and sustainability within the Northern Cape Province, as well as the country's targets for renewable energy, Vrede Solar Energy (Pty) Ltd is proposing the development of a commercial solar facility and associated infrastructure to add new capacity to the national electricity grid. The Vrede Solar PV Facility will be developed in a single phase and will have a contracted capacity of up to 150MW. The project will make

use of fixed-tilt, single-axis tracking, and/or double-axis tracking PV technology and will stand less than 5m above ground level. Monofacial or bifacial panels are both considered within this EIA Report. The solar PV panels will be connected to each other to form PV arrays which will generate direct electrical current when exposed to sunlight. Inverters convert the DC power generated by PV panels into AC power, and step-up transformers increase the AC voltage level, before it is fed into the grid.

2.3. Solar PV Technology

Solar energy facilities, such as those which utilise PV technology, use energy from the sun to generate electricity through a process known as the **Photovoltaic Effect**. Generating electricity using the Photovoltaic Effect is achieved through the use of the following components:

Photovoltaic Modules

PV cells are made of crystalline silicon, the commercially predominant PV technology, that includes materials such as polycrystalline and monocrystalline silicon or thin film modules manufactured from a chemical ink compound. PV cells are arranged in multiples / arrays and placed behind a protective glass sheet to form a PV module (Solar Panel). Each PV cell is positively charged on one side and negatively charged on the opposite side, with electrical conductors attached to either side to form a circuit. This circuit captures the released electrons in the form of an electric current (i.e., Direct Current (DC)). When sunlight hits the PV panels, free electrons are released and flow through the panels to produce direct electrical (DC) current. DC then needs to be converted to alternating current (AC) using an inverter before it can be directly fed into the electrical grid.

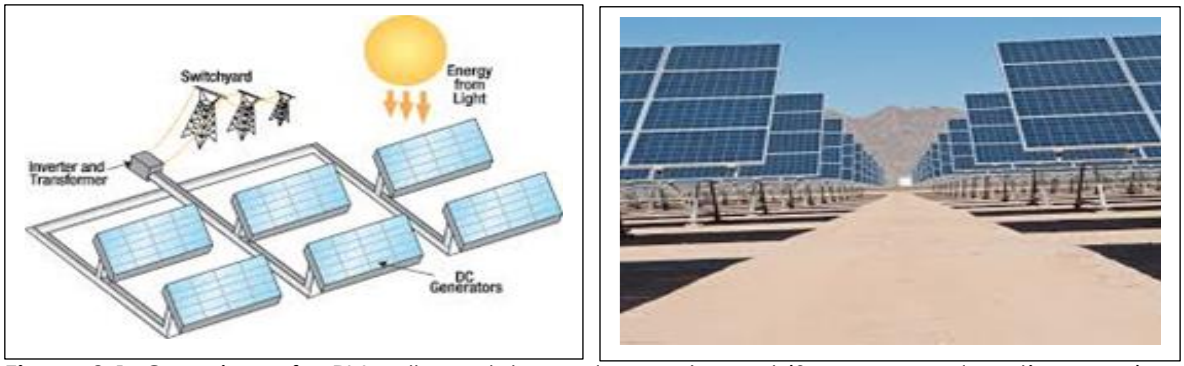

Figure 2.1: Overview of a PV cell, module, and array / panel (Source: pveducation.com)

Inverters

Inverters are used to convert electricity produced by the PV panels from DC into AC, to enable the facility to be connected to a grid connection point. In order to connect a large solar facility such as the one being proposed to a grid connection point, numerous inverters will be arranged in several arrays to collect, and convert power produced by the facility.

Support Structures

PV panels will be fixed to a support structure. PV panels can either utilise fixed / static support structures, or alternatively, they can utilise single or double axis tracking support structures. PV panels which utilise fixed / static support structures are set at an angle (fixed-tilt PV system) so as to optimise the amount of solar irradiation. With fixed / static support structures, the angle of the PV panel is dependent on the latitude of the proposed development and may be adjusted to optimise for summer and winter solar radiation

characteristics. PV panels which utilise tracking support structures track the movement of the sun throughout the day so as to receive the maximum amount of solar irradiation.

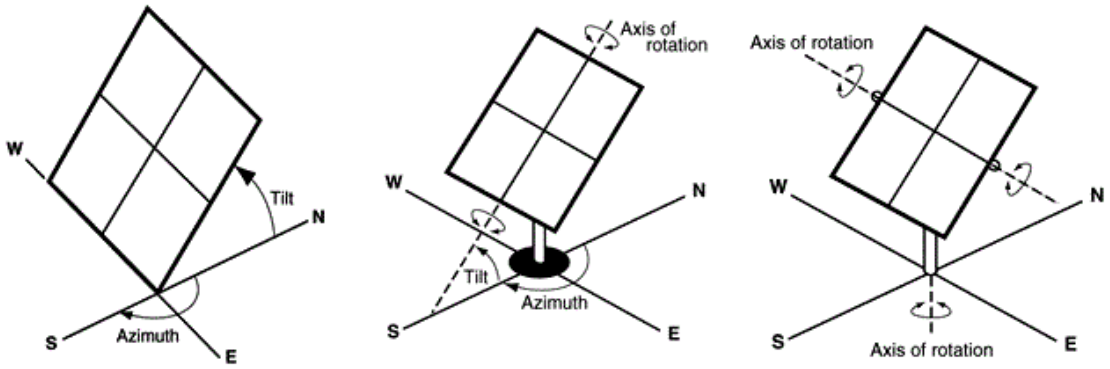

Figure 2.2: Overview of different PV tracking systems (from left to right: fixed-tilt, single-axis tracking, and double-axis tracking (Source: pveducation.com))

2.3.1. Technology Alternatives

Few technology options are available for solar energy PV facilities, and the use of those that are considered are usually differentiated by weather and temperature conditions that prevail in the area, so that optimality is obtained by the final site selection. Solar energy is considered the most suitable renewable energy technology for this area, based on the site location, ambient conditions and energy resource availability.

When considering PV as a technology choice, several types of panels are available, including *inter alia*:

- Bifacial PV panels
- Monofacial PV panels
- Fixed mounted PV systems (static / fixed-tilt panels).
- Single-axis tracking or double-axis tracking systems (with solar panels that rotate around a defined axis to follow the sun's movement).

The primary difference between PV technologies available relate to the extent of the facility, as well as the height of the facility (visual impacts), however the potential for environmental impacts remains similar in magnitude. Fixed mounted PV systems are able to occupy a smaller extent and have a lower height when compared to tracking PV systems, which require both a larger extent of land, and are taller in height. However, both options are considered to be acceptable for implementation from an environmental perspective.

Bifacial ("two-faced") modules produce solar power from both sides of the panel. Bifacial solar panels have solar cells on both sides, which enables the panels to absorb light from the back and the front (refer to **Figure 2.3**). Practically speaking, this means that a bifacial solar panel can absorb light reflected off the ground or another material. In general, more power can be generated from bifacial modules for the same area, without having to increase the development footprint.

The PV panels are designed to operate continuously for more than 20 years, mostly unattended and with low maintenance. The impacts associated with the construction, operation, and decommissioning of the

facility are anticipated to be the same irrespective of the PV panel selected for implementation. Once environmental constraining factors have been determined through the Scoping and EIA process, Akuo Energy Afrique, Africoast Investments and Golden Sunshine Trading will consider various solar panel options. The preferred option will be informed by efficiency as well as environmental impact and constraints (such as sensitive biophysical features). The PV panels proposed, will comprise solar panels which once installed, will stand less than 5m above ground level. The solar panels will be connected to centralised or string inverters. The project will include Battery Energy Storage System (BESS). The BESS capacity will depend on technology to be used and total installed capacity of solar, and it is expected to be up to 1 MWh per MW of solar PV facility. The detailed information on the BESS will be provided and assessed in the EIA phase.

The optimum tilt for a bifacial module has to be designed so as to capture a big fraction of the reflected irradiation. Use of trackers is recommended so the modules can track the sun's movement across the sky, enabling them to stay directed to receive the maximum possible sunlight to generate power.

Monofacial solar panels capture sunlight on one light-absorbing side. The light energy that cannot be captured is simply reflected away (refer to **Figure 2.2**).

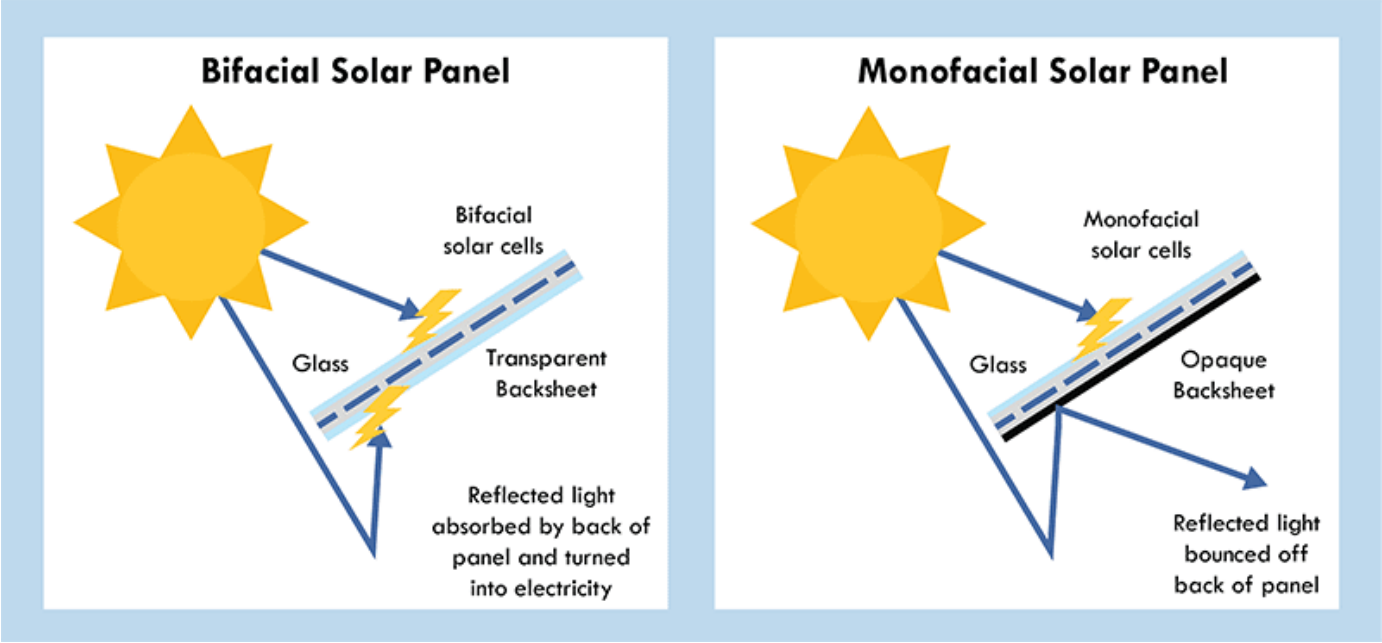

Figure 2.3: Diagram showing how bifacial and monofacial Solar PV panels work (Source: https://www.solarkobo.com/post/bifacial-solar-panels)

PV panels are designed to operate continuously for more than 20 years, unattended and with low maintenance.

2.4. Battery Energy Storage System (BESS)

Increasing BESS capacity is required as the penetration of renewable energy increases in the grid as the BESS provides the ancillary services required for grid stability that variable generation such as solar cannot provide. The general purpose and utilisation of a Battery Energy Storage System (BESS) is to save and store excess electrical output as it is generated, allowing for a timed release when the capacity is required the most and the provision of ancillary services to ensure reliable operation of power networks during normal

operation and contingency events. BESS systems therefore provide flexibility and reliability services for the efficient operation of the electric grid.

The BESS will store and integrate a greater amount of renewable energy from the solar energy facility into the electricity grid. This will assist with the objective to generate electricity by means of renewable energy to feed into the National Grid which will be procured under either the REIPPPP, other government run procurement programmes or for sale to private entities if required.

Figure 2.4 below illustrates a typical utility scale BESS system (a Lithium-Ion BESS).

Figure 2.4: Li-Ion BESS containerised modules located within the BESS enclosure footprint (Source: Tesla).

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Figure 2.4 below illustrates a typical utility scale BESS system (a Lithium-Ion BESS).

Figure 2.4: Li-Ion BESS containerised modules located within the BESS enclosure footprint (Source: Tesla).

2.4.1. Technology Alternatives

The applicant has taken cognisance of the fact that the technology within a BESS frequently advances and as such has not determined the specific technology that will be utilised at this stage. Two technology types however are envisaged, both of which have been assessed in this report to ensure that all impacts related to both types have been addressed:

- Lithium-Ion technology (e.g. Lithium Ferrophosphate (LFP), Nickel Manganese Cobalt Oxide (NMC) or similar technology and chemistries);
- Redox-flow technology (e.g. vanadium flow battery, or similar technology and chemistries); and
- Liquid Metal Technology (e.g. Calcium and Antimony, or similar technology and chemistries).

All of the above technologies include batteries housed within containers which are fully enclosed and self-contained. It is important to note that while both types are detailed and assessed in this report, no specific technology is proposed as that preferred for authorisation, as both are expected to have similar impacts due to their design and functions being closely related (refer to Chapter 6). Therefore, the assessment proposes both technologies for authorisation (i.e. a BESS of either Lithium-Ion, Redox-flow or Liquid Metal type), to allow the applicant to determine the precise technology when the project is implemented, on the understanding that further investigation into the specific technologies available at the time of being awarded preferred bidder status will allow for one of two to be selected and ultimately developed.

These technologies are described below.

i) Lithium-Ion technology

In comparison to electrochemical coupled batteries like nickel-cadmium, a lithium-ion (Li-ion) battery is a rechargeable electrochemical battery operating on a wide array of chemistries where lithium ions are transferred between the electrodes during the charge and discharge reactions (Parsons, 2017).

A Li-ion cell is comprised of three main components; cathode and anodes electrodes, and an electrolyte that allows lithium ions to move from the negative electrode to the positive electrode during discharge and back when charging (**Figure 2.5**) (Parsons, 2017). While charging, lithium ions flow from the positive metal oxide electrode, to the negative graphite electrode which is reversed during discharge (i.e. ion flow is in the opposite direction).

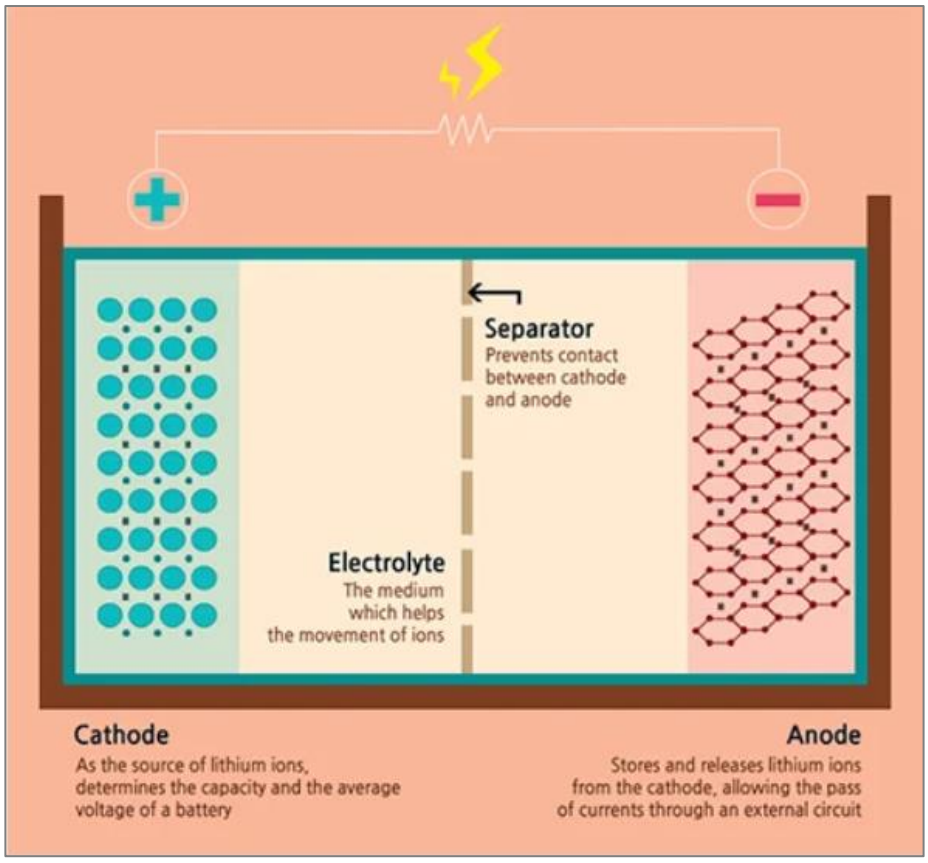

Figure 2.5: An example of a Li-ion cell and its component(Source: https://eepower.com/technical-articles/changing-the-world-with-lithium-ion-batteries/#)

Li-ion battery cells contain two reactive materials which are capable of electron transfer chemical reactions (commonly a lithium source cathode and a graphite anode). Lithium ion batteries utilise both lithium and a heavy metal (commonly cobalt or manganese) in the reactions required for energy storage. Lithium can however be recycled, adding the future potential use of this battery technology, however the recycling process is difficult and expensive.

This battery type is expected to be a dominant energy storage technology for utility-scale applications, with cycle durations up to 4 hours (Parsons, 2017). Developmental concerns related to the technology included cell monitoring and fire (due to thermal runaway, i.e. a heat positive feedback resulting in runaway heating

of the unit) although fire detection, cooling and suppression systems largely address these concerns (Parsons, 2017).

The High round-trip efficiency (the fraction of energy put into the storage that can be retrieved), high power and energy density of this technology provide a significant advantage where a small footprint and available space are an issue. A significant disadvantage to Li-ion has been the high initial cost, as well as the limited cycle lives produced by earlier (historical) chemistries used in the battery (Parsons, 2017). Regardless, recent technological advances and large-scale manufacturing have reduced the price drastically and increased performance, with the result that Li-ion batteries are expected to be an important BESS through to 2030 in both small- and large-scale applications.

ii) Flow Batteries

Flow batteries contain tanks filled with electrolyte, which flows through an electrochemical cell or reaction stack **(Figure 2.6)** (Parsons, 2017). They store and release energy through a reversible electrochemical reaction between two electrolytes (chemical reactants), which are separated by a membrane through which charging and discharging occurs. These batteries provide an energy output greater than or equal to lead acid batteries, and their storage capacity is dependent upon the size of the electrolyte tanks while the power output is dependent on the size of the reaction stack (Parsons, 2017).

Flow batteries are a technology of battery which requires mechanical systems (pumps, pipes, and tanks) and are therefore inherently more complex than a solid-state battery (for example, lithium-ion, lead or advanced lead acid batteries discussed above). The greatest advantage these batteries exhibit is their scalability and their longer duration discharge cycles which are more cost efficient when compared to solid-state batteries (Parsons, 2017). The most successful and widespread of these batteries use vanadium (discussed below) and zinc-bromine chemistries.

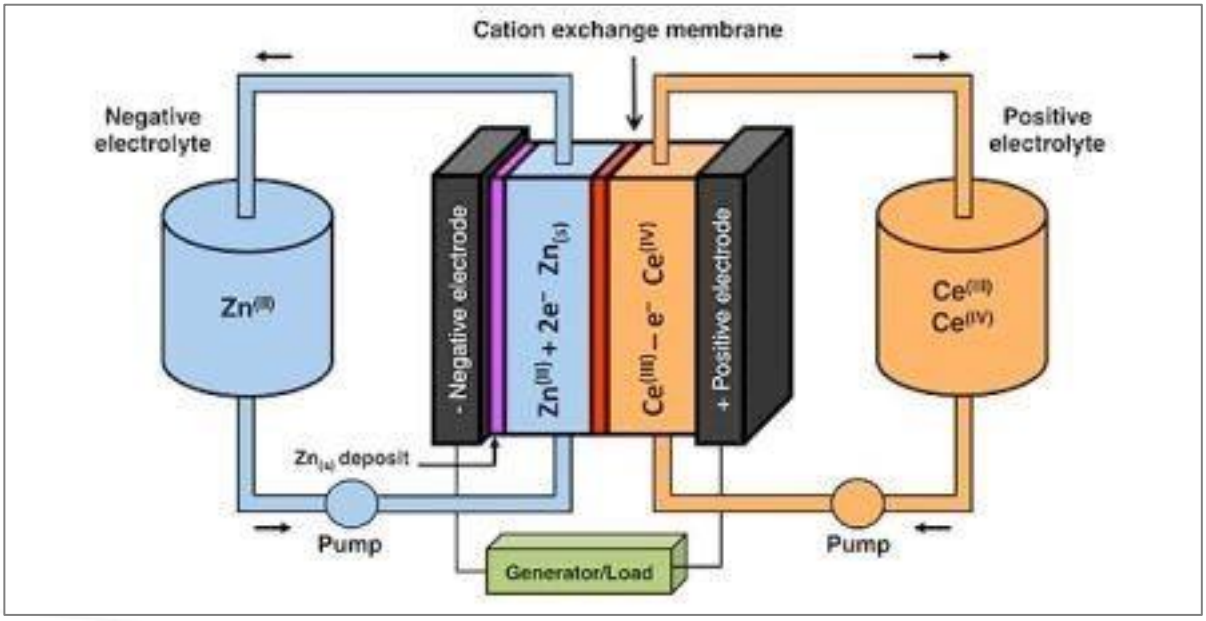

Figure 2.6: An example of a flow battery and its component
(Source: http://www.upsbatterycenter.com/blog/flow-batteries-bring-light-africa/#prettyPhoto)

Redox Flow Batteries (RFB) are a class of electrochemical energy storage technology which entail a chemical reduction and oxidation reaction that stores energy in liquid electrolyte solution flowing through a battery of electrochemical cells during charge and discharge. They are therefore a subset (or one variant) of flow batteries and essentially work by two separate containers of dissolved chemical components, separated by a membrane, which facilitate ion exchange (and thus the resulting flow of electric current) across the membrane when an electrical load is applied to the system. These batteries may act as a fuel cell, where spent electrolyte solution is exchanged once no longer effective, or rechargeable, where regeneration may be achieved by applying a source of electricity to the electrolyte). The energy capacity of this battery is a function of the volume of the electrolyte solution, allowing for a high degree of scalability.

Environmental impacts and their severity are likely to be influenced by the size and scale of the system employed, as larger quantities of land may be used for electrolyte storage as compared to other systems. In addition, while the electrolytes aren't specifically toxic, other chemicals used in their implementation (for example bromine) may be and therefore containment and safe handling are needed. No significant waste products are created by their use as the storage system has the capability to indefinitely perform discharge cycles (Parsons, 2017).

iii) Liquid Metal Battery technology

Unlike a traditional battery where the electrolyte/ electrodes are generally solid in liquid metal batteries. These batteries are comprised of a metal anode, metal cathode and a salt electrolyte, all of which are in liquid phase.

The anode is a low-density liquid metal which provides electrons whilst the cathode is of high density and accepts the electrons. The electrode is made up of a medium density molten electrolyte which allows ions to pass through from the anode to the cathode. The difference in densities between these materials naturally segregate them into three distinct layers and will not mix.

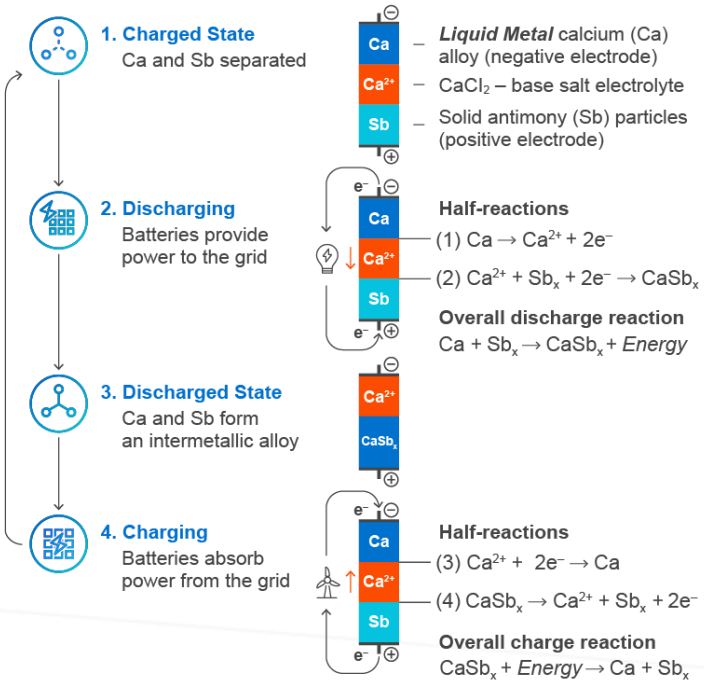

Figure 2.7: An example of a Liquid Metal battery cell and its component (Source: https://ambri.com/solution/)

When the battery is exposed to heat the layers become immiscible liquid layers, controlled by their density differences.

Historically liquid metal batteries utilized Magnesium, antimony and separated by molten salt. The negative electrode was made from Magnesium whilst the positive electrode from Antimony, and a molten salt electrolyte in the centre. Recent advancements in the liquid metal battery technology replaces the magnesium element with calcium.

Liquid metal batteries operate the same as lithium-ion batteries except for the initial startup process which will require an external source for heating the battery to a liquid state.

2.5. Overview of the Project Site

The project is to be developed within Portion 5 of the Farm Bas Berg 88, located approximately 20km north of Philipstown and 30km west of Petrusville. The project site falls within Ward 4 of the Renosterberg Local Municipality in the greater Pixley Ka Seme District Municipality in the Northern Cape. The full extent of the development area (i.e., ~ 400ha), located within the project site (i.e., ~ 1101ha) was considered within the Scoping Study, within which the Vrede Solar PV Facility has been appropriately located from a technical and environmental sensitivity perspective. The layout of the PV facility has been determined and takes into consideration any environmentally sensitive areas identified through this EIA process (refer to **Figure x2.5**.

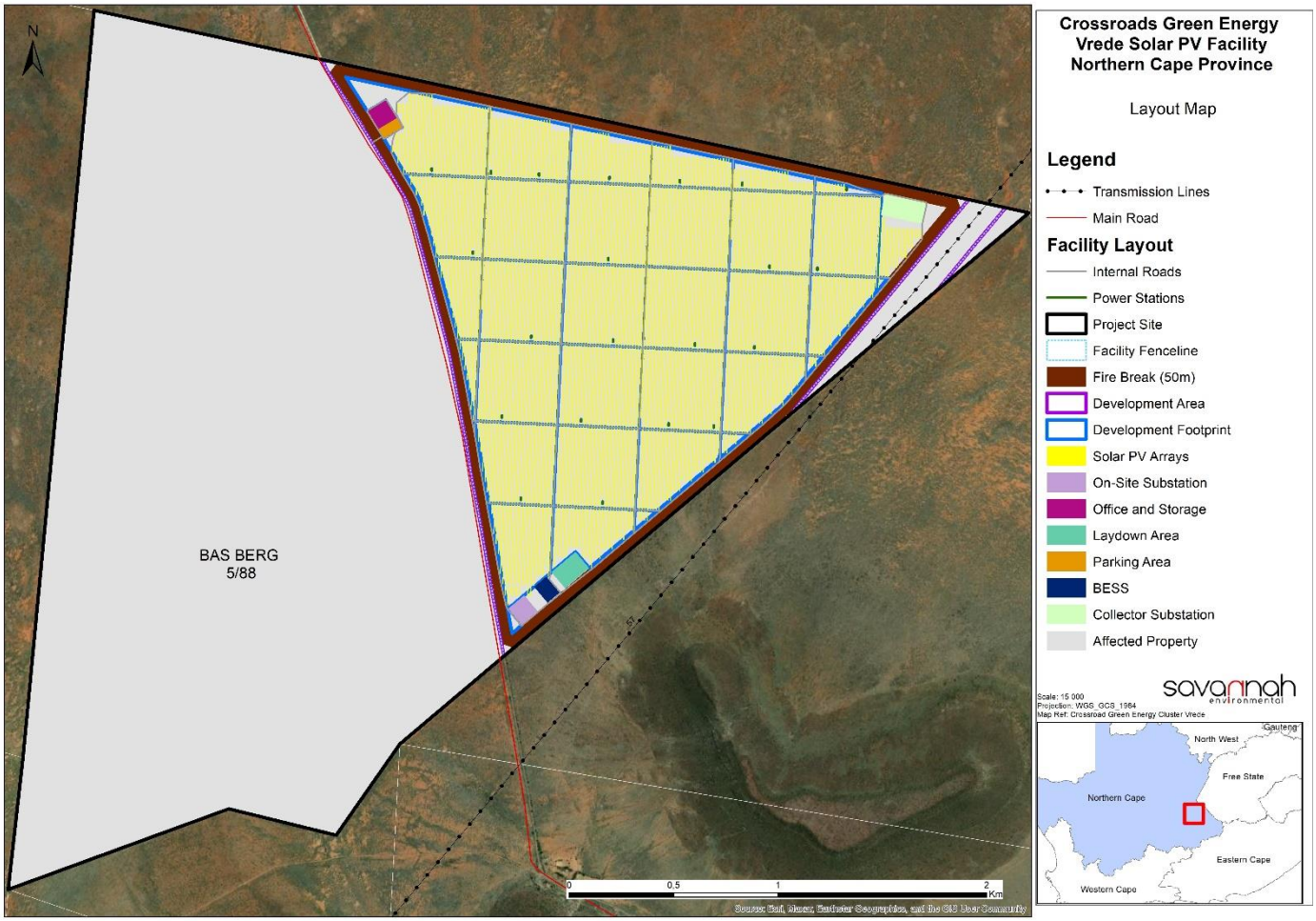

Figure 2.8: Layout map for Vrede Solar PV Facility

The site is accessible via existing roads in the area. The proposed main access road to the site is an existing gravel road located off the R48 at Philipstown. An existing gravel road between the proposed site and Petrusville can be considered as an alternative access road. The proposed access road will link to the internal road network of the facility. The applicant considers this preferred property and site location as being highly favourable and suitable from a technical perspective to establish a Solar PV Facility due to the following site-specific favourable characteristics:

» **Solar resource**: Solar resource is the first main driver of site selection and property viability when considering the development of Solar PV Energy Facilities. The economic viability of a Solar PV Energy Facility is directly dependent on the annual direct solar irradiation values of the area within which it will operate. The Northern Cape has the highest estimated solar potential of all areas within South Africa. The Global Horizon Irradiation (GHI) for the study area is in the region of approximately 2120kWh/m^2/annum (refer to **Figure 2.6**). Based on the solar resource available, no alternative locations are considered.

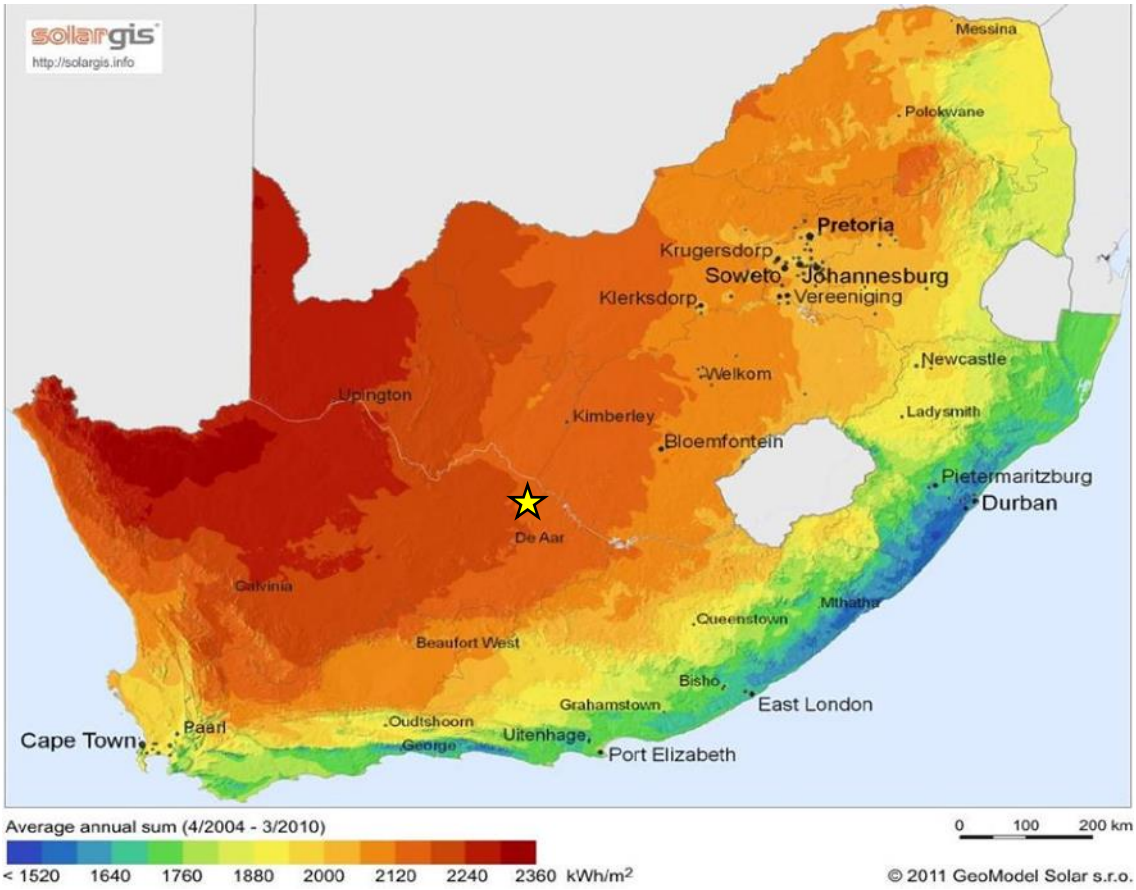

Figure 2.9: Solar irradiation map for South Africa; the proposed Vrede Solar PV Facility position is shown by the yellow star on the map. (Source: adapted from GeoModel Solar, 2011).

» **Land Availability**: In order to develop the Vrede Solar PV Facility with a contracted capacity of up to 150MW, sufficient space is required. The property proposed for the development is a privately-owned parcel available in the area. The land is available for a development of this nature through agreement with the landowner and is deemed technically feasible by the project developer for such development to take place. The affected property has an extent of ~1101ha, which was considered by the developer as sufficient for the development of the Vrede Solar PV Facility. A preferred development area of ~400ha within this larger project site has been identified for the location of the PV facility. An exact development footprint within the development area for the placement of infrastructure has been identified considering environmental constraints and sensitivities identified through the EIA process.

» **Landowner Support:** The selection of a site where the landowner is supportive of the development of renewable energy, and specifically solar PV, is essential for ensuring the success of the project. The landowner affected by the proposed Vrede Solar PV Facility does not view the development as a conflict with their current land use practices. The support from the landowner for the development to be undertaken on the affected property has been solidified by the provision of consent for the project to proceed on the property through the signing of consent forms for the EIA process and conclusion of a preliminary lease agreement with the developer.

» **Land suitability and land use activities**: The current land use of the development area is an important consideration in site selection in terms of limiting disruption to existing land use practices. The project site is currently used for agriculture (livestock farming, specifically sheep farming), which is generally

preferred for developments of this nature as the grazing activities can continue on the project site in tandem with the operation of the solar PV facility. There is no cultivated agricultural land on the project site or directly adjacent, which could be impacted upon by the proposed development. The proposed development is therefore considered to be compatible with the surrounding land uses and does not present a conflicting land use.

» **Geographical and Topographical Considerations:** Sites that facilitate easy construction conditions, (i.e. relatively flat topography, lack of major rock outcrops, limited watercourse crossings, etc.) are favoured by developers during the site selection process. The slope percentage of the project area has been calculated and most of the area is characterised by a slope percentage between 0 and 2%. This indicates a uniform topography with gentle slopes being present within the project area. Steep slopes (> 4%) are associated with the mountains and ridges (Mesas and Inselbergs) located outside of the areas identified for development. The site is therefore considered suitable for the proposed development in terms of topographical considerations.

» **Access to the National Electricity Grid**: A key factor in the siting of any power generation project is a viable grid connection. Since the introduction of renewable generation within the Northern Cape, it was clear that the network would need to be strengthened to enable the integration and evacuation of renewable power into the national electricity grid. The proposed Eskom Hydra B MTS offers very good grid connectivity as many major transmission lines connect via the Eskom Hydra MTS to all parts of the country. A proposed new Main Transmission Substation (the Hydra B MTS Substation[3]), included in the last Eskom Transmission Development Plan and located to the south-west of the site was identified as the preferred grid connection point for the project. The Vrede Solar PV Facility has good access to the proposed Eskom-Hydra B MTS.

» **Site Access**: The proposed main access road to the site is an existing gravel road located off the R48 between De Aar and Philipstown. An existing gravel road between the proposed site and Petrusville can be considered as an alternative access road, as shown in **Figure 2.10.** The proposed access road will link to the internal road network of the facility. The proposed access road to the development is deemed suitable as it is an existing gravel road. The gravel roads will require grading with a grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage (refer to **Figure 2.10**).

[3] The Hydra B MTS is the subject of a separate EIA application being undertaken by the Applicant on behalf of Eskom.

Figure 2.10: Proposed Access Road

Based on the above considerations, the Vrede Solar PV Facility project site was identified by the developer as being the most technically feasible and viable project site within the broader area for further investigation in support of an application for authorisation. As a result, no property/location alternatives are proposed as part of this Scoping and EIA process.

2.6. Design and Layout Alternatives

The overall aim of the facility layout (i.e., development footprint) is to maximise electricity production through exposure to the solar resource, while minimising infrastructure, operation, and maintenance costs, and social and environmental impacts. The findings of the specialist scoping assessments will assist the developer in selecting the optimum position for the PV arrays and associated infrastructures including, but not limited to, access roads, and laydown areas within the larger development area considered.

An overall environmental sensitivity map has been provided within this report in order to illustrate the sensitive environmental features located within the project site which needs to be considered and, in some instances completely avoided by the development footprint (refer to **Chapter 6**). Once more detailed information is available from an environmental and planning perspective for the broader site, a detailed micro-siting exercise will be undertaken to effectively 'design' the solar facility layout within the project site, which will be known as the development footprint. Through the process of determining constraining factors and environmentally sensitive areas, the layout of the PV facility footprint and infrastructure will be planned and adjusted if necessary to ensure the avoidance of no-go areas and mitigation of sensitive environmental features. A detailed facility layout is available within this report (refer to **Figure 2.8**). Where further conflicts

are predicted, a mitigation strategy will be developed to meet the objectives of the mitigation hierarchy (avoid, minimise, mitigate).

2.7. The 'Do-Nothing' Alternative

The 'Do-Nothing' alternative is the option of not constructing Vrede Solar PV Facility. Should this alternative be selected, there would be no environmental impacts or benefits as a result of construction and operation activities associated with a solar PV facility. The 'do-nothing' alternative will therefore likely result in minimising the cumulative impact on the land, although it is expected that pressure to develop the site for renewable energy purposes will be actively pursued due to the same factors which make the site a viable option for the current Applicant. This alternative has been assessed within Chapter 7 of this EIA Report.

2.8. Components of the Vrede Solar PV facility

Infrastructure associated with the Project will include:

- Solar PV array comprising PV modules and mounting structures (monofacial or bifacial and a fixed tilt or single axis tracking system)
- Inverters and transformers
- Cabling between the project components
- Battery Energy Storage System (BESS)
- On-site facility substation and power lines between the solar PV facility and the Eskom substation (to be confirmed and assessed through a separate process)
- Site offices, Security office, operations and control, and maintenance and storage laydown areas
- Access roads, internal distribution roads

A summary of the details and dimensions of the planned infrastructure associated with the Project is provided in **Table 2.1.**

Table 2.1: Details or dimensions of typical infrastructure required for the Project.

Infrastructure	Footprint and dimensions
Contracted Capacity	Up to 150MW
Number of Panels	~ 510, 000 units of 540Wp panels or higher capacity panels if available
Panel Height	Up to 5m from ground level
Technology	Use of fixed-tilt, single-axis tracking, and/or double-axis tracking PV technology. Monofacial or bifacial panels are both considered
Battery Energy Storage System (BESS)	» Standard 20ft HC ISO container with a capacity ranging from 200kWh to 2MWh » The total size of the Battery Energy Storage System will be determined at a later stage but could be up to 1 MWh per MW of solar PV, taking the assumption that 15% of daily consumption is stored resulting in a 240MWh BESS capacity. » The use of containerized battery storage solutions, which capacity ranges from 200kWh to 2MWh, and which size is 6.06 x 2.44 x 2.90m. Considering circa. 30m2 footprint for a container, the total BESS footprint would be 1.15ha
Other infrastructures	» Operations building – ~ 500m^2 » Workshop – ~ 500m^2 » Stores - ~ 500m^2

Infrastructure	Footprint and dimensions
Area occupied by laydown area	» Temporary laydown areas to be used in construction: 1ha/100MW » Permanent laydowns that will be used in operation: 0.25ha from temporary laydown area
Area occupied by the solar array	» Footprint of the infrastructure should be ~400 ha » Laydown Area 2.5ha » Buildings, workshops and store rooms: 1ha
Area occupied by the substations	Facility substation: Not exceeding 2ha.
Access and internal roads	» A minimum required road width of 4 m needs to be maintained and all turning radii must conform with the specifications needed for the abnormal load vehicles and haulage vehicles. It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will hence need to be maintained during the additional loading of the construction phase and then reinstated after construction is completed. The gravel roads will require grading with a grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage. » Main access road to the project site will be via the existing R48 gravel road. » Internal access roads (gravel) of up to 8m in width within a temporary 20 meter construction corridor will be required to access the PV facility.
Grid connection	» The on-site substation will increase the voltage level from 33kV to 132kV or possibly up to 275kV for transmitting the generated electric power to the proposed central collector substation (or switching station), where several projects totalling a capacity up to 500MVA will connect. » A new line will run from the central collector substation and tie into the proposed Hydra B MTS via a double circuit, whether it will be an underground or overhead power line is dependent on the environmental sensitivities. » The collector substation and the transmission line servitudes will be assessed as part of a separate Environmental Impact Assessment process in support of an application for Environmental Authorisation. It's infrastructure is not included as part of this application.
Temporary infrastructure	» Temporary infrastructure, including laydown areas, hardstand areas and a concrete batching plant, will be required during the construction phase. » All areas affected by temporary infrastructure will be rehabilitated following the completion of the construction phase, where it is not required for the operation phase.

Table 2.2
overleaf provides details regarding the requirements and the activities to be undertaken during the Vrede Solar PV Facility development phases (i.e., construction phase, operation phase and decommissioning phase).

Figure 2.11 provides photographs of the construction phase of a Solar Energy Facility similar to the Project.

2.9. Project Development Phases Associated with the Project

Table 2.2: Details of the Vrede Solar PV Facility project development phases (i.e., construction, operation, and decommissioning)

Construction Phase	
Requirements	» Project receives Environmental Authorisation from the DFFE, preferred bidder allocation granted by DMRE (or other offtaker), a generating license issued by NERSA (if applicable), and a Power Purchase Agreement secured with Eskom (or private entity) or a Connection and Wheeling Agreement with Eskom. » Construction period expected to be 15-18 months for Vrede Solar PV Facility. » Create direct construction employment opportunities. Up to 300 employment opportunities will be created. » Temporary accommodation will be built on site for construction workers. » Overnight on-site worker presence would be limited to security staff. » A technician will be one on standby during the construction period. » All wastes, which cannot be reused, will be managed and disposed of in accordance with the local regulatory standards. All debris, spoilt materials, rubbish and other waste, shall be cleared from the site during construction and disposed of accordingly at Municipal designated dump/landfill sites for such wastes. » Electricity required for construction activities will be generated by a generator. Where low voltage connections are possible, these will be considered. » Water required for the construction phase will be supplied by the municipality. In addition, where possible, borehole water will be used. Should water availability at the time of construction be limited, water will be transported to site via water tanks. Water will be used for sanitation and potable water on site as well as construction works.
Activities to be undertaken	
Conduct surveys prior to construction	» Including, but not limited to: a geotechnical survey, site survey and confirmation of the panel micro-siting footprint, and survey of the on-site substation site to determine and confirm the locations of all associated infrastructure.
Establishment of access roads to the Site	» Main access to and Internal access roads within the site will be established at the commencement of construction. » Existing access roads will be utilised, where possible, to minimise impact. It is unlikely that access roads will need to be upgraded as part of the proposed development. » Main access road will be approximately 8m wide and will be located within a 20m servitude to accommodate side drainage, etc. » Internal service road alignment will be approximately 8m wide. Location is to be determined by the final micro-siting or positioning of the PV panels.
Undertake site preparation	» Including the clearance of vegetation at the footprint of PV panel supports, establishment of the laydown areas, the establishment of internal access roads and excavations for foundations. » Stripping of topsoil to be stockpiled, for use during rehabilitation. » Vegetation clearance to be undertaken in a systematic manner to reduce the risk of exposed ground being subjected erosion.

	» Include search and rescue of floral species of concern (where required) and the identification and excavation of any sites of cultural/heritage value (where required).
Establishment of laydown areas and batching plant on site	» A laydown area for the storage of PV panels components and civil engineering construction equipment. » The laydown will also accommodate building materials and equipment associated with the construction of buildings. » No borrow pits will be required. Infilling or depositing materials will be sourced from licenced borrow pits within the surrounding areas. » A temporary concrete batching plant of 50m x 50m in extent to facilitate the concrete requirements for foundations, if required.
Construct foundation	» Excavations to be undertaken mechanically. » For PV array installation vertical support posts will be driven into the ground. » Depending on geological conditions, the use of alternative foundations may be considered (e.g., screw pile, helical pile, micropile or drilled post/piles).
Transport of components and equipment to and within the site	» The components for the solar PV facility and onsite substation will be transported to site by road. Transportation will take place via appropriate National and Provincial roads, and the dedicated access/haul road to the site. » Some of the components (i.e. substation transformer) may be defined as abnormal loads in terms of the Road Traffic Act (Act No. 29 of 1989) by virtue of the dimensional limitations. » Typical civil engineering construction equipment will need to be brought to the site (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.) as well as components required for the mounting of the PV support structures, construction of the substation and site preparation.
Erect PV Panels and Construct Substation, Invertors and BESS	» The construction phase involves installation of the solar PV panels and the structural and electrical infrastructure to make the plant operational. In addition, preparation of the soil and improvement of the access roads would continue for most of the construction phase. » For array installation, typically vertical support posts are driven into the ground. Depending on the results of the geotechnical study a different foundation method, such as screw pile, helical pile, micro-pile or drilled post/pile could be used. The posts will hold the support structures (tables) on which PV arrays would be mounted. Brackets attach the PV modules to the tables. » Trenches are dug for the underground AC and DC cabling and the foundations of the inverter enclosures and transformers are prepared. While cables are being laid and combiner boxes are being installed, the PV tables are erected. » Wire harnesses connect the PV modules to the electrical collection systems. » Underground cables and overhead circuits connect the Power Conversion Stations (PCS) to the on-site AC electrical infrastructure and ultimately the project's on-site substation. This process also involves the installation of the BESS facility.
Connection of PV panels to the onsite substation	» PV arrays to be connected to the on-site substation via underground electrical cables. » Excavation of trenches is required for the installation of the cables. Trenches will be approximately 1.5m deep. » Underground cables are planned to follow the internal access roads, as far as possible. » Onsite substation to be connected to the collector substation via overhead lines.
Establishment of ancillary infrastructure	» Site offices and maintenance buildings, including workshop areas for maintenance and storage will be required. » Establishment will require the clearing of vegetation, levelling, and the excavation of foundations prior to construction.

Connect substation to the power grid	» A new 132kV single- or double-circuit power line will run from the project on-site substation to the cluster collector substation and tie into the proposed Hydra B MTS.
Undertake site rehabilitation	» Commence with rehabilitation efforts once construction completed in an area, and all construction equipment is removed. » On commissioning, access points to the site not required during the operation phase will be closed and prepared for rehabilitation.
Operation Phase	
Requirements	» Duration will be ~30 years. » Requirements for security and maintenance of the project. » Employment opportunities relating mainly to operation activities and maintenance » Approximately 15 or up to 30 employees will be required during the operational phase of the larger Crossroads Green Energy Cluster. There will also be contractors and temporary workers.
Activities to be undertaken	
Operation and Maintenance	» Full time security, maintenance, and control room staff. » All PV panels will be operational except under circumstances of mechanical breakdown, inclement weather conditions, or maintenance activities. » Solar PV to be subject to periodic maintenance and inspection. » It is anticipated that the PV panels will be washed two times a year during operation using clean water with no cleaning products or using non-hazardous biodegradable cleaning products. » Disposal of waste products (e.g., oil) in accordance with relevant waste management legislation. » Areas which were disturbed during the construction phase to be utilised, should a laydown area be required during operation.
Decommissioning Phase	
Requirements	» Expected lifespan of approximately 30 years (with maintenance) before decommissioning is required. » Decommissioning of the Vrede Solar PV Facility infrastructure at the end of its economic life. » Decommissioning activities to comply with the legislation relevant at the time.
Activities to be undertaken	
Site preparation	» Confirming the integrity of site access to the site to accommodate the required decommissioning equipment. » Preparation of the site (e.g., laydown areas and construction platform). » Mobilisation of construction equipment.
Disassemble and remove PV panels	» Components to be reused, recycled, or disposed of in accordance with regulatory requirements. » Much of the above ground wire, steel, and PV panels of which the system is comprised are recyclable materials and would be recycled to the extent feasible. » Concrete will be removed to a depth as defined by an agricultural specialist and the area rehabilitated. Cables will be excavated and removed, as may be required

Post-decommissioning land use	» Following decommissioning of the facility, the project site will be returned to the current land use (i.e. agriculture: livestock farming, specifically sheep farming)

Figure 2.8: Photographs of the construction phase of a Solar Energy Facility similar to the Project (Source:https://medium.com/@solar.dao/how-to-build-pv-solar-plant-6c9f6a01020f; https://www.shutterstock.com/video/clip-1028794-workers-mounting-panels-on-solar-power-plant-construction; https://www.esi-africa.com/renewable-energy/kenya-construction-solar-farm-gets-green-light/)

CHAPTER 3: NEED AND DESIRABILITY

Appendix 3 of the 2014 EIA Regulations (GNR 326) requires that an EIA Report includes a motivation for the need and desirability of the proposed development, including the need and desirability of the activity in the context of the preferred location considering relevant policy and legislative provisions. The need and desirability of the development needs to consider whether it is the right time and the right place for locating the type of land-use/activity being proposed. The need and desirability of a proposed development is, therefore, associated with the wise use of land, and should be able to respond to questions such as, but not limited to, what the most sustainable use of the land may be.

This Chapter provides an overview of the need and desirability, and perceived benefits of the Project specifically as well as policy and legislative context within which the development of a Solar PV Facility, such as Vrede Solar PV Facility, is proposed. More details of the relevant policy and legislative context can be found in more detail in **Appendix O.**

3.1. Legal Requirements as per the EIA Regulations, 2014 (as amended), for the undertaking of an Environmental Impact Assessment Report

This chapter includes the following information required in terms of Appendix 3: Content of Environmental Impact Assessment Reports:

Requirement	Relevant Section
3(1)(f) a motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted scoping report.	The need and desirability for the development of the Project is included and discussed as a whole within this chapter. The need and desirability for the development of the Solar PV Facility has been considered from an international, national, regional and site-specific perspective.
3(1)(e) a description of the policy and legislative context within which the development is proposed and how the proposed development complies with and responds to the legislation and policy context.	**Section 3.2** provides an overview of the policy and legislative context which is considered to be associated with the development of the solar energy facility in the context of the need and desirability for the project. The regulatory and planning context has been considered at national, provincial and local levels. A detailed description of the policy and legislative context within which the Project is proposed and how the project complies with and responds to the legislation and policy context is included in **Appendix O.**

3.2. Policy Context

The need to expand electricity generation capacity in South Africa is based on national policy and informed by on-going strategic planning undertaken by the Department of Mineral Resources and Energy (DMRE). The policies or plans that have relevance to the development of the project are listed in **Table 3.1** and are discussed in more detail in **Appendix O**.

Table 3.1: Policies relevant to the Vrede Solar PV Facility

International Policy
» United Nations Framework Convention on Climate Change (UNFCCC) and Conference of the Party (COP) » The Equator Principles (EP) IV (October 2020) » International Finance Corporation (IFC) Performance Standards and Environmental and Social Sustainability (January 2012)
National Policy
» Constitution of the Republic of South Africa, 1996 » National Environmental Management Act (No. 107 of 1998) (NEMA) » National Energy Act (No. 34 of 2008) (NEA) » White Paper on the Energy Policy of the Republic of South Africa (1998) » White Paper on the Renewable Energy Policy of the Republic of South Africa (2003) » The Electricity Regulation Act (No. of 2006) (ERA) » Integrated Energy Plan (IEP), 2016 » Integrated Resource Plan for Electricity (IRP) 2010-2030 » New Growth Path (NGP) Framework, 23 November 2010 » National Development Plan 2030 (2012) (NDP) » Strategic Integrated Projects (SIPs) » National Climate Change Response Policy, 2011 (NCCRP) » Climate Change Bill, 2018 » National Biodiversity Economy Strategy (NBES) (March 2016)
Provincial Policy
» Northern Cape Province Provincial Growth and Development Strategy (PDP), 2020- 2025 » Northern Cape Provincial Spatial Development Framework (SDF) (2016) – Published 2017 » Northern Cape Climate Change Response Strategy (2017) » Northern Cape Province Green Document (2017-2018)
District and Local Policy
» Pixley Ka Seme District Municipality Integrated Development Plan (IDP), 2017-2022 » Pixley Ka Seme District Municipality Spatial Development Framework (2014) » Renosterberg Local Municipality Integrated Development Plan (2017- 2021) »

3.3. Need and Desirability from an Energy Perspective

Electricity is essential for most human activities and for South Africa's social and economic development. The development of large-scale electricity generation projects contributes towards security of supply and assists in minimising the costs of energy. In order for the benefits associated with electricity to be realised, it needs to be readily available, easily accessible, and affordable. It should also be generated in a sustainable manner, while minimising adverse social and environmental impacts. In addition to energy provision, large-scale electricity generation projects, such as Solar PV Facilities, have the ability to contribute positively to the creation of skilled, unskilled, and semi-skilled employment opportunities and mitigate climate change.

An increased supply of electricity within or to an area is also considered beneficial from a development perspective as the availability of electricity and other services can act as a pull factor attracting new development and industry.

3.4. Need and Desirability from an International Perspective

The need and desirability of Vrede Solar PV Facility, from an international perspective, can be described through the project's alignment with internationally recognised and adopted agreements, protocols and conventions. South Africa is a signatory to a number of international treaties and initiatives, including the United Nation's Development Programme's (UNDP's) Sustainable Development Goals (SDGs). The SDGs address global socio-economic challenges such as poverty, hunger, health, education, climate change, gender equality, water, sanitation, energy, urbanisation, environment and social justice. The SDGs consist of 17 global goals set by the United Nations. The 17 SDGs are characterised by 169 targets, and 304 indicators.

Goal 7 of the SDGs relates to "Affordable and Clean Energy", with the aim of the goal being to ensure access to affordable, reliable, sustainable, and modern energy for all. The following targets and indicators have been set for Goal 7:

Targets		Indicators	
7.1	By 2030, ensure universal access to affordable, reliable and modern energy services.	7.1.1 7.1.2	Proportion of population with access to electricity. Proportion of population with primary reliance on clean fuels and technology.
7.2	By 2030, increase substantially the share of renewable energy in the global energy mix.	7.2.1	Renewable energy share in the total final energy consumption.
7.3	By 2030, double the global rate of improvement in energy efficiency.	7.3.1	Energy intensity measured in terms of primary energy and GDP.
7.A	By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.	7.A.1	Mobilised amount of United States dollars per year starting in 2020 accountable towards the $100 billion commitment.
7.B	By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support.	7.B.1	Investments in energy efficiency as a percentage of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services.

The development of Vrede Solar PV Facility would contribute positively towards Goal 7 of the SDGs through the following:

- By generating up to 150MW (contracted capacity) of affordable and clean energy. PV technology is considered as one of the cleanest electricity generation technologies, as it does not result in the release of emissions during its operation.
- By contributing towards South Africa's total generation capacity, specifically through the utilisation of renewable energy resources.

The Kyoto Protocol (1997) is also relevant to the need for the development of the Vrede Solar PV Facility from an international perspective. The protocol calls for the reduction of South Africa's greenhouse gas emissions

through actively cutting down on using fossil fuels, or by utilising more renewable resources. The development of the Vrede Solar PV Facility will add capacity to the renewable energy sector of the country and strengthen the commitment and action plan to achieve the requirements, as set out in the protocol, through the generation of energy without the emission of greenhouse gasses.

3.5. Need and Desirability from a National Perspective

South Africa has experienced 15 years of intermittent black-outs and in the recent months, the country has yet again faced a considerable shortage in the availability and stability of electricity supply. Following the energy crisis in 2008, South African Government started to introduce renewable energy developments on a large scale and further enhanced the promotion of energy efficiency in all sectors to meet the demand of energy while reducing CO_2 emissions and creating jobs[4]. As a consequence, significant investment in renewable energy and energy efficient technologies is required. Increasing the diversity of South Africa's electricity mix is important, not only for enhancing the crucially important security of supply of the country, but also to support job creation and mitigate climate change.

The National Development Plan (NDP) envisages that, by 2030, South Africa will have an energy sector that provides reliable and efficient energy service at competitive rates; that is socially equitable through expanded access to energy at affordable tariffs; and that is environmentally sustainable through reduced emissions and pollution. Historically, coal has provided the primary fuel resource for baseload electricity generation in South Africa. Consequently, Eskom, who is the main electricity generating company in the country, generates approximately 85% of the country's electricity from coal resources (Stats SA, 2016), resulting in a large carbon footprint. Taking into consideration the need to ensure adequate supply of electricity and meet international obligations in terms of addressing climate change, Government has identified the need to diversify the energy mix within the country.

Vrede Solar PV Facility is proposed in specific response to the requirement for diversification of the country's energy mix to include renewable energy such as solar PV as detailed in the IRP 2019. As a result, the need and desirability of Vrede Solar PV Facility from a national perspective can largely be linked from the project's alignment with national government policies, plans, and programmes which have relevance to energy planning and production. The following key plans have been developed by National Government to consider South Africa's current energy production, projected future demands, and provides the necessary framework within which energy generation projects can be developed:

» Integrated Energy Plan (IEP)
» Integrated Resource Plan (IRP)

The above-mentioned energy plans have been extensively researched and are updated on an on-going basis to take into consideration changing scenarios, new information, developments in new technologies, and to reflect updated demands and requirements for energy production within the South African context. These plans form the basis of South Africa's energy generation sector and dictate national priorities for energy production.

According to the Integrated Resource Plan (IRP 2019), provision has been made for the following new additional capacity by 2030 (refer to **Figure 3.1**):

[4] https://energypedia.info/wiki/South_Africa_Energy_Situation

- 1 500MW of coal.
- 2 500MW of hydro.
- 6 000MW of solar PV.
- 14 400MW of wind.
- 1 860MW of nuclear.
- 2 088MW for storage.
- 3 000MW of gas/diesel.
- 4 000MW from other distributed generation, co-generation, biomass and landfill technologies.

	Coal	Coal (Decommis-sioning)	Nuclear	Hydro	Storage	PV		Wind	CSP	Gas & Diesel	Other (Distributed Generation, CoGen, Biomass, Landfill)
Current Base	37,149		1 860	2,100	2 912	1 474		1 980	300	3 830	499
2019	2,155	-2,373						244	300		Allocation to the extent of the short term capacity and energy gap.
2020	1,433	-557				114		300			
2021	1,433	-1403				300		818			
2022	711	-844			513	400	1,000	1,600			
2023	750	-555				1000		1,600			500
2024			1,860					1,600		1000	500
2025						1000		1,600			500
2026		-1,219						1,600			500
2027	750	-847						1,600		2000	500
2028		-475				1000		1,600			500
2029		-1,694			1575	1000		1,600			500
2030		-1,050		2,500		1000		1,600			500
TOTAL INSTALLED CAPACITY by 2030 (MW)	33,364		1,860	4,600	5,000	8,288		17,742	600	6,380	
% Total Installed Capacity (% of MW)	43		2.36	5.84	6.35	10.52		22.53	0.76	8.1	
% Annual Energy Contribution (% of MWh)	58.8		4.5	8.4	1.2*	6.3		17.8	0.6	1.3	

Installed Capacity
Committed/Already Contracted Capacity
Capacity Decommissioned
New Additional Capacity
Extension of Koeberg Plant Design Life
Includes Distributed Generation Capacity for own use

- 2030 Coal Installed Capacity is less capacity decommissioned between years 2020 and 2030.
- Koeberg power station rated/installed capacity will revert to 1,926MW (original design capacity) following design life extension work.
- Other/ Distributed generation includes all generation facilities in circumstances in which the facility is operated solely to supply electricity to an end-use customer within the same property with the facility.
- Short term capacity gap is estimated at 2,000MW.

Figure 3.1: Summary of energy allocations and commitments based on the IRP 2019

Vrede Solar PV Facility is proposed to contribute towards the planned 6000MW of PV development between 2022 and 2030.

3.5.1. Benefits of Renewable Energy and the Need and Desirability in the South African Environment

The generation of electricity from renewable energy resources offers a range of potential socio-economic and environmental benefits for South Africa. These benefits include:

Socio-economic upliftment of local communities: Vrede Solar PV Facility has the potential to create much needed employment for unskilled locals during the construction phase. Training opportunities will also be afforded to qualified local people who can be upskilled to undertake certain roles during the construction and operation phases. Some of the challenges facing the Local and District municipalities, as detailed in the IDPs include high rates of unemployment, high levels of poverty, and low levels of development despite the strategic local in terms of the national transport corridors. The Local and District municipalities are

therefore in need of economic development, sustainable employment opportunities and growth in personal income levels. Since inception of the REIPPPP in 2011 up to bid window 4, approximately 109 400 job years for South African citizens to date have been created.

Vrede Solar PV Facility also has the potential to make a positive contribution towards the identified community needs. In terms of the economic development requirements of the REIPPPP, the project will commit benefits to the local community in the form of job creation, localisation, and community ownership. In accordance with the DMRE's bidding requirements of the REIPPPP, a percentage of the revenue generated per annum during operation will be made available to local communities through a social beneficiation scheme. Therefore, the potential for creation of employment and business opportunities, and the opportunity for skills development for local communities is significant. Secondary social benefits can be expected in terms of additional spend in nearby towns due to the increased demand for goods and services. These socio-economic benefits would include an increase in the standard of living for local residents within the area as well as overall financial and economic upliftment.

Increased energy security: Given that renewables can often be deployed in a short timeframe and in a decentralised manner close to consumers, they offer the opportunity for improving grid strength and supply quality in the short-term, while reducing expensive distribution losses. According to CSIR's power sector statistics[5], South Africa experienced loadshedding for 1 169 hours in 2021 (~13% of the time) wherein 2 521GWh of estimated energy was shed (mostly stage 2 load shedding). This is a 40% increase on the total loadshedding experienced during 2020. It is important to note that although extensive load shedding continued during 2021, record relative variable renewable energy contributions were recorded, with solar PV contributing 5.1 TWh.

Resource saving: It is estimated that the achievement of the targets in the Renewable Energy White Paper will result in water savings of approximately 16.5 million kilolitres per annum. As an already water-stressed nation, it is critical that South Africa engages in a variety of water conservation measures, particularly due to the detrimental effects of climate change on water availability. Renewable energy also translates into revenue savings, as fuel for renewable energy facilities is free, while compared to the continual purchase of fuel for conventional power stations.

According to the IPP Procurement Programme overview report dated 31 March 2021, water savings of 71.7 million kilolitres has been realised by the programme from inception to the date of this publication, of which 4.2 million kilolitres is in the 2021 reporting quarter included in this report.

Exploitation of significant renewable energy resource: At present, valuable renewable resources, including biomass by-products, solar irradiation and wind power remain largely unexploited. The use of these energy flows will strengthen energy security through the development of a diverse energy portfolio in South Africa.

According to the IPP Procurement Programme overview report, as of 31 March 2021, the REIPPPP had made the following significant impacts in terms of energy supply:

» 6 422MW of electricity had been procured from 112 Renewable Energy Independent Power Producers (IPPs) in seven bid rounds[6].

[5] CSIR Energy Centre. Statistics of utility-scale power generation in South Africa in 2021. April 2022

[6] Bid windows1, 2 ,3 ,3.5 ,4 and small BW1(1S2) and small BW2(2S2). 2 583 MW of renewable energy capacity was awarded to IPPs in the REIPPPP bid window 5 in October 2021. 1000MW of renewable energy capacity was awarded to IPPs in the REIPPPP bid window 6 in December 2022 and April 2023, all of which were PV facilities.

- 5 078 MW of electricity generation capacity from 79 IPP projects has been connected to the national grid.
- 59 761GWh of energy has been generated by renewable energy sources procured under the REIPPPP since the first project became operational in November 2013. Renewable energy IPPs have proved to be very reliable. Of the 79 projects that have started operations, 67 projects have been operational for longer than a year. The electrical energy generated over the past 12-month period for the 67 projects is 11 679GWh, which is 94% of their annual energy contribution projections of 12 481GWh over a 12-month delivery period. Twenty-six (26) of the 67 projects (39%) have individually exceeded their projections.

In August 2021, Bid Window 5, which had aimed to sign up 2 600MW of power, including 1 600MW of wind and 1 000MW of solar was open. It attracted 102 bids, offering capacity of 9 644MW. 25 Preferred Bidders were selected to provide a total of 2 583MW from wind and solar developments.

Economics: As a result of the excellent resource and competitive procurement processes, both wind power and solar PV power are now proven in South Africa as cheaper forms of energy generation than coal power. They offer excellent value for money to the economy and citizens of South Africa while benefitting society as a whole through the development of clean energy.

The following has been achieved by the IPP programme (March 2021) in terms of investment and economics:

- Investment (equity and debt) to the value of R209.7 billion was attracted in seven bid rounds.
- Socio-economic development contributions of R1.5 billion to date, of which R103.5 million was spent in this 2021 reporting quarter.
- Enterprise development contributions of R463.5 million to date, of which R34.8 million was spent in this 2021 reporting quarter.

Pollution reduction: The release of by-products through the burning of fossil fuels for electricity generation has a particularly hazardous impact on human health and contributes to ecosystem degradation. The use of solar irradiation or wind for power generation is a non-consumptive use of a natural resource which produces zero emissions during its operation.

The overview of the Independent Power Producers Procurement Report (March 2021) indicates that a carbon emission reduction of 60.7 Mton CO_2 has been realised by the IPP programme from inception to date, of which 3.6 Mton is in the 2021 reporting quarter.

Climate friendly development: The uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner and thereby allows South Africa to contribute towards mitigating climate change through the reduction of GHG emissions. According to the Climate Transparency Report (2020), total GHG emissions in South Africa (excluding land use) have increased by 41% since 1990, but emissions in recent years have been almost constant, owing largely to low economic growth and a sharp rise in electricity prices. South Africa is ranked 12th worldwide in terms of per capita carbon dioxide emissions as of 202118. Since its inception, the REIPPPP has achieved carbon emission reductions19 of 60.7 Mton of CO_2. The development of Vrede Solar PV Facility, and the associated electricity generated as a result of the facility, will result in considerable savings on tons of CO_2 emissions.

Support for international agreements: The effective deployment of renewable energy provides a tangible means for South Africa to demonstrate its commitment to its international agreements under the Kyoto Protocol and the Paris Agreement, and for cementing its status as a leading player within the international community.

Employment creation: The development, procurement, installation, maintenance and management of renewable energy facilities have significant potential for job creation and skills development in South Africa. The construction phase will create temporary employment opportunities and the operation phase will create limited full-time employment opportunities.

Acceptability to society: Renewable energy offers a number of tangible benefits to society, including reduced pollution concerns, improved human and ecosystem health and climate friendly development.

Support to a new industry sector: The development of renewable energy offers the opportunity to establish a new industry within the South African economy, which will create jobs and skill local communities which have potential for further renewable energy projects.

Protecting the natural foundations of life for future generations: Actions to reduce our disproportionate carbon footprint can play an important part in ensuring our role in preventing dangerous anthropogenic climate change, thereby securing the natural foundations of life for generations to come; this is the basis of sustainable development.

3.6. Need and Desirability of the project from a Regional Perspective

South Africa's electricity generation mix has historically been dominated by coal. However, up to 2030, a new capacity demand will be driven by the decommissioning of existing coal-fired power stations. A further 24 100MW of coal power is expected to be decommissioned in the period 2030 to 2050. Therefore, additional capacity will be required from renewable energy sources, with the solar PV being allocated 1000MW per annum for the period up to 2030.

Although the majority of South Africa's electricity generation infrastructure (coal-fired power stations) is currently located within Mpumalanga due to the location of coal resources within this province, the Northern Cape has been identified as an area where electricity generation from solar energy facilities is highly feasible and a viable option as a result of the high solar irradiation. The Northern Cape Provincial Growth and Development Strategy identifies poverty reduction as the most significant challenge facing the government and its partners. All other societal challenges that the province faces emanate predominantly from the effects of poverty. The development of the Vrede Solar PV Facility has the potential to create employment opportunities, promote skills development, create opportunities to promote private sector investment and the development of SMMEs in the Northern Cape Province.

The NCPGDS makes reference to the need to ensure the availability of inexpensive energy. The section notes that in order to promote economic growth in the Northern Cape the availability of electricity to key industrial users at critical localities at rates that enhance the competitiveness of their industries must be ensured. At the same time, the development of new sources of energy through the promotion of the adoption of energy applications that display a synergy with the province's natural resource endowments must be encouraged. In this regard the NCPGDS notes "*the development of energy sources such as solar energy, the natural gas fields, bio-fuels, etc., could be some of the means by which new economic opportunity and activity is*

generated in the Northern Cape". The Northern Cape Provincial Spatial Development Framework (NCSDF) (2012) lists a number of sectoral strategies and plans that are to be read and treated as key components of the PSDF. Section C8.2.3, Energy Objectives, sets out the energy objectives for the Northern Cape Province. The section makes specific reference to renewable energy, including to "*Promote the development of renewable energy supply schemes. Large-scale renewable energy supply schemes are strategically important for increasing the diversity of domestic energy supplies and avoiding energy imports while minimizing detrimental environmental impacts*".
The development of the Vrede Solar PV Facility would contribute positively towards increased electricity provision in the Northern Cape Province, which could be used in the development of socio-economic infrastructure within the province, as well as to increase employment opportunities. The location of the study area and project site within the Northern Cape is therefore considered to support the Province/Region's generation targets.

3.7. Need and Desirability of the project from a District and Local Perspective

The Pixley Ka Seme District Municipality SDF (2014) notes that the vision for the PKSDM is "*Pixley Ka Seme DM, pioneers of development, a home and future for all*". The Mission Statement that underpins the vision refers to:

- Effective and efficient service delivery.
- Optimal human and natural resource development.
- Local economic growth and development, job creation and poverty alleviation.
- A vibrant tourism industry.
- To participate in the fight to reduce the infection rate and lessen the impact of HIV/ Aids and other communicable diseases.
- A safe, secure and community friendly environment.

The SDF identifies the opportunities and constraints associated with the district. Of relevance to the project the opportunities include Renewable Energy and the identification of a renewable energy hub in the region. The natural environment and maintenance and conservation of the pristine natural environment to support sustainable farming into the future is also identified as an opportunity. The SDF notes that Pixley Ka Seme District area with its abundance of sunshine and vast tracts of available land has attracted considerable interest from solar energy investors. The high solar index of the area provides many opportunities in terms of the development of renewable energy. This has been acknowledged by the Northern Cape Government with the identification of the Renewable Energy Hub. The areas around the northern and eastern borders of the Pixley Ka Seme District Municipality form part of this hub with the potential to stimulate special economic development zoned within the area that have the potential to stimulate industrial development.

The PKSDM also falls within the Solar Development Corridor as identified in the Northern Cape Provincial Spatial Development Framework. The corridor extends from Kakamas to Upington and down to De Aar in the south-east. The development of the Vrede Solar PV Facility will promote economic development in the De Aar area, thereby assisting in addressing some the challenges faced by the district municipality as detailed in the IDP.

The Strategic Objectives to address Pixley Ka Seme District Municipality and Renosterberg Local Municipality vision that are relevant to the project include the promotion of economic growth in the district and

enhancement of service delivery. The potential in the area for Renewable Energy developments including the development of the Vrede Solar PV Facility will promote economic development in the Pixley Ka Seme District and the Renosterberg Local Municipality area, thereby assisting in addressing some of the challenges faced locally such as.

- High levels of poverty and low levels of education.
- Low levels of development despite the strategic location in terms of the national transport corridors.
- High rate of unemployment, poverty, and social grant dependence.
- Prone to significant environmental changes owing to long-term structural changes (such as climate change, energy crises and other shifts).

These issues can be addressed by supplier and enterprise development and enterprise development spend linked to the Vrede Solar PV Facility.

3.8. Receptiveness of the project site to the development of the Project

The placement of a solar PV facility is strongly dependent on several factors including climatic conditions (solar irradiation levels), topography, the location of the site, and in particular the location in a node for renewable projects, availability of grid connection, the extent of the site and the need and desirability for the project. From a local level perspective, the project site and development area have specifically been identified by the proponent as being highly desirable from a technical perspective for the development of a solar PV facility, as detailed in **Chapter 2**.

3.9. Conclusion

From the detail presented in this chapter, it is clear that the need and desirability for the project is supported from a planning and policy perspective on a national, provincial, district, and local level, as well as from a technical perspective when considering solar resource. It is however important to also consider the potential impacts and benefits that the proposed solar facility may have for the affected site and surrounding area from both a biodiversity sustainability perspective and a socio-economic perspective. Therefore, it is imperative for the assessment being undertaken for the project to consider this project not only from a policy (national, provincial, and local level) perspective, but also from a biodiversity and socio-economic perspective. The aim of the EIA process is to ensure a balance between these three spheres and to ensure that conclusions made regarding the proposed project draw on both the positive and negative consequences of the proposed development, as well as the potential for impacts to be compounded through the development of the solar facility and its associated infrastructure in proximity to other similar developments (i.e. cumulative impact). The potential impacts associated with the project are identified and assessed within **Chapter 7** of this EIA Report.

CHAPTER 4: APPROACH TO UNDERTAKING THE EIA PROCESS

In terms of the EIA Regulations of December 2014 (as amended) published in terms of the NEMA (Act No. 107 of 1998) as amended, the construction and operation of Vrede Solar PV Facility is a listed activity requiring Environmental Authorisation (EA). The application for EA is required to be supported by an Environmental Impact Assessment (EIA) process based on the contracted capacity of the facility being 240MW, which triggers Activity 1 of Listing Notice 2 (GNR 325).

An EIA process refers to the process undertaken in accordance with the requirements of the 2014 EIA Regulations (GNR 326), as amended, which involves the identification and assessment of direct, indirect, and cumulative environmental impacts associated with a proposed project or activity. The EIA process comprises two main phases: i.e., **Scoping** and **EIA Phase**, and is illustrated in **Figure 4.1**. Public participation forms an important component of the process and is undertaken throughout both phases.

Figure 4.1: The Phases of an Environmental Impact Assessment (EIA) Process

4.1 Legal Requirements as per the EIA Regulations, 2014 (as amended), for the undertaking of an Environmental Impact Assessment Report

This chapter includes the following information required in terms of Appendix 3: Scope of Assessment and Content of Environmental Impact Assessment Reports:

Requirement	Relevant Section
3(1)(d)(i) a description of the scope of the proposed activity, including all listed and specified activities triggered and being applied for; and (ii) a description of the associated structures and infrastructure related to the development.	All listed activities triggered and applied for are included in **Section 4.2** and **Table 4.1**.
3(1)(h)(ii) details of the public participation process undertaken in terms of Regulation 41 of the Regulations, including copies of the supporting documents and inputs.	The public participation process followed throughout the EIA process of the Project is included in **Section 4.5.2** and copies of the supporting documents and inputs are included in **Appendix C**.

Requirement	Relevant Section
3(1)(h)(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them.	The main issues raised through the undertaking of the public participation process, including consultation with I&APs, are included in the Comments and Responses Report in **Appendix C8**.
3(1)(h)(vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks.	The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives are included in **Section 4.6.3**.
3(1)(p) a description of any assumptions, uncertainties, and gaps in knowledge which relate to the assessment and mitigation measures proposed.	The assumptions and limitations of the S&EIA process being undertaken for the Project is included in **Section 4.6**.

4.2 Relevant legislative permitting requirements

The legislative permitting requirements applicable to the Project as identified at this stage in the process and considered within this EIA process, are described in more detail under the respective sub-headings below. Additional permitting requirements applicable to the project are detailed within **Section 4.8**.

4.2.1 National Environmental Management Act (No. 107 of 1998) (NEMA)

NEMA (No. 107 of 1998) is South Africa's key piece of national environmental legislation that provides for the authorisation of certain controlled activities known as "listed activities". In terms of Section 24(1) of NEMA, the potential impact on the environment associated with listed activities must be considered, investigated, assessed and reported on to the Competent Authority (the decision-maker) charged by NEMA with granting of the relevant Environmental Authorisation (EA). Due to the fact that Vrede Solar PV Facility is a power generation project and therefore relates to the IRP for Electricity 2010 – 2030, the National Department of Forestry, Fisheries and the Environment (DFFE) has been determined as the Competent Authority (CA) in terms of GNR 779 of 01 July 2016. The Provincial authority, the Northern Cape Department: Economic Development and Tourism, is a Commenting Authority on the project.

The need to comply with the requirements of the EIA Regulations published under NEMA ensures that developers are provided the opportunity to consider the potential environmental impacts of their activities early in the project development process, and also allows for an assessment to be made as to whether environmental impacts can be avoided, minimised or mitigated to acceptable levels. Comprehensive, independent environmental studies are required to be undertaken in accordance with the EIA Regulations to provide the Competent Authority with sufficient information in order for an informed decision to be taken regarding the Application for EA.

The EIA process being conducted for the Vrede Solar PV Facility is undertaken in accordance with Section 24(5) of the NEMA, which defines the procedure to be followed in applying for EA, and requires that the potential consequences for, or impacts of, listed or specified activities on the environment be considered, investigated, assessed, and reported on to the competent authority. Listed Activities are activities identified in terms of Section 24 of the NEMA which are likely to have a detrimental effect on the environment, and which may not commence without an EA from the competent authority subject to the completion of an environmental assessment process (either a Basic Assessment (BA) or full Scoping and EIA).

Table 4.1 contains all the listed activities identified in terms of NEMA, the 2014 EIA Regulations (GNR 326), and Listing Notice 1 (GNR 327), Listing Notice 2 (GNR 325), and Listing Notice 3 (GNR 324) which may be triggered by the proposed development of the Vrede Solar PV Facility and associated infrastructure, and for which an application for EA has been made:

Table 4.1: Listed activities identified in terms of the Listing Notices (GNR 327, 325 and 324).

Notice Number	Activity Number	Description of listed activity
Listing Notice 1 (GNR 327) 08 December 2014 (as amended)	11(i)	The development of facilities or infrastructure for the transmission and distribution of electricity- (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts excluding the development of bypass infrastructure for the transmission and distribution of electricity where such bypass infrastructure is — (a) temporarily required to allow for maintenance of existing infrastructure; (b) 2 kilometres or shorter in length; (c) within an existing transmission line servitude; and (d) will be removed within 18 months of the commencement of development. ***The development of Vrede Solar PV Facility will include a 33/132kV on-site substation (IPP portion) which will be connected to the proposed central collector substation via overhead cabling with a capacity of up to 132kV.***
Listing Notice 1 (GNR 327) 08 December 2014 (as amended)	14	The development and related operation of facilities and infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres. ***The development of Vrede Solar PV Facility will require the construction and operation of facilities and infrastructure for the storage and handling of dangerous goods (combustible and flammable liquids, such as oils, lubricants, solvents) associated with the on-site substation where such storage will occur inside containers with a combined capacity exceeding 80 cubic meters but not exceeding 500 cubic meters.***
Listing Notice 1 (GNR 327) 08 December 2014 (as amended)	24 (ii)	The development of a road – (ii) with a reserve wider than 13.5m, or where no reserve exists where the road is wider than 8m. ***Access roads will be developed during the construction phase of the project. These will be 8m in width with a temporary reserve of 20m during construction.***
Listing Notice 1 (GNR 327) 08 December 2014 (as amended)	28 (ii)	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development:

Notice Number	Activity Number	Description of listed activity
		(ii) will occur outside an urban area, where the total land to be developed is bigger than 1ha. ***The total area to be developed for the PV facility and associated infrastructure is 400ha and occurs outside an urban area in an area currently zoned for agriculture.***
Listing Notice 2 (GNR 325) 08 December 2014 (as amended)	1	The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20MW or more. ***The Vrede Solar PV Facility will have a contracted capacity of 150MW.***
Listing Notice 2 (GNR 325) 08 December 2014 (as amended)	15	The clearance of an area of 20ha or more of indigenous vegetation[7]. ***Vrede Solar PV Facility will require the clearance of an area of 400ha for the development of the PV facility and associated infrastructure.***

4.2.2 National Water Act (No. 36 of 1998) (NWA)

In accordance with the provisions of the National Water Act (No. 36 of 1998) (NWA), all water uses must be licensed with the Competent Authority (i.e., the Regional Department of Water and Sanitation (DWS) or the relevant Catchment Management Agency (CMA)). Water use is defined broadly, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation.

Table 4.2 contains Water Uses associated with the proposed project and identified in terms of the NWA which require licensing either in the form of a General Authorisation (GA), or in the form of a Water Use License (WUL). The table also includes a description of those project activities which relate to the applicable Water Uses.

Table 4.2: List of Water Uses published under Section 21 of NWA, as amended.

Notice No.	Activity No.	Description of Water Use
NWA (No. 36 of 1998)	Section 21 (a)	Taking water from a water resource ***The developer intends to source water from existing boreholes in the project area (extraction from groundwater). A geohydrological assessment has been completed to assess the feasibility of using the existing boreholes. The geohydrological survey is being conducted for the existing infrastructure which can be used for operational use. Should the existing infrastructure not be***

[7] "Indigenous vegetation" as defined by the 2014 EIA Regulations (GNR 326) refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.

Notice No.	Activity No.	Description of Water Use
		sufficient, a groundwater exploration potential report will be provided to identify borehole development options.
NWA (No. 36 of 1998)	Section 21 (c)	Impeding or diverting the flow of water in a watercourse ***The layout provided for assessment does not overlap with any water resources. Therefore, this activity is not applicable.***
NWA (No. 36 of 1998)	Section 21 (g)	Disposing of waste in a manner which may detrimentally impact on a water Resource ***The Vrede Solar PV facility will* make use of underground septic tanks. Waste from these tanks will be disposed of by a qualified contractor at a registered wastewater treatment works.**
NWA (No. 36 of 1998)	Section 21 (i)	Altering the bed, banks, course or characteristics of a watercourse. ***The layout provided for assessment does not overlap with any water resources. Therefore, this activity is not applicable.***

In the event that any water uses as defined in Section 21 of the Water Act are applicable, then a water use authorisation would be required. This will need to be in accordance with the requirements of the Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals (GN R267), or a GA registered in accordance with the requirements of Revision of General Authorisation. The process of applying for a WUL or GA registration will only be completed once a positive EA has been received and the project selected as Preferred Bidder. This is in line with the requirements of the Department of Water and Sanitation (DWS).

4.2.3 National Heritage Resources Act (No. 25 of 1999) (NHRA)

NHRA provides an integrated system which allows for the management of national heritage resources, and to empower civil society to conserve heritage resources for future generations. Section 38 of NHRA provides a list of activities which potentially require the undertaking of a Heritage Impact Assessment (HIA).

Section 38: Heritage Resources Management

1). Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as –

- *a. the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;*
- *b. the construction of a bridge or similar structure exceeding 50m in length;*
- *c. any development or other activity which will change the character of a site –*
  - *i). exceeding 5 000m² in extent; or*
  - *ii). involving three or more existing erven or subdivisions thereof; or*

iii). involving three or more erven or divisions thereof which have been consolidated within the past five years; or

iv). the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority.

Must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In terms of Section 38(8), approval from the heritage authority is not required if an evaluation of the impact of such development on heritage resources is required in terms of any other legislation (such as NEMA), provided that the consenting authority ensures that the evaluation of impacts fulfils the requirements of the relevant heritage resources authority in terms of Section 38(3) and any comments and recommendations of the relevant resources authority with regard to such development have been taken into account prior to the granting of the consent. However, should heritage resources of significance be affected by the proposed development, a permit is required to be obtained prior to disturbing or destroying such resources as per the requirements of Section 48 of the NHRA, and the South African Heritage Resources Agency (SAHRA) Permit Regulations (GNR 668).

4.3 Overview of the Scoping Phase

The final Scoping Report which was submitted to the DFFE on **24 February 2023** and subsequently accepted on **05 April 2023** documented the evaluation of identified potential environmental impacts associated with the Project. The Scoping Phase was conducted in accordance with the requirements of the 2014 EIA Regulations, as amended (GNR 326), and therefore aimed to:

- Identify and evaluate potential environmental (biophysical and social) impacts and benefits of all phases of the proposed development (including design, construction, operation, and decommissioning) within the broader project site and development footprint through a review of existing baseline data, including specialist studies which were undertaken within the development footprint.
- Identify potentially sensitive environmental features and areas within the development footprint in order to inform the preliminary design process of the Solar Energy Facility.
- Define the scope of studies to be undertaken during the EIA process.
- Provide the authorities with sufficient information in order to make a decision regarding the scope of issues to be addressed in the EIA Phase, as well as regarding the scope and extent of specialist studies that will be required to be undertaken.

Within this context, the objectives of the Scoping Phase were to, through a consultative process:

- Identify the policies and legislation relevant to the project.
- Motivate the need and desirability of the proposed project, including the need and desirability of the activity in the context of the preferred project location.
- Identify and confirm feasible alternatives for the project.
- Identify and describe potential impacts associated with the undertaking of the identified activities and proposed technology.
- Identify areas of high sensitivity to be avoided by the project infrastructure.
- Identify and list key issues associated with the project to be addressed during the EIA Phase through further detailed study and ground-truthing.

- Agree on the level of assessment, including the methodology to be applied, the expertise required, and the extent of further consultation to be undertaken in the EIA Phase of the process, with the aim of determining the extent of impacts associated with the activities through the life cycle of the project (i.e., construction, operation, and decommissioning).
- Identify suitable measures to avoid, manage or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

Key tasks undertaken within the Scoping Phase include:

- Consultation with relevant decision-making and regulating authorities (at National, Provincial and Local levels).
- Submission of the completed application for EA to the competent authority (i.e., the DFFE) in terms of Regulations 5 and 16 of the 2014 EIA Regulations (GNR 982), as amended.
- Undertaking a public participation process in accordance with Chapter 6 of GNR 982 and the Department of Environmental Affairs (2017) Public Participation guidelines in terms of the NEMA EIA Regulations (hereinafter referred to as "the Guidelines") in order to obtain comments on and identify issues and concerns associated with the proposed project.
- Undertaking of independent specialist studies in accordance with Appendix 6 of the EIA Regulations, 2014 (GNR 982), as amended, and the requirements of the Specialist Protocols published in Regulation GNR 320, issued on 20 March 2020 and GNR 1150 of 30 October 2020, where relevant, as well as other relevant guidelines.
- Preparation of a Scoping Report and Plan of Study for the EIA in accordance with the requirements of Appendix 2 of the 2014 EIA Regulations (GNR 982).
- Provision of a 30-day public and authority review period for the Scoping Report.
- Preparation of a Comments and Response (C&R) Report detailing all comments raised by I&APs and responses provided as part of the Scoping Phase.
- Submission of a Final Scoping Report, including a Plan of Study for the EIA, to the DFFE for review and acceptance on **24 February 2023**.

Table 4.3 provides a summary of the public participation process undertaken during the Scoping Phase.

Table 4.3: Summary of the public participation process undertaken during the Scoping Phase

Activity	Date
Announcement of the availability of the Scoping Report for a 30-day review and comment period, including details on how to access the Scoping Report via the online stakeholder engagement platform, in one provincial newspaper: » 'Volksblad' Newspaper (English advert)	13 January 2023
Distribution of the BID, process notification letters and stakeholder reply form announcing the EIA process and inviting I&APs to register on the project database. The BID and electronic reply form was also made available on the online stakeholder engagement platform.	08 July 2022
Placement of site notices at the Project Site, including placement of further notices in the town of Northam and Setaria.	26 May 2022 to 28 May 2022
Distribution of notification letters announcing the availability of the Scoping Report for a 30-day review and comment period. These letters were	08 July 2022

Activity	Date
distributed to Organs of State, Government Departments, Ward Councillors, landowners within the surrounding area (including neighbouring landowners) and key stakeholder groups.	
30-day review and comment period of the Scoping Report.	Friday, 13 January 2023 to Monday, 13 February 2023
Virtual meetings through the use of virtual platforms as determined through discussions with the relevant stakeholder group: » Landowners » Authorities and key stakeholders (including Organs of State, local municipality and official representatives of community-based organisations).	FGM meetings – 26 January 2023 KSW meetings – 31 January 2023
On-going consultation (i.e., telephone liaison; e-mail communication) with all I&APs.	» Throughout the EIA process

The Scoping Report was accepted by DFFE on **05 April 2023** and included the following requirements for the EIA Phase:

Table 4.4: DFFE requirements and response/ reference to section in the EIA Report

DFFE Requirement for EIA	Response/Location in this EIA Report
a) Listed Activities » It is noted that certain listed activities applied for will be confirmed during the EIA Phase. Please ensure that only listed activities that are triggered by the proposed development are applied for, in the amended application form and draft EIAr for the proposed development. » The description of activities applied for in the amended application form is not the same as the description given in the final SR. You are advised to ensure that the information submitted in the draft EIAr is consistent. » It has been noted that the exclusions on the triggered listed activities applied for are not included. Therefore, you are advised to include in the amended application form as well as final SR all the relevant exclusions related to the listed activities applied for. For instance, activity 11 of Listing Notice (LN) 1 have been applied for, however the exclusions have not been quoted in the application form. » Activity 19 is hereby applied for, quoting the infilling or depositing of any material of more than 5 cubic metres, however, the Regulations refer to more than 10 cubic meters. You are expected to quote the correct activity and indicate how this activity is triggered. » Activity 15 of LN 2 and 12 of LN 3 for the clearance of an area more than 20ha and 300 square metres, (respectively) of indigenous vegetation are applied for without specifying the exact total amount of vegetation to be cleared. You are advised to include this information in the amended application form and final SR. In addition, please specify the type of vegetation to be cleared for activity 15 of LN 2. » Under activity 56 of LN 1 and 4 of LN 3, the CA acknowledged that the access roads to be widened or upgraded have been provided. However, the length of the aforesaid access roads has not been included in the application form and draft SR to determine the applicability of the abovementioned activity. You are advised to include the relevant details to determine if the said activity is triggered by the proposed development or not.	The listed activities applicable to the project have been updated in response to these comments, and are included in Table 4.1 of the Draft EIA Report. An amended application form has been compiled and is submitted to the DFFE together with the Draft EIA Report. An assessment of the listed activities and mitigation measures for the management of impacts is included in Chapter 6 of this EIA Report and within the specialist reports included in **Appendix D to K**.

DFFE Requirement for EIA	Response/Location in this EIA Report
» It has been noted that activities 4,10, 12, 14, and 18 of LN 3 have been applied for because Critical Biodiversity Areas (CBAs) will be affected by the proposed development, however, the description of the portion of the proposed project to which the applicable listed activity relates indicated as Ecological Support Areas (ESA) will be affected. However, the listed activities under Listing Notice 3 does not include ESA specifically for the Northern Cape Province in order for the development to trigger a listed activity. Therefore, you are requested to explain and provide evidence why the above-mentioned listed activities are triggered for the proposed development. In addition, the description of the proposed project must make reference to the systematic biodiversity plans adopted by the CA or in bioregional plans and proof of such must be obtained from the relevant CA and be part of the amended application form and draft EIAr. » Activity 11 of LN 1 has been applied for, however, page 13 of 34 of the application form indicated that "the switching station forming part of the 132kV collector substation and the new 132kV double circuit will be assessed as part of a separate Environmental Impact Assessment process in support of an application for Environmental Authorisation". As such, you are requested to clarify why this activity is triggered for the proposed development. » The EIAr must provide an assessment of the impacts and mitigation measures for each of the listed activities applied for. » Please ensure that all relevant listed activities are applied for, are specific and can be linked to the development activity or infrastructure as described in the project description. In addition, the onus is thus on the applicant and the environmental assessment practitioner (EAP) to ensure that all the applicable listed activities are included in the application. Failure to do so may result in unnecessary delays in the processing of the application. » If the activities applied for in the application form differ from those mentioned in the final EIAr, an amended application form must be submitted. Please note that the Department's application form template has been amended and can be downloaded from the following link https://www.environment.gov.za/documents/forms.	
b) Public Participation	

DFFE Requirement for EIA	Response/Location in this EIA Report
» Please ensure that comments from all relevant stakeholders are submitted to the Department with the final EIAr. This includes but is not limited to the Department of Forestry, Fisheries, and the Environment (DFFE): Protected Areas Planning and Management Effectiveness Directorate, DFFE: Biodiversity Planning and Conservation (BCAdmin@environment.gov.za); Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform, Telkom, South African Heritage Resources Agency (SAHRA), South African Civil Aviation Authority, Endangered Wildlife Trust, Birdlife South Africa, Department of Human Settlement, Water and Sanitation, South African National Defence Force, Local interest groups, for example: Councillors and Rate Payers associations; Surrounding landowners, Farmer Organisations, Environmental Groups and NGOs; and Grassroots communities and structures as well as the affected district and local municipalities. » Please ensure that all issues raised, and comments received during the circulation of the FSR from registered I&APs and organs of state which have jurisdiction in respect of the proposed activity are adequately addressed in the final EIAr. Please ensure that these concerns and objections are addressed and adequately responded to. Proof of correspondence with the various stakeholders must be included in the final EIAr. Should you be unable to obtain comments, proof should be submitted to the Department of the attempts that were made to obtain comments. » A Comments and Response trail report (CRR) must be submitted with the final EIAr. The CRR must incorporate all comments for this development. The CRR must be a separate document from the main report and the format must be in the table format as indicated in Annexure 1 of this comments letter in chronological order. Please refrain from summarising comments made by I&APs. All comments from I&APs must be copied verbatim and responded to clearly. Please note that a response such as "noted" is not regarded as an adequate response to I&AP's comments. » The Public Participation Process must be conducted in terms of Regulations 39, 40, 41, 42, 43 & 44 of the EIA Regulations, 2014, as amended.	» All comments received during the EIA process to date have been included in Appendix C of this EIA Report. Comments received during the review period of the draft report will be included within the final report to be submitted to the DFFE for review and decision-making. » All issues raised, and comments received during the circulation of the FSR from registered I&APs and organs of state which have jurisdiction in respect of the proposed activity have been addressed. A Comments and Responses report, including all comments received to date and responses provided, is included in Appendix C of this report. Comments received during the review period of the draft report and responses provided will be included in this CRR and included in final EIA Report to be submitted to the DFFE for review and decision-making. » Proof of correspondence with the various stakeholders to date is included in Appendix C of the report. Proof of ongoing correspondence during the review period of the draft EIA Report will be included within the final report to be submitted to the DFFE for review and decision-making. » The Public Participation Process is being conducted in terms of Regulations 39, 40, 41, 42, 43 & 44 of the EIA Regulations, 2014, as amended.
c) <u>Alternatives</u>	Alternatives considered for the project are detailed within Chapter 2 of the EIA Report. Where no alternatives exist, a motivation has been

DFFE Requirement for EIA	Response/Location in this EIA Report
» The final SR on page 27 indicates that three technologies, i.e., Lithium-ion batteries (LFP/NMC or others) (Li-Ion), Lithium capacitors/Electrochemical capacitors (LiC) or Redox Flow BESS are being considered and that "the total size of the Battery Energy Storage System (BESS) will be determined at a later stage but could be up to 1MWh per MW of solar PV,". Please note the EAP is required to present a preferred technology in terms of BESS. The CA does not grant authorisation for three technologies i.e., one technology for BESS must be chosen in the final EIAr. You are required to further provide clear motivation and reasons as to why the preferred alternative proves to be the preferred compared to other alternatives. This applies to all other alternatives considered. » Alternatively, you should submit written proof of an investigation and motivation if no reasonable or feasible alternatives exist.	provided. The technologies considered for the BESS from a technical perspective are detailed in Chapter 2 of this EIA Report. An assessment of impacts in this regard and conclusion regarding recommended technology are included in Chapter 6.
d) <u>Layout & Sensitivity Maps</u> » Please provide a layout map which indicates the following: * The PV development area. * Position of all infrastructure e.g., panels, BESS, on-site substations, etc. * Permanent laydown area footprint. * All supporting onsite infrastructure e.g., roads (existing and proposed). * Connection routes (including pylon positions) to the distribution/ transmission network); * The location of sensitive environmental features on site e.g., CBAs, heritage sites, wetlands, drainage lines etc. that will be affected. * Buffer areas; and * All "no-go" areas. » The above map must be overlain with a sensitivity map and a cumulative map which shows neighbouring renewable energy developments and existing grid infrastructure. All available biodiversity information must be used in the finalisation of the map and infrastructure must not encroach on highly sensitive areas as far as possible. » Ensure that similar colours are not used to differentiate between infrastructure. i.e., items must be easily distinguishable in the Legend. » Google maps will not be accepted for decision-making purposes.	A layout map providing the required information is presented in Chapter 6 of this EIA Report.

DFFE Requirement for EIA	Response/Location in this EIA Report
e) Specialist assessments » The comments dated 07 February 2023 from this CA still apply and must be addressed in the final Environmental Impact Assessment phase. » The following Specialist Assessments will form part of the EIAr: * Soils and Agriculture Potential. * Ecology (Terrestrial, and Freshwater) Assessment. * Aquatic Biodiversity Impact Assessment. * Avifauna Impact Assessment. * Visual Impact Assessment. * Heritage Impact Assessment (Archaeology, Cultural Landscape, and palaeontology). * Social Impact Assessment, and * Traffic Impact Assessment. » It is brought to your attention that Procedures for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation, which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e., "the Protocols"), and in Government Notice No. 1150 of 30 October 2020, have come into effect. Please note that specialist assessments (for all environmental themes identified by screening tool) must be conducted in accordance with these protocols unless proof is provided to demonstrate that the specialist assessments were commissioned prior to 50 days after the promulgation of GN 320 and after promulgation of GN1150 (30 October 2020). » Additionally, the protocols specify that an assessment must be prepared by a specialist who is an expert in the field and is SACNASP registered for e.g.an aquatic assessment must be prepared by a specialist registered with SACNASP, with expertise in the field of aquatics sciences. » The EAP must ensure that the terms of reference for all the identified specialist studies include the following: * A detailed description of the study's methodology; indication of the locations and descriptions of the development footprint, and all other associated infrastructures that they have assessed and are recommending	Specialist studies undertaken are listed in Table 4.7 and reports are included in Appendix D-L of this report. These specialist studies have been undertaken in accordance with the relevant specialist protocols (where applicable) as well as other relevant standards and guidelines. Where required, specialists are appropriately registered. Specialist reports include details of methodology used, a description of all limitations to the studies, are final and provide detailed/practical mitigation measures for the preferred alternatives and recommendations. Specific mitigation measures are detailed and have been included within the project EMPr, included in Appendix M and N of this report. The definition of 'no go' areas used by the specialists does not differ from that of the Department. Table 4.6 provides the outcome of the site sensitivity verification undertaken by the specialists in the scoping phase (and confirmed in the EIA Phase), and the assessment undertaken in terms of the relevant protocols (i.e. full impact assessment or Compliance Statement). Findings of the specialist studies, including conclusions in terms of alternatives considered (where relevant) have been included in Chapter 6 and 7 of this EIA Report.

DFFE Requirement for EIA	Response/Location in this EIA Report
for authorisations. You are advised to provide a table listing all the specialist studies undertaken with the recommendation for the proposed development. * Provide a detailed description of all limitations to the studies. All specialist studies must be conducted in the right season and providing that as a limitation will not be allowed. * Please note that the Department considers a 'no-go' area, as an area where no development of any infrastructure is allowed; therefore, no development of associated infrastructure including access roads is allowed in the 'no-go' areas. * Should the specialist definition of 'no-go' area differ from the Departments definition; this must be clearly indicated. The specialist must also indicate the 'no-go' area's buffer. * All specialist studies must be final, and provide detailed/practical mitigation measures for the preferred alternatives and recommendations, and must not recommend further studies to be completed post EA. * Should a specialist recommend specific mitigation measures, these must be clearly indicated. * Should the appointed specialists specify contradicting recommendations, the EAP must clearly indicate the most reasonable recommendation and substantiate this with defendable reasons; and were necessary, include further expertise advice. * It is the responsibility of the EAP to confirm the list of specialist assessments and to motivate in the assessment report, the reason for not including any of the identified specialist studies including the provision of photographic evidence of the site situation. The site sensitivity verification for each of the recommended studies, as per the protocols, must be compiled and attached. * Please include a table that shows the proposed studies and the relevant specialists carrying out the study. In addition, a summary should be included of the specialist's recommendations in terms of the alternatives that are preferred based on the findings of their study.	

DFFE Requirement for EIA	Response/Location in this EIA Report
∗ All specialist studies must be final, and provide detailed/practical mitigation measures for the preferred alternative and recommendations, and must not recommend further studies to be completed post EA.	
f) Cumulative Impact Assessment » It has been noted on page iii and 1 of the final SR that the proposed project is one (1) of 9 projects (in process application submitted) in batch 1, summing up all 3 batches into a total of 21 projects. Further to this there are other similar projects or renewable projects within a 30km radius of the proposed development site, therefore, the cumulative impact assessment for all identified and assessed impacts must be refined to indicate the following: ∗ Assess the cumulative impacts of the proposed (not yet authorised), authorised (not yet constructed) and existing solar energy facilities. ∗ Detailed process flow and proof must be provided, to indicate how the specialist's recommendations, mitigation measures and conclusions from the various similar developments in the area were taken into consideration in the assessment of cumulative impacts and when the conclusion and mitigation measures were drafted for this project. ∗ The cumulative impacts significance rating must also inform the need and desirability of the proposed development. ∗ A cumulative impact environmental statement on whether the proposed development must proceed.	An assessment of cumulative impacts is included in Chapter 6 of this EIA Report as well as within the specialist reports included in Appendix D-K. The cumulative impact significance rating is considered in the overall conclusion on the need and desirability of the project and the impact statement for the project included in Chapter 7 of this EIA Report.
g) Environmental Management Programme (EMPr) » Page 13 of 34 of the application form indicated that "the switching station forming part of the 132kV collector substation and the new 132kV double circuit will be assessed as part of a separate Environmental Impact Assessment process in support of an application for Environmental Authorisation". However, it is unclear whether the abovementioned infrastructures will form part of the proposed development. Therefore, should these infrastructure form part of the proposed development, ensure that the generic EMPr (for both 132kV collector substation and 132kV double circuit) that complies with the GN 435 of March 2022 is submitted in the final report.	The PV facility will include an onsite substation (IPP portion). The generic EMPr for substation development has been compiled and is included in the EIA Report as Appendix N. An EMPr for the facility compiled in terms of Appendix 4 of the EIA Regulations and which includes mitigation and monitoring measures for the Solar PV is included in Appendix M of this EIA Report.

DFFE Requirement for EIA	Response/Location in this EIA Report
» Ensure that the EMPr in terms of Appendix 4 of the EIA Regulations includes mitigation and monitoring measures for the Solar PV is submitted with the final EIAR.	
General The EIAr must provide the technical details for the proposed facility in a table format as well as their description and/or dimensions. A sample for the minimum information required is listed under Annexure 2 below.	Technical details for the proposed facility are included in Table 2.7 of this EIA Report.

4.4 Overview of the EIA Phase

As per the EIA Regulations (GNR 982), the objectives of the EIA Phase are to, through a consultative process:

- Determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context.
- Describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the development footprint on the approved site as contemplated in the accepted Scoping Report.
- Identify the location of the development footprint within the approved site as contemplated in the accepted Scoping Report based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment.
- Determine the:
  - Nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
  - Degree to which these impacts:
    - Can be reversed;
    - May cause irreplaceable loss of resources; and
    - Can be avoided, managed or mitigated.
- Identify the most ideal development footprint for the activity within the project site as contemplated in the accepted Scoping Report based on the lowest level of environmental sensitivity identified during the assessment.
- Identify, assess, and rank the impacts the activity will impose on the development footprint on the approved site as contemplated in the accepted Scoping Report through the life of the activity.
- Identify suitable measures to avoid, manage or mitigate identified impacts.
- Identify residual risks that need to be managed and monitored.

This EIA Report assesses potential positive and negative, direct, indirect, and cumulative impacts associated with all phases of the project life cycle including pre-construction, construction, operation and decommissioning. In this regard the EIA Report aims to provide the relevant authorities with sufficient information to make an informed decision regarding the proposed project.

The following subsections outline the activities within the EIA process that have been undertaken to date.

4.4.1 Authority Consultation and Application for Environmental Authorisation in terms of the 2014 EIA Regulations (as amended)

As noted above, DFFE is the CA for the Project. Consultation with this authority is being undertaken throughout the Scoping and EIA Phase. To date, this consultation has included the following:

- Submission of the application for EA and the draft Scoping Report to DFFE via the DFFE Filr System **13 January 2023**.
- Submission of the final Scoping Report on **24 February 2023**.
- Receipt of acceptance of the Scoping Report and approval of the Plan of Study for the EIA Phase on **05 April 2023**.

The following steps are to be undertaken as part of the EIA Phase of the process:

- Make the EIA Report available for a 30-day public review and comment period from **29 May 2023 to 29 June 2023.**
- Notification and consultation with stakeholders, I&APs and Organs of State that may have jurisdiction over the project, including provincial and local government departments, and State-Owned Enterprises.
- Incorporating comments received during the 30-day public review and comment period into the final EIA Report.
- Submission of the final EIA Report to DFFE for decision making.

The submissions, as listed above, were submitted via the DFFE Filr System, as required by the DFFE. A record of all authority correspondence undertaken during the Scoping Phase is included in **Appendix B**.

4.4.2 Public Participation Process

Public participation is an essential and regulatory requirement for an environmental authorisation process and is guided by Regulations 41 to 44 of the EIA Regulations 2014 (GN R326) (as amended). The purpose of public participation is clearly outlined in Regulation 40 of the EIA Regulations 2014 (GN R326) (as amended) and is being followed for this proposed project.

The Public Participation Process for Vrede Solar PV Facility has been undertaken concurrently with the following facilities as they form part of the Crossroads Green Energy Cluster and are located in close proximity to one another.

No	Project name	Farm Name and portion Number	Capacity
1	Tafelkop Solar PV Facility	Portion 3 of the Farm Grass Pan 40	240MW
2	Koppy Alleen Solar PV Facility	Portion 5 of the Farm Koppy Alleen 83	100MW
3	Vrede Solar PV Facility	Portion 5 of the Farm Bas Berg 88	150MW
4	Zionsheuvel Solar PV Facility	Remainder of Farm Leeuwberg 79	240MW
5	Amper Daar Solar PV Facility	Remainder of Farm Wolwe Kuil 44	100MW
6	Wag-'n-Bietjie Solar PV Facility	Portion 1 of the Farm Leeuwe Berg 45	100MW
7.1	Ruspoort 1 Solar PV Facility (Option A)	Portion 5 of the Farm Bokken Kraal 81 (Option A)	100MW
7.2	Ruspoort 1 Solar PV Facility (Option B)	Portion 4 on the Farm Knoffelfontein 74 Portion 1 on the Farm 78 Portion 2 on the Farm Leeuwberg 79 (Option B)	100MW
8	Ruspoort 2 Solar PV Facility	Portion 2 of the Farm Leeuwberg 79	100MW
9	Middelplaas Solar PV Facility	Portion 4 of the Farm Grass Pan 40	100MW

The benefit to the stakeholder is that all information relevant to all related applications has been made available for review together, and not only for comments to be raised across the seven applications at one

time, but also provided a complete picture of the potential for impacts and/or benefits related to the suite of projects located in close proximity to one another.

A consultation process has been designed and implemented by Savannah Environmental to ensure that I&APs are afforded sufficient opportunity to access project information through an interactive web-based platform (i.e. online stakeholder engagement platform) readily available and accessible to any person registering their interest in the project, and ensures that the public participation process is undertaken in line with Regulations 41 to 44 of the EIA Regulations, 2014 as amended. The sharing of information forms the basis of the public participation process and offers the opportunity for I&APs to become actively involved in the EIA process from the outset. The public participation process is designed to provide sufficient and accessible information to I&APs in an objective manner. The public participation process affords I&APs opportunities to provide input into and receive information regarding the EIA process in the following ways:

During the **Scoping Phase**:
- Provide an opportunity to submit comments regarding the project.
- Assist in identifying reasonable and feasible alternatives, where required.
- Contribute relevant local information and knowledge to the environmental assessment.
- Allow registered I&APs to verify that their comments have been recorded, considered, and addressed, where applicable, in the environmental investigations.
- Foster trust and co-operation.
- Generate a sense of joint responsibility and ownership of the environment.
- Comment on the findings of the Scoping Phase results.
- Identify issues of concern and suggestions for enhanced benefits.

During the **EIA Phase**:
- Contribute relevant local information and knowledge to the environmental assessment.
- Verify that issues have been considered in the environmental investigations as far as possible as identified within the Scoping Phase.
- Comment on the findings of the environmental assessments.
- Attend Focus Group Meetings, Key Stakeholder Workshop and in-person Public Meetings to be conducted for the project.

During the **decision-making phase**:
- To advise I&APs of the outcome of the competent authority's decision, and how and by when the decision can be appealed.

The Public Participation process therefore aims to ensure that:
- Information containing all relevant facts in respect of the application is made available to potential stakeholders and I&APs for their review.
- The information presented during the public participation process is presented in such a manner, i.e., local language and technical issues, that it avoids the possible alienation of the public and prevents them from participating.
- Public participation is facilitated in such a manner that I&APs are provided with a reasonable opportunity to comment on the project.
- A variety of mechanisms are provided to I&APs to correspond and submit their comments i.e., fax, post, email, telephone, text message (SMS and WhatsApp).

» An adequate review period is provided for I&APs to comment on the findings of the Scoping and EIA Reports.

The following sections detail the tasks undertaken as part of the public participation process within the EIA Phase.

i. Advertisements and Notifications

The availability of the EIA Report for review and comment was announced to the Organs of State, potentially affected and adjacent landowners, tenants and occupiers, and the general public via the following:

» Notification letter distributed to all registered I&APs advising them of the availability of the EIA Report for review on comment on **29 May 2023.**
» An advertisement announcing the availability of and inviting comment on the EIA Report in the » 'Volksblad' Newspaper (English advertisement) on **29 May 2023**. A copy of the newspaper advert as sent to the newspaper is included an **Appendix C2** of the EIA Report. The advert tear sheet is included in the final EIA Report as **Appendix C2**.
» The EIA Report is available for review and comment by I&APs for a 30-day period from **29 May 2023** to **29 June 2023.** The EIA Report is available on the Savannah Environmental website http://www.savannahsa.com/public-documents/energy-generation/ I&APs will be encouraged to review the EIA Report and submit written comment. The EIA Report will be circulated to Organs of State via electronic transfer (Dropbox, WeTransfer, etc), or CD and/or hardcopy as per individual request. Evidence of distribution of the EIA Report will be included in the final EIA Report as **Appendix C4** and **Appendix C5**.

ii. Public Involvement and Consultation

In order to accommodate the varying needs of stakeholders and I&APs within the surrounding area, as well as capture their views, comments, issues and concerns regarding the project, various opportunities will be provided to I&APs to note their comments and issues. I&APs will be consulted through the following means:

» Opportunity to review the EIA Report for a 30-day review and comment period from **29 May 2023** to **29 June 2023.**
» Comments received during this review period will be captured within a Comments and Responses Report (**Appendix C8**), which will be included within the final EIA Report.
» Public Consultation Meetings:
  * Virtual focus group meetings with key government departments, stakeholders and landowners. The purpose of these meetings will be to provide an overview of the findings of the EIA studies in order to facilitate comments on the EIA process and the content of the EIA Report, as well as to record any issues or concerns raised by stakeholders regarding the project, environmental studies and mitigation measures.
  * Face-to-face consultation meetings will be held with key stakeholders and landowners.
  * The minutes of these meetings will be included in the final EIA Report as **Appendix C7**.
» Telephonic consultation sessions.
» Written, faxed or e-mail correspondence.

Table 4.5: Public involvement during EIA Phase

Activity	Date
Advertising of the availability of the EIA Report for a 30-day review and comment period in the »'Volksblad' Newspaper (English advertisement).	29 May 2023
Distribution of notification letters announcing the availability of the EIA Report for a 30-day review and comment period. These letters were distributed to Organs of State, Government Departments, Ward Councillors, landowners within the surrounding area (including neighbouring landowners), registered I&APs and key stakeholder groups.	29 May 2023
30-day review and comment period of the EIA Report.	29 May 2023 to 29 June 2023
Virtual meetings through the use of virtual platforms as determined through discussions with the relevant stakeholder group: » Landowners » Authorities and key stakeholders (including Organs of State, local municipality and official representatives of community-based organisations).	Virtual Focus Group Meetings, Key Stakeholder Workshop and in-person Public Meetings will be held during the EIA Report review period.
On-going consultation (i.e., telephone liaison; e-mail communication) with all I&APs.	Throughout the EIA process

iii. Registered I&APs entitled to Comment on the EIA Report

I&APs registered on the database have been notified on **29 May 2023** by means of a notification letter of the release of the EIA Report for a 30-day review and comment period, invited to provide comment on the EIA Report, and informed of the manner in which, and timeframe within which such comment must be made.

The EIA Report is available on the Savannah Environmental website http://www.savannahsa.com/public-documents/energy-generation/). Hard copies of the report are available on request.

Comments are requested to be submitted in writing via email, fax or post. Where I&APs are not able to provide written comments (including SMS and WhatsApp), other means of consultation, such as telephonic discussions and face-to-face discussions will be used. All comments raised as part of the discussions and written comments submitted during the 30-day review and comment period will be recorded and included in **Appendix C7 and C8** of the final EIA Report.

iv. Identification and Recording of Comments

Comments raised by I&APs to date have been included into a Comments and Responses (C&R) Report, which is included in **Appendix C8** of this EIA Report. The C&R Report includes detailed responses from members of the EIA project team, applicant and/or relevant specialist to the issues and comments raised. The C&R Report will be updated with all comments received during the 30-day review and comment period of the EIA Report and will be included as **Appendix C8** in the final EIA Report submitted to the DFFE for decision-making.

Notes of all the telephonic discussions, virtual meetings, and face-to-face meetings (if any) to be conducted during the 30-day review and comment period of the EIA Report will be included in **Appendix C7** of the final EIA Report.

4.5 Outcome of the DFFE Web-Based Screening Tool

In terms of GNR 960 (promulgated on 5 July 2019) and Regulation 16(1)(b)(v) of the 2014 EIA Regulations (as amended), the submission of a Screening Report generated from the national web based environmental screening tool is compulsory for the submission of applications in terms of Regulations 19 and 21 of the EIA Regulations.

The requirement for the submission of a Screening Report (included as **Appendix R** of the EIA Report) for the Project is applicable as it triggers Regulation 19 of the EIA Regulations, 2014, as amended. **Table 4.6** provides a summary of the specialist assessments identified in terms of the screening tool and responses to each assessment from the project team considering the project site under consideration. A site sensitivity verification report compiled by the EAP with inputs from the specialist studies is included in **Appendix R**.

Table 4.6: Sensitivity ratings from the DFFE's web-based online Screening Tool associated with the development of the Vrede Solar PV Facility.

Environmental Theme/ Specialist Assessment	Sensitivity Rating as per the Screening Tool (relating to the need for the study)	Verification of Site Sensitivity
Agriculture	High	The proposed Vrede Solar PV Facility and associated infrastructure project The most sensitive soil forms that can be expected within the assessment corridor is the Hutton and Oakleaf soil forms. The land capability sensitivities (DAFF, 2017) indicate land capabilities with "Very Low to Moderate" sensitivities, which correlates with the requirements for a compliance statement only. The available climate can limit crop production significantly. The harsh climatic conditions are associated with low annual rainfall and high evapotranspiration potential demands of the area. The area is not favourable for most cropping practices. The proposed project will have limited impact on the agricultural production ability of the land. Additionally, the solar facility and associated infrastructure will not result in the segregation of any high production agricultural land. A Soils and Agricultural Potential Compliance Statement is included in the EIA Report as **Appendix G**.
Animal Species	Medium	The main expected impacts of the proposed infrastructure will include the following: » Habitat loss and fragmentation as well as degradation of surrounding habitat; » Disturbance and displacement caused during the construction and maintenance phases; and » Direct mortality during the construction phase. The primary expected impacts of the proposed project will be the loss of habitat and emigration of fauna. Based on the outcomes of the SEI determination, the PAOI is considered to have a Medium SEI which indicated that minimisation mitigation must be applied to the site.

Environmental Theme/ Specialist Assessment	Sensitivity Rating as per the Screening Tool (relating to the need for the study)	Verification of Site Sensitivity
		It must be noted, when taken into consideration in conjunction with the other Solar PV facilities planned for all three phases of the overall proposed development, that the cumulative fragmentation of the ESA is very high. The associated cumulative fragmentation impacts are expected to be high for the overall development. This project should ideally not be considered in insolation but rather as a part of the full proposed development when considering impacts to the ESA. Considering that this area has been identified as being of significance for biodiversity maintenance and ecological processes (ESA), development may proceed but with caution and only with the implementation of mitigation measures. Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinion of the specialists that the project may be favourably considered, on condition that all prescribed mitigation measures and supporting recommendations are implemented. A Terrestrial Biodiversity Assessment has been undertaken for the Solar Energy Facility and is included as **Appendix D** of the EIA Report.
Archaeological and Cultural Heritage	Low	According to the DFFE Screening Tool analysis, the development area has High levels of sensitivity for impacts to palaeontological heritage and Low levels of sensitivity for impacts to archaeological and cultural heritage resources. The results of this assessment in terms of site sensitivity are summarised below: » No significant archaeological resources were identified within the broader area (Low) » The limited excavations associated with the PV facility development should not impact significant palaeontological heritage (Moderate) As per the findings of this assessment, and its supporting documentation, the outcome of the sensitivity verification confirms the results of the DFFE Screening Tool for Archaeology and disputes the results of the screening tool for Palaeontology - this should be considered to be Moderate. A Heritage Impact Assessment has been undertaken for the Solar PV Facility and is included as **Appendix H** of the EIA report.
Palaeontology	High	According to the DFFE Screening Tool analysis, the development area has High levels of sensitivity for impacts to palaeontological heritage and Low levels of sensitivity for impacts to archaeological and cultural heritage resources. The results of this assessment in terms of site sensitivity are summarised below: » No significant archaeological resources were identified within the broader area (Low) » The limited excavations associated with the PV facility development should not impact significant palaeontological heritage (Moderate)

<table>
<tr><th>Environmental Theme/ Specialist Assessment</th><th>Sensitivity Rating as per the Screening Tool (relating to the need for the study)</th><th>Verification of Site Sensitivity</th></tr>
<tr><td></td><td></td><td>As per the findings of this assessment, and its supporting documentation, the outcome of the sensitivity verification confirms the results of the DFFE Screening Tool for Archaeology and disputes the results of the screening tool for Palaeontology - this should be considered to be Moderate.

A Heritage Impact Assessment has been undertaken for the Solar PV Facility and is included as Appendix H of the EIA report.</td></tr>
<tr><td>Terrestrial Biodiversity</td><td>Very High</td><td>One (1) habitat type (vegetation community) was delineated within the assessment area. All habitats within the project area of the proposed development were allocated a sensitivity category or SEI, which is considered a combined SEI for Terrestrial Biodiversity, Animal Species and Plant Species Themes.

Summary of habitat types delineated within the project area is provided in the table below.
<table>
<tr><th>Habitat Type</th><th>Description</th><th>Ecosystem Processes and Services</th><th>Conservation Importance (CI)</th><th>Functional Integrity (FI)</th><th>Biodiversity Importance (BI)</th></tr>
<tr><td>Karoo Grassland</td><td>Karroid shrubs and grasses on flat plains, homogenous in nature.</td><td>Provides foraging areas for fauna, provides landscape-level; pollination and dispersal.</td><td><u>Medium</u>
> 50% of receptor contains natural habitat with potential to support SCC.</td><td><u>High</u>
Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type.</td><td>Medium</td></tr>
</table>
A Terrestrial Biodiversity Assessment has been undertaken for the Solar Energy Facility and is included as Appendix D of the EIA Report.</td></tr>
<tr><td>Aquatic Biodiversity</td><td>Very High</td><td>One (1) form of a watercourse was identified and delineated within the regulated area. This includes an ephemeral river (watercourse). No natural wetland systems, or even cryptic wetlands were identified for the area. The proposed development area is more than 650 m south of the watercourse. A borrow bit with no drainage was identified</td></tr>
</table>

Environmental Theme/ Specialist Assessment	Sensitivity Rating as per the Screening Tool (relating to the need for the study)	Verification of Site Sensitivity
		within the project area, but this is not considered to be a natural water resource. The results of the habitat assessment indicates natural (class A) and largely natural (class B) instream and riparian conditions for the watercourse catchment respectively. The recommended buffer was calculated to be 20 m for the river. A site sensitivity verification forms part of reporting requirements. In this regard, the allocated sensitivities of low for the general area and medium sensitivity for the drainage features agrees with the Environmental Screening Tool. The project must take cognizance of this and avoid any unnecessary disturbance of the drainage features and adjacent habitat. Therefore, the aforementioned post-mitigation buffer should be implemented and treated as 'no go areas'. The development footprint is not located within 100 m of the delineated water resource [as per the National Water Act, 1998 (Act No. 36 of 1998) in accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i)]. Since the development footprint is outside of the regulation zone and buffer zone, no risks to the freshwater systems are foreseen for the proposed project. Therefore, no impacts or risks were anticipated to the freshwater systems and therefore not assessed in this report. Despite the absence of risks expected for the project, this report presents supporting mitigation and management measures for consideration. No fatal flaws were identified for the project, and the development may be favourably considered and all prescribed mitigation measures must be considered by the issuing authority. No monitoring measures are deemed necessary for the development. A Freshwater Ecology Compliance Statement has been undertaken for the Solar Energy Facility and is included as **Appendix F** of the EIA Report.
Avian	Low	Sensitivities were compiled for the avifauna study based on the field results and desktop information. All habitats within the assessment area of the proposed project were allocated a sensitivity category. The Water resources and Nest buffers were given a very high sensitivity based on the low receptor resilience these areas and species will have to change. The Karoo scrubland and Karoo Grasslands all support a large number of SCCs (9 species), the biodiversity importance of these areas are thus high. Summary of habitat types delineated within the project area is provided in the table below.

<table>
<tr><th>Environmental Theme/ Specialist Assessment</th><th>Sensitivity Rating as per the Screening Tool (relating to the need for the study)</th><th>Verification of Site Sensitivity</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Habitat</th><th>Conservation Importance</th><th>Functional Integrity</th><th>Biodiversity Importance</th><th>Receptor Resilience</th></tr>
<tr><td>Karoo grassland</td><td>High</td><td>High</td><td>High</td><td>Medium</td></tr>
<tr><td>Karoo scrubland</td><td>High</td><td>High</td><td>High</td><td>Medium</td></tr>
<tr><td>Water resources</td><td>High</td><td>High</td><td>High</td><td>Low</td></tr>
<tr><td>Nest buffers (Core)</td><td>High</td><td>High</td><td>High</td><td>Low</td></tr>
<tr><td>Nest Buffers (Outside)</td><td>High</td><td>High</td><td>High</td><td>Medium</td></tr>
</table>

An Avifauna Specialist Assessment has been undertaken for the Solar Energy Facility and is included as Appendix E of the EIA Report.</td></tr>
<tr><td>Civil Aviation (Solar PV)</td><td>Low</td><td>No major aerodromes or small airfields are known to occur in the larger area. The Civil Aviation Authority (CAA) and Air Traffic Navigation Services (ATNS) will be consulted throughout the S&EIA process to obtain input. No objections have been received to date.</td></tr>
<tr><td>Defence</td><td>Low</td><td>The project site is not located within close proximity of any military base or infrastructure. The low sensitivity rating is supported, and no study is required in this regard.</td></tr>
<tr><td>RFI</td><td>Medium</td><td>The project site under consideration is not located near a telecommunications tower. Relevant telecommunications service providers will be consulted during the Scoping&EIA process to obtain any relevant comments regarding the proposed project. In addition, SARAO will be consulted regarding any specific requirements in terms of the SKA.</td></tr>
<tr><td>Plant Species</td><td>Low</td><td>An Ecological scoping study (including flora and fauna) has been undertaken for the PV facility and is included as Appendix D of the Scoping Report. Based on the outcomes of the desktop study and available data, it has been indicated that the development area falls within the areas identified as Medium Sensitivity in terms of animal and plant species sensitivity. The sensitivity will be confirmed, and the impacts will be further assessed during the EIA phase.

A Terrestrial Biodiversity Assessment has been undertaken for the Solar Energy Facility and is included as Appendix D of the EIA Report.</td></tr>
<tr><td>Socio-Economic Assessment</td><td>The screening report does not indicate a rating for this theme.</td><td>A Socio-Economic Impact Assessment has been undertaken and is included in the EIA Report as Appendix K.</td></tr>
<tr><td>Traffic Impact Assessment</td><td>The screening report does not indicate a rating for this theme.</td><td>The construction and decommissioning phases of a development is the only significant traffic generator and therefore noise and dust pollution will be higher during this phase. The duration of this phase is short term i.e., the impact of the traffic on the surrounding road network is temporary and solar facilities, when operational, do not add any significant traffic to the road network.</td></tr>
</table>

Environmental Theme/ Specialist Assessment	Sensitivity Rating as per the Screening Tool (relating to the need for the study)	Verification of Site Sensitivity
		The development is supported from a transport perspective provided that the recommendations and mitigations contained in this report are adhered to. The impacts associated with the facility are acceptable with the implementation of the recommended mitigation measures and can therefore be authorised. A Traffic Impact Assessment has been undertaken and is included in the EIA report as **Appendix I**.
Visual Impact Assessment	The screening report does not indicate a rating for this theme.	The findings of the Visual Impact Assessment undertaken for the proposed Vrede Solar PV Facility is that the visual environment surrounding the site, especially within a 1km radius (and potentially up to a radius of 3km) of the proposed facility, may be visually impacted during the anticipated operational lifespan of the facility (i.e. a minimum of 20 years). A Visual Impact Assessment has been undertaken and is included in the EIA report as **Appendix J**.

4.6 Assessment of Issues Identified throughout the EIA Process

Based on the outcomes of the screening tool report and the Scoping Phase evaluation of the project, the following studies were identified as requiring detailed assessment, The specialist consultants involved in the assessment of these impacts are indicated in **Table 4.7** below.

Table 4.7: Specialist studies undertaken as part of the EIA Phase

Specialist	Area of Expertise	Refer Appendix
Dr Lindi Steyn and Andrew Husted – The Biodiversity Company	Ecology (Terrestrial)	Appendix D
Dr Lindi Steyn and Andrew Husted – The Biodiversity Company	Freshwater	Appendix F
Dr Lindi Steyn and Andrew Husted – The Biodiversity Company	Avifauna	Appendix E
Michael Mamera and Andrew Husted – The Biodiversity Company	Soils & Agricultural Potential	Appendix G
Nicholas Wiltshire and Jenna Lavin – CTS Heritage	Heritage (including archaeology, cultural landscape and palaeontology)	Appendix H
Lourens du Plessis – LOGIS Bryony Van Niekerk- NuLeaf Environmental	Visual	Appendix J
Tony Barbour – Tony Barbour Consulting	Social	Appendix K
Adrian Johnson – JG Afrika	Traffic	Appendix I

Specialist studies considered direct and indirect environmental impacts associated with the development of all components of the facility. Identified impacts are assessed in terms of the following criteria:

- The **nature**, a description of what causes the effect, what will be affected, and how it will be affected
- The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. A score of between 1 and 5 is assigned as appropriate (with a score of 1 being low and a score of 5 being high)
- The **duration**, wherein it is indicated whether:
  - The lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1
  - The lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2
  - Medium-term (5–15 years) – assigned a score of 3
  - Long term (> 15 years) - assigned a score of 4
  - Permanent - assigned a score of 5
- The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
  - 0 is small and will have no effect on the environment
  - 2 is minor and will not result in an impact on processes
  - 4 is low and will cause a slight impact on processes
  - 6 is moderate and will result in processes continuing but in a modified way
  - 8 is high (processes are altered to the extent that they temporarily cease)
  - 10 is very high and results in complete destruction of patterns and permanent cessation of processes
- The **probability of occurrence**, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale, and a score assigned:
  - Assigned a score of 1–5, where 1 is very improbable (probably will not happen)
  - Assigned a score of 2 is improbable (some possibility, but low likelihood)
  - Assigned a score of 3 is probable (distinct possibility)
  - Assigned a score of 4 is highly probable (most likely)
  - Assigned a score of 5 is definite (impact will occur regardless of any prevention measures)
- The **significance**, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high
- The **status**, which is described as either positive, negative or neutral
- The degree to which the impact can be reversed
- The degree to which the impact may cause irreplaceable loss of resources
- The degree to which the impact can be mitigated

The **significance** is determined by combining the criteria in the following formula:

S = (E+D+M) P; where

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
- **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated)

» **60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area)

Specialist studies also considered cumulative impacts associated with similar developments within the broader project site. The purpose of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e., whether the addition of the proposed project in the area will increase the impact). In this regard, specialist studies considered whether the construction of the proposed development will result in:

» Unacceptable risk
» Unacceptable loss
» Complete or whole-scale changes to the environment or sense of place
» Unacceptable increase in impact

A conclusion regarding whether the proposed development will result in any unacceptable loss or impact considering all the projects proposed in the area is included in the respective specialist reports.

As the project developer has the responsibility to avoid or minimise impacts and plan for their management (in terms of the requirements of NEMA and the 2014 EIA Regulations (GNR 326)), the mitigation of significant impacts is discussed. Assessment of impacts with mitigation is made in order to demonstrate the effectiveness of the proposed mitigation measures. A facility EMPr and a generic substation EMPr (required in terms of Government Gazette of 42323 of 22 March 2019) that include all the mitigation measures recommended by the specialists for the management of significant impacts are included as **Appendix M and N** to this EIA Report.

4.7 Assumptions and Limitation of the EIA Process

The following assumptions and limitations are applicable to the EIA process for Vrede Solar PV Facility:

» All information provided by the developer and I&APs to the environmental team was correct and valid at the time it was provided.
» The project site identified by the developer represents a technically suitable site for the establishment of a Solar Energy Facility, which is based on the design undertaken by technical consultants for the project.
» The development footprint (the area that will be affected during the operation phase) will include the footprint for the Solar Energy Facility and associated infrastructure (i.e., internal access roads, and grid connection infrastructure).
» Conclusions of the specialist studies undertaken, and this overall impact assessment assume that any potential impacts on the environment associated with the proposed development will be avoided, mitigated, or offset in accordance with the relevant recommendations made.
» This report and its investigations are project specific, and consequently the environmental team did not evaluate any other power generation alternatives.

Refer to the specialist studies contained in **Appendices D - K** for limitations specific to the independent specialist studies.

4.8 Legislation and Guidelines that have informed the preparing of the Scoping Report

The following legislation and guidelines have informed the scope and content of the Scoping Report:

- National Environmental Management Act (Act No. 107 of 1998).
- EIA Regulations of December 2014, published under Chapter 5 of NEMA (as amended).
- Department of Environmental Affairs (2017), Public Participation guidelines in terms of NEMA EIA Regulations.
- Department of Environmental Affairs (2017), Integrated Environmental Management Guideline: Guideline on Need and Desirability.
- Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation; and
- International guidelines – the Equator Principles, the IFC Performance Standards, the Sustainable Development Goals, World Bank Environmental and Social Framework, and the and World Bank Group Environmental, Health, and Safety Guidelines (EHS Guidelines).

Several other Acts, standards or guidelines have also informed the project process and the scope of issues addressed and assessed in this Scoping Report. A review of legislative requirements applicable to the proposed project as identified at this stage in the process is provided in **Table 4.8**.

Table 4.8: Relevant legislative permitting requirements applicable to Vrede Solar PV Facility

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
National Legislation			
Constitution of the Republic of South Africa (No. 108 of 1996)	In terms of Section 24, the State has an obligation to give effect to the environmental right. The environmental right states that: "*Everyone has the right –* » *To an environment that is not harmful to their health or well-being, and* » *To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:* * *Prevent pollution and ecological degradation,* * *Promote conservation, and* * *Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*."	Applicable to all authorities	There are no permitting requirements associated with this Act. The application of the Environmental Right however implies that environmental impacts associated with proposed developments are considered separately and cumulatively. It is also important to note that the "right to an environment clause" includes the notion that justifiable economic and social development should be promoted, through the use of natural resources and ecologically sustainable development.
National Environmental Management Act (No 107 of 1998) (NEMA)	The 2014 EIA Regulations have been promulgated in terms of Chapter 5 of NEMA. Listed activities which may not commence without EA are identified within the Listing Notices (GNR 327, GNR 325 and GNR 324) which form part of these Regulations (GNR 326). In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be assessed and reported on to the competent authority	DFFE – Competent Authority Northern Cape Department: Economic Development and Tourism – Commenting Authority	The listed activities triggered by the proposed project have been identified and are being assessed as part of the EIA process currently underway for the project. Considering the capacity of the proposed Vrede Solar PV Facility project (i.e. contracted capacity of 240MW) and the triggering of Activity 1 of Listing Notice 2 (GNR 325) a full Scoping and EIA process is required in support of the Application for EA.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	charged by NEMA with granting of the relevant environmental authorisation.		
National Environmental Management Act (No 107 of 1998) (NEMA)	In terms of the "Duty of Care and Remediation of Environmental Damage" provision in Section 28(1) of NEMA every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment. In terms of NEMA, it is the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of a variety of impacts.	DFFE Northern Cape Department of Economic Development and Tourism – Commenting Authority	While no permitting or licensing requirements arise directly by virtue of the proposed project, this section finds application through the consideration of potential cumulative, direct, and indirect impacts. It will continue to apply throughout the life cycle of the project.
Environment Conservation Act (No. 73 of 1989) (ECA)	The Noise Control Regulations in terms of Section 25 of the ECA contain regulations applicable for the control of noise in the Provinces of Limpopo, North West, Mpumalanga, Northern Cape, Eastern Cape, and KwaZulu-Natal Provinces. The Noise Control Regulations cover the powers of a local authority, general prohibitions, prohibitions of disturbing noise, prohibitions of noise nuisance, use of measuring instruments, exemptions, attachments, and penalties.	Northern Cape Department of Economic Development and Tourism Renosterberg Local Municipality	Noise impacts are expected to be associated with the construction phase of the project. Considering the location of the development area in relation to residential areas and provided that appropriate mitigation measures are implemented, construction noise is unlikely to present a significant intrusion to the local community. There is therefore no requirement for a noise permit in terms of the legislation.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	In terms of the Noise Control Regulations, no person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof (Regulation 04).		
National Water Act (No. 36 of 1998) (NWA)	A water use listed under Section 21 of the NWA must be licensed with the Regional DWS, unless it is listed in Schedule 1 of the NWA (i.e. is an existing lawful use), is permissible under a GA, or if a responsible authority waives the need for a licence. Water use is defined broadly, and includes consumptive and non-consumptive water uses, taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation. Consumptive water uses may include taking water from a water resource (Section 21(a)) and storing water (Section 21(b)). Non-consumptive water uses may include impeding or diverting of flow in a water course (Section 21(c)), and altering of bed, banks or characteristics of a watercourse (Section 21(i)).	Regional Department of Water and Sanitation or relevant Catchment Management Agency	A Freshwater Ecology Compliance Statement has been undertaken for the PV facility and is included as **Appendix F** of the EIA Report. Since the development footprint is outside of the regulation zone and buffer zone of water resources, no risks to the freshwater systems are foreseen for the proposed project. The applicant intends to source the water from existing boreholes in the area. A geohydrologist is performing geohydrological assessments and surveying the existing boreholes to analyse the existing infrastructure which can be used for operational use. Should the existing infrastructure not be sufficient, a groundwater exploration potential report will be provided to identify borehole development options. The Vrede Solar PV facility will make use of underground septic tanks. Waste from these tanks will be disposed of in an environmentally sound manner that includes the appropriate control of emissions and residues resulting from the handling and processing of the waste material.
	In accordance with the provisions of the MPRDA a mining permit is required in	Department of Mineral Resources and Energy (DMRE)	Any person who wishes to apply for a mining permit in accordance with Section 27(6) must

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
Minerals and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA)	accordance with Section 27(6) of the Act where a mineral in question is to be mined, including the mining of materials from a borrow pit.		simultaneously apply for an Environmental Authorisation in terms of NEMA. No borrow pits are expected to be required for the construction of the project, and as a result a mining permit or EA in this regard is not required to be obtained.
	Section 53 of the MPRDA states that any person who intends to use the surface of any land in any way which may be contrary to any object of the Act, or which is likely to impede any such object must apply to the Minister for approval in the prescribed manner.		In terms of Section 53 of the MPRDA approval is required from the Minister of Mineral Resources and Energy to ensure that the proposed development does not sterilise a mineral resource that might occur on site.
National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA)	The National Dust Control Regulations (GNR 827) published under Section 32 of NEM:AQA prescribe the general measures for the control of dust in all areas, and provide a standard for acceptable dustfall rates for residential and non-residential areas. In accordance with the Regulations (GNR 827) any person who conducts any activity in such a way as to give rise to dust in quantities and concentrations that may exceed the dustfall standard set out in Regulation 03 must, upon receipt of a notice from the air quality officer, implement a dustfall monitoring programme. Any person who has exceeded the dustfall standard set out in Regulation 03 must, within three months after submission of the dustfall monitoring report, develop and submit a dust management plan to the air quality officer for approval.	Northern Cape Department of Economic Development and Tourism / Pixley Ka Seme District Municipality	In the event that the project results in the generation of excessive levels of dust the possibility could exist that a dustfall monitoring programme would be required for the project, in which case dustfall monitoring results from the dustfall monitoring programme would need to be included in a dust monitoring report, and a dust management plan would need to be developed.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
National Heritage Resources Act (No. 25 of 1999) (NHRA)	Section 07 of the NHRA stipulates assessment criteria and categories of heritage resources according to their significance. Section 35 of the NHRA provides for the protection of all archaeological and palaeontological sites, and meteorites. Section 36 of the NHRA provides for the conservation and care of cemeteries and graves by SAHRA where this is not the responsibility of any other authority. Section 38 of the NHRA lists activities which require developers or any person who intends to undertake a listed activity to notify the responsible heritage resources authority and furnish it with details regarding the location, nature, and extent of the proposed development. Section 44 of the NHRA requires the compilation of a Conservation Management Plan as well as a permit from SAHRA for the presentation of archaeological sites as part of tourism attraction.	South African Heritage Resources Agency (SAHRA) Ngwao Boswa Kapa Bokone (NBKB) – provincial heritage authority	A Heritage Impact Assessment will be undertaken for the project as per the requirements Section 38 of the NHRA. The Heritage Impact Assessment will be made available in the EIA Phase. Should a heritage resource be impacted upon, a permit may be required from SAHRA or The Northern Cape Heritage Resources Authority (previously called Ngwao Boswa jwa Kapa Bokone) in accordance with of Section 48 of the NHRA, and the SAHRA Permit Regulations (GN R668).
National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEM:BA)	Section 53 of NEM:BA provides for the MEC / Minister to identify any process or activity in such a listed ecosystem as a threatening process.	DFFE Northern Cape Department of Economic Development and Tourism	Under NEM:BA, a permit would be required for any activity that is of a nature that may negatively impact on the survival of a listed protected species. An Ecological Impact Assessment has been undertaken for the PV facility and is included as **Appendix D** of the

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	Three government notices have been published in terms of Section 56(1) of NEM:BA as follows: » Commencement of TOPS Regulations, 2007 (GNR 150). » Lists of critically endangered, vulnerable and protected species (GNR 151). » TOPS Regulations (GNR 152). It provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), and vulnerable (VU) or protected. The first national list of threatened terrestrial ecosystems has been gazetted, together with supporting information on the listing process including the purpose and rationale for listing ecosystems, the criteria used to identify listed ecosystems, the implications of listing ecosystems, and summary statistics and national maps of listed ecosystems (NEM:BA: National list of ecosystems that are threatened and in need of protection, (Government Gazette 37596, GNR 324), 29 April 2014).		EIA Report. No NEM:BA listed species were recorded within the project area.
National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEM:BA)	Chapter 5 of NEM:BA pertains to alien and invasive species, and states that a person may not carry out a restricted activity involving a specimen of an alien species without a permit issued in terms of Chapter 7 of NEM:BA, and that a permit may only be issued after a prescribed assessment of risks and potential impacts on biodiversity is carried out.	DFFE Northern Cape Department of Economic Development and Tourism	An Ecological Impact Assessment has been undertaken for the PV facility and is included as **Appendix D** of the EIA Report. Several alien invasive species were recorded within the area. Such species require appropriate management throughout the life cycle of the project.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	Applicable, and exempted alien and invasive species are contained within the Alien and Invasive Species List (GNR 864).		
Conservation of Agricultural Resources Act (No. 43 of 1983) (CARA)	Section 05 of CARA provides for the prohibition of the spreading of weeds. Regulation 15 of GN R1048 published under CARA provides for the classification of categories of weeds and invader plants, and restrictions in terms of where these species may occur. Regulation 15E of GN R1048 published under CARA provides requirement and methods to implement control measures for different categories of alien and invasive plant species.	Department of Agriculture, Rural Development, and Land Reform (DARDLR)	CARA will find application throughout the life cycle of the project. In this regard, soil erosion prevention and soil conservation strategies need to be developed and implemented. In addition, a weed control and management plan must be implemented. In terms of Regulation 15E (GN R1048) where Category 1, 2 or 3 plants occur a land user is required to control such plants by means of one or more of the following methods: » Uprooting, felling, cutting or burning. » Treatment with a weed killer that is registered for use in connection with such plants in accordance with the directions for the use of such a weed killer. » Biological control carried out in accordance with the stipulations of the Agricultural Pests Act (No. 36 of 1983), the ECA and any other applicable legislation. » Any other method of treatment recognised by the executive officer that has as its object the control of plants concerned, subject to the provisions of sub-regulation 4. » A combination of one or more of the methods prescribed, save that biological control reserves and areas where biological control agents are effective

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
			shall not be disturbed by other control methods to the extent that the agents are destroyed or become ineffective.
National Forests Act (No. 84 of 1998) (NFA)	According to this Act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. Notice of the List of Protected Tree Species under the National Forests Act (No. 84 of 1998) was published in GNR 734. The prohibitions provide that "no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister".	DFFE	A licence is required for the removal of protected trees. It is therefore necessary to conduct a survey that will determine the number and relevant details pertaining to protected tree species present in the development footprint for the submission of relevant permits to authorities prior to the disturbance of these individuals. An Ecological Impact Assessment has been undertaken (Appendix D). No protected trees were identified within the project site.
National Veld and Forest Fire Act (No. 101 of 1998) (NVFFA)	Chapter 4 of the NVFFA places a duty on owners to prepare and maintain firebreaks, the procedure in this regard, and the role of adjoining owners and the fire protection association. Provision is also made for the making of firebreaks on the international boundary of the Republic of South Africa. The applicant must ensure that firebreaks are wide and long enough to have a reasonable chance of preventing a veldfire from spreading to or from neighbouring land, it does not cause soil erosion, and it is reasonably free of inflammable material capable of carrying a veldfire across it.	DFFE	While no permitting or licensing requirements arise from this legislation, this Act will be applicable during the construction and operation of Vrede Solar PV Facility, in terms of the preparation and maintenance of firebreaks, and the need to provide appropriate equipment and trained personnel for firefighting purposes.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	Chapter 5 of the Act places a duty on all owners to acquire equipment and have available personnel to fight fires. Every owner on whose land a veldfire may start or burn or from whose land it may spread must have such equipment, protective clothing and trained personnel for extinguishing fires, and ensure that in his or her absence responsible persons are present on or near his or her land who, in the event of fire, will extinguish the fire or assist in doing so, and take all reasonable steps to alert the owners of adjoining land and the relevant fire protection association, if any.		
Hazardous Substances Act (No. 15 of 1973) (HAS)	This Act regulates the control of substances that may cause injury, or ill health, or death due to their toxic, corrosive, irritant, strongly sensitising or inflammable nature or the generation of pressure thereby in certain instances and for the control of certain electronic products. To provide for the rating of such substances or products in relation to the degree of danger, to provide for the prohibition and control of the importation, manufacture, sale, use, operation, modification, disposal or dumping of such substances and products. » Group I and II: Any substance or mixture of a substance that might by reason of its toxic, corrosive etc., nature or because it generates pressure through decomposition, heat or other means, cause extreme risk of injury etc., can be declared as Group I or Group II substance	Department of Health (DoH)	It is necessary to identify and list all Group I, II, III, and IV hazardous substances that may be on site and in what operational context they are used, stored or handled. If applicable, a license would be required to be obtained from the DoH.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	» Group IV: any electronic product, and » Group V: any radioactive material. The use, conveyance, or storage of any hazardous substance (such as distillate fuel) is prohibited without an appropriate license being in force.		
National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA)	The Minister may by notice in the Gazette publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment. The Minister may amend the list by – » Adding other waste management activities to the list. » Removing waste management activities from the list. » Making other changes to the particulars on the list. In terms of the Regulations published in terms of NEM:WA (GNR 912), a BA or EIA is required to be undertaken for identified listed activities. Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that: » The containers in which any waste is stored, are intact and not corroded or in » Any other way rendered unlit for the safe storage of waste.	DFFE – Hazardous Waste Northern Cape Department of Economic Development and Tourism DEDECT – General Waste	No waste listed activities are triggered by Vrede Solar PV Facility; therefore, no Waste Management License is required to be obtained. General and hazardous waste handling, storage and disposal will be required during construction and operation. The National Norms and Standards for the Storage of Waste (GNR 926) published under Section 7(1)(c) of NEM:WA will need to be considered in this regard.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	» Adequate measures are taken to prevent accidental spillage or leaking. » The waste cannot be blown away. » Nuisances such as odour, visual impacts and breeding of vectors do not arise, and » Pollution of the environment and harm to health are prevented.		
National Road Traffic Act (No. 93 of 1996) (NRTA)	The technical recommendations for highways (TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outline the rules and conditions which apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed. Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges, and culverts. The general conditions, limitations, and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass distribution, and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the National Road Traffic Act and the relevant Regulations.	South African National Roads Agency (SANRAL) – national roads Northern Cape Department of Roads and Public Works	An abnormal load / vehicle permit may be required to transport the various components to site for construction. These include route clearances and permits required for vehicles carrying abnormally heavy or abnormally dimensioned loads and transport vehicles exceeding the dimensional limitations (length) of 22m. Depending on the trailer configuration and height when loaded, some of the on-site substation and BESS components may not meet specified dimensional limitations (height and width) which will require a permit.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
Astronomy Geographic Advantage Act (Act 21 of 2007)	» Preservation and protection of areas within South Africa that are uniquely suited for optical and radio astronomy. » In terms of section 7(1) and 7(2) of this Act, the Minister declared core astronomy advantage areas on 20 August 2010 under Regulation No. 723 of Government Notice No. 33462. In this regard, all land within a 3 kilometres radius of the centre of the Southern African large Telescope dome falls under the Sutherland Core Astronomy Advantage Area. The declaration also applies to the core astronomy advantage area containing the MeerKAT radio telescope and the core of the planned Square Kilometre Array (SKA) radio telescope. The study area does not fall within the 3 km radius of SALT or within an area which could affect the MeerKAT and SKA developments. » Under Section 22(1) of the Act the Minister has the authority to protect the radio frequency spectrum for astronomy observations within a core or central astronomy advantage area. As such, the Minister may still under section 23(1) of the Act, declare that no person may undertake certain activities within a core or central astronomy advantage area. These activities include the construction, expansion or operation of any fixed radio frequency interference source, facilities for the generation, transmission or distribution of electricity, or any activity capable of	Department of Science and Technology	The study area falls within the Northern Cape. SARAO should be consulted as a key stakeholder to confirm that the project will not impact on the SKA and to determine any specific requirements.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	causing radio frequency interference or which may detrimentally influence the astronomy and scientific endeavour.		
Provincial Policies / Legislation			
Northern Cape Nature Conservation Act 9 of 2009.	This Act To provide for the sustainable utilisation of wild animals, aquatic biota and plants; to provide for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; to provide for offences and penalties for contravention of the Act; to provide for the appointment of nature conservators to implement the provisions of the Act; to provide for the issuing of permits and other authorisations; and to provide for matters connected therewith. Amongst other regulations, the following may apply to the current project: » Restricted activities involving specially protected animals » 17. Keeping of wild animals in captivity » 18. Release of certain wild animals » 19. Manipulation of boundary fences » 23. Auctioning of certain wild animals » 26. Prohibitions regarding wild animals » SUSTAINABLE UTILISATION OF PLANTS » Restricted activities involving specially protected plants » Picking, receipt, possession, acquisition or handling of indigenous plants » CHAPTER 7 » Invasive plant species	Northern Cape DEDECT Cape Nature	An Ecological Impact Assessment has been undertaken (Appendix D). Several geophytic species were recorded but could not be identified and may well be provincially protected, requiring permits to destroy or remove from the provincial authorities. A collection/destruction permit must be obtained from Northern Cape Nature Conservation for the removal of any protected plant or animal species found on site.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	The Act provides lists of protected species for the Province.		

4.8.1 Best Practice Guidelines Birds & Solar Energy (2017)

The Best Practice Guidelines for Birds and Solar Energy (2017) proposed by the Birds and Renewable Energy Specialist Group (BARESG) (convened by BirdLife South Africa and the Endangered Wildlife Trust) contain guidelines for assessing and monitoring the impact of solar generation facilities on birds in Southern Africa. The guidelines recognise the impact that solar energy may have on birds, through for example the alteration of habitat, the displacement of populations from preferred habitat, and collision and burn mortality associated with elements of solar hardware and ancillary infrastructure; and the fact that the nature and implications of these effects are poorly understood.

The guidelines are aimed at Environmental Assessment Practitioners (EAPs), avifaunal specialists, developers and regulators and propose a tiered assessment process, including:

(i) Preliminary avifaunal assessment – an initial assessment of the likely avifauna in the area and possible impacts, preferably informed by a brief site visit and by collation of available data; also including the design of a site-specific survey and monitoring project should this be deemed necessary.
(ii) Data collection – further accumulation and consolidation of the relevant avian data, possibly including the execution of baseline data collection work (as specified by the preliminary assessment), intended to inform the avian impact study.
(iii) Impact assessment – a full assessment of the likely impacts and available mitigation options, based on the results of systematic and quantified monitoring if this was deemed a requisite at preliminary assessment.
(iv) Monitoring – repetition of baseline data collection, plus the collection of mortality data. This helps to develop a complete before and after picture of impacts, and to determine if proposed mitigation measures are implemented and are effective, or require further refinement. Monitoring may only be necessary for projects with the potential for significant negative impacts on birds (i.e. large area affected and / or vulnerable species present).

In terms of the guidelines the quantity and quality of baseline data required to inform the assessment process at each site should be set in terms of the size of the site and the predicted impacts of the solar technology in question, the anticipated sensitivity of the local avifauna (for example, the diversity and relative abundance of priority species present, proximity to important flyways, wetlands or other focal sites) and the amount of existing data available for the area.

Data collection could vary from a single, short field visit (Regime 1, for e.g. at a small or medium sized site with low avifaunal sensitivity), to a series of multi-day survey periods, including the collection of various forms of data describing avian abundance, distribution and movement and spread over 12 months (Regime 3, for e.g. at a large developments located in a sensitive habitat, or which otherwise may have significant impacts on avifauna). **Table 4.9** is taken from the best practise guidelines and provides a summary of the recommended assessment regimes in relation to proposed solar energy technology, project size, and likely risk).

Table 4.9: Recommended avian assessment regimes in relation to proposed solar energy technology, project size, and known impact risks.

Type of technology*	Size**	Avifaunal Sensitivity***		
		Low	Medium	High
All except CSP power tower	Small (< 30ha)	Regime 1	Regime 1	Regime 2

Type of technology*	Size**	Avifaunal Sensitivity***		
		Low	Medium	High
	Medium (30 – 150ha)	Regime 1	Regime 2	Regime 2
	Large (> 150ha)	Regime 2****	Regime 2	Regime 3
CSP power tower	All	Regime 3		

Regime 1: One site visit (peak season); minimum 1 – 5 days.
Regime 2: Pre- and post-construction; minimum 2 – 3 x 3 – 5 days over 6 months (including peak season); carcass searches.
Regime 3: Pre- and post-construction; minimum 4 – 5 x 4 – 8 days over 12 months, carcass searches.

* Different technologies may carry different intrinsic levels of risk, which should be taken into account in impact significance ratings

** For multi-phased projects, the aggregate footprint of all the phases should be used. At 3ha per MW, Small = < 10MW, Medium = 10 – 50MW, Large = > 50MW.

*** The avifaunal sensitivity is based on the number of priority species present, or potentially present, the regional, national or global importance of the affected area for these species (both individually and collectively), and the perceived susceptibility of these species (both individually and collectively) to the anticipated impacts of development. For example, an area would be considered to be of high avifaunal sensitivity if one or more of the following is found (or suspected to occur) within the broader impact zone:

1) Avifaunal habitat (e.g. a wetlands, nesting or roost sites) of regional or national significance.
2) A population of a priority species that is of regional or national significance.
3) A bird movement corridor that is of regional or national significance.
4) A protected area and / or Important Bird and Biodiversity Area.

An area would be considered to be of medium avifaunal sensitivity if it does not qualify as high avifaunal sensitivity, but one or more of the following is found (or suspected to occur) within the broader impact zone

1) Avifaunal habitat (e.g. a wetland, nesting or roost sites) of local significance.
2) A locally significant population of a priority species.
3) A locally significant bird movement corridor.

An area would be considered to be of low avifaunal sensitivity if it is does not meet any of the above criteria.

**** Regime 1 may be applied to some large sites, but only in instances where there is abundant existing data to support the assessment of low sensitivity.

Bird distribution patterns fluctuate widely in response to environmental conditions (e.g. local rainfall patterns, nomadism, migration patterns, seasonality), meaning that a composition noted at a particular moment in time will differ during another time period at the same locality. For this reason, an austral winter season and an austral summer season bird monitoring survey has been conducted in line with Regime 2 for the Vrede Solar PV Facility.

4.8.2 Best Practice Guidelines Agriculture and Land Capability (2020

From an agricultural perspective, current and historical cultivation activities undertaken within the study area need to be considered as the National Department of Agriculture consider the loss of agricultural land to the development of solar energy facilities as a potential issue in terms of food security within South Africa.

The major concern from an agricultural perspective with any development is the possible loss of high potential agricultural land, and this is linked to the land types for the study area. Hence when considering the potential for agricultural activities within the study area, the potential of the landtypes for the undertaking of agricultural activities needs to be considered in order to understand what limitations are associated with the area.

National Department of Agriculture in principle does not support any renewable energy related footprint in high potential or cultivated agricultural land. Within the context of South Africa's very limited availability of arable land, National Department of Agriculture considers any land that is capable of consistently and sustainably producing agricultural crops to be high potential agricultural land. According to this definition, any land that has been cultivated at least once in the past 10 years, or has the potential to be cultivated in future, is restricted in terms of renewable energy development, and must comply with current Department of Agriculture internal guidelines.

The Department of Environmental Affairs prescribes procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation. The DFFE undertook a Strategic Environmental Assessment for Wind and Solar PV Energy in South Africa, 2015, for the effective and efficient roll- out of large-scale wind and solar development in South Africa. The SEA process was undertaken in specific areas referred to as the Renewable Energy Development Zones (REDZs) as published under Government Notice No. 114, Gazette No. 41445 on 16 February 2018 and GNR 144 (February 2021). This process identified potential environmental sensitivities of the areas to renewable energy development. The sensitivities were refined through further public consultation and stakeholder interaction and have been captured in the DFFE screening tool.

From an agricultural potential perspective, allowable development limits were defined through the SEA process to allow for reasonably small footprints of renewable energy development to be allowed on appropriate agricultural land. These allowable development limits refer to the area of a particular land capability that can be directly impacted (i.e., taken up by the physical footprint) by a renewable energy development. Physical footprint in this context is the area that is directly occupied by all infrastructure, including roads, hard standing areas, buildings, substations, etc. that is associated with the renewable energy generation facility during its operational phase, and that result in the exclusion of that land from potential cultivation or grazing. It excludes all areas that were already occupied by roads and other infrastructure prior to the establishment of the renewable energy facility but includes the surface area required for expanding existing infrastructure (e.g., widening existing roads). It excludes the corridor underneath overhead power lines but includes the pylon footprints. It therefore represents the total land that is excluded from agricultural use because of the renewable energy facility. **Figure 4.2** outlines the allowable development limits for renewable energy developments as defined by the DFFE.

Table 1: Allowable development limits for renewable energy generation developments generating electricity of 20 MW or more		
Criteria (land capability evaluation value and category of crop boundary)	**Allowable development limits in hectares per MW of installed generation capacity (with sensitivity ratings from the national web based environmental screening tool shown in brackets)**	
	Within field crop boundaries	Outside field crop boundaries
Land capability evaluation value of 11 – 15; Irrigation, horticulture/viticulture, shade-net; high value agricultural areas with a priority rating A and/or B	0 (Very High Sensitivity)	0 (Very High Sensitivity)
Land capability evaluation value of 8 – 10; all cultivated areas including sugarcane; high value agricultural areas with a priority rating C and/or D	0.20 (High Sensitivity)	0.35 (Medium Sensitivity)
Land capability evaluation value of 6 - 7;	0.25 (High Sensitivity)	2.50 (Low Sensitivity)
Land capability evaluation value of 1 - 5;	0.30 (High Sensitivity)	2.50 (Low Sensitivity)

Figure 4.2: Details the allowable development limits for RE developments of 20MW or more in hectares (Source: DFFE Screening (2020). GN320 Protocol for the specialist assessment and minimum report content requirements of environmental impacts on agricultural resources by onshore wind and/or solar photovoltaic energy generation facilities where the electricity output is 20 megawatts or more).

MEDIUM SENSITIVITY RATING - Land capability evaluation values of 6 – 7. Medium sensitivity areas are likely to be very marginal arable land.	

4.8.3 The IFC Environmental Health and Safety (EHS) Guidelines

The IFC EHS Guidelines are technical reference documents with general and industry specific examples of Good International Industry Practice (GIIP). The following IFC EHS Guidelines have relevance to the proposed project:

» IFC EHS General Guidelines
» IFC EHS Guidelines for Electric Power Transmission and Distribution

The General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines, however no Industry Sector EHS Guidelines have been developed for PV solar power to date. The application of the General EHS Guidelines should be tailored to the hazards and risks associated with a project, and should take into consideration site-specific variables which may be applicable, such as host country context, assimilative capacity of the environment, and other project factors. In instances where host country regulations differ from the standards presented in the EHS Guidelines, whichever is the more stringent of the two in this regard should be applied.

The General EHS Guidelines include consideration of the following:

» Environmental:

- Air Emissions and Ambient Air Quality
- Energy Conservation
- Wastewater and Ambient Water Quality
- Water Conservation
- Hazardous Materials Management
- Waste Management
- Noise
- Contaminated Land

» Occupational Health and Safety:
- General Facility Design and Operation
- Communication and Training
- Physical Hazards
- Chemical Hazards
- Biological Hazards
- Radiological Hazards
- Personal Protective Equipment (PPE)
- Special Hazard Environments
- Monitoring

» Community Health and Safety:
- Water Quality and Availability
- Structural Safety of Project Infrastructure
- Life and Fire Safety (L&FS)
- Traffic Safety
- Transport of Hazardous Materials
- Disease Prevention
- Emergency Preparedness and Response

» Construction and Decommissioning:
- Environment
- Occupational Health & Safety
- Community Health & Safety

4.8.4 IFC's Project Developer's Guide to Utility-Scale Solar Photovoltaic Power Plants (2015)

While no Industry Sector EHS Guidelines have been developed for PV Solar Power, the IFC has published a Project Developer's Guide to Utility-Scale Solar Photovoltaic Power Plants (IFC, 2015). Chapter 8 of the Project Developer's Guide pertains to Permits, Licensing and Environmental Considerations, and states that in order to deliver a project which will be acceptable to international lending institutions, environmental and social assessments should be carried out in accordance with the requirements of the key international standards and principles, namely the Equator Principles and IFC's Performance Standards (IFC PS).

Some of the key environmental considerations for solar PV power plants contained within the Project Developer's Guide include:

» Construction phase impacts (i.e. OHS, temporary air emissions from dust and vehicle emissions, noise related to excavation, construction and vehicle transit, solid waste generation and wastewater generation from temporary building sites and worker accommodation).
» Water usage (i.e. the cumulative water use requirements).

- Land matters (i.e. land acquisition procedures and the avoidance or proper mitigation of involuntary land acquisition / resettlement).
- Landscape and visual impacts (i.e. the visibility of the solar panels within the wider landscape and associated impacts on landscape designations, character types and surrounding communities).
- Ecology and natural resources (i.e. habitat loss / fragmentation, impacts on designated areas and disturbance or displacement of protected or vulnerable species).
- Cultural heritage (i.e. impacts on the setting of designated sites or direct impacts on below-ground archaeological deposits as a result of ground disturbance during construction).
- Transport and access (i.e. impacts of transportation of materials and personnel).
- Drainage / flooding (i.e. flood risk associated with the site).
- Consultation and disclosure (i.e. consulting with key authorities, statutory bodies, affected communities and other relevant stakeholders as early as possible).
- Environmental and Social Management Plan (ESMP) (i.e. compile an ESMP to ensure that mitigation measures for relevant impacts are identified and incorporated into project construction procedures and contracts).

CHAPTER 5: DESCRIPTION OF THE AFFECTED ENVIRONMENT

This chapter provides a description of the local environment. This information is provided in order to assist the reader in understanding the possible effects of the project on the environment within which it is proposed to be developed. Aspects of the biophysical, social, and economic environment that could be directly or indirectly affected by, or could affect, Vrede Solar PV Facility have been described. This information has been sourced from both existing information available for the area as well as collected field data by specialist consultants and aims to provide the context within which this S&EIA process is being conducted.

5.1 Legal Requirements as per the EIA Regulations, 2014 (as amended), for the undertaking of an Environmental Impact Assessment

This chapter includes the following information required in terms of the EIA Regulations, 2014 - Appendix 3: Scope of Assessment and Content of Environmental Impact Assessment Reports:

Requirement	Relevant Section
3(1)(h)(iv) the environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects.	The environmental attributes associated with the development of The Project are included as a whole within this chapter. The environmental attributes that are assessed within this chapter include the following: » The regional setting of the broader study area indicates the geographical aspects associated with The Project. This is included in **Section 5.2**. » The climatic conditions for the study area have been included in **Section 5.3**. » The biophysical characteristics of the project site and the surrounding areas are included in **Section 5.4**. The characteristics considered are topography and terrain, geology, soils and agricultural potential and the ecological profile which includes the vegetation patterns, listed plant species, critical biodiversity areas and broad-scale processes, freshwater resources, terrestrial fauna and avifauna. » The heritage and cultural aspects (including archaeology and palaeontology) have been included in **Section 5.5**. » The visual quality of the surrounding area and the project site has been considered in **Section 5.6**. » The social and socio-economic characteristics associated with the broader study area and the project site have been included in **Section 5.7.**

A more detailed description of each aspect of the affected environment is included within the specialist reports contained within **Appendices D – K**.

5.2. Regional Setting

The Vrede Solar PV Facility development area is located approximately 20km north of Philipstown and 30km west of Petrusville within the Renosterberg Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province.

The vast and arid Northern Cape is the largest province in South Africa and covers an area of 372 889km² taking up nearly a third of the country's land area and constitutes approximately 30% of South Africa. The province is divided into five district municipalities (DM), namely, Frances Baard, Karoo, Namakwa, Pixley Ka Seme and ZF Mgcawu District Municipality (known before 1 July 2013 as Siyanda DM). The site itself is located in the Pixley Ka Seme DM.

The Northern Cape has a population of 1 193 780, the least populous of South Africa's provinces. It is bordered by Namibia and Botswana to the north, and also by the Northwest, Free State, Eastern Cape and Western Cape provinces. The cold Atlantic Ocean forms the province's western boundary.

The capital city is Kimberley. Other important towns are Upington, centre of the karakul sheep and dried-fruit industries, and the most northerly winemaking region of South Africa; Springbok, in the heart of the Namaqualand spring-flower country; Kuruman and De Aar, the second most important junction of South Africa's railway network. Sutherland is host to the southern hemisphere's largest astronomical observatory; the multinational sponsored Southern African Large Telescope.

The Northern Cape is rich in minerals. Alluvial diamonds are extracted from the beaches and the sea between Alexander Bay and Port Nolloth. The Sishen Mine near Kathu is the biggest source of iron ore in South Africa, while the copper mine at Okiep is one of the oldest mines in the country. Copper is also mined at Springbok and Aggeneys. The province is rich in asbestos, manganese, fluorspar, semi-precious stones and marble.

The province has fertile agricultural land in the Orange River Valley, especially at Upington, Kakamas and Keimoes, where grapes and fruit are cultivated intensively. The interior Karoo relies on sheep farming, while the karakul-pelt industry is one of the most important in the Gordonia district of Upington. Wheat, fruit, peanuts, maize and cotton are produced at the Vaalharts Irrigation Scheme near Warrenton.

The Northern Cape is divided into five district municipalities and further subdivided into 26 local municipalities (**Refer to Figure 5.1**). The study area is located within the Renosterberg Local Municipality (RLM), which falls within the greater Pixley Ka Seme District Municipality (PKSDM) (**Figure 5.2**). The PKSDM is made up of eight category B local municipalities which include Emthanjeni, Kareeberg, Thembelihle, Siyathemba, Ubuntu, Siyancuma and Umsobomvu municipalities. De Aar is the administrative seat of the PKSDM. The administrative seat of the RLM is Petrusville.

The Renosterberg Local Municipality is a Category B municipality located in the Pixley Ka Seme District of the Northern Cape, known as the Karoo region. It is the smallest of eight municipalities in the district, making up only 5% (Area: 5 529km²) of its geographical area.

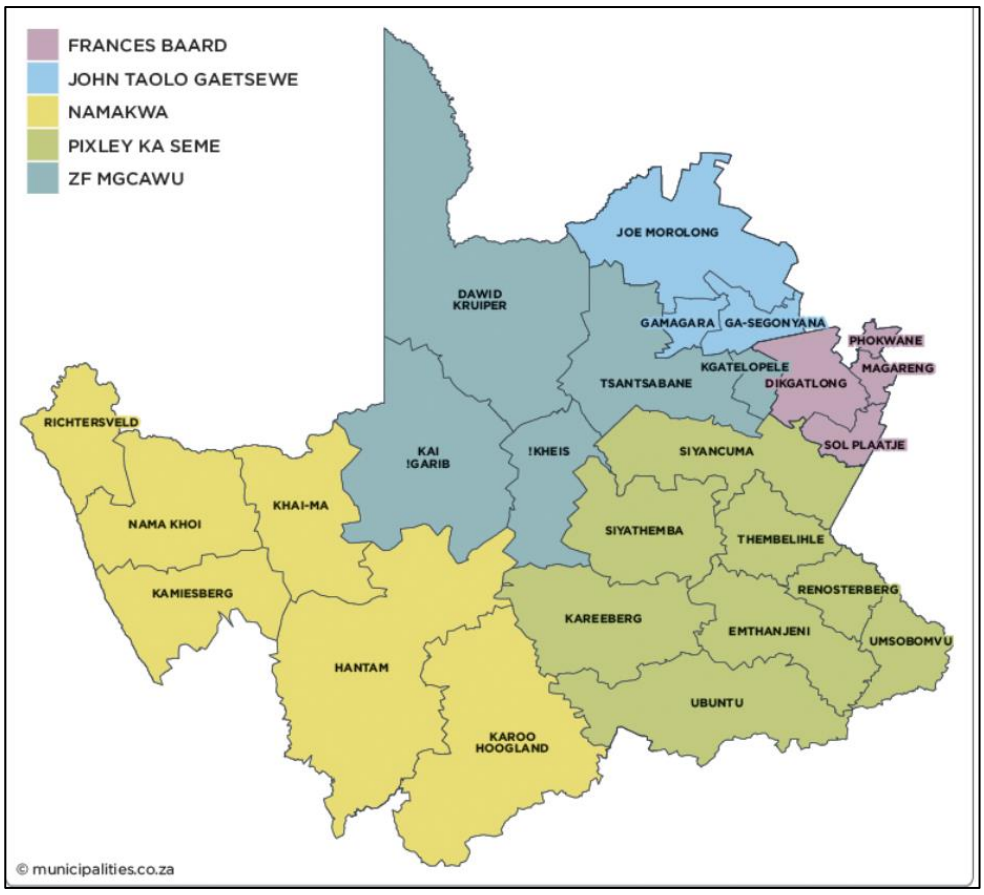

Figure 5.1: Map showing the municipalities of the Northern Cape Province (Source: www.municipalities.co.za).

Figure 5.2: Location of the Renosterberg Local Municipality within the Pixley Ka Seme District Municipality (Source: www.municipalities.co.za).

5.3. Climatic Conditions

Climate data for the De Aar area was used as a baseline for this report. De Aar is located approximately 33km southwest of the project site. The climate within the De Aar region is semi-arid, with the study area receiving between 320mm and 433mm of rainfall per annum. The climate here is considered to be a local steppe climate. The driest month is July, with 11 mm of rain. Most of the precipitation falls in January, averaging 56 mm.

The average annual temperature is 17.4 °C. January is the warmest month of the year. The temperature in January averages 24.3 °C. July is the coldest month, with temperatures averaging 9.1 °C.

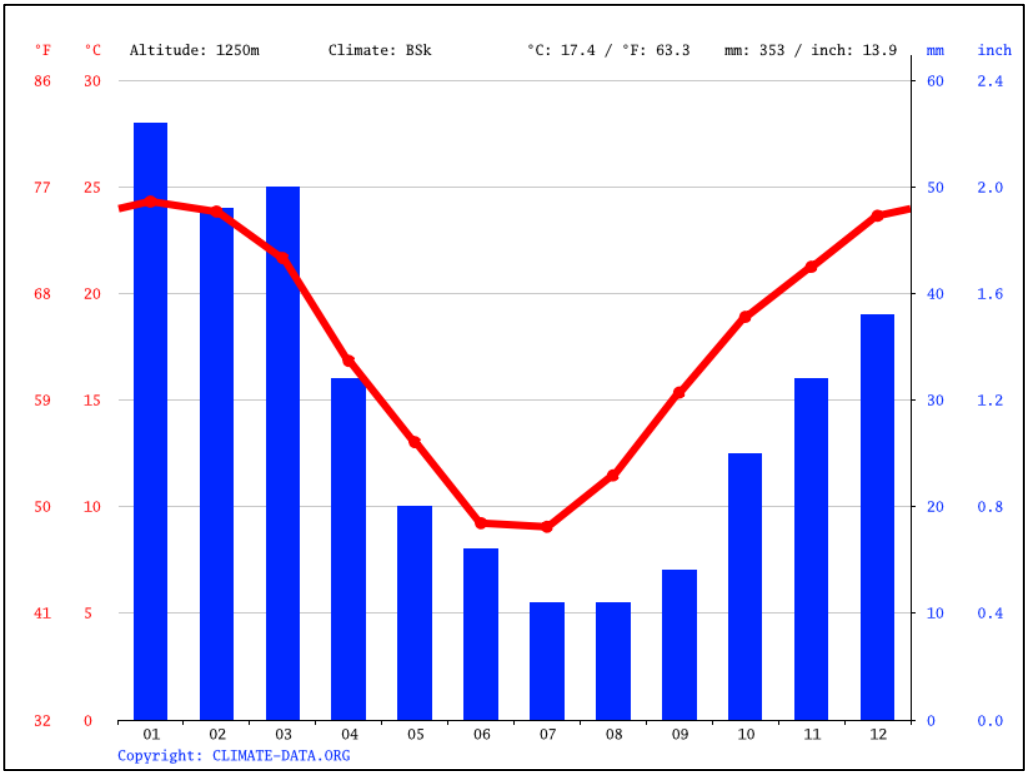

Figure 5.3: Temperature graphs for De Aar area, Northern Cape Province (Source: en.climate-data.org).

Table 5.1: Climate data for De Aar area, Northern Cape Province (Source: en.climate-data.org).

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	24.3 °C (75.7) °F	23.8 °C (74.9) °F	21.7 °C (71) °F	16.8 °C (62.3) °F	13 °C (55.4) °F	9.2 °C (48.6) °F	9.1 °C (48.3) °F	11.5 °C (52.6) °F	15.3 °C (59.6) °F	18.9 °C (66) °F	21.2 °C (70.2) °F	23.6 °C (74.5) °F
Min. Temperature °C (°F)	16.8 °C (62.3) °F	16.8 °C (62.2) °F	14.9 °C (58.8) °F	10.5 °C (51) °F	7 °C (44.6) °F	3.3 °C (37.9) °F	2.7 °C (36.8) °F	4.2 °C (39.5) °F	7.4 °C (45.3) °F	10.7 °C (51.3) °F	12.9 °C (55.3) °F	15.5 °C (60) °F
Max. Temperature °C (°F)	31.4 °C (88.6) °F	30.9 °C (87.6) °F	28.6 °C (83.5) °F	23.3 °C (74) °F	19.6 °C (67.3) °F	15.9 °C (60.7) °F	16.1 °C (61) °F	18.9 °C (66.1) °F	23.1 °C (73.5) °F	26.6 °C (79.9) °F	28.8 °C (83.9) °F	31.1 °C (88) °F
Precipitation / Rainfall mm (in)	56 (2)	48 (1)	50 (1)	32 (1)	20 (0)	16 (0)	11 (0)	11 (0)	14 (0)	25 (0)	32 (1)	38 (1)
Humidity(%)	36%	38%	42%	47%	49%	52%	45%	37%	29%	29%	29%	30%
Rainy days (d)	5	6	5	4	2	2	2	2	2	3	3	4
avg. Sun hours (hours)	11.9	11.2	10.4	9.3	8.8	8.3	8.6	9.3	10.2	11.1	11.9	12.3

5.4. Topographical profile

The study area occurs on land that ranges in elevation from approximately 1 175m above sea level (areas to the north) to 1 675m at the top of the Tierberg Mountain in the south. The terrain surrounding the proposed properties is generally flat. A few farm dams are present in the broader area. The terrain type of the region is relatively homogenous and is described as predominantly lowlands with hills. Some prominent hills and ridges occur in the study area - a small range of hills lies in the southern portion of the study area, inclusive of the Tierberg.

The slope percentage of the larger area is illustrated in **Figure 5.4.** Most of the area is characterised by a slope percentage between 0 and 2%. This illustration indicates a uniform topography with gentle slopes being present within the project area. Steep slopes (> 4%) area associated with the mountains and ridges (Mesas and Inselbergs).

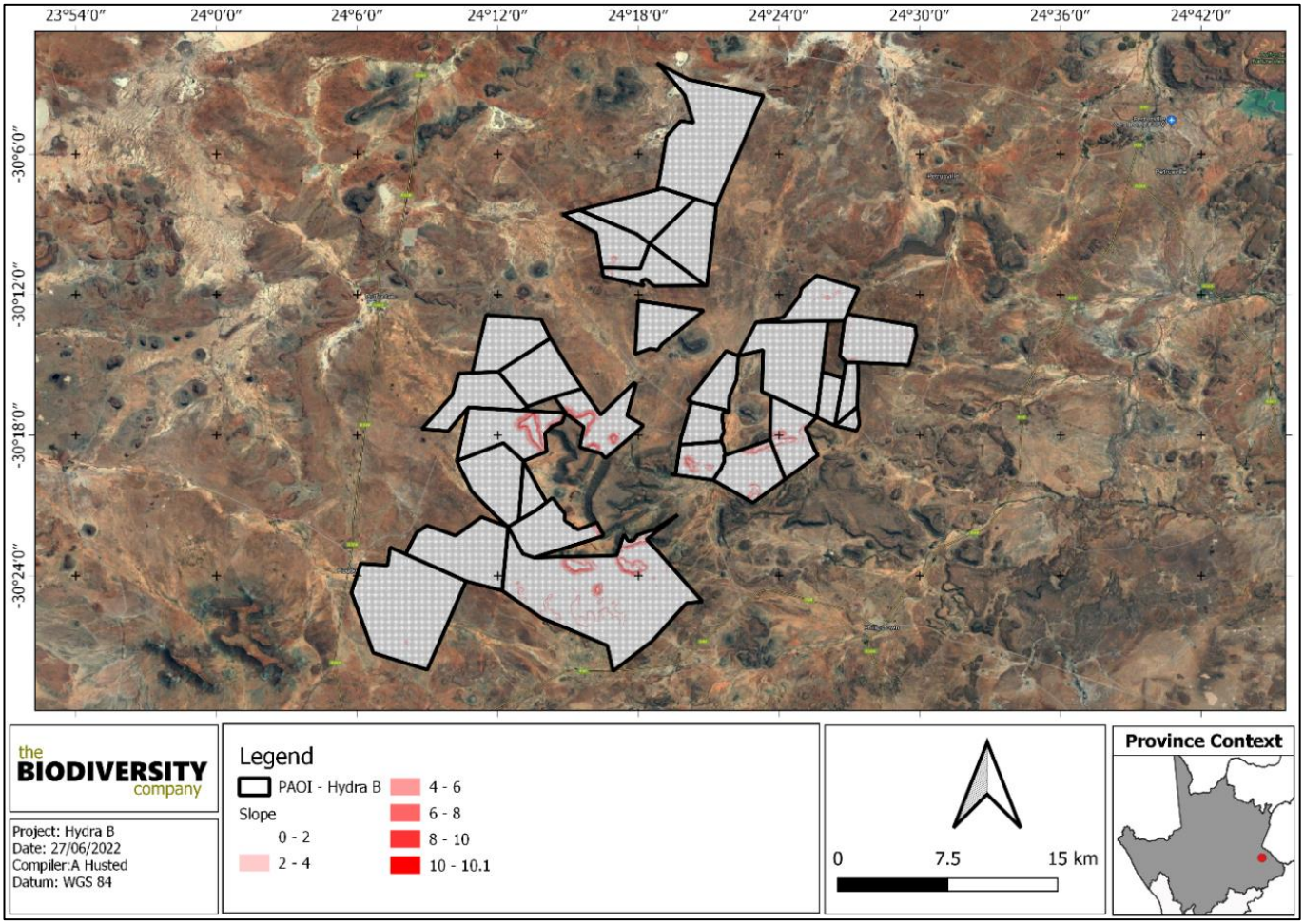

Figure 5.4: Slope percentage map for the broader project area

5.5. Geology, Soils, Land Type and Agricultural Potential

According to the land type database (Land Type Survey Staff, 1972 - 2006), the broader study area is located in the Ae, Da, Fb and Ib broad land types. The Ae land type consists of red-yellow apedal soils which are freely drained. The soils tend to have a high base status and is deeper than 300 mm. The Da land type is

characterised by prismacutanic and/or pedocutanic horizons with the possibility of red apedal B-horizons occurring. The Fb land type consists of Glenrosa and/or Mispah soil forms with the possibility of other soils occurring throughout. Lime is generally present within the entire landscape. The Ib land type consists of miscellaneous land classes including rocky areas with miscellaneous soils.

The broad land types for the area are illustrated in **Figure 5.5** with a description of the land types listed in **Table 5.3**.

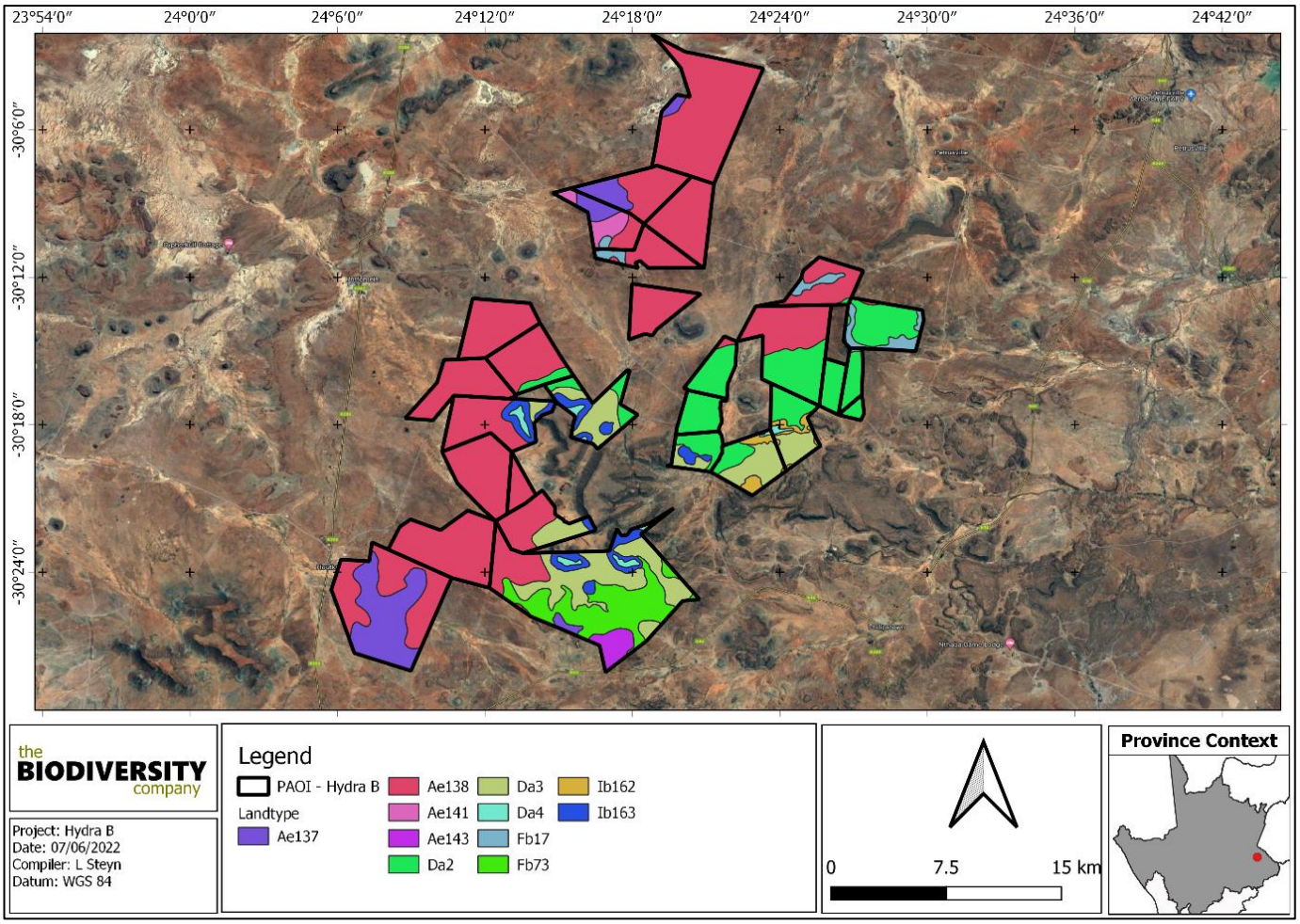

Figure 5.5: Illustration of broad land types for the broader study area (Land Type Survey Staff, 1972 - 2006)

Table 5.3: The descriptions for the broad land types (Land Type Survey Staff, 1972 - 2006)

Land Type	Description
Ae	RED, YELLOW APEDAL, FREELY DRAINED SOILS; Red, high base status > 300 mm deep (no dunes)
Da	PRISMACUTANIC AND/OR PEDOCUTANIC DIAGNOSTIC HORIZONS DOMINANT; Red B horizons
Fb	GLENROSA AND/OR MISPAH FORMS (other soils may occur); Lime rare or absent in upland soils but generally present in low-lying soils
Ib	MISCELLANEOUS LAND CLASSES; Rock areas with miscellaneous soils

Fifteen land capabilities have been digitised by (DAFF, 2017) across South Africa, of which two are located within the proposed development area, including:

» Land Capability 1 to 5 (Very Low to Low Sensitivity); and

» Land Capability 6 to 8 (Low/Moderate to Moderate Sensitivity).

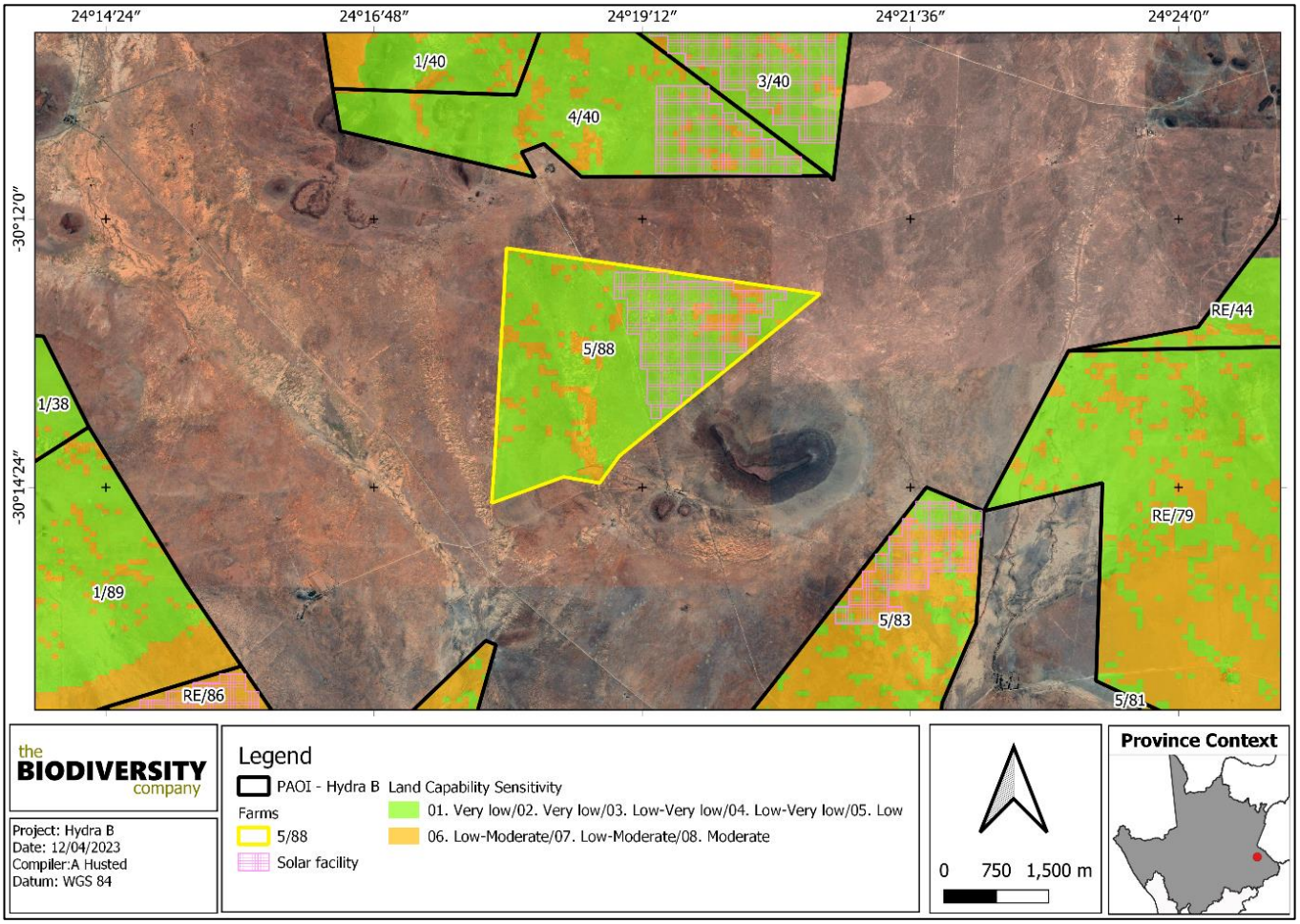

Figure 5.6: Land capability for the study area

5.6. Land Cover and Land Use

The landscape associated with the site is a typical Karoo landscape consisting of dolerite koppies and ridges separated by valley bottoms. Some degraded land is evident along the hills within the area, particularly around Jagpoort and Tierberg in the south. Vegetation types include Northern Upper Karoo on the flat terrain within the study area, and Besemkaree Koppies Shrubland on the more elevated terrain and hills. Merino and Dorper sheep as well as cattle ranching are the primary agricultural activities in the district. Maize and lucerne are also produced on a small scale.

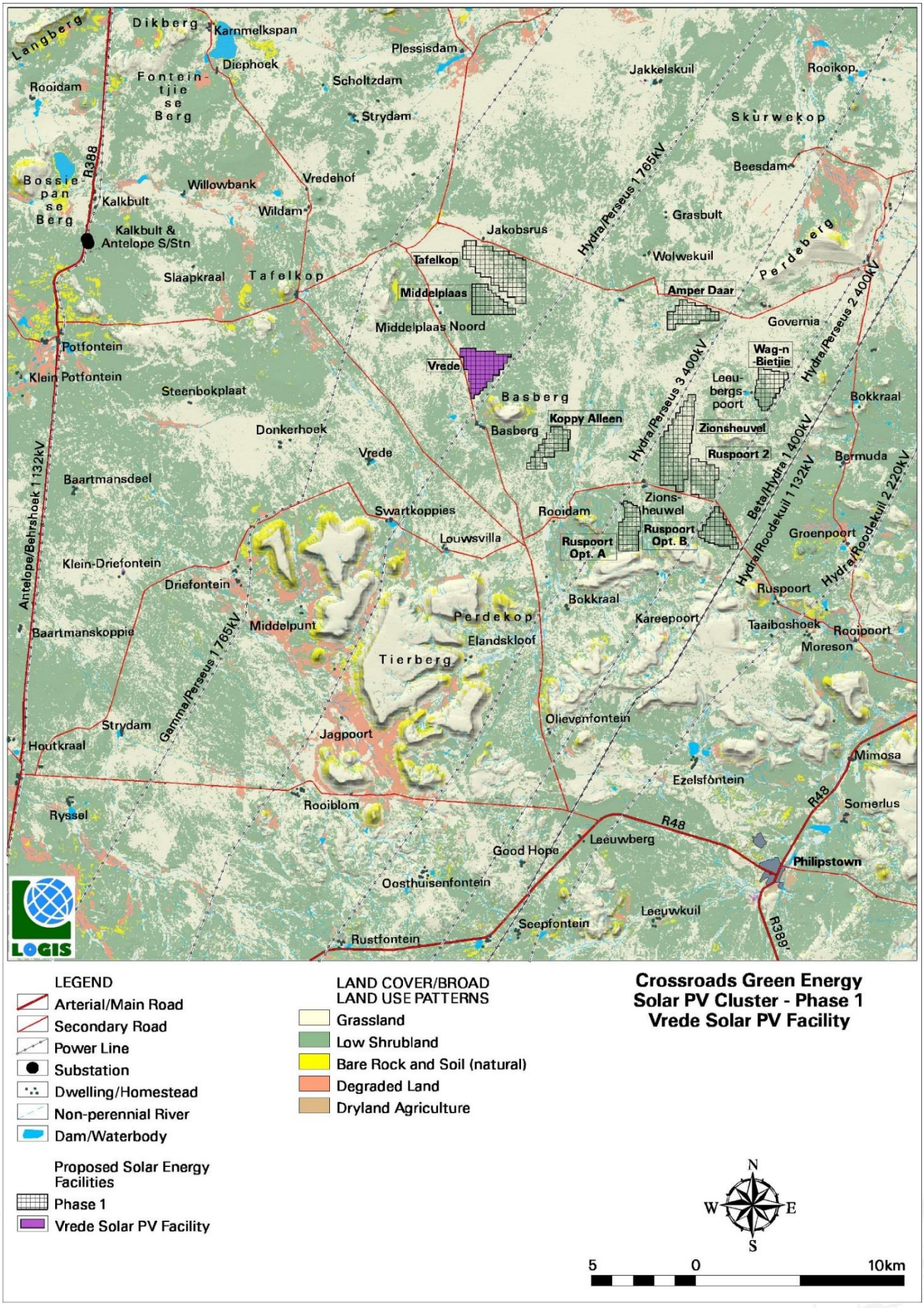

Figure 5.7: Land cover/ broad land uses patterns

5.7. Ecological Profile of the Study Area and the Project Site

5.7.1. Ecologically Important Landscape Features

The relevance of the proposed development to ecologically important landscape features is summarised in **Table 5.4**.

Table 5.4: Summary of relevance of the proposed development to ecologically important landscape features

Desktop Information Considered	Relevant/Irrelevant	Section
Ecosystem Threat Status	Irrelevant – Located within a Least Concern ecosystem	3.1.1.1
Ecosystem Protection Level	Relevant – Located within a Not Protected ecosystem	0
Protected Areas	Irrelevant – The project area is over 30 km away from the nearest Protected Area	-
National Protected Area Expansion Strategy	Irrelevant – Is over 20 km away from the nearest Focus Area	-
Important Bird and Biodiversity Areas	Relevant – The project area is within the Platberg Karoo Conservancy IBA	3.1.1.4
Bioregional Plan	Relevant – Is located within an ESA	0
South African Inventory of Inland Aquatic Ecosystems	Relevant - The project area overlaps with an unclassified wetland	0
Freshwater Ecosystem Priority Areas	Irrelevant – no NFEPA wetlands or rivers are present on within the project area	0

Ecosystem Threat Status

The Ecosystem Threat Status is an indicator of an ecosystem's wellbeing, based on the level of change in structure, function or composition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Least Concern (LC), based on the proportion of the original extent of each ecosystem type that remains in good ecological condition. According to the spatial dataset the proposed development is located within a LC ecosystem (refer to **Figure 5.8**).

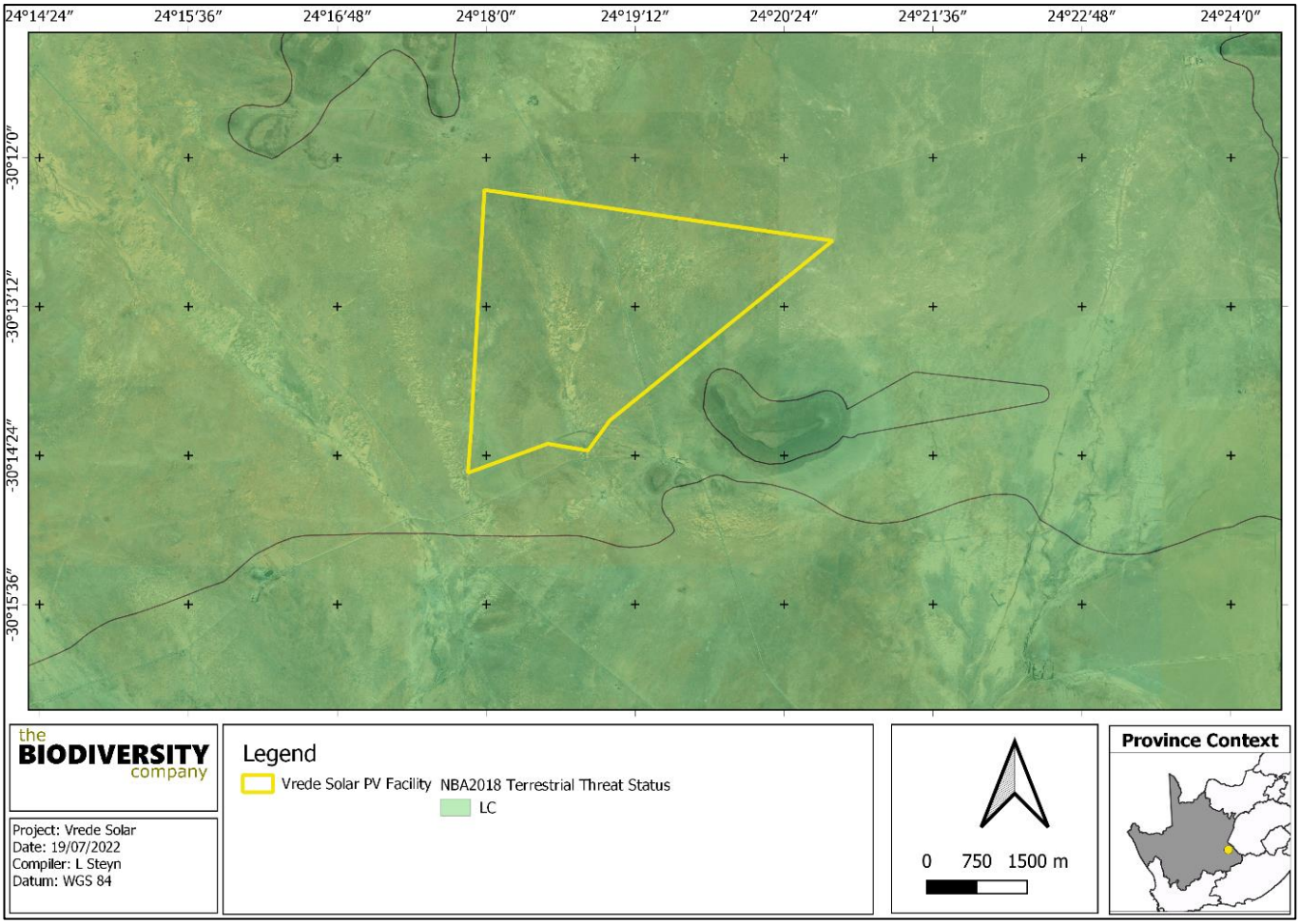

Figure 5.8: Map illustrating the ecosystem threat status associated with the assessment area

Ecosystem Protection Level

Indicator of the extent to which ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Well Protected (WP), Moderately Protected (MP), Poorly Protected (PP), or Not Protected (NP), based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. Not Protected, PP or MP ecosystem types are collectively referred to as under-protected ecosystems. The proposed development is located within a NP ecosystem (refer to **Figure 5.9**).

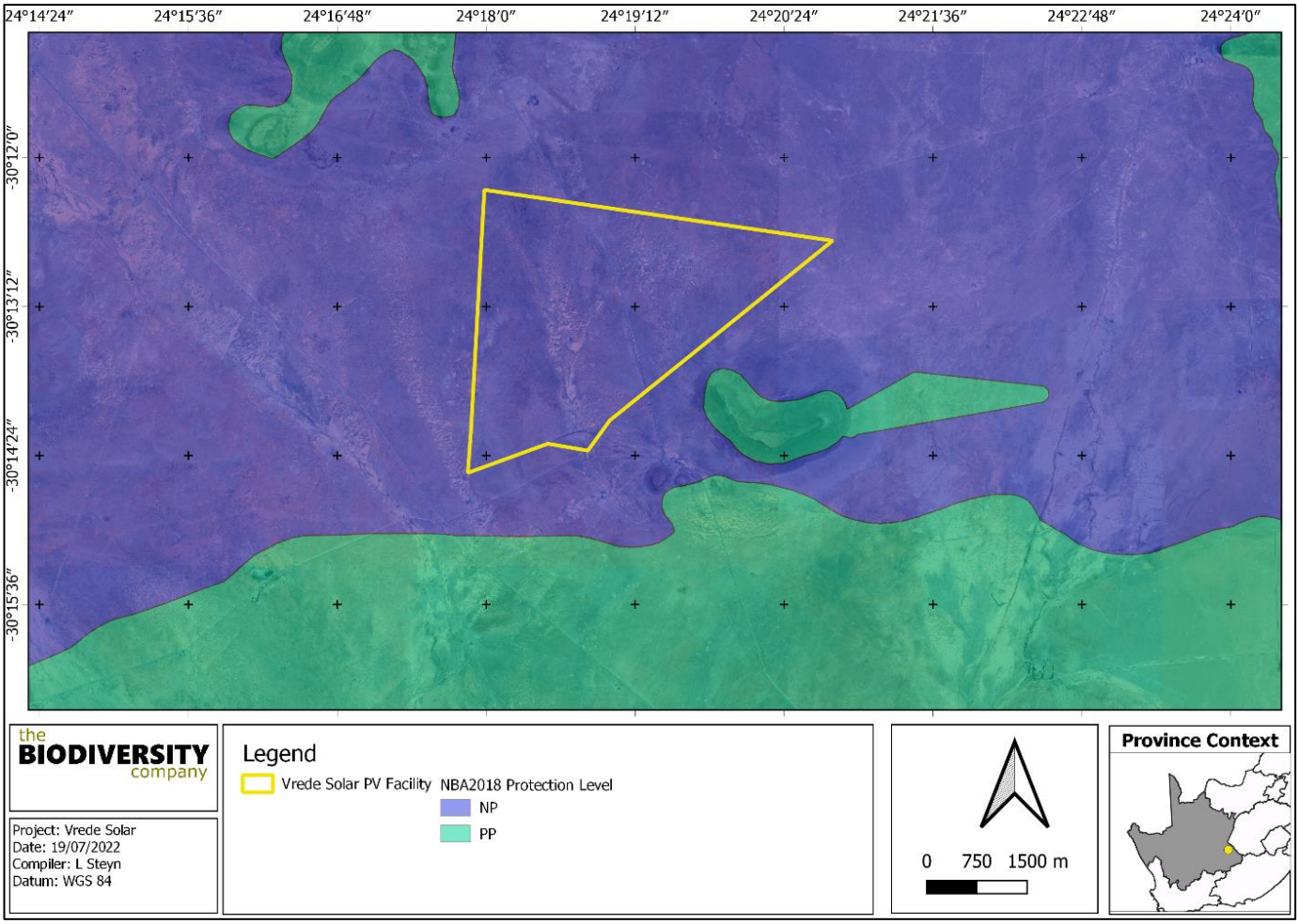

Figure 5.9: Map illustrating the ecosystem protection level associated with the assessment area

Important Bird and Biodiversity Areas

Important Bird & Biodiversity Areas (IBAs) are the sites of international significance for the conservation of the world's birds and other conservation significant species as identified by BirdLife International. These sites are also all Key Biodiversity Areas; sites that contribute significantly to the global persistence of biodiversity (Birdlife, 2017).

According to Birdlife International (2017), the selection of IBAs is achieved through the application of quantitative ornithological criteria, grounded in up-to-date knowledge of the sizes and trends of bird populations. The criteria ensure that the sites selected as IBAs have true significance for the international conservation of bird populations and provide a common currency that all IBAs adhere to, thus creating consistency among, and enabling comparability between, sites at national, continental and global levels.

Platberg–Karoo Conservancy IBA can be found in the districts of De Aar, Philipstown and Hanover. This IBA falls across two biomes, the Nama Karroo and the Grassland Biome, which contributes to its diversity of species. In total 289 bird species have been recorded here. Threats in this IBA include overgrazing, erosion and encroachment by Karroo shrubs, all of which result in the loss of habitat and a decrease in available food for large terrestrial birds.

Figure 5.10 shows that the project area is within the Platberg Karoo Conservancy IBA.

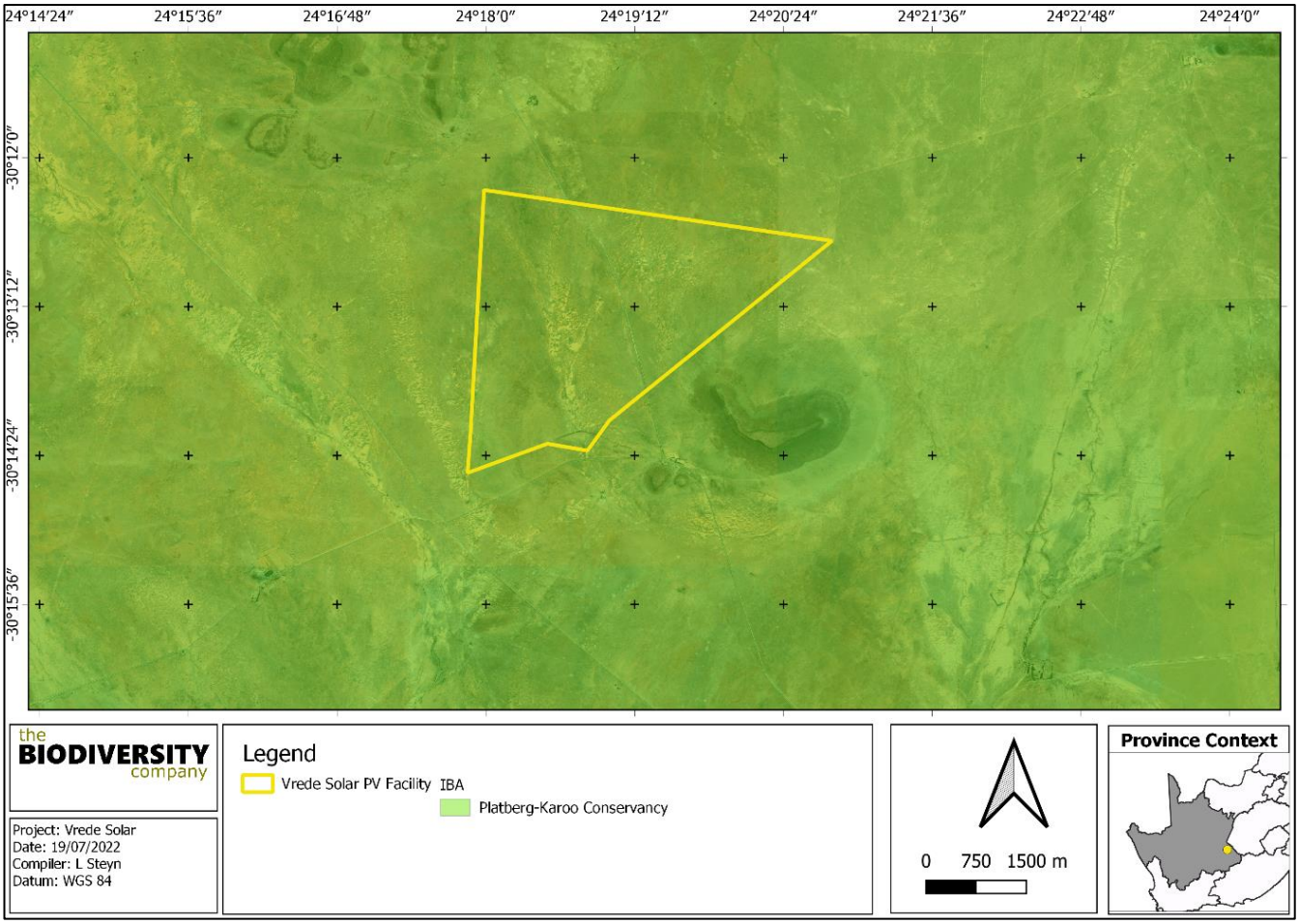

Figure 5.10: Map illustrating the location of the IBAs proximal to the project area

Biodiversity Sector Plan

The Northern Cape Department of Environment and Nature Conservation has developed the Northern Cape CBA Map which identifies biodiversity priority areas for the province, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These biodiversity priority areas, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole.

The project area includes ESA (refer to **Figure 5.11**). Development of this nature (i.e.: Solar PV facilities and associated infrastructure) may occur in an ESA area provided all mitigation measures are adhered to.

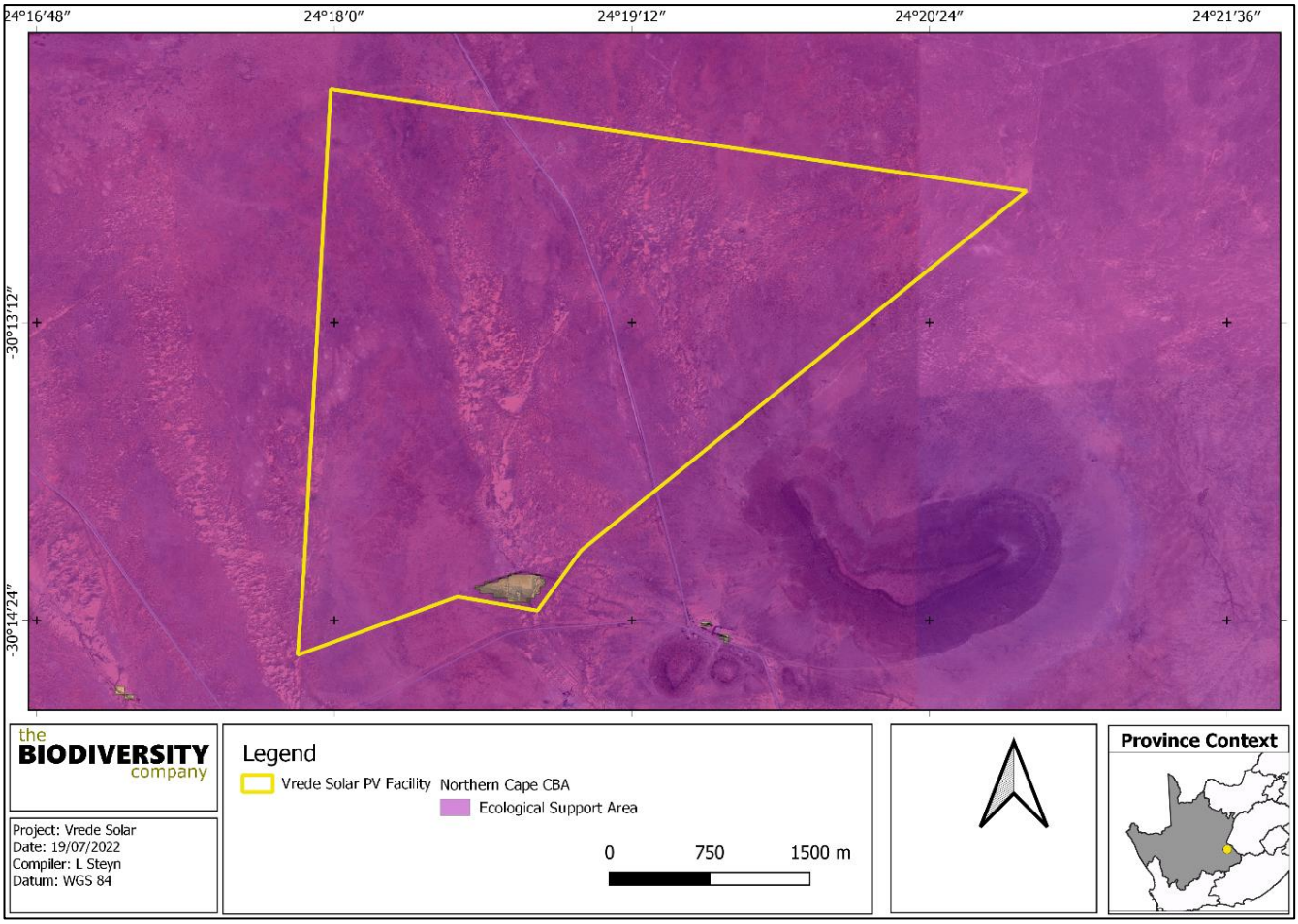

Figure 5.11: Map illustrating the location of Critical Biodiversity Areas proximal to the project area

Hydrological Setting

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was released with the National Biodiversity Assessment (NBA) 2018. Ecosystem threat status (ETS) of ecosystem types is based on the extent to which each river ecosystem type had been altered from its natural condition. Ecosystem types are categorised as CR, EN, VU or LT. Critically Endangered, EN and VU ecosystem types collectively referred to as 'threatened' (Van Deventer *et al.*, 2019; Skowno *et al.*, 2019). The project area overlaps with an unclassified wetland (refer to **Figure 5.12**).

The National Freshwater Ecosystem Priority Areas (NFEPAs) (Driver *et al.*, 2011) spatial data has been incorporated in the above mentioned SAIIAE spatial data set. They are included here as the database is intended to be conservation support tools and are envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act (NEM:BA) biodiversity goals (Nel *et al.,* 2011). The NFEPA spatial layer indicates that the wetlands do not intersect with a Ramsar site and are not within 500 m of an IUCN threatened frog point locality. No NFEPA wetlands or rivers are present within the project area (refer to **Figure 5.13**).

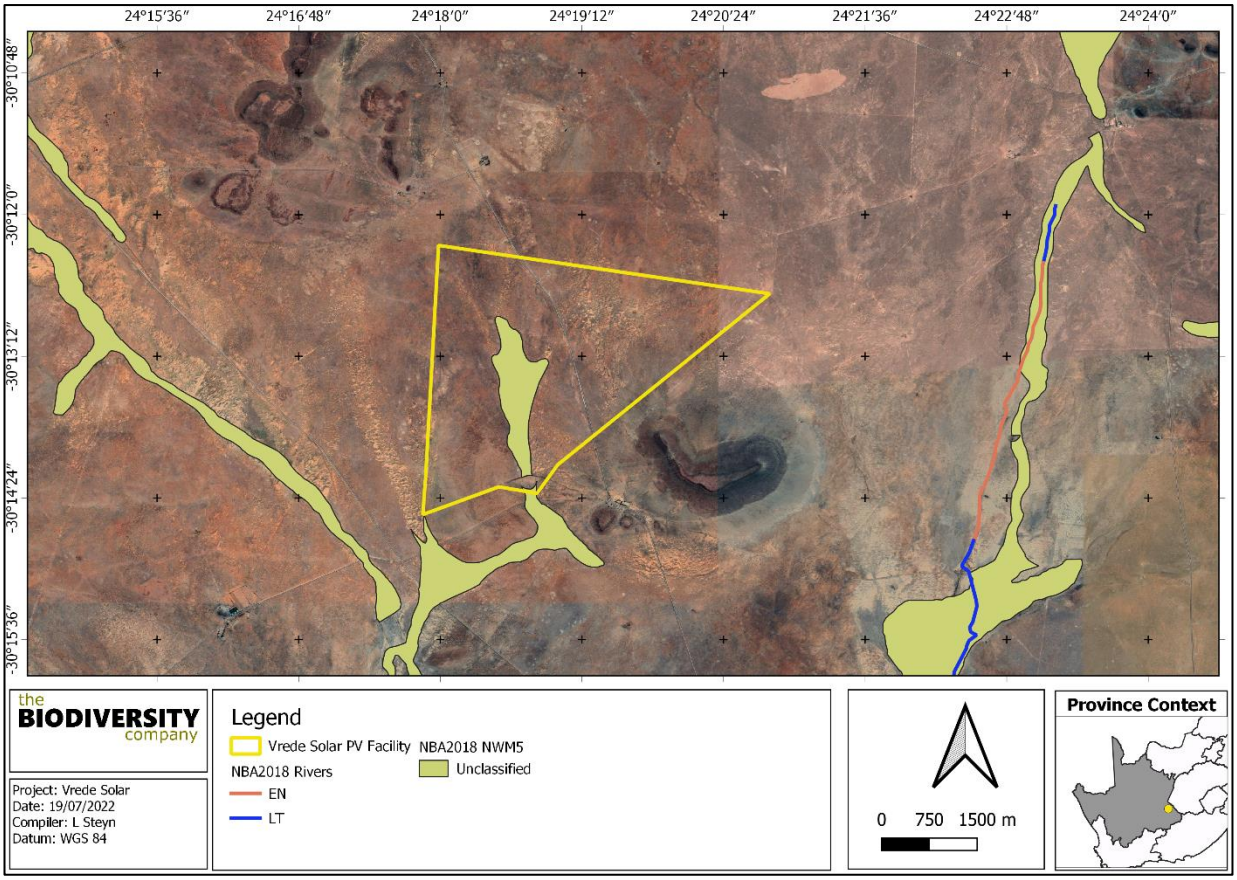

Figure 5.12: The inland water features associated with the project area

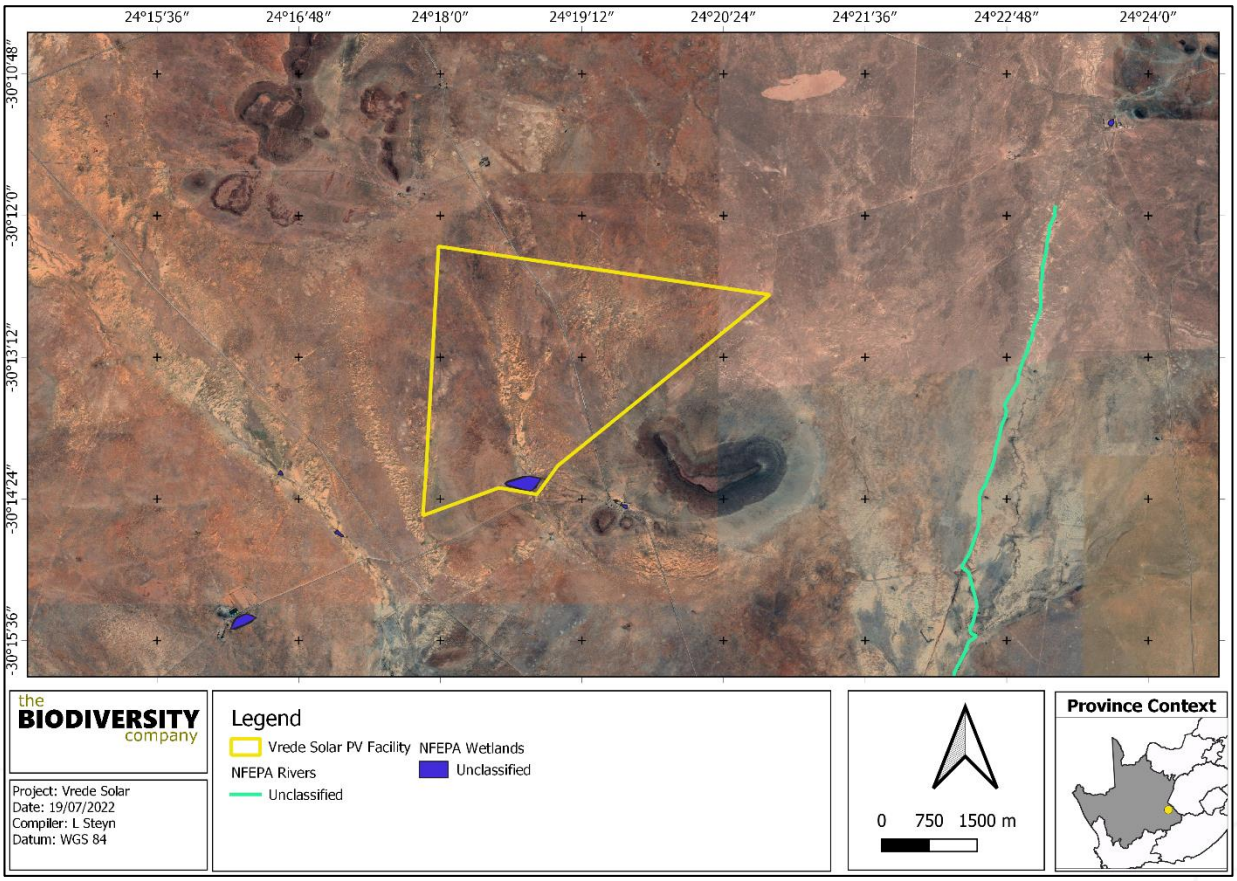

Figure 5.13: Map illustrating the NFEPA wetland and river systems associated with the assessment area

5.7.2. Vegetation

The project area is situated in the Northern Upper Karoo vegetation type according to SANBI (2018) (refer to **Figure 5.14**). The Nama Karoo Biome is found in the central plateau of the western half of South Africa. One vegetation community type can be found in the project area: Karoo Grassland, which approximates Northern Upper Karoo. Northern Upper Karoo occurs in the Northern Cape and Free State Provinces. It occurs on flat to gently sloping terrain with isolated hills of Upper Karoo Hardeveld in the south and Vaalbos Rocky Shrubland in the northeast with interspersed pans. It is a shrubland dominated by dwarf karoo shrubs, grasses and *Acacia mellifera* subsp. *Detinens* and some other low trees. It occurs at an altitude of 1 000 to 1 500 m.

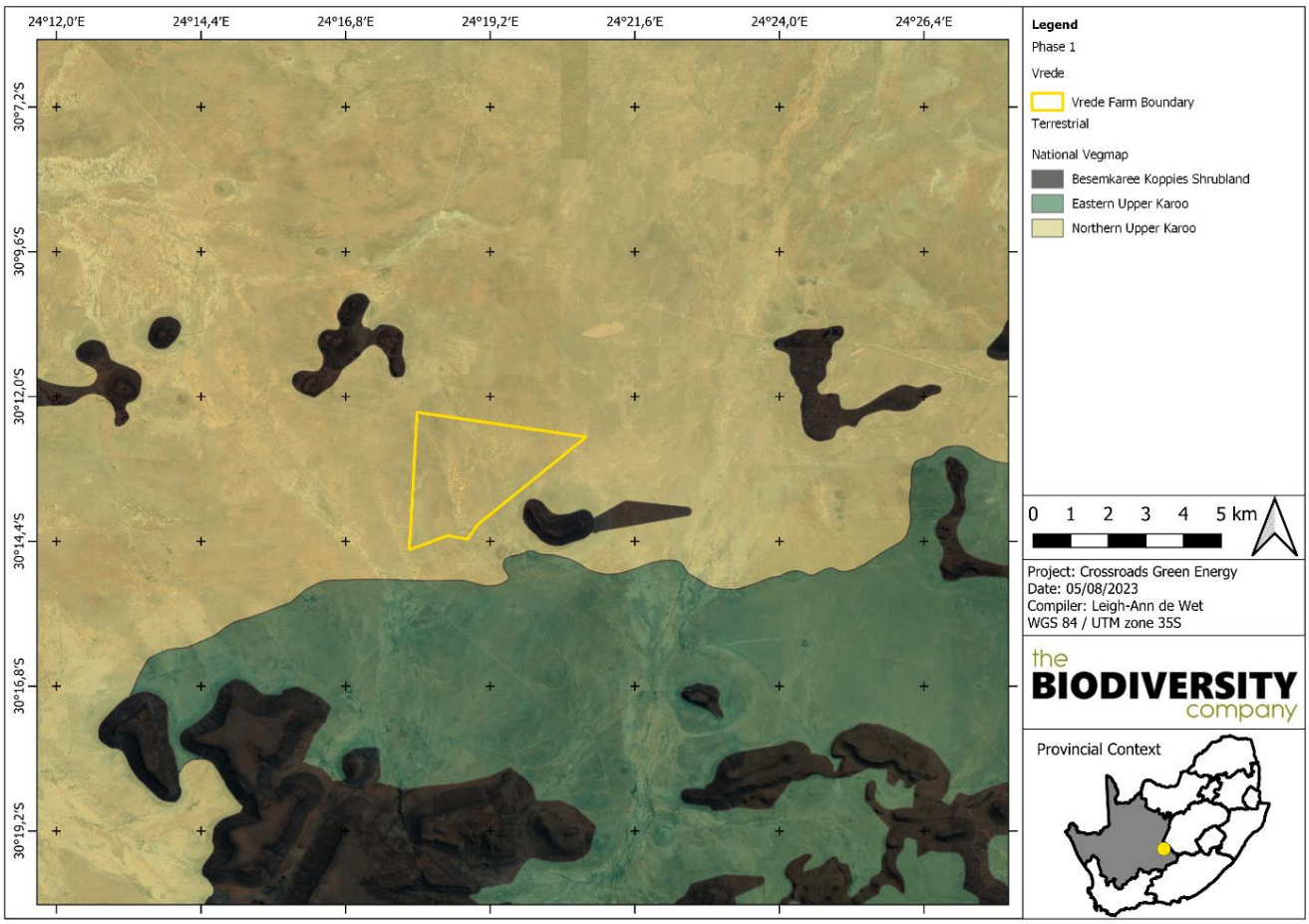

Figure 5.14: Map illustrating the vegetation types associated with the assessment area and surrounding landscape based on the Vegetation Map of South Africa, Lesotho & Swaziland

The project area is homogenous in terms of vegetation with a low karroid scrub grassland occurring throughout. Dominant species of this vegetation community include, but are not limited to *Chrysocoma ciliata, Pentzia incana, Pentzia globose, Lycium cinereum, Aptsimum spinescens, Asparagus sauvolens, Eriocephalus ericoides, Eriocephalus spinscens, Felicia muricata, Ruschia intricata, Roepera lichbtenteinii, Morae pallida, Heteropogon contortus, Aristida congesta, Aristida diffusa,* and *Eragrostis lehmanniana*. Several geophytic species were recorded and may well be provincially protected, requiring permits to destroy or remove from the provincial authorities.

Expected Species of Conservation Concern (SCC)

The Plants of South Africa (POSA) database indicates that 480 species of indigenous plants are expected to occur within the project area (the full list of species can be found in the Ecology Assessment Report included in **Appendix D**). One SCC is expected in the project area as identified by the DFFE Screening Tool (none previously recorded as per POSA): *Tridentea virescens*, which is listed as Rare. No Species of Conservation Concern (SCC) were recorded from the project area.

Alien and Invasive Species

Twelve (12) alien invasive species were recorded from the project area and surrounds (and therefore likely to invade as a result of disturbance) representing nine (9) families (refer to **Table 5.5**).

Table 5.5: Alien Invasive Plants recorded from the project area

Family	Scientific name	Common name	NEM:BA
Asparagaceae	*Agave americana*	American century plant	**3**
Asteraceae	*Bidens Pilosa*	Black jack	
Asteraceae	*Tagetes minuta*	Tall kaki weed	
Cactaceae	*Cereus jamacaru*	Queen-of-the-night	1b
Cactaceae	*Opuntia ficus-indica*	Indian fig opuntia	1b
Cactaceae	*Opuntia robusta*	nopal tapón	1a
Chenopodiaceae	*Salsola kali*	Tumbleweed	1b
Fabaceae	*Prosopis velutina*	velvet mesquite	1b
Malvaceae	*Malva parviflora*	Small mallow	
Myrtaceae	*Eucalyptus camaldulensis*	Red river gum	1b
Papaveraceae	*Argemone ochroleuca*	Mexican Poppy	1b
Solanaceae	*Datura ferox*	Large thorn apple	1b

Land use and Current Impacts

The main impact to the vegetation and habitat types within and surrounding the project area is grazing (refer to **Figure 5.15**). According to Jan Vlok, Richard Dean and Sue Milton many areas in the Karoo still have a high vegetation cover, but that species composition has altered significantly due to overgrazing (Skowno et al. 2009). It could be argued that these areas contribute little to the biodiversity of the region, and that many more habitat types are under threat (Skowno et al. 2009). Disturbances noted within the project area include, farm roads and fences, and alien invasive plant infestation (mainly along roads).

Van der Merwe et al. (2008) noted that inadequate farming practices, due to lack of infrastructure such as fencing, pose a serious threat to the vegetation. Esler et al. (2006) further added that "although damage can happen fast, recovery in the Karoo is very slow, as it depends mainly upon unpredictable rainfall events". Presently about 12% of the Karoo district's ecosystems are transformed or degraded, with mining, agriculture and urbanization the main reasons of biodiversity loss (Skowno et al. 2009). Recently, the prospects of uranium mining and shale gas exploration have also come under the spotlight.

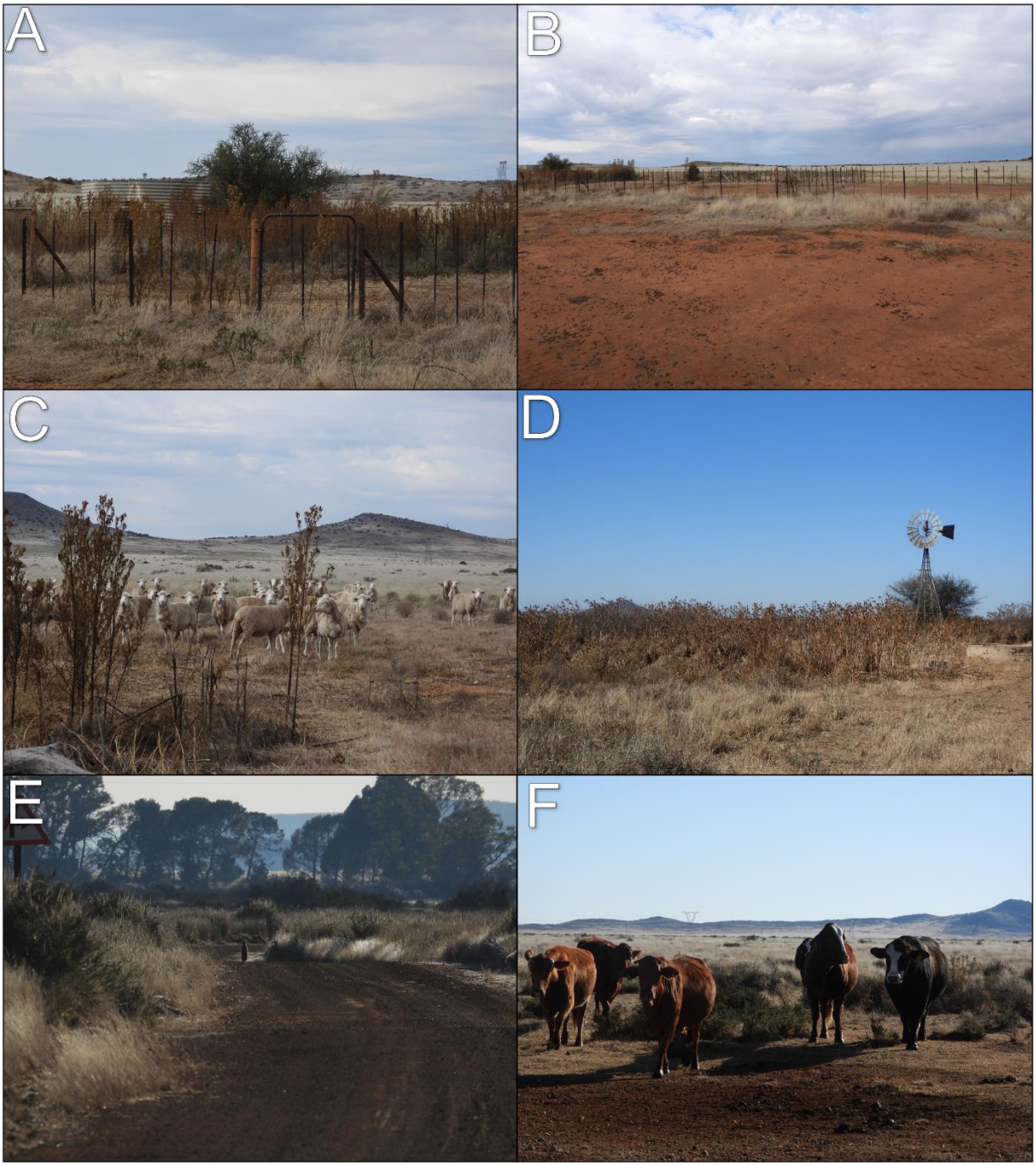

Figure 5.15: Land use and current impacts of the study area in general. A: invasive alien plant species and fences, B: overgrazing and fences, C: Sheep grazing, D: invasive alien plants, E: roads and associated alien plant species and F: Cattle grazing.

5.7.3. Terrestrial Fauna

Amphibians

One amphibian species, *Xenopus laevis*, was recorded during the survey period. The lack of species richness was attributed to the dry nature of the project area with most water bodies and perennial drainage lines in the region being dry at the time of the site visit.

Reptiles

Five reptile species, representing three families were recorded within the project area during the survey periods (refer to **Table 5.6**). The presence of suitable habitat suggests that the project area supports a diverse reptile community but as per the DFFE screening tool report, no SCC are likely to occur within the project area.

Table 5.6: Summary of reptile species recorded within the project area during the survey period. LC = Least Concern

Family	Scientific Name	Common Name	Conservation Status	
			Regional	Global
Leptotyphlopidae	*Leptotyphlops scutifrons scutifrons*	Peters' Thread Snake	LC	Unlisted
Scincidae	*Acontias gracilicauda*	Thin-tailed Legless Skink	LC	LC
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	LC	LC
Scincidae	*Trachylepis variegata*	Variegated Skink	LC	Unlisted
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	LC	LC

Mammals

A total of twenty eight (28) mammal species were recorded across the project area during the survey period (refer to **Table 5.7**), accounting for 48% of the expected mammal species. It is considered highly likely that additional small mammal species would be recorded from the project area with extensive sampling. The lack of records may have been due to hunting that was observed on site.

Table 5.7: Mammal SCC recorded within the project area during the survey period

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Aepyceros melampus	Impala	LC	LC
Antidorcas marsupialis	Springbok	LC	LC
Canis mesomelas	Black-backed Jackal	LC	LC
Connochaetes gnou	Black Wildebeest	LC	LC
Cryptomys hottentotus	Common Mole-rat	LC	LC
Cynictis penicillata	Yellow Mongoose	LC	LC
Damaliscus pygargus	Blesbok	LC	LC
Felis nigripes	Black-footed Cat	VU	VU
Felis silvestris	African Wildcat	LC	LC
Genetta genetta	Small-spotted Genet	LC	LC
Herpestes pulverulentus	Cape Grey Mongoose	LC	LC
Hippotragus niger	Sable Antelope	VU	LC
Hystrix africaeaustralis	Cape Porcupine	LC	LC
Ictonyx striatus	Striped Polecat	LC	LC
Lepus capensis	Cape Hare	LC	LC
Orycteropus afer	Aardvark	LC	LC
Oryx gazella	Gemsbok	LC	LC
Otocyon megalotis	Bat-eared Fox	LC	LC
Pedetes capensis	Springhare	LC	LC
Phacochoerus africanus	Common Warthog	LC	LC
Procavia capensis	Rock Hyrax	LC	LC

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Proteles cristata	Aardwolf	LC	LC
Raphicerus campestris	Steenbok	LC	LC
Rhabdomys pumilio	Xeric Four-striped Mouse	LC	LC
Suricata suricatta	Suricate	LC	LC
Tragelaphus strepsiceros	Greater Kudu	LC	LC
Vulpes chama	Cape Fox	LC	LC
Xerus inauris	Cape Ground Squirrel	LC	LC

5.7.4. Avifauna

The SABAP2 Data lists 234 avifauna species that could be expected to occur within the area. Eleven (11) of these expected species are regarded as SCC. One hundred and twenty-four (124) bird species were recorded across all properties within the Crossroads Green Energy Cluster in the first survey undertaken during 25 April- 6 May 2022, with Pied Crow, Red-billed Quelea, Spiked-heel Lark and Pink-billed Lark being the most abundant species. A number of species were found during the survey that would be regarded as 'high risk' species (refer to **Table 5.8** and **Figure 5.16**).

One hundred and two (102) bird species were recorded during the second survey across all properties within the Crossroads Green Energy Cluster in the second survey which was conducted from 1-10 July 2022. Nine of the species recorded were SCC on a national or international scale (refer to **Table 5.9** and **Figure 5.17**). They were found in varying degrees of frequency. During the second survey similar SCCs were recorded with the exception of the Karoo Korhaan and Lanner Falcon.

Table 5.8: At risk species found during the field surveys

Common Name	Scientific Name	Collision	Electrocution	Habitat Loss
African Darter	*Anhinga rufa*	x		
African Fish Eagle	*Haliaeetus vocifer*	x	x	
African Harrier-Hawk	*Polyboroides typus*	x	x	
African Sacred Ibis	*Threskiornis aethiopicus*	x	x	
Black Harrier	*Circus maurus*	x	x	x
Black-chested Snake Eagle	*Circaetus pectoralis*		x	
Black-headed Heron	*Ardea melanocephala*	x	x	
Blue Crane	*Grus paradisea*	x		x
Blue Korhaan	*Eupodotis caerulescens*	x	x	x
Cape Eagle-Owl	*Bubo capensis*		x	
Egyptian Goose	*Alopochen aegyptiaca*	x	x	
Gabar Goshawk	*Micronisus gabar*		x	
Greater Kestrel	*Falco rupicoloides*		x	
Grey Heron	*Ardea cinerea*	x	x	
Hadeda (Hadada) Ibis	*Bostrychia hagedash*	x	x	
Hamerkop	*Scopus umbretta*	x		

Common Name	Scientific Name	Collision	Electrocution	Habitat Loss
Helmeted Guineafowl	*Numida meleagris*		x	
Jackal Buzzard	*Buteo rufofuscus*	x	x	
Karoo Korhaan	*Eupodotis vigorsii*	x	x	x
Kori Bustard	*Ardeotis kori*	x	x	x
Lanner Falcon	*Falco biarmicus*			x
Northern Black Korhaan	*Afrotis afraoides*	x	x	x
Pale Chanting Goshawk	*Melierax canorus*	x	x	
Pied Crow	*Corvus albus*		x	
Reed Cormorant	*Microcarbo africanus*	x	x	
Rock Kestrel	*Falco rupicolus*		x	
Secretarybird	*Sagittarius serpentarius*	x		x
South African Shelduck	*Tadorna cana*	x	x	
Spotted Eagle-Owl	*Bubo africanus*		x	
Spur-winged Goose	*Plectropterus gambensis*	x	x	
Tawny Eagle	*Aquila rapax*	x	x	x
Verreaux's Eagle	*Aquila verreauxii*	x	x	x
Western Barn Owl	*Tyto alba*		x	
Western Cattle Egret	*Bubulcus ibis*		x	
White-breasted Cormorant	*Phalacrocorax lucidus*	x	x	
White-faced Whistling Duck	*Dendrocygna viduata*	x	x	
White-necked Raven	*Corvus albicollis*		x	
Yellow-billed Duck	*Anas undulata*	x	x	

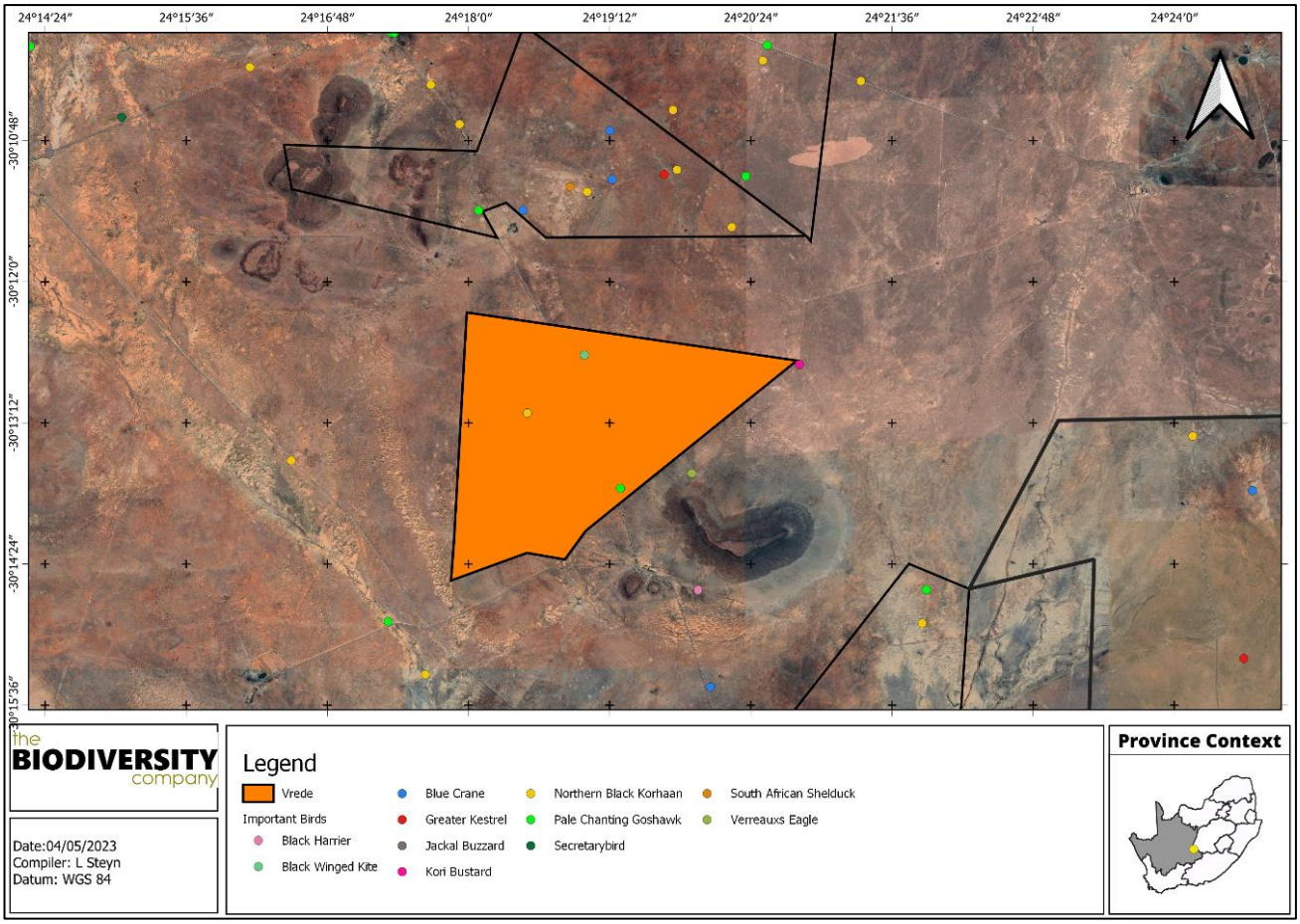

Figure 5.16: Risk species in close proximity to the project area

Table 5.9: Species of conservation concern observed during the survey (EN = Endangered; VU= Vulnerable, LC = Least Concerned, NT = Near Threatened)

Common Name	Scientific Name	Conservation Status		Total Birds	Total Sightings
		Regional	Global		
Tawny Eagle	*Aquila rapax*	EN	VU	3	2
Verreaux's Eagle	*Aquila verreauxii*	VU	LC	5	3
Kori Bustard	*Ardeotis kori*	NT	NT	1	1
Black Harrier	*Circus maurus*	EN	EN	1	1
Blue Korhaan	*Eupodotis caerulescens*	LC	NT	2	1
Karoo Korhaan	*Eupodotis vigorsii*	NT	LC	3	2
Lanner Falcon	*Falco biarmicus*	VU	NT	1	1
Blue Crane	*Grus paradisea*	NT	VU	69	4
Secretarybird	*Sagittarius serpentarius*	VU	EN	18	12

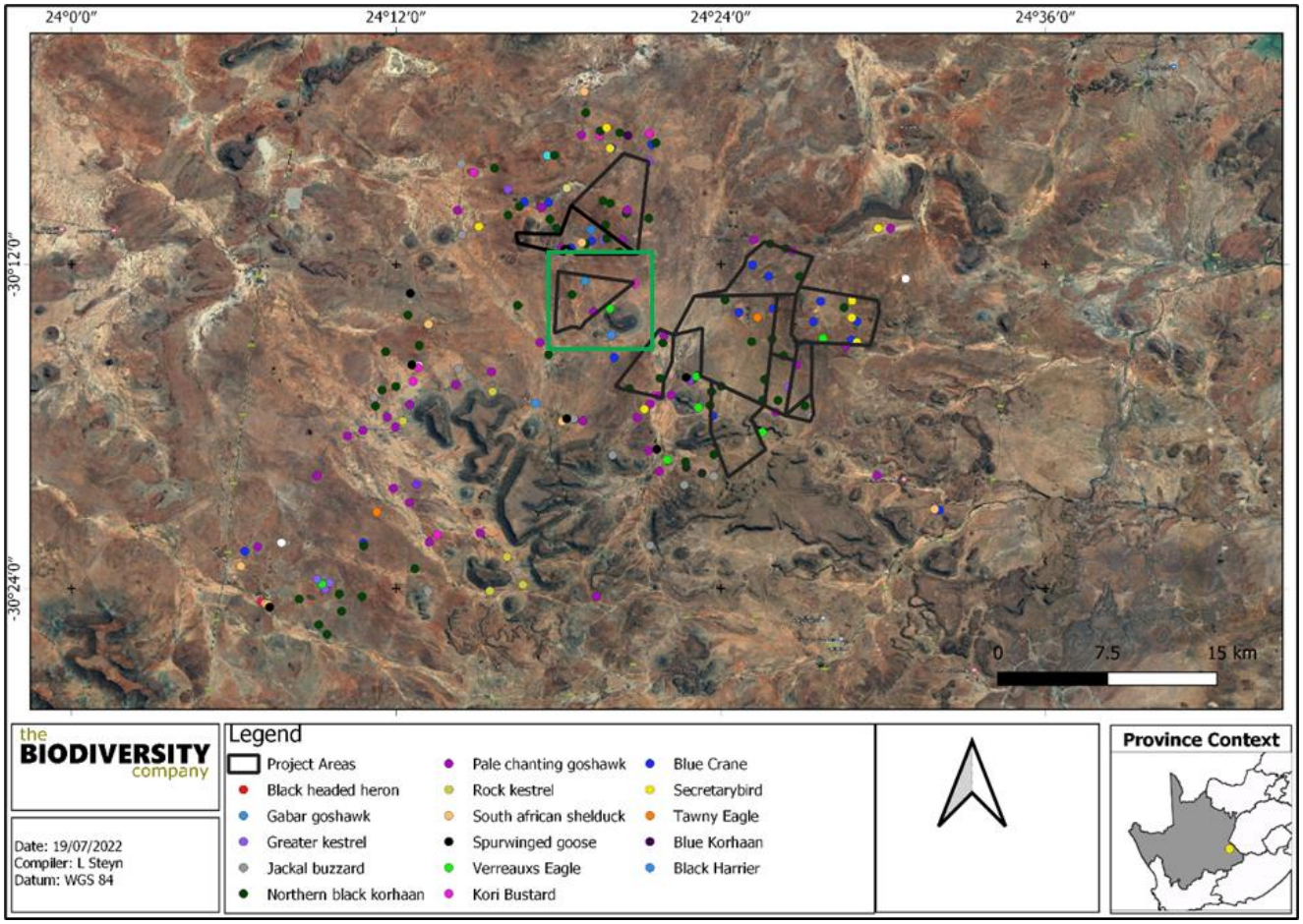

Figure 5.17: Location of the recordings of the species of conservation concern in the 2nd survey. Vrede site indicated by green rectangle

5.8. Heritage Resources

De Aar was originally established on the Farm "De Aar." The name means "the artery," a reference to its underground water supply. The Cape Government Railways were founded in 1872, and the route that the government chose for the line to connect the Kimberley diamond fields to Cape Town on the coast, ran directly through De Aar. Because of its central location, the government also selected the location for a junction between this first railway line, and the other Cape railway networks further east, in 1881. In 1899 two brothers who ran a trading store and hotel at the junction, Isaac and Wulf Friedlander, purchased the farm of De Aar. Following the Anglo Boer War, the Friedlander brothers surveyed the land for the establishment of a town. The municipality was created a year later in 1900.

Kruger (2012) describes the development area as "characterised by flat undulating Karoo vegetation comprised out of relatively sparse scrub and grasses, with dolerite hills in the surrounding landscape. Large portions of the land is currently devoted to livestock farming but a number of solar energy facilities are to be constructed on farms around De Aar. Shallow soils covers a combination of calcrete, shale and dolerite substrates, and large sections in the landscape are exposed to sheet erosion, specifically along low lying areas and drainage lines. Dolerite and sandstone is present, while exotic rocks occur in the gravel of the Orange River bed and terraces. These provided suitable material for stone tool production during the Earlier, Middle and Later Stone Ages."

5.8.1. Archaeology

As part of the 2012 process for approval of the Vetlaagte Solar Energy Facility, Kruger conducted a detailed Heritage Impact Assessment. According to Kruger (2012), "*During the survey, widespread Middle Stone Age (MSA) material, including characteristic formal MSA stone tools such as points, blades and scrapers were documented in the survey area along a north-south oriented drainage on the eastern periphery of the property. The lithic remains occur in three large scatters and, almost without exception, in low lying areas along non-perennial drainage lines and wetland areas where precipitation and groundwater have exposed the stone tools, originally deposited on a decomposed calcrete rock layer approximately 30cm sub surface. Preliminary examinations of some of the lithics indicated that a number of flakes displayed facetted platforms, characteristic of the MSA.*"

Kruger (2012) also documented historical period remains, "*specifically the old Vetlaagte homestead with restored farmhouse, outbuildings, midden and labourers' quarters, as well as a dilapidated dam wall constructed in the drainage line east of the farmstead are present on the property. The date of construction of the farm house is denoted by a year count ("1930") on the front gable of the structure. The entire farmstead is situated in an area excluded from the solar farm development. A small family graveyard, associated with the farmstead at Vetlaagte, also occurs in the exclusion zone about 100m north of the farmhouse.*"

The approved Castle Wind Energy Facility lies on the hills just to the south-east of the project area. The development area has been subject to a previous heritage impact assessment process (Van der Walt, 2014, SAHRIS ID 183142) and a palaeontology assessment (Milsteed, 2014, SAHRIS ID 183143). A number of San engravings can be found on the dolerite boulders spread throughout the area and a more recent historical set of engravings has been made since the establishment of diamond mining at Kimberley and the spread of stock farming in the area.

In a recent (2021) assessment of Wag n Bietjie PV Facility completed by CTS Heritage, over 25 archaeological observations were made. Hornfels dominated the assemblages with smaller components of CCS and siltstones. While the vast majority of the scatters were made during the Middle Stone Age, there was also a relatively clear Later Stone Age presence in the study area. Many examples of blade forms were found which is typical of the Still Bay period (>70 000 years BP). The neighbouring Vetlaagte farm was also surveyed whilst conducting an HIA for a similar solar PV facility there. Relatively dense Later Stone Age sites were found on the far eastern end of Wag 'n Bietjie and these date within the last 2000 years due to the presence of pottery in these sites. The increasing density of material as one moved eastwards was probably due to the shortening distance from the Brakrivier which runs around Caroluspoort (4km northeast of Wag 'n Bietjie).

Two sites warranted protection with an interesting scatter of Still Bay tools on top of a dolerite outcrop with excellent views of the surrounding area. Another site was found warranting a IIIB rating with pottery, bone and an extensive stone tool assemblage amongst the dolerite outcrops on the eastern end of the property. The rest of the observations are typical of the area and are ubiquitously distributed in low densities of less than 5 artefacts per observation. Much of the archaeological material will be well conserved within a series of areas that can't be developed for the solar PV arrays while the flat, grassy vlaktes that are ideal for the solar PV areas also have the lowest archaeological sensitivity.

The area also played a part in the South African War from 1899-1902. According to Cloete (2010), a Boer party led by Generals Fourie and De Wet had to abandon ammunition and goods near Houtkraal when they encountered British troops guarding the railway line.

5.8.2. Palaeontology

According to the SAHRIS Palaeosensitivity Map (**Figure 5.18**), the area proposed for development is underlain by sediments of high and very high paleontological sensitivity. According to the extract from the Council for GeoSciences Map 3024 for Colesburg (**Figure 5.19**), the development area is underlain by Jurassic Dolerite, the Tierberg Formation of the Ecca Group and the Adelaide Subgroup of the Beaufort Group.

As part of the Vetlaagte project in 2012, Almond completed a field-based palaeontological assessment. Almond (2012) found that "*The potentially fossiliferous sediments of the Late Palaeozoic Karoo Supergroup (Ecca and Lower Beaufort Groups) that underlie the study area are almost entirely mantled in a thick layer of superficial deposits of probable Pleistocene to Recent age. These include various soils, gravels and – at least in some areas - a well-developed calcrete hardpan. The upper Ecca Group bedrocks in the northern portion of the study area contain locally abundant fossil wood (of palaeontological interest for dating and palaeoenvironmental studies), as well as low diversity non-marine trace fossil assemblages typical of the Waterford Formation, rather than the Tierberg Formation as mapped. No vertebrate fossils and only scattered woody plant impressions of the Permian Glossopteris Flora were observed within the Lower Beaufort Group rocks that are very poorly exposed in the southern portion of the Vetlaagte study area. Trace fossils, silicified wood and rare vertebrate remains (therapsids, parareptiles) of the Middle Permian Pristerognathus Assemblage Zone have recently been recorded from this succession in the De Aar region (Almond 2010b). Extensive dolerite sills and dykes of the Early Jurassic Karoo Dolerite Suite intruding the Karoo Supergroup sediments are entirely unfossiliferous, as are rare intrusive kimberlite pipe rocks of Cretaceous age. The diverse superficial deposits within the three study areas (e.g. soils, gravels, alluvium, calcrete hardpans) are of low palaeontological sensitivity as a whole. Abundant fragments of reworked fossil wood material of Ecca provenance occur widely within subsurface and surface gravels overlying the Ecca Group outcrop area*."

In Bamford's assessment completed for the area in 2021, she notes that "*Based on experience, other reports and the lack of any significant previously recorded fossils from the area, it is unlikely that any fossils would be preserved in the Tierberg Formation or Adelaide Subgroup. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr.*"

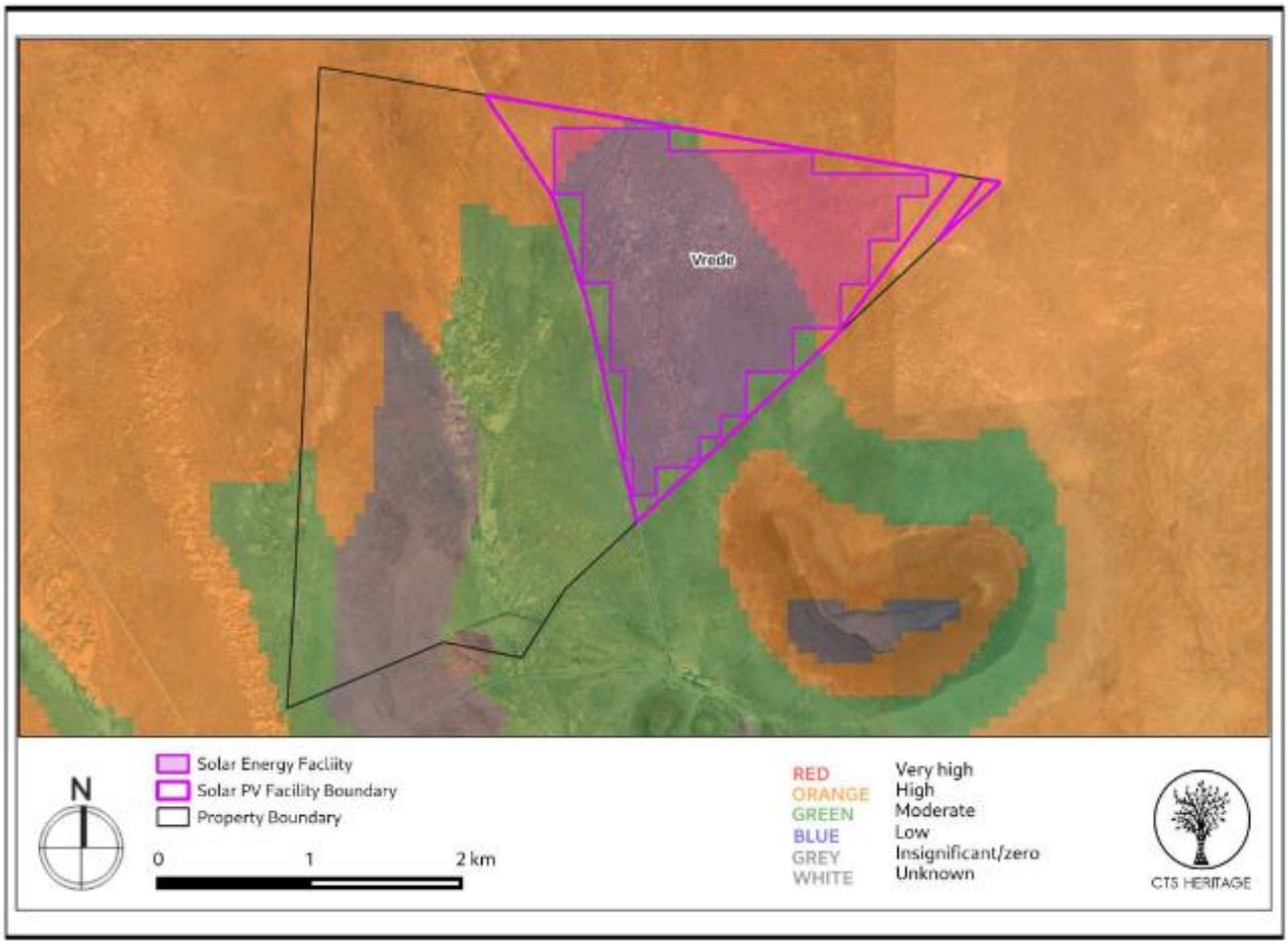

Figure 5.18: Palaeontological sensitivity of the proposed development area

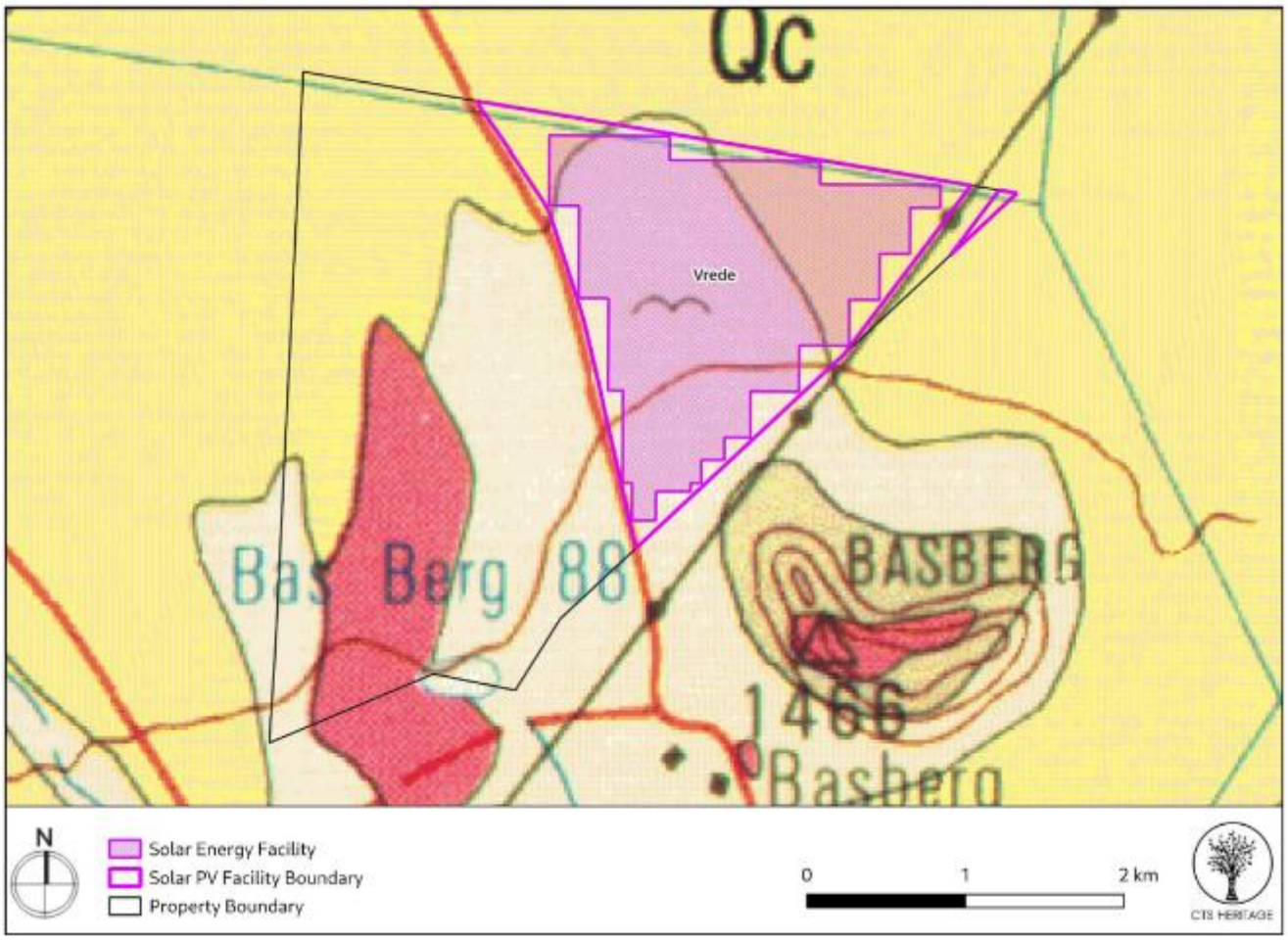

Figure 5.19: Extract from the Council of GeoScience Geology Map tile 3024 for Colesberg indicating that the area proposed for development is underlain by Quaternary Sands.

5.9 Visual Quality

The areas of the study area outside of formal towns are sparsely populated (i.e. less than two people per km^2 within the district municipality). A number of isolated homesteads occur throughout the study area. Some of these in the study area include:

- Vredehof
- Jakobsrus
- Wolwekuil
- Leeubergspoort
- Donkerhoek
- Swartkoppies
- Rooidam
- Driefontein
- Vrede
- Bokkraal

Figure 5.20: Examples of types of dwellings found in the area

The R388 traverses the study area and is found to the west of the proposed Crossroads Green Energy Cluster. The R48 is located to the south of the study area passing through Philipstown. Rail infrastructure runs from north to south adjacent to the R388 in the west of the study area. These lines include both freight and passenger lines. Various secondary roads provide access to the various sites.

Other industrial infrastructure within the study area includes the Kalkbult and Antelope switching stations (to the west of the proposed Vrede Solar PV Facility). There is a significant network of power lines transecting the study area. Some of these include:

- Antelope/Behrshoek 1 132 kV
- Gamma/Perseus 1 765 kV
- Hydra/Perseus 1 765 kV
- Hydra/Perseus 3 400 kV
- Hydra/Perseus 2 400 kV
- Beta/Hydra 1 400 kV
- Hydra/Roodekuil 1 132 kV
- Hydra/Roodekuil 2 200 kV

Most of the study area landowners are affected by at least one line (Photograph 3.4). Eskom is currently envisaging the construction of a Main Transmission Station (MTS) on Koppy Alleen 83/1, approximately 11 km to the southwest of the project site.

Figure 5.21: Electrical infrastructure that traverses the study area

Despite the significant industrial type infrastructure, the greater landscape of the study area is characterised by wide-open spaces and otherwise very limited development. It should however be noted that there are a number of authorised (and current) renewable energy applications within the study area and the greater region, that may change the landscape to some degree in the future. There are no formally protected or conservation areas within the study area[8].

5.10 Road Infrastructure

The study area is primarily accessed off the R48 via a network of intersecting public gravel roads. The R48 links Petrusville to De Aar via Philipstown. The road currently carries significant ore truck traffic and sections of the road are in a poor state. The key intersecting public gravel roads providing access to the study area (from north to south) are the Graspan-, Rooipoort- and Houtkraal roads. The relevant roads are connected by a network of further gravel roads. Many properties are accessible by more than one road.

5.11 Social Context

5.11.1 Profile of the Broader Area

The proposed site located in the Northern Cape Province, which is the largest province in South Africa and covers an area of 361 830 km2 and, constitutes approximately 30% of South Africa. The province is divided into five district municipalities (DM), namely, Frances Baard, Karoo, Namakwa, Pixley Ka Seme and ZF

[8] Sources: DEAT (ENPAT Northern Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland), NLC2018 (ARC/CSIR), REEA_OR_2021_Q1 and SAPAD2021 (DFFE), Wikipedia.

Mgcawu District Municipality (known before 1 July 2013 as Siyanda DM). The site itself is located in the Pixley Ka Seme DM.

Population, Households and House Types, Income, Employment Profile and Education

Population

The population of the RLM in 2016 was 11 818. The RLM is therefore a sparsely populated municipality. Of this total, 37% were under the age of 18, 56.8% were between 18 and 64, and the remaining 6.1% were 65 and older. The RLM therefore has a relatively large young population. This creates challenges in terms of creating employment opportunities. In terms of race groups, Coloureds made up 57% of the population, followed by Black Africans (32.8%) and Whites (9.8%). The main first language spoken in the RLM was Afrikaans (69.9%), followed by IsiXhosa (26.3%) and Sesotho (1%).

The high percentage of young people in the RLM means that a large percentage of the population is dependent on a smaller productive sector. The dependency ratio is the ratio of non-economically active dependents (usually people younger than 15 or older than 64) to the working age population group (15-64). The higher the dependency ratio the larger the percentage of the population dependent on the economically active age group. This in turn translates reduced revenue for local authorities to meet the growing demand for services. The national dependency ratio in 2011 was 52.7%, similar to that of the Northern Cape Province (55.7%). The dependency ratio for the RLM (2011) was 64%. The traditional approach is based people younger than 15 or older than 64. The 2016 information provides information for the age group under 18. The total number of people falling within this age group will therefore be higher than the 0-15 age group. However, most people between the age of 15 and 17 are not economically active (i.e., they are likely to be at school).

Using information on people under the age of 18 is therefore likely to represent a more accurate reflection of the dependency ratio. Based on these figures, the dependency ratio for the RLM in 2016 was 75.8%. This figure is significantly higher than the national and provincial levels in 2011 (52.7% and 55.7% respectively). The higher dependency ratio reflects the limited employment opportunities in the area and represent a significant risk to the district and local municipality. The high dependency ratio also highlights the importance to maximising local employment opportunities and the key role played by training and skills development programmes.

Households and House Types

Based on the information from the 2016 Community Survey there were a total of 3 563 households in the RLM. Most of the households reside in formal houses (71.4%). The figure for the RLM is lower that the district (78.1%) and Provincial (74.4%) figures. Approximately 14.7% of the households in the RLM reside in shacks and 7.5% in backyard flats. A relatively high percentage of the households therefore live in informal structures.

Based on the information from the 2016 Community Household Survey 34.4% of the households in the RLM are headed by females. The figure for RLM was lower than the District and Provincial figures of 37% and 39% respectively. The high number of female-headed households at the local municipal reflects the lack on formal employment and economic opportunities in the RLM. As a result, job seekers from the RLM need to leave the areas to seek work in the larger centres. The majority of the job seekers are likely to be males. This is due to traditional rural patriarchal societies where the role of the women is usually linked to maintaining

the house and raising the children, while the men tend to be the ones that migrate to other areas in search of employment.

Household Income

Based on the data from the 2011 Census, 11.7% of the population of the RLM had no formal income, 3.8% earned less than R 4 800, 6.3% earned between R 5 000 and R 10 000 per annum, 23.8% between R 10 000 and R 20 000 per annum and 23.4% between R 20 000 and 40 000 per annum (2011). The poverty gap indicator produced by the World Bank Development Research Group measures poverty using information from household per capita income/consumption. This indicator illustrates the average shortfall of the total population from the poverty line. This measurement is used to reflect the intensity of poverty, which is based on living on less than R3 200 per month for an average sized household (~ 40 000 per annum). Based on this measure, in the region of 70% of the households in the RLM live close to or below the poverty line. This figure is higher that the provincial level of 62.9%. The low-income levels reflect the limited employment opportunities in the area and dependence on the agricultural sector. This is also reflected in the high unemployment rates.

The low-income levels are a major concern given that an increasing number of individuals and households are likely to be dependent on social grants. The low-income levels also result in reduced spending in the local economy and less tax and rates revenue for the RLM. This in turn impacts on the ability of the RLM to maintain and provide services.

Employment

The official unemployment figure in 2011 for the RLM was 14.3%. The figures also indicate that the majority of the population are not economically active, namely 41.8%. These figures are similar to the official unemployment rate for the Northern Cape Province (14.5%) and Pixley ka Seme District (14.8%). This reflects the limited employment opportunities in the area, which in turn are reflected in the low income and high poverty levels. Unemployment Rate in South Africa averaged 26.32% from 2000 until 2021, reaching an all-time high of 34.90 % in the third quarter of 2021 (StatSA). Even more concerning, the Youth Unemployment Rate in South Africa averaged 54.21% from 2013 until 2021, reaching an all-time high of 64.40 % in the second quarter of 2021. The current rates in the RLM are therefore likely to be significantly higher that the 2011 rates. These rates will also have been exacerbated by the impact of COVID-19 pandemic.

Education

In terms of education levels, the percentage of the population over 20 years of age in the RLM with no schooling was 11.2% in 2011, compared to 7.9% for the Northern Cape Province and 11.9% for the district. The percentage of the population over the age of 20 with matric was 33.6%, which was significantly higher that the provincial and district figures of 29.1% and 25.3% respectively. Only 1.4% and 2% of the population over the age of 20 years in the RLM had an undergraduate and postgraduate qualification, respectively. Despite the higher matric qualification rate, the relatively poor education levels in the RLM pose potential challenge for economic development.

5.11.2 Profile of the Project Affected Area

The study area properties are used primarily for farming livestock, predominantly sheep for wool production. Carrying capacities are modest, around 3 ha per sheep. Most operations rely on networks of boreholes and

watering points. No significant cropping activities are associated with the study area, although a few livestock operations grow modest quantities of irrigated fodder for own use. Economic farming units in the study area are large, typically consisting of several properties. Some farmers lease additional land. The study area settlement is consequently sparse, and mainly concentrated on a few base farms, typically near public roads. Labourers typically live on the base properties. Caretaker staff reside on a few secondary properties. Farmsteads and labourers' houses on several properties have become redundant and are no longer inhabited.

Game occurs on most study area properties. Several properties offer annual (winter) commercial hunting opportunities. Trophy hunting in the Petrusville-Philipstown area is currently only associated with mixed livestock operations based on Wolwekuil (Fourie), Jakkalskuil (de Villiers) and Vlakplaas (Bester). Each of these properties offer accommodation specifically for hunting parties. Jakkalskuil is the only operation primarily focused on international hunters. No safari related tourism is associated with any of the three operations. No farm stay accommodation or other tourism is associated with the study area. No protected natural areas are located in or in significant proximity of the study area.

5.11.3. Site and adjacent properties

The Vrede PV site is proposed on a portion of a single property, Grass Pan 40/3. The site property borders onto 9 properties. Grass Pan 40/3 is owned by Mr Pierre van der Berg. The site-adjacent properties are owned by six landowners, namely Mr Kobus de Villiers, Mr Chris Nel, Ms Marie Haumann, Ms Carin de Bruin, Ms. Santi Botha, and Mr Charley Louw. Mr van der Berg and his labour force (3 households) reside on near-adjacent Tafel Kop 39/RE (Vrede) (Table 3.1 and Photograph 3.5). The farmstead and labourers' dwellings on Grass Pan 40/3 (Jakobsrus, site) are no longer inhabited (Photograph 3.6). Mr de Villiers is based on Jakkalskuil 209/RE (Jakkalskuil). The dwellings on Ventersdam are uninhabited. The dwelling on Grass Pan 40/5 (Middelplaas) is not permanently inhabited.

In as far as could be established, all the relevant properties apart from the 27 ha Grass Pan 40/5 (Middelplaas) are used for livestock farming. In addition, the de Villiers properties (Jakkalskuil, Ventersdam) and Grass Pan 40/4 (leased by Mr de Villiers) are also used for trophy hunting. The operation focuses on the international market. The Karoo ('African') sense of place is a key anchoring attraction. Accommodation is offered on Jakkalskuil (yard). No safari tourism or farm stay accommodation is associated with the operation. The combined livestock/ game operation provides full time employment to 10 workers. Seven labourer households reside on Jakkalskuil.

Seven site-adjacent properties are currently affected by transmission line infrastructure. Four site-adjacent properties are currently proposed to accommodate Crossroads Phase 1 or ABO Kudu PV SEFs, namely Grass Pan 40/4 (Middelplaas PV), Wolwe Kuil 43/2 (Kudu 11 and 12 PV), Annexe Wolve Kuil 41/1 (Kudu 8-11 PV), and Grass Pan 40/2 (Kudu 6 & 7 PV). Two site-adjacent property owners are affected by one or more PV projects currently proposed on their larger properties. Mr van der Berg, the Koppy Alleen PV site owner, is also affected by the proposed Koppy Alleen PV on another property.

The site property is used for grazing by livestock (sheep) and commercial hunting. Total footprint losses to the relevant operation would be <10% of the economic unit. Footprint losses to grazing associated with infrastructure could be absorbed by the larger operation. No cropping areas would be affected by proposed infrastructure.

Only one permanently inhabited farm is located within a 5 km range of the Vrede site, namely Wolve Kuilen 42/RE (Wolwekuil, 4.5 km). The Kudu 8-12 PV sites are located on intervening properties belonging to the owner of Wolwekuil, Mr Chris Nel.

The only potentially visually sensitive receptor, the overseas-market orientated trophy hunting Jakkalskuil-based operation, is located approximately 3.6 km (boundary) to the north-east of the site. As indicated above, accommodation for hunters is provided at the Jakkalskuil yard, approximately 10.6 km to the north of the site. No accommodation or other tourism facilities are associated with the study area.

Information pertaining to proposed site access and project roads is not currently available. Several farmyards are located directly adjacent to various public gravel roads in the study area.

CHAPTER 6: ASSESSMENT OF IMPACTS

This chapter serves to assess the significance of the positive and negative environmental impacts (direct, indirect and cumulative) expected to be associated with the development of the Vrede Solar PV Facility. This assessment has considered the construction of a solar PV facility with a contracted capacity of up to 150MW, within a development footprint of approximately 400ha. The development footprint includes the following infrastructure:

- Solar PV array comprising PV modules and mounting structures (monofacial or bifacial and of fixed-tilt, single-axis tracking, and/or double-axis tracking PV technology)
- Inverters and transformers
- Cabling between the project components
- Battery Energy Storage System (BESS)
- On-site facility substation and power lines between the solar PV facility and the Eskom substation (to be confirmed and assessed through a separate process)
- Site offices, Security office, operations and control, and maintenance and storage laydown areas
- Access roads, internal distribution roads

The development of the Project will comprise the following phases:

- *Pre-Construction and Construction* – will include pre-construction surveys; site preparation; establishment of access roads, construction camps, batching plant, laydown areas, and facility infrastructure; construction of foundations involving excavations and cement pouring; the transportation of components/construction equipment to site; laying cabling; and commissioning of new equipment and site rehabilitation. The construction phase for the Project is estimated up to 18 months.
- *Operation* – To evacuate the generated power to the surrounding properties, power lines will be established to connect the on-site facility transformers to the existing Eskom substations. The existing access roads will be utilised for maintenance during operation.
- *Decommissioning* – at the end of the Project's life, decommissioning will include site preparation, disassembling of the components of the solar facility, clearance of the relevant infrastructure at the site and rehabilitation.

6.1. Approach to the Assessment of Impacts

The full extent of the project site (~1 101ha) was considered through the Scoping Phase of the EIA process by the independent specialists and the EAP. On-site sensitivities were identified through the review of existing information, desktop evaluations and detailed field surveys. The identification of a development footprint for the solar PV facility within the project site was undertaken by the developer through consideration of the sensitive environmental features and areas, and application of a mitigation hierarchy which aimed at avoidance as the first level of mitigation. The specialist assessments undertaken as part of this EIA process have considered the development footprint (refer to **Figure 6.1**) which was provided by the developer.

The sections which follow provide a summary of the specialist input for each field of study in terms of the impacts which are expected to occur, the significance of the impacts, the opportunity for mitigation of the impacts to an acceptable level and the appropriate mitigation measures recommended for the reduction

of the impact significance. Note that impacts associated with decommissioning are expected to be similar to those associated with construction activities and in certain instances, these impacts are not considered separately within this chapter. This section of the report must be read together with the detailed specialist studies contained in **Appendix D** to **K**.

Impacts associated with the Vrede Solar PV Facility have the potential to become more significant when considered in combination with the other developments within the area. The role of the cumulative assessment is to confirm if such impacts are relevant to the Vrede Solar PV Facility within the project site being considered for the development. This assessment considers whether the cumulative impact will result in:

- Unacceptable loss of threatened or protected vegetation types, habitat, or species through clearing, resulting in an impact on the conservation status of such flora, fauna, or ecological functioning.
- Unacceptable risk to freshwater features through disturbance associated with construction activities and increased runoff and erosion during the operation phase.
- Unacceptable risk to avifauna through habitat loss, displacement, and collision with project infrastructure.
- Unacceptable loss of high agricultural potential areas presenting a risk to food security and increased soil erosion.
- Unacceptable loss of heritage resources (including palaeontological and archaeological resources and the cultural landscape).
- Complete or whole-scale change in the sense of place and character of an area and unacceptable visual intrusion.
- Unacceptable negative impact to socio-economic factors and components.

It is important to explore the potential for cumulative impacts as this will lead to a better understanding of these impacts and the potential for mitigation that may be required to ensure that the concentration of renewable energy projects do not lead to detrimental environmental impacts. For practical purposes, a sub-regional scale of 30km has been selected for this cumulative impact evaluation. In addition to renewable energy developments, there are a number of industrial-type developments in the immediate vicinity of the site, including mines which also occur within the region. Similar projects proposed within the 30km study area are reflected in **Figure 6.2**.

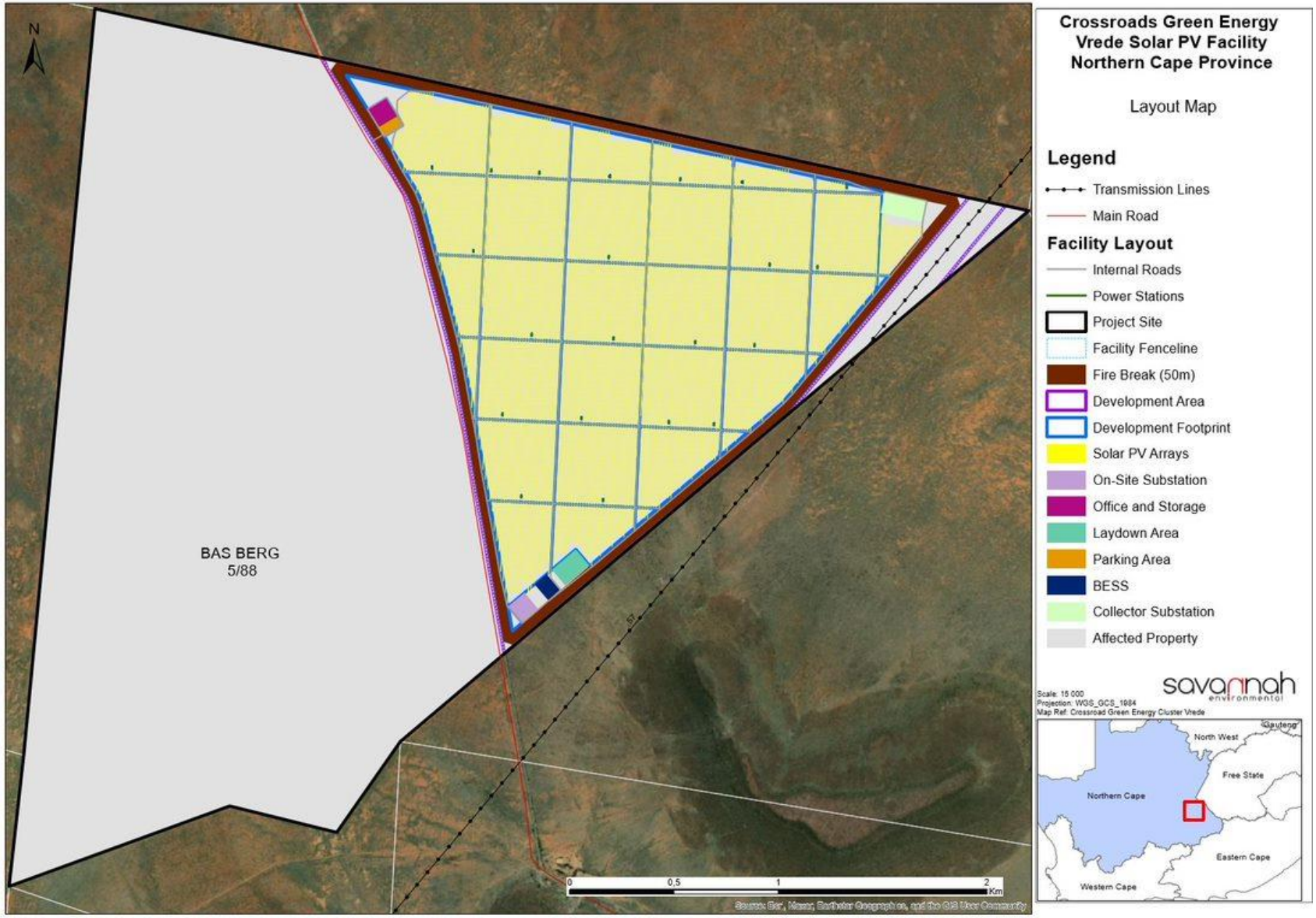

Figure 6.1: Layout map for Vrede Solar PV Facility

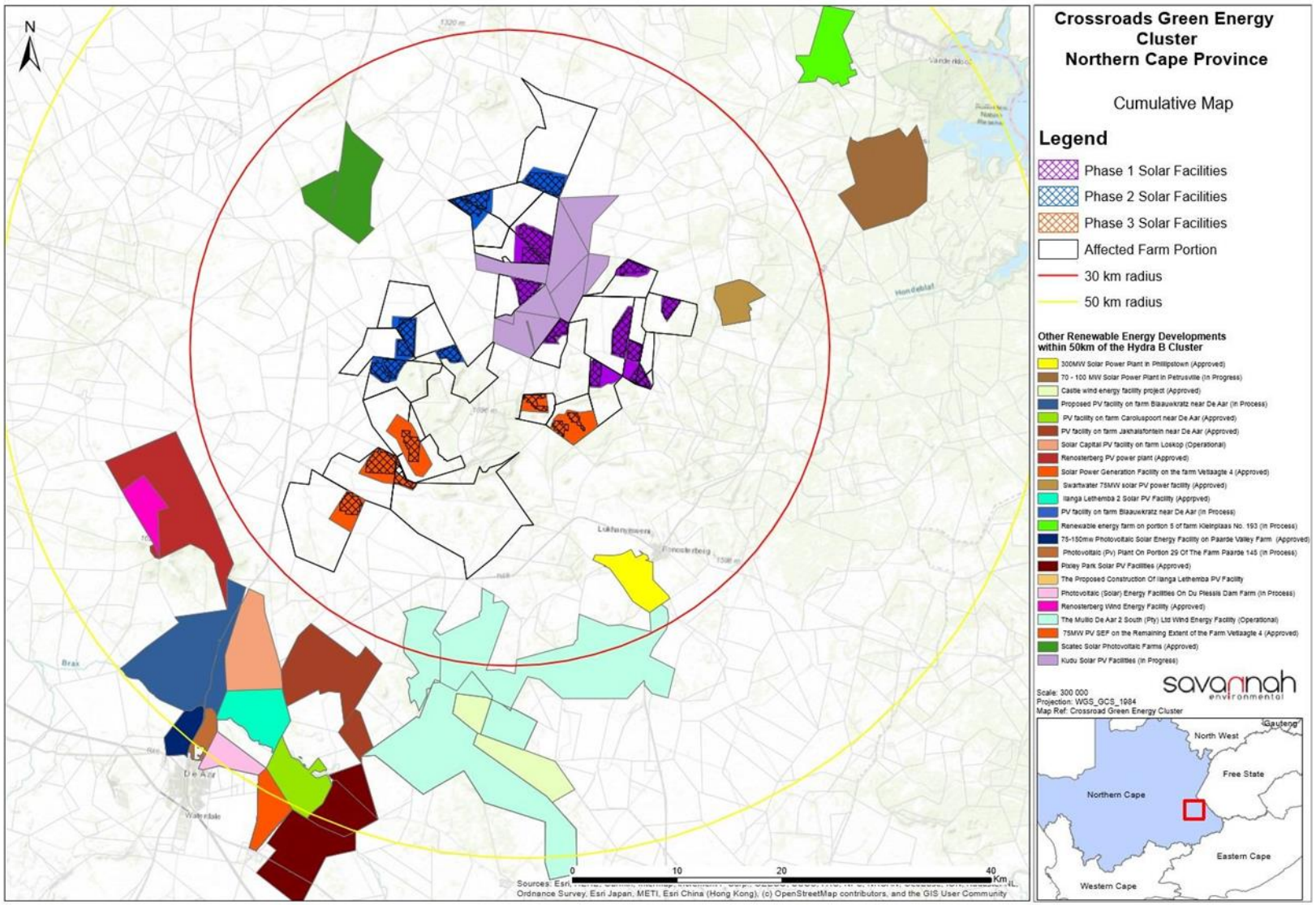

Figure 6.2: Map showing the Project Area within which the development footprint for the Vrede Solar PV Facility has been placed and assessed as part of this EIA process (also refer to **Appendix L** for maps).

6.2. Legal Requirements as per the EIA Regulations, 2014 (as amended), for the undertaking of an Environmental Impact Assessment Report

This chapter of the EIA Report includes the following information required in terms of the EIA Regulations, 2014 - Appendix 3: Scope of Assessment and Content of Environmental Impact Assessment Reports:

Requirement	Relevant Section
3(1)(h)(v) the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts (aa) can be reversed, (bb) may cause irreplaceable loss of resources, and (cc) can be avoided, managed or mitigated.	The impacts and risks associated with the development of the Project, including the nature, significance, consequence, extent, duration and probability of the impacts and the degree to which the impact can be reversed and cause an irreplaceable loss of resources are included in **Sections 6.3.2, 6.4.2, 6.5.2, 6.6.2, 6.7.2, 6.8.2, 6.9.2, 6.10.2,** and **6.11.2.**
3(1)(h)(vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects.	The positive and negative impacts associated with the development of the Project are included in **Sections 6.3.2, 6.4.2, 6.5.2, 6.6.2, 6.7.2, 6.8.2, 6.9.2, 6.10.2,** and **6.11.2**.
3(1)(h)(viii) the possible mitigation measures that could be applied and the level of residual risk.	The mitigation measures that can be applied to the impacts associated with the Project are included in **Sections 6.3.2, 6.4.2, 6.5.2, 6.6.2, 6.7.2, 6.8.2, 6.9.2, 6.10.2,** and **6.11.2**.
3(1)(i) a full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity, including (i) a description of all environmental issues and risks that were identified during the environmental impact assessment process and (ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.	A description of all environmental impacts identified for the Project during the EIA process, and the extent to which the impact significance can be reduced through the implementation of the recommended mitigation measures provided by the specialists are included in **Sections 6.3.2, 6.4.2, 6.5.2, 6.6.2, 6.7.2, 6.8.2, 6.9.2, 6.10.2,** and **6.11.2**.
3(1)(j) an assessment of each identified potentially significant impact and risk, including (i) cumulative impacts, (ii) the nature, significance and consequences of the impact and risk, (iii) the extent and duration of the impact and risk, (iv) the probability of the impact and risk occurring, (v) the degree to which the impact and risk can be reversed, (vi) the degree to which the impact and risk may cause irreplaceable loss of resources and, (vii) the degree to which the impact and risk can be avoided, managed or mitigated.	An assessment of each impact associated with the development of the Project, including the nature and significance, the extent and duration, the probability, the reversibility, and the potential loss of irreplaceable resources, as well as the degree to which the significance of the impacts can be mitigated are included in **Sections 6.3.2, 6.4.2, 6.5.2, 6.6.2, 6.7.2, 6.8.2, 6.9.2, 6.10.2,** and **6.11.2**
3(1)(m) based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as well as for inclusion as conditions of authorisation.	Mitigation measures recommended by the various specialists for the reduction of the impact significance are included in **Sections 6.3.2, 6.4.2, 6.5.2, 6.6.2, 6.7.2, 6.8.2, 6.9.2, 6.10.2,** and **6.11.2**.

6.3. Quantification of Areas of Disturbance on the Site

Site-specific impacts associated with the construction and operation of the Project relate to the direct loss of vegetation and species of special concern, disturbance of animals and loss of habitat and impacts on soils. In order to assess the impacts associated with the Project, it is necessary to understand the extent of the affected area.

The development footprint (**Figure 6.1**) will comprise of PV modules (mounted on either a fixed tilt or single axis tracker structure, dependent on optimisation, technology available and cost), a Battery Energy Storage System (with a capacity of up to 1 MWh per MW of solar PV, taking the assumption that 15% of daily consumption is stored resulting in a 240MWh BESS capacity within an extent of 1,15ha), and a laydown area. The maximum area of disturbance is approximated to be 400ha in extent (this is also the extent of the development footprint), some of which will be temporary and will be rehabilitated following construction.

Wherever possible, existing access roads will be utilised to access the Project Site and development footprint, essentially reducing the extent of disturbance resulting from access road construction. It is unlikely that access roads will need to be upgraded as part of the proposed development.

6.4. Potential Impacts on Terrestrial Ecology (including flora and fauna)

The development of the project is likely to result in a variety of impacts associated largely with the disturbance, loss and transformation of intact vegetation and faunal habitat to hard infrastructure such as PV panels and service areas, roads, operations buildings etc. Potential impacts and the relative significance of the impacts are summarised below (refer to **Appendix D** for more details).

6.4.1 Results of the Terrestrial Impact Assessment

One vegetation community type can be found in the project area: Karoo Grassland, which approximates Northern Upper Karoo (refer to **Table 6.1** and **Figure 6.3**). Based on the ecological assessment, all habitats within the project area of the proposed development were allocated a sensitivity category or Site Ecological Importance (SEI), which is considered a combined SEI for Terrestrial Biodiversity, Animal Species and Plant Species Themes (refer to **Figure 6.4**).

Table 6.1: Habitat types and associated SEI delineated within the field assessment area of the proposed development

Habitat Type	Description	Ecosystem Processes and Services	Conservation Importance (CI)	Functional Integrity (FI)	Biodiversity Importance (BI)	Receptor Resilience (RR)	Guidelines for interpreting SEI in the context of the proposed development activities
Karoo Grassland	Karroid shrubs and grasses on flat plains, homogenous in nature.	Provides foraging areas for fauna, provides	**Medium** > 50% of receptor contains natural	**High** Large (> 20 ha but < 100 ha) intact area for any	**Medium**	**Medium** Will recover slowly (~ more than 10 years) to	**Medium** Minimisation and restoration mitigation –

Habitat Type	Description	Ecosystem Processes and Services	Conservation Importance (CI)	Functional Integrity (FI)	Biodiversity Importance (BI)	Receptor Resilience (RR)	Guidelines for interpreting SEI in the context of the proposed development activities
		landscape-level; pollination and dispersal.	habitat with potential to support SCC.	conservation status of ecosystem type.		restore > 75% of the original species composition and functionality of the receptor	development activities of medium impact acceptable followed by appropriate restoration activities.

Much of the project area comprises large areas of intact indigenous vegetation with little to no existing degradation, making these areas suitable for a wide variety of plant species (not all of which could be identified as a result of the seasonality of the site visit) as well as suitable habitat for a suite of faunal species, most notably various mammals.

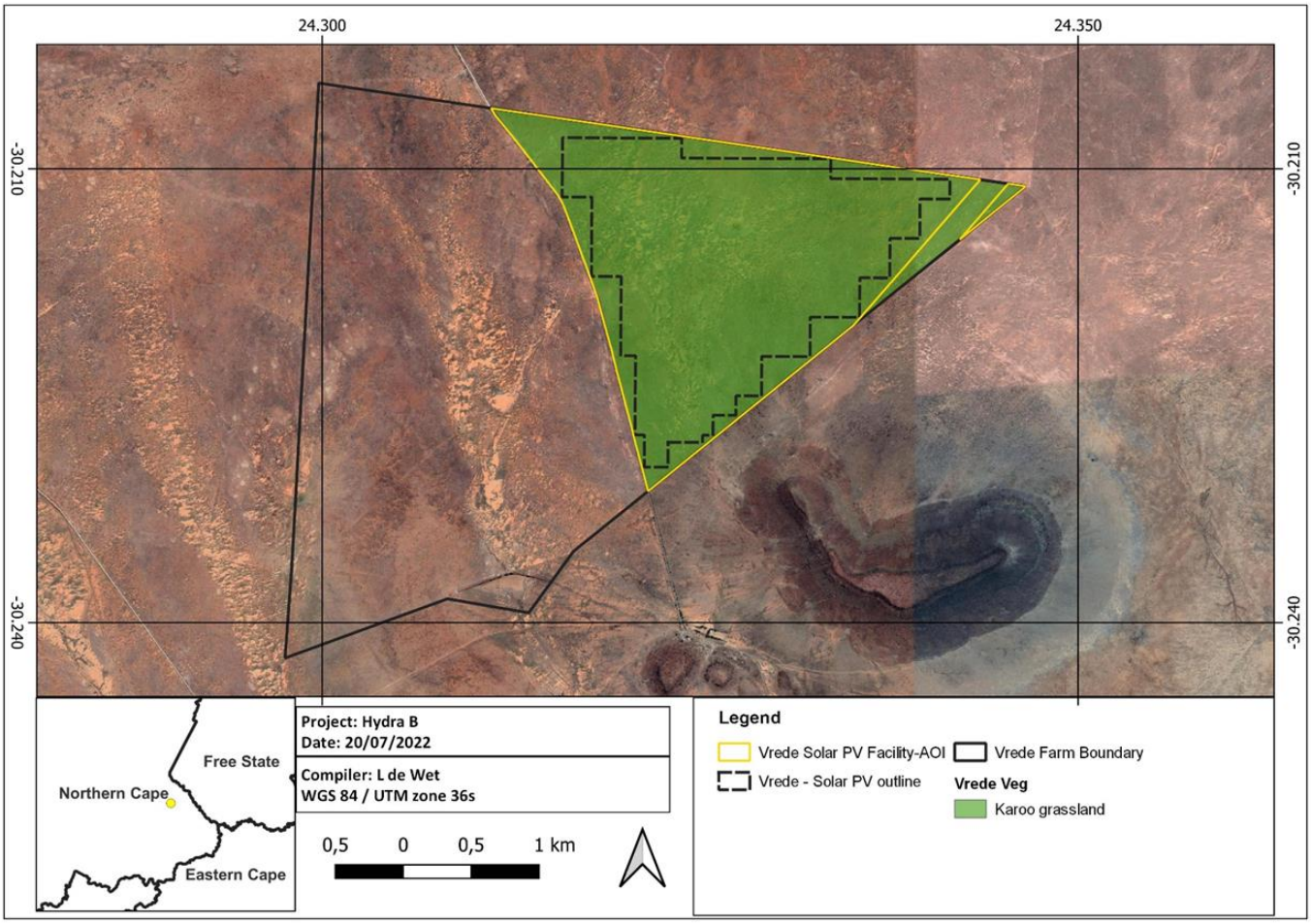

Figure 6.3: Map illustrating the habitats defined within the project area

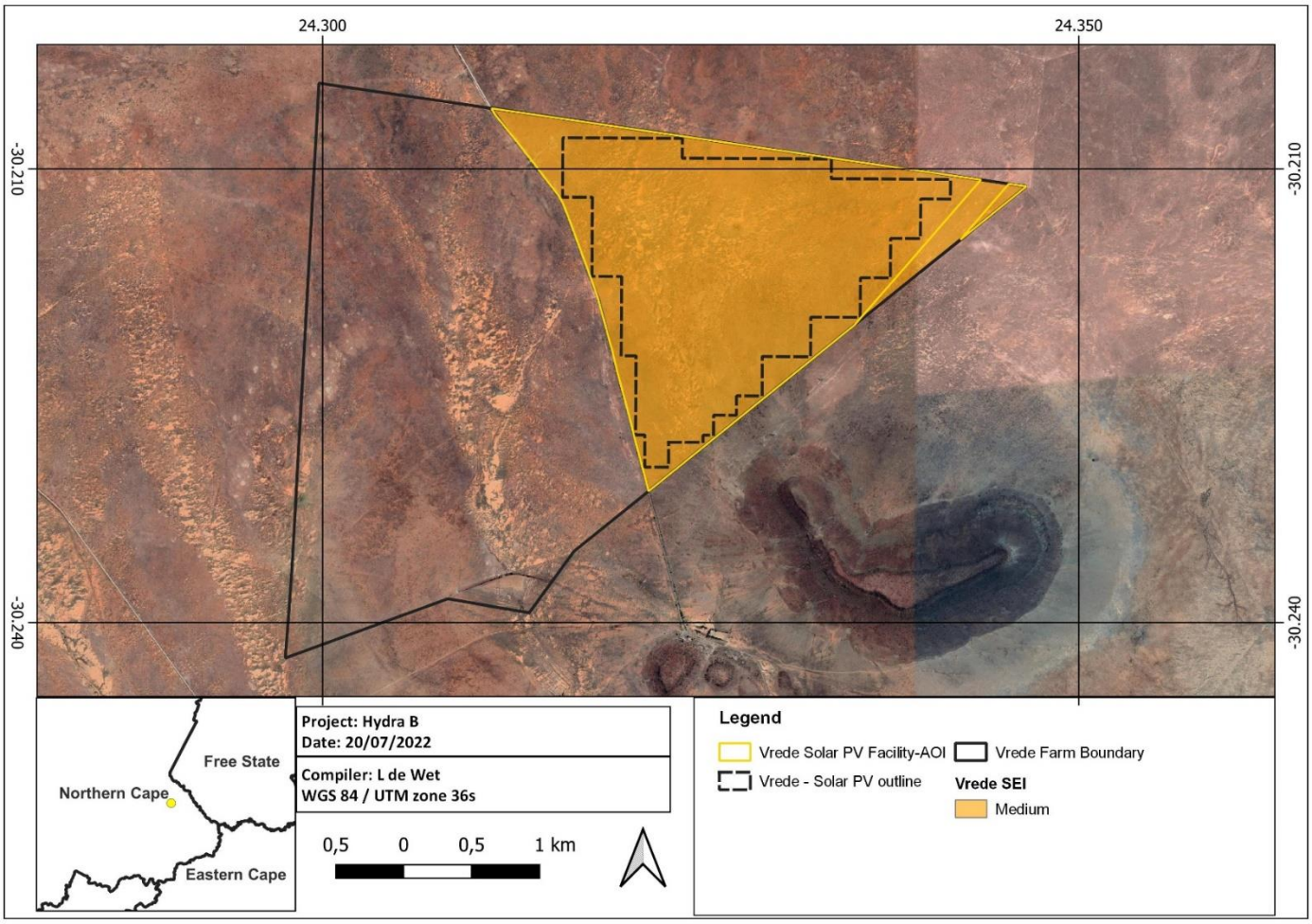

Figure 6.4: Map illustrating Site Ecological Importance (SEI) of the habitat types within the project area

6.4.2 Description of Impacts on Terrestrial Ecology

The potential impacts during the construction and operation phases of the project are presented in **Table 6.2**.

Table 6.2: Potential impacts to biodiversity associated with the proposed activity

Main Impact	Project activities that can result in impact	Secondary impacts anticipated
1. Destruction, fragmentation and degradation of habitats and ecosystems	Physical removal of vegetation, including protected species.	Displacement/loss of flora & fauna (including possible SCC)
	Access roads and servitudes	Increased potential for soil erosion
	Soil dust precipitation	Habitat fragmentation
	Dumping of waste products	Increased potential for establishment of alien & invasive vegetation
	Random events such as fire (cooking fires or cigarettes)	Erosion
2. Spread and/or establishment of alien and/or invasive species	Vegetation removal	Habitat loss for native flora & fauna (including SCC)
	Vehicles potentially spreading seed	Spreading of potentially dangerous diseases due to invasive and pest species

Main Impact	Project activities that can result in impact	Secondary impacts anticipated
	Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive rodents	Alteration of fauna assemblages due to habitat modification
3. Direct mortality of fauna	Clearing of vegetation	Loss of habitat
		Loss of ecosystem services
	Roadkill due to vehicle collision	Increase in rodent populations and associated disease risk
	Pollution of water resources due to dust effects, chemical spills, etc.	
	Intentional killing of fauna for food (hunting)	
4. Reduced dispersal/migration of fauna	Loss of landscape used as corridor	Reduced dispersal/migration of fauna
		Loss of ecosystem services
	Compacted roads	Reduced plant seed dispersal
	Removal of vegetation	
5. Environmental pollution due to water runoff, spills from vehicles and erosion	Chemical (organic/inorganic) spills	Pollution in watercourses and the surrounding environment
	Erosion	Faunal mortality (direct and indirectly)
		Groundwater pollution
		Loss of ecosystem services
6. Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and light pollution	Operation of machinery (Large earth moving machinery, vehicles)	Disruption/alteration of ecological life cycles due to noise
		Loss of ecosystem services
	Project activities that can cause disruption/alteration of ecological life cycles due to dust	Secondary impacts associated with disruption/alteration of ecological life cycles due to dust
	Vehicles	Loss of ecosystem services
7. Staff and others interacting directly with fauna (potentially dangerous) or poaching of animals	All unregulated/supervised activities outdoors	Loss of SCCs

6.4.3 Assessment of Potential Impacts and Recommended Mitigation Measures

Construction Phase Impacts

The following potential main impacts on the biodiversity (based on the framework above) were considered for the construction phase of the proposed development. This phase refers to the period during construction when the proposed features are constructed; and is considered to have the largest direct impact on biodiversity. The following potential impacts to terrestrial biodiversity were considered:

- Destruction, further loss and fragmentation of the habitats, ecosystems and vegetation community
- Introduction of alien and invasive species, especially plants
- Displacement of faunal community due to habitat loss, direct mortalities and disturbance (road collisions, noise, dust, vibration and poaching)

Impact Nature: Loss of vegetation within development footprint

Destruction, further loss and fragmentation of the of habitats, ecosystems and vegetation community

	Without mitigation	**With mitigation**
Extent	Moderate (3)	Very low (1)
Duration	Permanent (5)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (56)**	**Low (21)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes, although this impact cannot be fully mitigated as the loss of vegetation is unavoidable.	

Mitigation:

- Demarcate work areas during the construction phase to avoid affecting outside areas. Use physical barriers e.g., safety tape, not painted lines, and use signage
- Do not clear areas of indigenous vegetation outside of the direct project footprint
- Minimise vegetation clearing to the minimum required
- Consult a fire expert and compile and implement a fire management plan to minimise the risk of veld fires around the project site
- Compile and implement a rehabilitation plan from the onset of the project;
- Dust-reducing mitigation measures must be put in place and must be strictly adhered to, for all roads and bare (unvegetated) areas.
  - Reduce the dust generated by operational vehicles and earth moving machinery, through wetting the soil surface (with "dirty water") and putting up signs to enforce speed limits to enforce reduced speeds.
  - No non-environmentally friendly suppressants may be used as this could result in pollution of water sources.
- Rehabilitate areas as soon as they are no longer impacted by construction
  - The rehabilitated areas must be revegetated with indigenous vegetation
- Progressive rehabilitation will enable topsoil to be returned more rapidly, thus ensuring more recruitment from the existing seedbank. Surplus rehabilitation material can be applied to other others in need of stabilisation and vegetation cover
- Indigenous vegetation to be maintained under the solar panels to ensure biodiversity is maintained and to prevent soil erosion (Beatty et al, 2017; Sinha et al, 2018).
- Environmental Officer (EO) to provide supervision and oversight of vegetation clearing activities.

Residual Impacts:

The loss of currently intact vegetation is an unavoidable consequence of the project and cannot be entirely mitigated. The residual impact would however be low.

Impact Nature: Introduction of alien and invasive species, especially plants

Degradation and loss of surrounding natural vegetation, competition with indigenous fauna and flora, persecution of indigenous fauna species

	Without mitigation	**With mitigation**
Extent	Moderate (3)	Low (2)
Duration	Permanent (5)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (56)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High

Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

» Compile and implement an alien vegetation management plan from the onset of construction. The plan must identify areas for action (if any) and prescribe the necessary removal methods and frequencies to be applied. This plan must be also prescribing a monitoring plan and be updated as/when new data is collated;
» Implementation of a waste management plan, this plan must also prescribe a monitoring plan and be updated as/when new data is collated. Waste management must be a priority and all waste must be collected, stored and disposed of adequately. It is recommended that all waste be removed from site on a weekly basis (as a minimum) to prevent rodents and pests entering the site.
» Refuse bins must be emptied and secured.
» Temporary storage of domestic waste shall be in covered waste skips.
» Maximum domestic waste storage period will be 7 days.
» A pest control plan must be put in place and implemented; it is imperative that poisons not be used.

Residual Impacts:
Long-term broad scale. IAP infestation if not mitigated.

Impact Nature: Displacement of faunal community due to habitat loss, direct mortalities and disturbance

Construction activity will likely lead to direct mortality of fauna due to earthworks, vehicle collisions, accidental hazardous chemical spills and persecution. Disturbance due to dust and noise pollution and vibration may disrupt behaviour.

	Without mitigation	**With mitigation**
Extent	Moderate (3)	Very low (1)
Duration	Moderate term (3)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (48)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes, to some extent. Noise and disturbance cannot be well mitigated, impacts on fauna due to human presence, such as vehicle collisions, poaching, and persecution can be mitigated.	

Mitigation:

» Demarcate work areas during the construction phase to avoid affecting outside areas. Use physical barriers e.g., safety tape, not painted lines, and use signage.
» Prior to vegetation clearing activities, the area to be cleared should be walked on foot by 1-2 individuals to create a disturbance in order for fauna to move off. Sites should be disturbed only prior to the area having to be cleared, not more than 1 day in advance.
» Any fauna threatened by the construction activities should be removed safely by an appropriately qualified environmental officer or removal specialist.
» All construction vehicles should adhere to a speed limit of maximum 40 km/h to avoid collisions. Appropriate speed control measures and signs must be erected.
» Wildlife-permeable fencing with holes large enough for mongoose and other smaller mammals should be installed, the holes must not be placed in the fence where it is next to a major road as this will increase road killings in the area.
» Minimise vegetation clearing to the minimum required. Areas should be cleared and disturbed on a needs-only basis, as opposed to clearing and disturbing a number of sites simultaneously.
» All personnel and contractors must undergo Environmental Awareness Training. A signed register of attendance

must be kept for proof.
» The timing between clearing of an area and subsequent development must be minimized to avoid fauna from re-entering the site to be disturbed.
» Any holes/deep excavations must be done in a progressive manner on a needs-only basis. No holes/excavations may be left open overnight. In the event holes/excavations are required to remain open overnight, these areas must be covered to prevent fauna falling into these areas and subsequently inspected prior to backfilling.
» Where possible, work should be restricted to one area at a time and be systematic. This is to reduce the number and extent of on-site activities, allowing fauna to move off as the project progresses. This will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.
» Considering that many of the mammal fauna recorded within the project area are nocturnal, no construction activity is to occur at night.

Residual Impacts:
It is probable that some individuals of susceptible species will be lost to construction-related activities despite mitigation. However, this is not likely to impact the viability of the local population of any fauna species.

Operation Phase Impacts

The operational phase of the impact of daily activities is anticipated to further spread the IAP, as well as the deterioration of the habitats due to the increase of dust and edge effect impacts. Dust reduces the ability of plants to photosynthesize and thus leads to degradation/retrogression of the veld. Moving maintenance vehicles do not only cause sensory disturbances to fauna, affecting their life cycles and movement, but will lead to direct mortalities due to collisions.

The following potential impacts were considered:

» Continued fragmentation and degradation of habitats and ecosystems
» Spread of alien and/or invasive species
» Ongoing displacement and direct mortalities of faunal community (including SCC) due to disturbance (road collisions, noise, light, dust, vibration)

Impact Nature: Continued fragmentation and degradation of habitats and ecosystems

Disturbance created during the construction phase will leave the project area vulnerable to erosion and IAP encroachment.

	Without Mitigation	**With Mitigation**
Extent	Low (2)	Low (2)
Duration	Long term (4)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (48)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes, with proper management and avoidance, this impact can be mitigated to a low level.	

Mitigation:
» It should be made an offence for any staff to /take bring any plant species into/out of any portion of the PAOI. No plant species whether indigenous or exotic should be brought into/taken from the PAOI, to prevent the spread of exotic or invasive species or the illegal collection of plants.
» A Rehabilitation Plan must be written for the development area and ensured that it be adhered to.

- » Access roads should have run-off control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.
- » All erosion observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.
- » There should be follow-up rehabilitation and re-vegetation of any remaining denuded areas with local indigenous perennial grass, shrubs and trees.

Residual Impacts
There is still the potential some potential for erosion and IAP encroachment even with the implementation of control measures but would have a low impact.

Impact Nature: Spread of alien and/or invasive species

Degradation and loss of surrounding natural vegetation, competition with indigenous faunal species.

	Without mitigation	**With mitigation**
Extent	Moderate (3)	Low (2)
Duration	Long term (4)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (52)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- » Implementation of an alien vegetation management plan.
  - * Regular monitoring for IAP encroachment during the operation phase to ensure that no alien invasion problems have developed as result of the disturbance. This should be every 3 months during the first two years of the operation phase and every six months for the life of the project.
  - * All IAP species must be removed/controlled using the appropriate techniques as indicated in the IAP management plan
- » Compile and implement a Solid Waste Management Plan. Waste management must be a priority and all waste must be collected, stored and disposed of adequately. It is recommended that all waste be removed from site on a weekly basis as a minimum.
- » A pest control plan must be implemented; it is imperative that poisons not be used.

Residual Impacts:
Long term broad scale IAP infestation if not mitigated.

Impact Nature: Ongoing displacement and direct mortalities of faunal community (including potential SCC) due to disturbance (road collisions, noise, light, dust, vibration).

The operation and maintenance of the proposed development may lead to mortality, disturbance or persecution of fauna in the vicinity of the development.

	Without Mitigation	**With Mitigation**
Extent	Low (2)	Very low (1)
Duration	Long term (4)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (48)**	**Low (10)**
Status (positive or negative)	Negative	Negative

Reversibility	Moderate	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- No vehicle traffic nor the use of vehicle lights should be permitted during the night.
- Noise must be kept to a minimum from dusk to dawn to minimize all possible disturbances to amphibian species and nocturnal mammals
- Latest technology solar panels with an anti-reflective coating must be used. This will also improve the light transmittance and therefore increases the overall efficiency.
- If panels do not possess anti-reflective coatings, then non-polarising white tape can be used around and/or across panels to minimise reflection (Bennun et al, 2021).
- All personnel and contractors must undergo Environmental Awareness Training and must include awareness about not harming or collecting species.
- Any fauna threatened by the maintenance and operational activities should be removed to a safe location by an appropriate individual.
- All vehicles accessing the site should adhere to a max 40 km/h max to avoid collisions. Appropriate signs must be erected.
- If any excavations are to be dug these must not be left open for more than a few hours without ramps for trapped fauna to leave and must be filled at night.

Residual Impacts

Disturbance from maintenance activities will occur albeit at a low and infrequent level.

Cumulative Impacts

Cumulative impacts are assessed within the context of the extent of the proposed project area, other similar developments and activities in the area (existing and in-process), and general habitat loss and transformation resulting from any other activities in the area. Localised cumulative impacts include those from operations that are close enough (within 30 km) to potentially cause additive effects on the local environment or any sensitive receptors (relevant operations include nearby large road networks, other solar PV facilities, and power infrastructure). Relevant impacts include the overall reduction of foraging and habitat where reproduction takes place, dust deposition, noise and vibration, disruption of functional corridors of habitat important for movement and migration, disruption of waterways, groundwater drawdown, increase risk of collisions; and groundwater and surface water quality depletion.

Long-term cumulative impacts associated with the site development activities can lead to the loss of endemic and threatened species, including natural habitat and vegetation types, and these impacts can even lead to the degradation of conserved areas such as the adjacent game parks and reserves. In order to spatially quantify the cumulative effects of the proposed development, the project in isolation is compared with the overall effects of surrounding development (including total transformation and transformation as a result of new and proposed developments of a similar type, i.e., solar).

A total area of 30 km surrounding the project area was used to assess the total habitat loss in the area and subsequently the cumulative impact. To determine the intact remnant habitat the NBA (2018) remnant spatial data was utilised. The future renewable energy projects were also considered by utilising the REEA Q4 (2022) spatial dataset. In order to remove any duplication, only the areas that overlap with the remnant areas were considered. The total cumulative loss was found to be 16.8% (refer to **Table 6.3**), a visual representation of this is shown in **Figure 6.5**.

Table 6.3: The cumulative impacts considered for habitat loss (relevant to ecological processes, flora, fauna and avifauna)

Total Area of 30 km²	Intact Remnant Habitat	REEA area that does not overlap with disturbed areas	Total Disturbed/Transformed habitat	Percentage area lost
494454.44 Ha	460532.1 Ha	49369 Ha	83291.31 Ha	16.8%

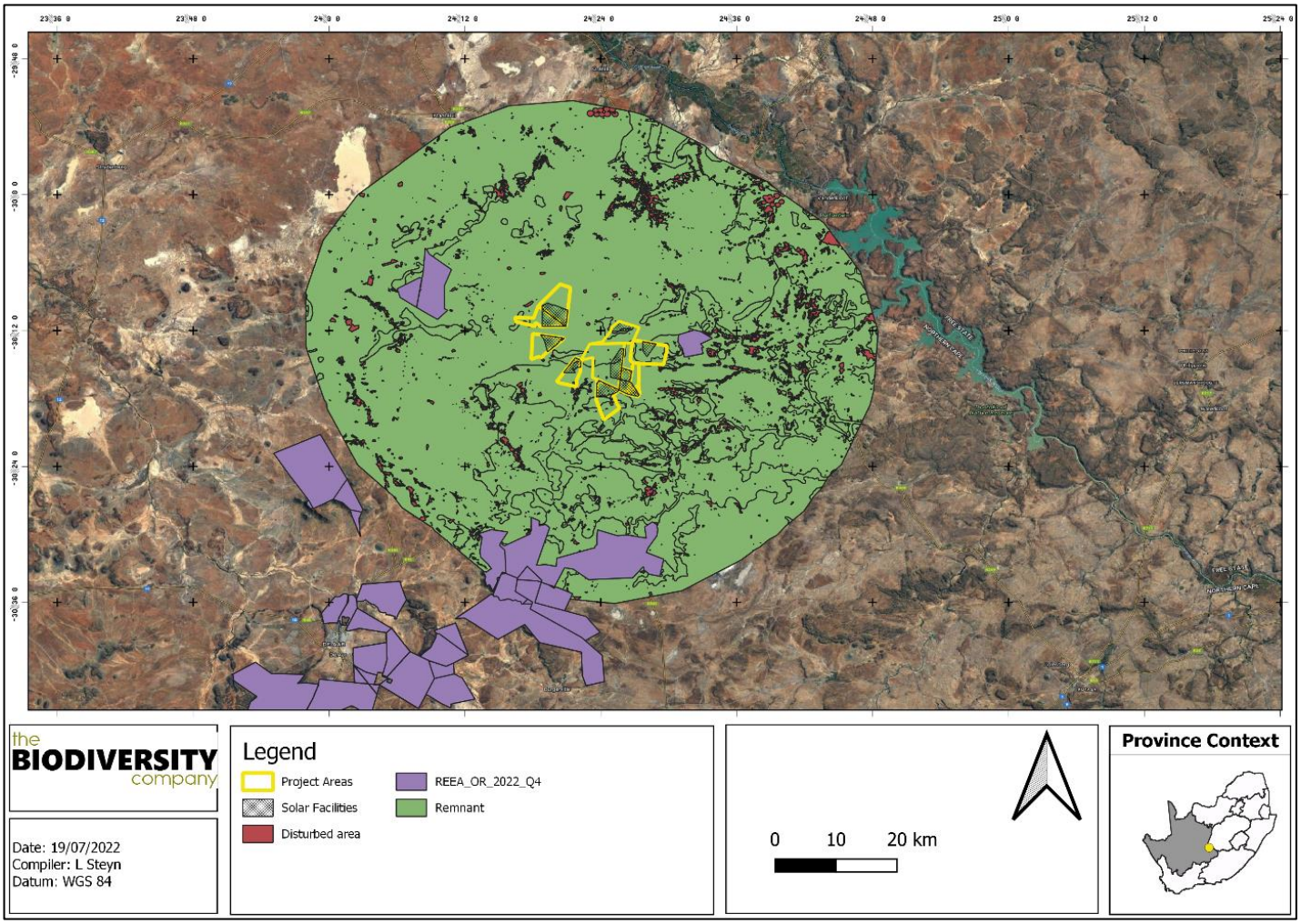

Figure 6.5: Map illustrating the additional renewable energy developments within the landscape overlaid onto the remnant vegetation types

Impact Nature: Cumulative habitat loss within the region The development of the proposed infrastructure will contribute to cumulative habitat loss within ESAs and thereby impact the ecological processes in the region.		
	Overall impact of the proposed development considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Very low (1)	High (4)
Duration	Moderate term (3)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Definite (5)
Significance	**Low (24)**	**High (70)**

Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Low
Irreplaceable loss of resources?	No	Yes
Can impacts be mitigated	To some degree, but most of the impact results from the presence of the various facilities which cannot be well mitigated.	
Mitigation: » Over and above all provided mitigation measures; ensure that a rehabilitation plan and IAP management plan be compiled for each development and are effectively implemented.		

6.4.4 Overall Result

The study area has been altered, albeit limited, both currently and historically. Grazing from livestock and sheep and associated mismanagement has led to (limited) deterioration of the area. Most areas can be regarded as important, not only within the local landscape, but also regionally; as they are used for habitat, foraging and movement corridors for fauna within a landscape fragmented by farming activities. The habitat sensitivity of these habitats is regarded as Medium, and the following aspects support this classification:

» Functions as an ESA as per the Northern Cape Critical Biodiversity Areas spatial database; and
» Supports various organisms and may play an important role in the ecosystem, if left to recover from the superficial impacts.

The ecological integrity, importance and functioning of these terrestrial biodiversity areas provide a variety of ecological services considered beneficial, with one key service being the maintenance of biodiversity. The preservation of these systems is the most important aspect to consider for the proposed project.

The habitat physiognomy within the PAOI is largely heterogenous and, based on the fauna components recorded within the PAOI and proximal landscape, the area provides important ecosystem services, particularly with regards to the maintenance of dynamic soil properties and pollination services. The combined SEI (sensitivity) of the PAOI was determined to be Medium, due to the extent of the area considered and its connectivity to natural areas within the landscape, and the low resilience of the habitat/vegetation type.

The main expected impacts of the proposed infrastructure will include the following:

» Habitat loss and fragmentation as well as degradation of surrounding habitat;
» Disturbance and displacement caused during the construction and maintenance phases; and
» Direct mortality during the construction phase.

The primary expected impacts of the proposed project will be the loss of habitat and emigration of fauna. Based on the outcomes of the SEI determination, the study area is considered to have a Medium SEI which indicates that minimisation mitigation must be applied to the site.

It must be noted, when taken into consideration in conjunction with the other Solar PV facilities planned for all three phases of the overall proposed development, that the cumulative fragmentation of the ESA is very high. The associated cumulative fragmentation impacts are expected to be high for the overall development. This project should ideally not be considered in insolation but rather as a part of the full proposed development when considering impacts to the ESA.

Considering that this area has been identified as being of significance for biodiversity maintenance and ecological processes (ESA), development may proceed but with caution and only with the implementation of mitigation measures. Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinion of the specialists that the project may be favourably considered, on condition that all prescribed mitigation measures and supporting recommendations are implemented.

6.5. Potential Impacts on Freshwater Resources

The development of the project could result in a variety of impacts on aquatic systems in the study area. Potential impacts and the relative significance of the impacts are summarised below (refer to **Appendix F** for more details).

6.5.1 Results of the Aquatic Impact Assessment

One (1) form of a watercourse was identified and delineated within the regulated area (Refer to **Figure 6.6**). This includes an ephemeral river (watercourse). No natural wetland systems, or even cryptic wetlands were identified for the area. The proposed development area is more than 650 m south of the watercourse. A borrow bit with no drainage was identified within the project area, but this is not considered to be a natural water resource. The results of the habitat assessment indicates natural (class A) and largely natural (class B) instream and riparian conditions for the watercourse catchment respectively. The recommended buffer was calculated to be 20 m for the river.

A site sensitivity verification forms part of reporting requirements. In this regard, the allocated sensitivities of low for the general area and medium sensitivity for the drainage features agrees with the Environmental Screening Tool. The project must take cognisance of this and avoid any unnecessary disturbance of the drainage features and adjacent habitat. Therefore, the aforementioned post-mitigation buffer should be implemented and treated as 'no go areas'.

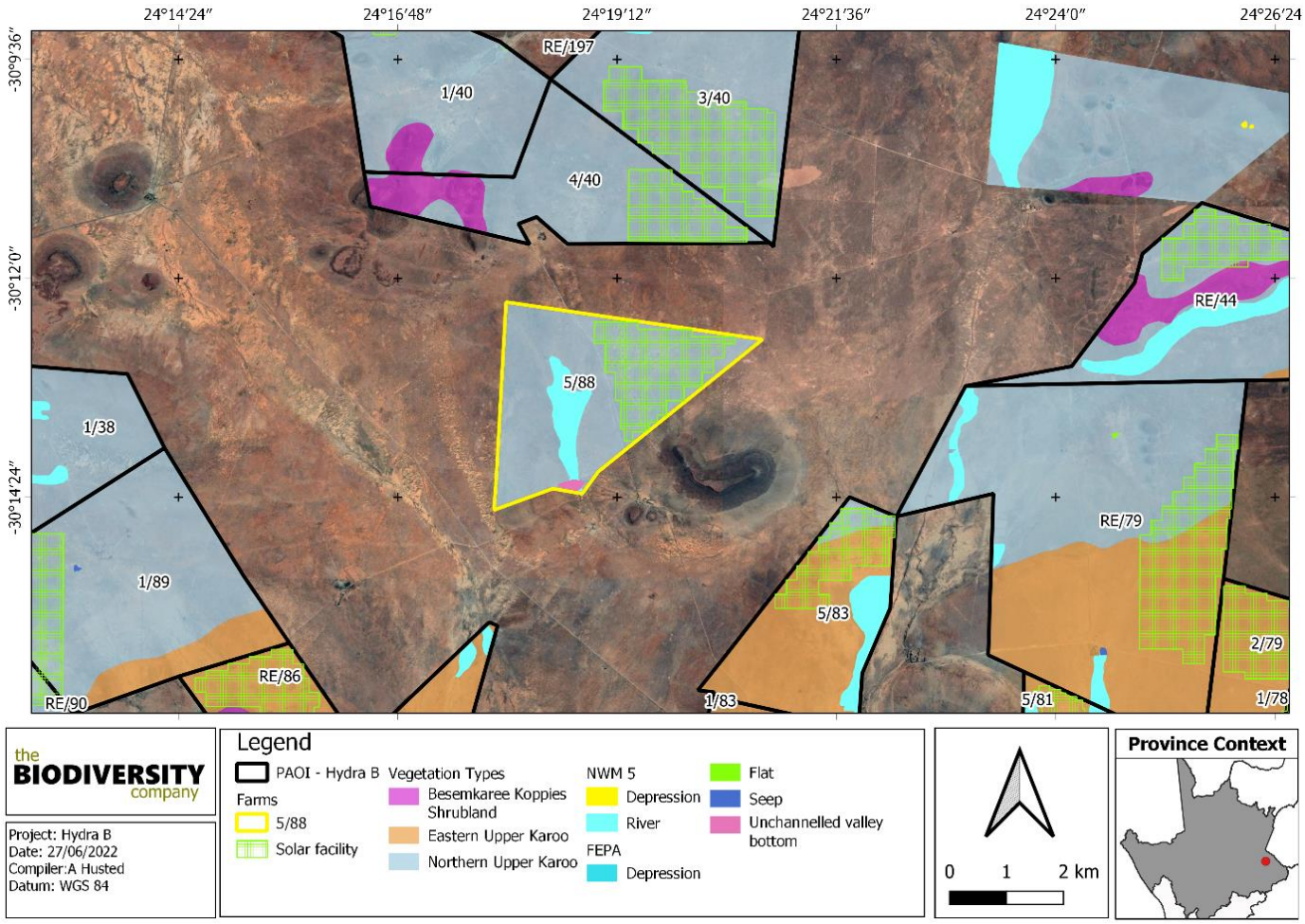

Figure 6.6: The respective farm portions in consideration of the ecological features

6.5.2 Assessment of Potential Impacts and Recommended Mitigation Measures

The development footprint is not located within 100 m of the delineated water resource [as per the National Water Act, 1998 (Act No. 36 of 1998) in accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i)]. However, the closest water resource (ephemeral river) is rated as Very High sensitivity, and no development activities should take place within the delineated buffer zone. Since the development footprint is outside of the regulation zone and buffer zone, no risks to the freshwater systems are foreseen for the proposed project. Therefore, no impacts or risks were anticipated to the freshwater systems and therefore not assessed in this report. A Compliance Statement has been prepared by the specialist in accordance with the specialist protocols.

As a result of the absence of impacts or risks to freshwater systems, the contribution of the project to cumulative impacts in the region are expected to be low.

Despite the absence of risks expected for the project, this report presents supporting mitigation and management measures for consideration.

Activity	Aspect	Impact	Control Measures
Site clearing and preparation.	Water resource disturbance / loss.	Direct disturbance / degradation / loss to water resource soils or vegetation due to the construction of the solar facility.	» Clearly demarcate the construction footprint and restrict all construction activities to within the proposed infrastructure area. » When clearing vegetation, allow for some vegetation cover as opposed to bare areas. Maintain vegetation cover beneath the panels. » Minimize the disturbance footprint and the unnecessary clearing of vegetation outside of this area. » Educate staff and relevant contractors on the location and importance of the identified water resources through toolbox talks and by including them in site inductions as well as the overall master plan. » All activities (including driving) must adhere to the 20 m buffer area. » Promptly remove / control all alien and invasive plant species that may emerge during construction (i.e. weedy annuals and other alien forbs) must be removed. » Landscape and re-vegetate all denuded areas as soon as possible.
	Water runoff from construction site.	Increased erosion and sedimentation.	» Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash. » No activities are permitted within the water resource and associated buffer areas. » Landscape and re-vegetate all unnecessarily denuded areas as soon as possible.
		Potential contamination of water resources with machine oils and construction materials.	» Make sure all excess consumables and building materials / rubble is removed from site and deposited at an appropriate waste facility. » Appropriately stockpile topsoil cleared from the project area. » Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) or construction materials on site (e.g. concrete) in such a way as to prevent them leaking and entering the water resources. » No activities are permitted within the water resource and associated buffer areas.
Operation of the solar facility.	Hardened surfaces.	Potential for increased stormwater runoff leading to Increased erosion and sedimentation.	» Design and Implement an effective stormwater management plan. » Promote water infiltration into the ground beneath the solar panels.

Activity	Aspect	Impact	Control Measures
			» Release only clean water into the environment. » Stormwater leaving the site should not be concentrated in a single exit drain but spread across multiple drains around the site each fitted with energy dissipaters (e.g. perforated bricks such as Armorflex blocks with rocks/ aggregate placed overtop). » Re-vegetate denuded areas as soon as possible. » Regularly clear drains. » Minimise the extent of concreted / paved / gravel areas. » A covering of soil and grass (regularly cut and maintained) below the solar panels is ideal for infiltration. If not feasible then gravel is preferable over concrete or paving. » Avoid excessively compacting the ground beneath the solar panels.
	Contamination.	Potential for increased contaminants entering the water resource systems.	» Where possible minimise the use surfactants to clean solar panels and herbicides to control vegetation beneath the panels. If surfactants and herbicides must be used do so well prior to any significant predicted rainfall events.
Decommissioning of the solar facility.	Rehabilitation.	Potential loss or degradation of nearby water resources through inappropriate closure.	» Develop and implement a rehabilitation and closure plan. » Appropriately rehabilitate the project area by ripping, landscaping and re-vegetating with locally indigenous species.

6.5.3 Overall Result

The development footprint is not located within 100 m of the delineated water resource [as per the National Water Act, 1998 (Act No. 36 of 1998) in accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i)].

Since the development footprint is outside of the regulation zone and buffer zone, no risks to the freshwater systems are foreseen for the proposed project. Therefore, no impacts or risks were anticipated to the freshwater systems and therefore are not assessed in this report. Despite the absence of risks expected for the project, this report presents supporting mitigation and management measures for consideration.

No fatal flaws were identified for the project, and the development may be favourably considered and all prescribed mitigation measures must be considered by the issuing authority. No monitoring measures are deemed necessary for the development.

6.6. Potential Impacts on Avifauna

The development of the project is likely to result in a variety of impacts from an avifaunal perspective. Potential impacts and the relative significance of the impacts are summarised below (refer to **Appendix E** for more details).

6.6.1 Results of the Avifauna Impact Assessment

Habitats

Fine-scale habitats within the landscape are important in supporting a diverse avifauna community as they provide differing nesting, foraging and reproductive opportunities. The assessment area overlapped with three habitat types namely, Grassland Karoo, Shrubland Karoo and Water Resources (Dams, drainage lines and river). These habitats were based on the species compositions in the various areas. The areas of interests outside of the direct footprint were included as these areas could also support species that could be influenced by the development. Habitat types delineated within the direct project footprint and adjacent survey areas are illustrated **Figures 6.7 and 6.8** respectively.

Nest Analysis

Observing and monitoring nesting sites are important in ascertaining habitat sensitivity and evaluating the impact risk significance of any proposed development. During the field survey recording nesting sites within the larger cluster area were undertaken for certain species. Three active Verreaux's Eagle nests were observed and an additional two inactive nests were also noted. Two active Secretarybird nests were also recorded (refer to **Figure 6.9**). As per the Species Environmental Assessment Guidelines (2020) a core area of 1km (core buffer) surrounding the nests must be treated as a no-go area, an additional area of 5.2km (seasonal buffer) was also placed around the nest as per the Birdlife Verreaux's Eagle and Wind Farms Guidelines (2021). This 5.2km area is based on the average home range of the Verreaux's Eagle during the breeding season, and as such this area must be avoided during the breeding season of the species which stretches from April to July to avoid disturbing the species. As per the guidelines, buffers were also placed around the inactive nests. For the Secretarybird nests a 4 km buffer was placed around the nests, of which 2km must be treated as no go (core buffer), while the other 2 km must be low impact development (low impact buffer) (pers comms Birdlife, 2022). Secretarybirds breeds year around therefore low impact development is required and a breeding season limitation will not suffice.

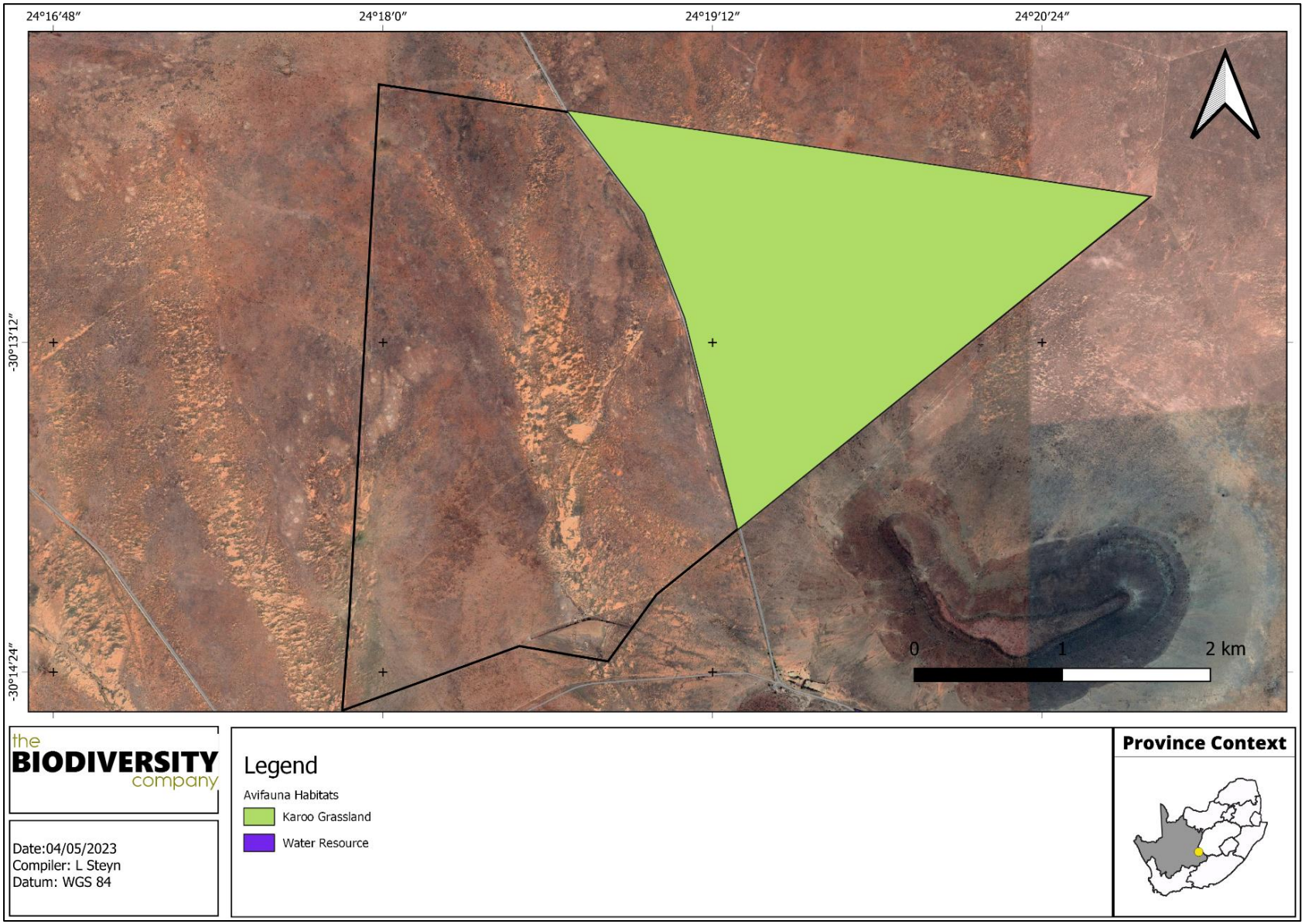

Figure 6.7: The avifauna habitats found in the project area

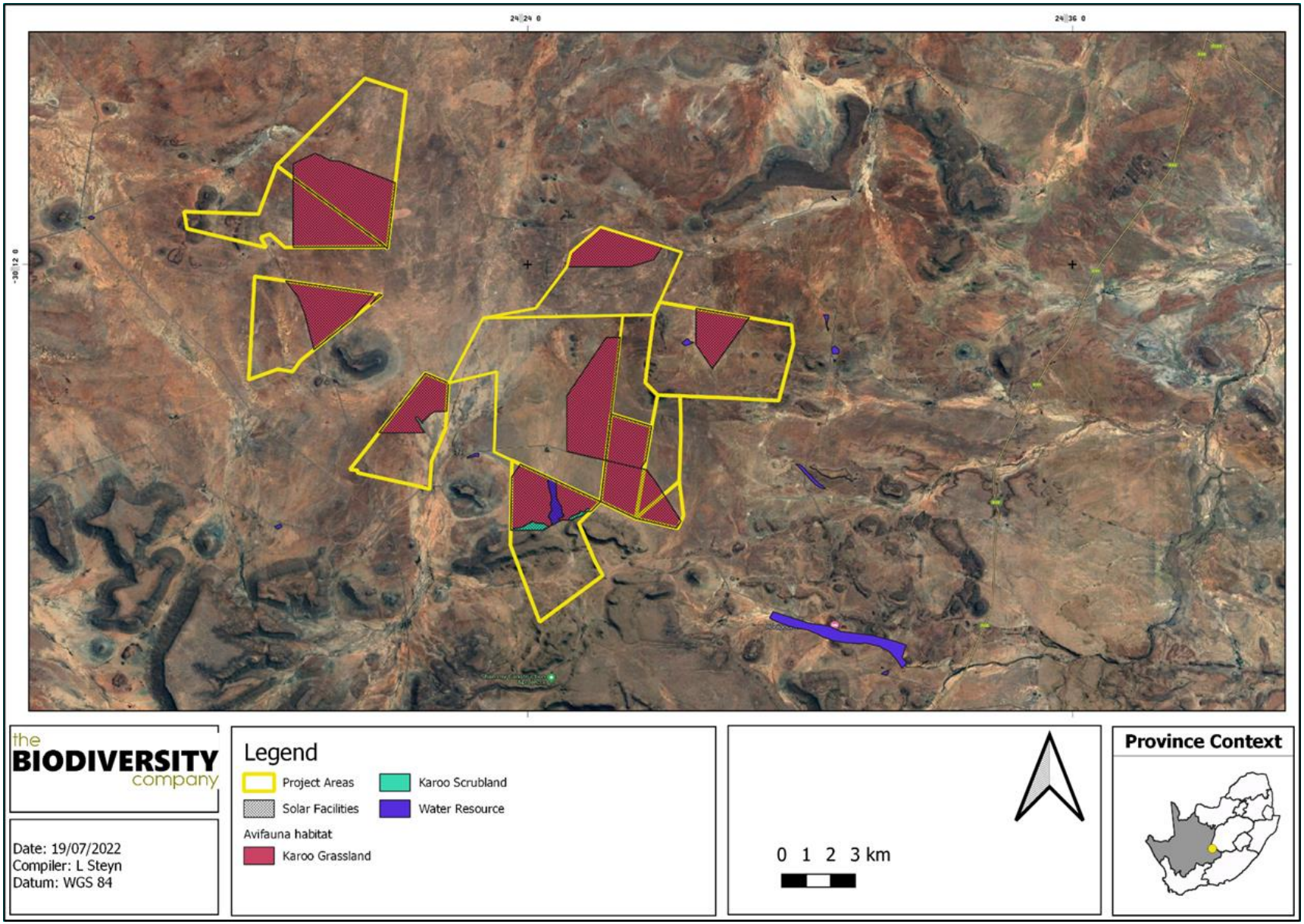

Figure 6.8: The avifauna habitats found in the cluster area.

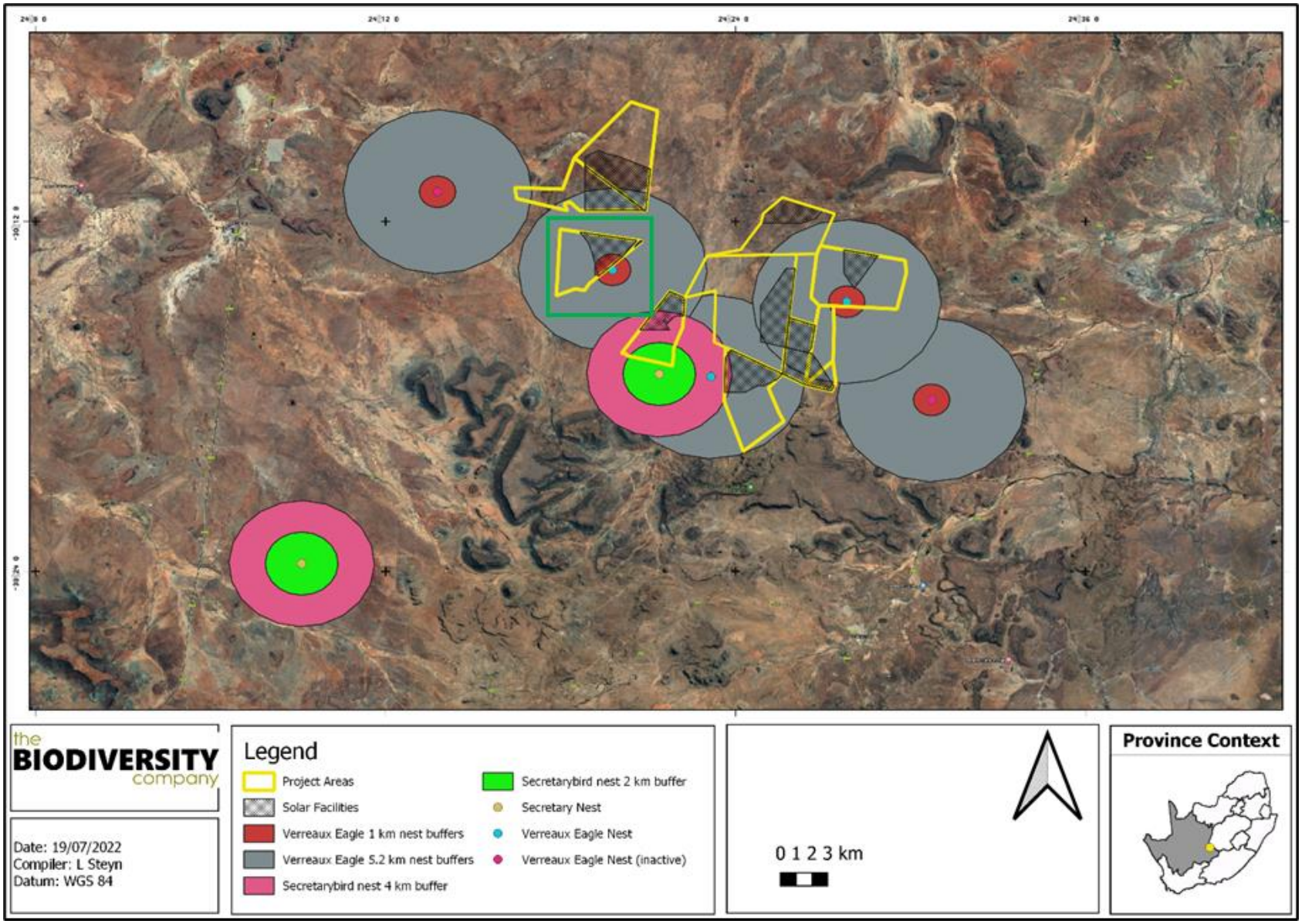

Figure 6.9: Nests of the SCC in the project area and surrounds and their associated buffers

Site Sensitivity

The biodiversity theme sensitivity, as indicated in the DFFE screening report, was derived to be Very High, while the fauna sensitivity was rated as 'High'. The very high terrestrial sensitivity was due to the CBA1, CBA2, 2 and ESA1 status of the project area as well as the FEPA sub catchment with which the project area overlaps. The High fauna sensitivity is based on the known occurrence of both Verreaux's Eagles and Ludwig's Bustards in the area.

Sensitivities were compiled by the specialist for the avifauna study based on the field results and desktop information. All habitats within the assessment area of the proposed project were allocated a sensitivity category (refer to **Table 6.4**). The sensitivities of the habitat types delineated are illustrated in **Figure 6.10**. The Water resources and Nest buffers were given a very high sensitivity based on the low receptor resilience these areas and species will have to change. The Karoo scrubland and Karoo Grasslands all support a large number of SCCs (9 species), the biodiversity importance of these areas are thus high.

Table 6.4: SEI Summary of habitat types delineated within field assessment area of project area

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Karoo grassland	High	High	High	Medium	High
Karoo scrubland	High	High	High	Medium	High
Water resources	High	High	High	Low	Very High
Nest buffers (Core)	High	High	High	Low	Very High
Nest Buffers (Outside)	High	High	High	Medium	High

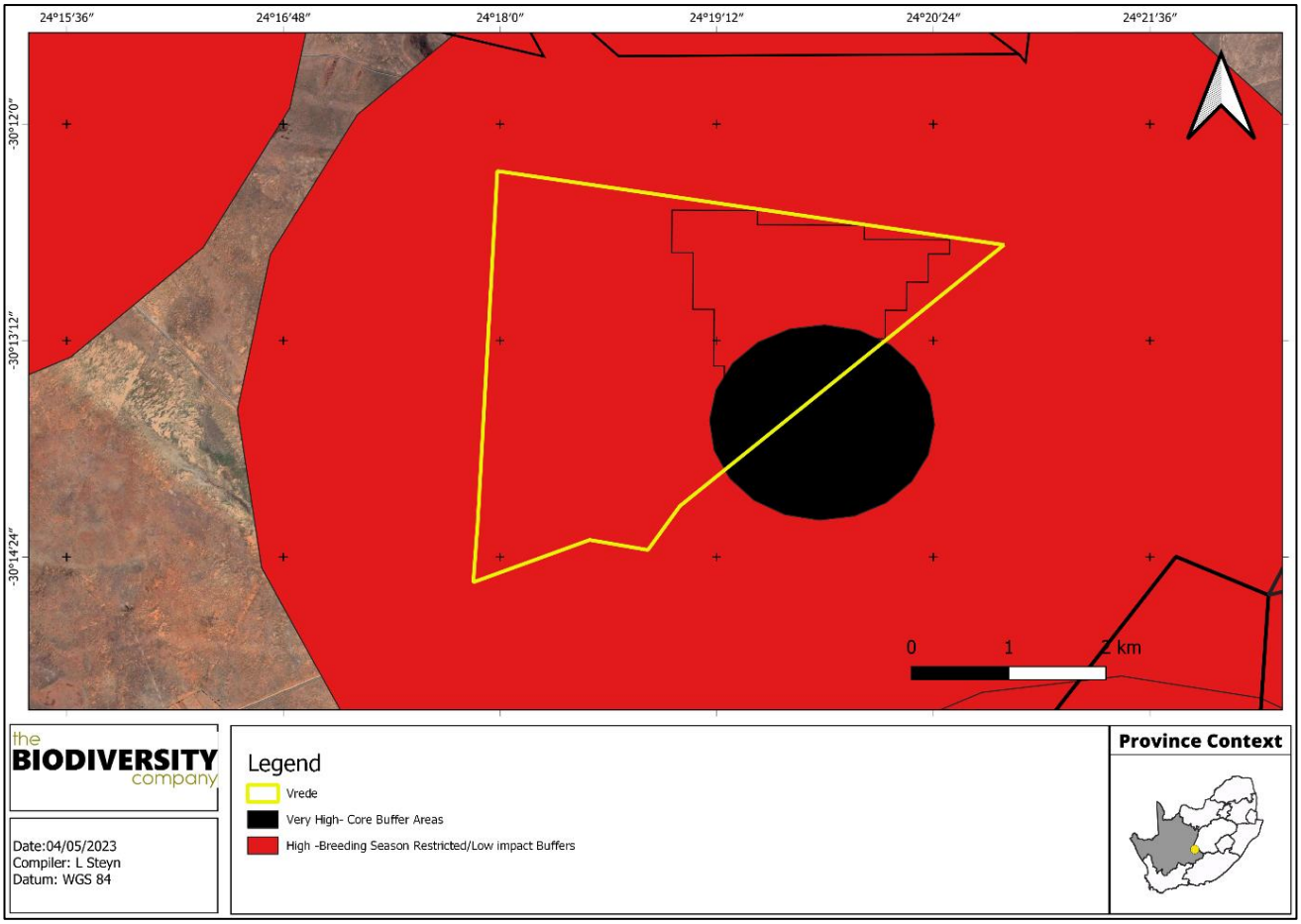

Figure 6.10: Avifaunal sensitivities overlain on the indicative layout.

6.6.2 Description of Avifaunal Impacts

This section describes the potential impacts on avifauna associated with the construction and operational phases of the proposed development and is only relevant to the PV site and associated infrastructure and does not consider the power line grid system, which is the subject of a separate application for authorisation. During the construction phase vegetation clearing and brush cutting of vegetation for the associated infrastructure will lead to direct habitat loss. Vegetation clearing will create a disturbance and will therefore potentially lead to the displacement of avifaunal species. The operation of construction machinery on site will generate noise and cause dust pollution. Should non-environmentally friendly dust suppressants be used, chemical pollution can take place. Increased human presence can lead to poaching and the increase in vehicle traffic will potentially lead to roadkill.

The principal impacts of the operational phase are electrocution, collisions, fencing, chemical pollution due to chemical for the cleaning of the PV panels and habitat loss. Solar panels have been implicated as a potential risk for bird collisions. Collisions are thought to arise when birds (particularly waterbirds) mistake the panels for waterbodies, known as the "lake effect" (Lovich & Ennen, 2011), or when migrating or dispersing birds become disorientated by the polarised light reflected by the panels. This "lake-effect" hypothesis has not been substantiated or refuted to date (Visser et al., 2019). It can however be said that the combination of powerlines, fencing and large infrastructure will influence avifauna species. Visser et al. (2019) performed a study at a utility-scale photovoltaic solar energy facility in the Northern Cape and found that most of the species affected by the facility were passerine species. Larger species were said to be more influenced by

the facilities when they were found foraging close by and were disturbed by predators which resulted in collisions.

Large passerines are particularly susceptible to electrocution because owing to their relatively large bodies, they are able to touch conductors and ground/earth wires or earthed devices simultaneously. The chances of electrocution are increased when feathers are wet, during periods of high humidity or during defecation. Prevailing wind direction also influences the rate of electrocution casualties.

Fencing of the PV site can influence birds in six ways (Birdlife SA, 2015):
» Snagging: Occurs when a body part is impaled on one or more barbs or razor points of a fence.
» Snaring: When a birds foot/leg becomes trapped between two overlapping wires.
» Impact injuries: birds flying into a fence, the impact may kill or injure the bird.
» Snarling: When birds try and push through a mesh or wire stands, ultimately becoming trapped (uncommon).
» Electrocution: Electrified fence can kill or severely injure birds.
» Barrier effect: Fences may limit flightless birds (e.g. Moulting waterfowl) from resources.

Chemical pollution from PV cleaning, if not environmentally friendly will result in either long term or short-term poisoning. Should this chemical run into the water sources it would also impact the whole bird population and not just species found in and around the PV footprint.

6.6.3 Assessment of Potential Impacts and Recommended Mitigation Measures

Construction Phase Impacts

Nature: Destruction, fragmentation and degradation of habitats;		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Local (3)
Duration	Permanent (5)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Definite (5)	Highly probable (4)
Significance	**High (85)**	**Medium (60)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some extent, habitat will still be lost	
Mitigation: » The loss of habitat in the project footprint cannot be negated but can be restricted to some extent. The loss of habitat will result in the loss of territory, feeding area, nesting sites and prey availability for numerous species. » The habitat outside the footprint can be protected by implementing the following mitigations: » Construction activity to only be within the project footprint and the area is to be well demarcated. » Areas where vegetation has been cleared must be re-vegetated within local indigenous plant species. » The affected area must be monitored for invasive plant encroachment and erosion and must be controlled. » The use of laydown areas within the development footprint must be used, to avoid habitat loss and disturbance to adjoining areas. » All areas to be developed must be walked through prior to any activity to ensure no nests or avifauna species are found in the area. » Should any Species of Conservation Concern not move out of the area, or their nest be found in the area a suitably qualified specialist must be consulted to advise on the correct actions to be taken.		

» Nest Core Buffers must be regarded as no-go buffers and the seasonal buffers must be avoided from April - July.
Residual Impacts: The loss of habitat is a residual impact that is unavoidable. The disturbance may also cause some erosion and invasive alien plant encroachment. Movement corridors will be disrupted in the area.

Nature: Displacement of avifaunal community (Including several SCC) due to disturbance such as noise, light, dust, vibration		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Footprint and Surrounds (2)
Duration	Long term (4)	Short term (2)
Magnitude	High (8)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**High (64)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, but only to a limited extent. The mitigation of noise pollution during construction is difficult to mitigate against	
Mitigation: » Minimize disturbance impact by abbreviating construction time. » Schedule the activities to avoid breeding and movement time. » Ensure lights are kept to a minimum, lights must be red or green and not white to reduce confusion for nocturnal migrants. Lights should be placed so that they face downward onto working areas and not straight or upward to reduce the sky glow effect. » Dust management need to be done in the areas where the vegetation will be removed, this includes wetting of the soil.		
Residual Impacts: Displacement of endemic and SCC avifauna species.		

Nature: Collection of eggs and poaching		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Footprint and surrounding areas (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (48)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » All personnel should undergo environmental induction with regards to avifauna and in particular awareness about not harming, collecting or hunting terrestrial species (e.g., guineafowl and francolin), and owls, which are often persecuted out of superstition. » Signs must be put up stating that should any person be found poaching any species they will be fined.		
Residual Impacts: There is a possibility that the eggs to be poached could be that of an SCC with decreasing numbers		

Nature: Roadkill		
	Without mitigation	**With mitigation**
Extent	Local (3)	Footprint and Surrounding areas (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (44)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area. » All vehicles (construction or other) accessing the site should adhere to a low speed limit on site (40 km/h max) to avoid collisions with susceptible avifauna, such as nocturnal and crepuscular species (e.g., nightjars and owls) which sometimes forage or rest on roads, especially at night.		
Residual Impacts: Roadkills could still occur		

Nature: Loss and disruption of SCC nests		
	Without mitigation	**With mitigation**
Extent	Very high (5)	Very low (1)
Duration	Permanent (5)	Very short term (1)
Magnitude	Very high (10)	None (0)
Probability	Highly probable (4)	Very improbable (1)
Significance	**High (80)**	**Low (2)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes, but only if the nest buffers are treated as no go areas	
Mitigation: » If the nest buffers are not adhered to then this impact cannot be mitigated. The core area of 1 km surrounding the nests must be treated as a no-go area, the additional areas must be avoided from April to July to avoid disturbing the species.		
Residual Impacts: Nests can still be disturbed		

Operation Phase Impacts

Nature: Collisions with PV panels, BESS, associated connection lines and fences		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Moderate (3)
Duration	Permanent (5)	Long term (4)
Magnitude	Very high (10)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High (76)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

» Infrastructure should be consolidated where possible in order to minimise the amount of ground and air space used.
» White strips must be placed on the edge of the solar panels to reduce reflection and prevent collisions.
» If any connection lines are to be placed above ground, they must be marked with industry standard bird flight diverters.
» During the first year of operation quarterly reports, summarizing interim findings should be complied and submitted to BirdLife South Africa. If the findings indicate that electrocutions have not occurred or are minimal with no red-listed species, an annual report can be submitted.
» Fencing mitigations:
  * Top 2 strands must be smooth wire
  * Routinely retention loose wires
  * Minimum 30cm between wires
  * Place markers on fences

Residual Impacts:
Some collisions of SCCs might still occur regardless of mitigations

Nature: Electrocution with solar plant connections		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Footprint and Surrounding areas (2)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Improbable (2)
Significance	**High (64)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

» Infrastructure should be consolidated where possible/practical in order to minimise the amount of ground and air space used.
» Ensure that monitoring is sufficiently frequent to detect electrocutions reliably and that any areas where electrocutions occurred are repaired as soon as possible.
» During the first year of operation quarterly reports, summarizing interim findings should be complied and submitted to BirdLife South Africa. If the findings indicate that electrocutions have not occurred or are minimal with no red-listed species, an annual report can be submitted.

Residual Impacts:
Electrocutions might still occur regardless of mitigations

Nature: Roadkill during maintenance procedures		
	Without mitigation	**With mitigation**
Extent	Footprint & surrounding areas (2)	Footprint & surrounding areas (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (20)**
Status (positive or negative)	Negative	Negative

Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » All personnel should undergo environmental induction with regards to avifauna and their behaviour on roads. » All vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed. » All vehicles accessing the site should adhere to a low speed limit on site (40 km/h max) to avoid collisions with susceptible avifauna, such as nocturnal and crepuscular species (e.g., nightjars and owls) which sometimes forage or rest on roads, especially at night.		
Residual Impacts: Road collisions can still occur regardless of mitigations.		

Nature: Habitat degradation and displacement of resident, visiting and breeding species (as well as SCCs) in areas affected by maintenance.		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Local (3)
Duration	Long term (4)	Short term (2)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High (64)**	**Medium (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	No, the footprint has already been disturbed. The area surrounding the development can be mitigated to some extent	
Mitigation: » Minimising habitat destruction caused by the maintenance by demarcating the footprint so that it does not increase yearly. » All areas where maintenance must be for example grass cutting walked through prior to any activity to ensure no nests or fauna species are found in the area. Should any Species of Conservation Concern not move out of the area, or their nest be found in the area a suitably qualified specialist must be consulted to advise on the correct actions to be taken.		
Residual Impacts: Some habitat degradation can still occur regardless of mitigations		

Decommissioning Phase Impacts

This phase is when the scaling down of activities ahead of temporary or permanent closure is initiated. During this phase, the operational phase impacts will persist until of the activity reduces and the rehabilitation measures are implemented.

Nature: Continued fragmentation and degradation of habitats		
	Without mitigation	**With mitigation**
Extent	Local (3)	Footprint and surrounding areas (2)
Duration	Short term (2)	Very short term (1)
Magnitude	High (8)	Minor (2)
Probability	Highly probable (4)	Very improbable (1)
Significance	**Medium (52)**	**Low (5)**
Status (positive or negative)	Negative	Negative

Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » Implementation of a rehabilitation plan. » Implementation of an alien invasive management plan and monitoring on an annual basis for 3 years post construction. » There should be follow-up rehabilitation and revegetation of any remaining bare areas with indigenous flora.		
Residual Impacts: No significant residual risks are expected, although IAP encroachment and erosion might still occur but would have a negligible impact if effectively managed.		

Nature: Displacement of faunal community (including SCC) due disturbance (road collisions, noise, dust, vibration).		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Local (3)
Duration	Short term (2)	Short term (2)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (56)**	**Low (22)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » Minimize disturbance impact by abbreviating decommissioning time » Schedule the activities to avoid breeding and movement times report » Dust management need to be done in the areas where the vegetation will be removed, this includes wetting of the soil. This area must be rehabilitated as soon as possible. » All vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the decommissioning area. » All vehicles accessing the site should adhere to a low speed limit on site (40 km/h max) to avoid collisions with susceptible avifauna, such as nocturnal and crepuscular species (e.g., nightjars and owls) which sometimes forage or rest on roads, especially at night.		
Residual Impacts: If this is mitigated and monitored correctly no residual impacts should be present		

Cumulative Impacts

Localised cumulative impacts include those from operations that are close enough to potentially cause additive effects on the local environment or any sensitive receivers (such as nearby large road networks, other solar PV facilities, and power infrastructure). Relevant activities and impacts include dust deposition, noise and vibration, loss of corridors or habitat, disruption of waterways, groundwater drawdown, groundwater and surface water depletion, and transport activities. Long-term cumulative impacts associated with the site development activities can lead to the loss of endemic and threatened species, including natural habitat and vegetation types, and these impacts can even lead to the degradation of conserved areas such as the adjacent game parks and reserves.

A total area of 30 km surrounding the study area was used to assess the total habitat loss in the area and subsequently the cumulative impact. To determine the intact remnant habitat, the NBA (2018) remnant

spatial data was utilised. The future renewable energy projects were also considered by utilising the REEA Q4 (2022) spatial dataset. In order to remove any duplication, only the areas that overlap with the remanence areas were considered. The total cumulative loss was found to be 16.8% (refer to **Table 6.3**), a visual representation of this is shown in **Figure 6.5**.

Impact Nature: Cumulative habitat loss within the region The development of the proposed infrastructure will contribute to cumulative habitat loss within ESAs and result in the loss of habitat for SCCs		
	Project in isolation	**Project with adjacent PV projects with associated infrastructure**
Extent	Moderate (3)	High (4)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	High (8)
Probability	Probable (3)	Probable (3)
Significance	**Medium (42)**	**Medium (51)**
Status (positive or negative)	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: Even though collisions can be mitigated to some extent for individual solar plants their combined densities will increase the rate of collisions. Monitoring of the implementation of mitigation measures needs to be done to ensure the cumulative impact does not become high.		
Residual Impacts: Loss of habitat for endemic and SCC. Loss of SCC due to collisions.		

6.6.4 Overall Result

During the first field assessment 124 bird species were recorded of which seven are SCCs on a national or international scale. Kori Bustard (*Ardeotis kori*) (NT Regional, NT International); Verreaux's Eagle (*Aquila verreauxii*) (VU, LC); Blue Crane (*Grus paradisea*) (NT, VU); Secretarybird (*Sagittarius serpentarius*) (EN, EN); Tawny Eagle (*Aquila rapax*) (EN, VU); Black Harrier (*Circus maurus*) (EN, EN) and Blue Korhaan (*Eupodotis caerulescens*) (LC, NT). During the second survey 109 species were recorded, the same groupd of SCCs were again observed with the addition of the Karoo Korhaan (*Eupodotis vigorsii*) (NT, LC) and Lanner Falcon (*Falco biarmicus*) (VU; NT).

Three active Verreaux's Eagle nests were observed and an additional two inactive nests were also noted. Two active Secretarybird nests were also found. As per the Birdlife South Africa (2021) guidelines a 5.2 km buffer were placed around the Verreaux Eagle nests, a core area of 1km surrounding the nests must be treated as a no-go area, while the rest of the buffer area low impact development can take place. As per the guidelines buffers were also placed around the inactive nests. For the Secretarybird nests a 4km buffer were placed around the nests, of which 2km must be treated as no go, while the other 2km must be low impact development (pers comms Birdlife, 2022). Renewable energy is classed as low impact developments per the Species Guidelines. Should the mitigations and recommendations be taken into account the project can be proceed within the seasonal/low impact buffer areas. Should the PV site fall in the core buffer area it must be relocated to outside of the nest buffer areas.

Apart from the disruption of the nests, habitat loss, collisions and electrocutions are regarded as the main impacts. Should the mitigations, monitoring and avoidance guidelines be followed the impacts can be reduced to a Moderate-Low level.

The following is concluded by the specialist:

» The development within the area of the nest core buffers is regarded as a fatal flaw and no development is to be allowed in these areas.
» Construction is permitted In the seasonal/low impact buffer areas, however must be considered with caution based on the high number of species of conservation concern and 'risk' species present. It is recommended that should development take place in the seasonal/ low impact buffers that the rest of the property remain undeveloped.

As is evident from **Figure 6.10**, the Vrede PV facility development footprint falls outside of the identified core buffers. A small portion of the PV facility falls within the seasonal/low impact buffer areas. With the implementation of the recommended mitigation measures, the project is considered to be acceptable as proposed.

6.7. Potential Impacts on Soils and Agricultural Potential

The development of the project could result in a variety of impacts on soils and agricultural potential in the study area. Potential impacts and the relative significance of the impacts are summarised below (refer to **Appendix G** for more details).

6.7.1 Results of the Soils and Agricultural Potential Assessment

The developable area is located in the Ae138 land type. The Ae land types are characterized with Hutton, Oakleaf and Mispah soil forms according to the Soil Classification Working Group, (1991) with the possibility of other soils and bare rocky areas. The Ae land type consists of red to yellow apedal soils which are freely drained. The soils tend to have a high base status and are deeper than 300 mm.

Fifteen land capabilities have been digitised by (DAFF, 2017) across South Africa, of which two are located within the proposed development area, including:

» Land Capability 1 to 5 (Very Low to Low Sensitivity); and
» Land Capability 6 to 8 (Low/Moderate to Moderate Sensitivity).

The baseline findings and the sensitivities as per the Department of Agriculture, Forestry and Fisheries (DAFF, 2017) national raster file concur with one another. It therefore is the specialist's opinion that the land capability and land potential of the resources in the project area ranges from "Very Low" to "Moderate" (refer to **Figure 6.11**). A Compliance Statement has been prepared by the specialist in accordance with the specialist protocols.

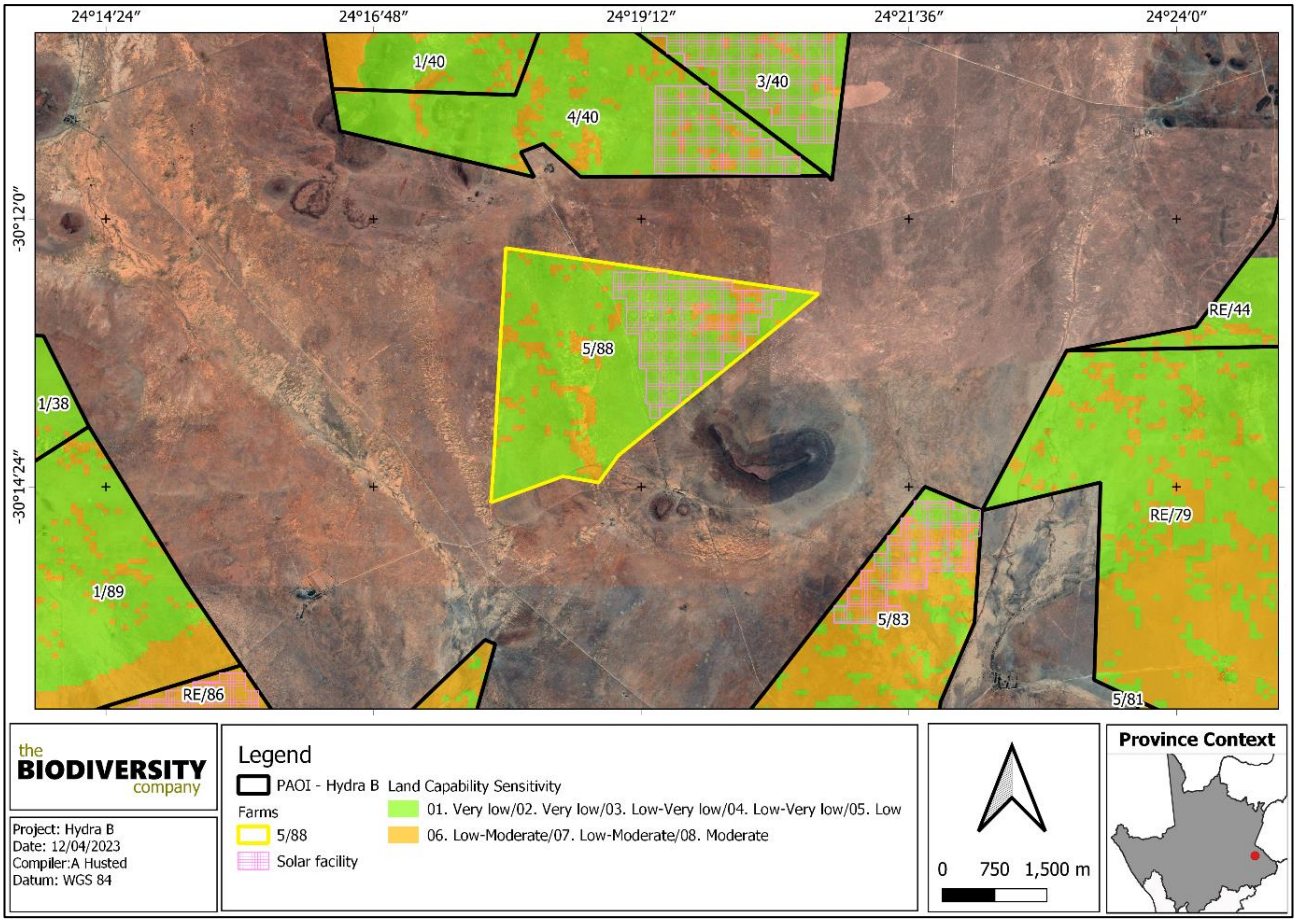

Figure 6.11: Land Capability Sensitivity (DAFF, 2017)

6.7.2 Assessment of Potential Impacts and Recommended Mitigation Measures

The proposed project will have limited impact on the agricultural production ability of the land. Additionally, the solar facility and associated infrastructure will not result in the segregation of any high production agricultural land. As a result of the absence of impacts to soils and agricultural potential, the contribution of the project to cumulative impacts in the region are expected to be low.

The following general mitigation measures have been prescribed. Even though the land potential and land capability in the area is of medium to low sensitivity, the following measures will ensure the conservation of soil resources:

- Demarcate areas to be stripped of topsoil. Keep these areas to an absolute minimum.
- Compacted areas are to be ripped to loosen the soil structure.
- The extent of vegetation clearance must be kept to a minimum. A vegetative cover must remain beneath the panels.
- All waste must be removed from the area, and disposed of at a licenced facility (where applicable).
- All laydown yards must be constructed within the shallow soil and bare rock areas.
- Prevent any spills from occurring. Machines must be parked within hard park areas and must be checked daily for fluid leaks.
- If a spill occurs, it is to be cleaned up immediately and reported to the appropriate authorities.

6.7.3 Overall Result

It is the specialist's opinion that the baseline findings concur with the land capabilities identified by means of the DAFF (2017) desktop findings regarding land capability sensitivities. No "High" land capability sensitivities were identified within the developable area. Considering the relatively medium to low sensitivities, it is the specialist's opinion that the proposed activities will have an acceptable level of impact on agricultural productivity for the area. Furthermore, no measures regarding moving components in their micro-setting are required to avoid or minimise fragmentation and disturbances of agricultural activities.

No fatal flaws were identified for the project. It is the specialist's opinion that the proposed activities may proceed as have been planned without the concern of loss of high sensitivity land capabilities or agricultural productivity for the developable area.

6.8. Potential Heritage Impacts

Negative impacts on heritage resources may occur during the undertaking of construction activities and the operation of the project. Potential impacts and the relative significance of the impacts are summarised below (refer to **Appendix H**).

6.8.1 Results of the Heritage Impact Assessment

Archaeology

Nearly 400 observations were made during the field assessments of the 21 project areas. These were predominantly MSA open air scatters of hornfels and siltstone flakes that were made from locally abundant raw materials. Given the ubiquity of available quarrying and sourcing areas, the flaked material is spread widely and thinly across a very wide area of the landscape and some good examples of radial cores and backed tools were found.

The various Later Stone Age sites held higher grade and unpatinated hornfels flakes, many retouched in microlithic form (bladelets, points, scrapers and reduced cores). The sites of significance include the identification of the possible Houtkraal South African War site where Gen. de Wet abandoned a munitions wagon to the south west of the Driefontein facility. Engravings, one of a very well engraved eland, were found at Roodekraal, Pro Deo and Uitkyk and careful buffers and micro siting of the solar PV facility at Uitkyk and Pro Deo will need to be done to avoid any disturbance of these sites. The engravings were done during the Later Stone Age, most likely in the last 10 000 years, as well as a number of more recent engravings that fall within the historical period of the last 150 years.

The built environment history of the area became more established between the 1930s to 1950s and the farms have largely remained unchanged in their layout and extent since then. The location of the solar PV facilities have been positioned well away from any farm werfs and will not have an impact on the zone of sensitivity surrounding the werfs. Site TK001 located within the project site, but outside the development footprint of the facility, is a Grade IIIB site requiring a 100m buffer.

No archaeological resources of significance were identified within the area proposed for the Vrede Solar PV Facility (refer to **Figure 6.12**).

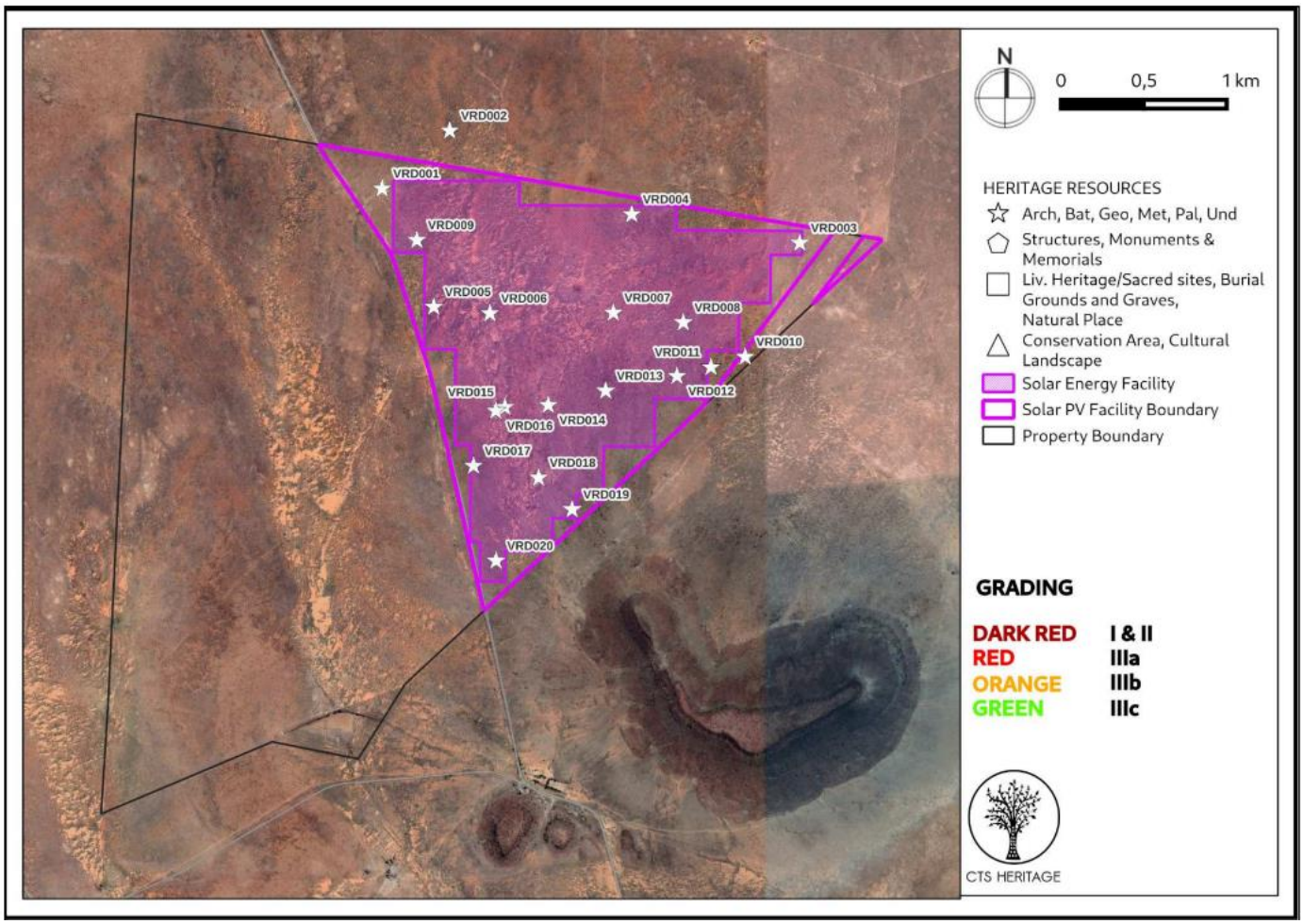

Figure 6.12: All heritage resources within proximity to the development area

The overall archaeological sensitivity of the development area with regard to the preservation of Early, Middle and Later Stone Age archaeology as well as Khoe and San heritage, early colonial settlement is regarded as very high. Despite this, the field assessment conducted for this project has demonstrated that the specific areas proposed for development have an overall low sensitivity for impacts to significant archaeological heritage.

The results of this assessment align with the findings of other specialists such as Morris (2011) who notes that ephemeral MSA and LSA scatters are the dominant archaeological signature of the area and are therefore not archaeologically significant. Specific mitigation measures are proposed for the few sensitive sites identified. Often, rock engravings and some archaeological sites from this area are associated with dolerite outcrops as these outcrops provide the raw material resource for rock engravings. The dolerite outcrops that are present within the areas proposed for development therefore have high levels of archaeological sensitivity and impacts to these outcrops must be avoided.

Palaeontology

Based on previous surveys in the area, the land use (for grazing by sheep), the presence of superficial deposits (probable Pleistocene to Recent age) covering the fossiliferous sediments (probably Ecca and Beaufort Groups), as well as the extensive network of intrusive dolerite dykes and sills that bake (thermally metamorphose) adjacent mudrocks, it is anticipated that the impact of the development will mainly be low

to moderate. However, any excavations > 1.5m could disrupt Ecca and Beaufort Group sediments which are highly fossiliferous and would increase the impact of the development to moderate to high.

Cultural Landscape

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

An impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

In general, the landscape character of the greater study area and site itself presents as largely undeveloped and natural in character. The visual quality of the region is generally high and large tracts of intact vegetation and rolling hills characterise most of the visual environment.

The anticipated significance of the visual impacts on the sense of place within the region (i.e. beyond a 6km radius of the development and within the greater region) is expected to be of moderate significance."

As noted above, to the south around De Aar, a number of renewable energy projects, particularly solar PV farms, have been completed with several new projects proposed such as Wag 'n Bietjie, De Aar Solar and Paarde Valley. A completed 144MW wind farm lies on the plateau south east of the development and can be seen from the study area. Existing 765kV powerlines run through the study area along the southwest - northeast trajectory. Most of the study area is covered in vlaktes covered in grassland in order to take advantage of level ground suitable for solar PV facilities. The Tierberg and Basberg koppies lie prominently in the middle of the study area in otherwise predominantly flat and level terrain.

The following recommendations are adapted from Winter and Wilson (2021) in terms of Solar PV placement ("where" and "how"). The following general principles apply to the PV layout:

- Avoid steep slopes.
- Avoid proximity to historic corridors.
- Avoid placement within viewshed of farmsteads.

The layout provided comply with the above general principles. The impact tables for this impact are fully addressed in the VIA.

6.8.2 Description of Heritage Impacts

Impacts on heritage resources are largely associated with the construction phase and include the loss of resources during excavation of foundations. Impacts on cultural landscape relate to visual impacts on the sense of place within the region, which have been addressed through the VIA undertaken for the project (refer to **Section 6.9** and **Appendix J**). As a result of the absence of any heritage resources of significance within the project site, the contribution of the project to cumulative impacts in the region are expected to be low.

6.8.3 Assessment of Potential Impacts and Recommended Mitigation Measures

Nature of Impact: The construction phase of the project will require excavation, which may impact on archaeological heritage resources if present

The results of the archaeological field assessment conducted largely aligns with the findings of previous archaeological assessments completed in the vicinity of the proposed development. The archaeological resources identified within the development area are dominated by Later and Middle Stone Age flakes, which corresponds with similar findings of others (Kruger, 2012). The majority of the archaeological resources identified within the area proposed for the development in this field assessment have been determined to be not conservation-worthy. As such, these resources have been sufficiently recorded and there is no objection to the proposed development in these locations from an archaeological perspective. No archaeological resources of significance were identified within the areas proposed for the Vrede Solar PV Facility.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (3)	Low (1)
Probability	Improbable (1)	Improbable (1)
Significance	**Low (9)**	**Low (7)**
Status (positive or negative)	Neutral	Neutral
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Possible	Possible
Can impacts be mitigated?	Yes	

Mitigation:

» Should any buried archaeological resources or human remains or burials be uncovered during the course of development activities, work must cease in the vicinity of these finds. The South African Heritage Resources Agency (SAHRA) must be contacted immediately in order to determine an appropriate way forward.

Residual impacts:

Should any significant resources be impacted (however unlikely) residual impacts may occur, including a negative impact due to the loss of potentially scientific cultural resources.

Nature of Impact: The construction phase of the project will require excavation, which may impact on palaeontological heritage resources if present

Based on previous surveys in the area, the land use (for grazing by sheep), the presence of superficial deposits (probable Pleistocene to Recent age) covering the fossiliferous sediments (probably Ecca and Beaufort Groups), as well as the extensive network of intrusive dolerite dykes and sills that bake (thermally metamorphose) adjacent mudrocks, it is anticipated that the impact of the development will mainly be LOW to MODERATE. However, any excavations > 1.5m could disrupt Ecca and Beaufort Group sediments which are highly fossiliferous and would increase the impact of the development to MODERATE to HIGH.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (4)	Moderate (4)
Probability	Improbable (1)	Improbable (1)
Significance	**Low (9)**	**Low (9)**
Status (positive or negative)	Negative	Positive
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Possible	Possible
Can impacts be mitigated?	Yes	

Mitigation: » A Chance Fossil Finds Procedure must be implemented.
Residual impacts: Should any significant resources be impacted (however unlikely) residual impacts may occur, including a negative impact due to the loss of potentially scientific cultural resources.

6.8.4 Overall Result

There is no objection to the proposed development in terms of impacts to heritage resources on condition that:

» There are no objections on palaeontological heritage grounds, granted the excavations do not exceed 1m in depth. Any fossil finds, most likely in the superficial Quaternary sediments, are to be reported by the developer. Should important fossil material be found during excavations, an appropriate Fossil Finds Procedure must be implemented.
» A 100m Buffer is implemented around site TK001
» Should any buried archaeological resources or human remains or burials be uncovered during the course of development activities, work must cease in the vicinity of these finds. The South African Heritage Resources Agency (SAHRA) must be contacted immediately in order to determine an appropriate way forward.

6.9. Potential Visual Impacts

Negative impacts on visual receptors within close proximity of the project site will occur during the undertaking of construction activities and the operation of the Project. Potential impacts and the relative significance of the impacts are summarised below (refer to **Appendix J**).

6.9.1 Results of the Visual Impact Assessment

Despite the significant industrial type infrastructure which is present in the area, the greater landscape of the study area is characterised by wide-open spaces and otherwise very limited development. The study area is sparsely populated outside of the Philipstown (i.e. less than two people per km^2 within the district municipality). A number of isolated homesteads occur throughout the study area. Some of these in the study area include[9]:

» Vredehof
» Jakobsrus
» Wolwekuil
» Leeubergspoort
» Donkerhoek
» Swartkoppies
» Rooidam
» Driefontein
» Vrede
» Bokkraal

[9] The names listed here are of the homestead or farm dwelling as indicated on the SA 1: 50 000 topographical maps and do not refer to the registered farm name.

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed Vrede Solar PV Facility are displayed on **Figure 6.13**. Here the weighted impact and the likely areas of impact have been indicated as a visual impact index. Values have been assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.
The criteria which inform the visual impact index are:

- Visibility or visual exposure of the structures
- Observer proximity or visual distance from the structures
- The presence of sensitive visual receptors
- The perceived negative perception or objections to the structures (if applicable)
- The visual absorption capacity of the vegetation cover or built structures (if applicable)

An area with short distance visual exposure to the proposed infrastructure, a high viewer incidence and a potentially negative perception (i.e. a sensitive visual receptor) would therefore have a higher value (greater impact) on the index. This helps in focussing the attention to the critical areas of potential impact and determining the potential magnitude of the visual impact.

The index indicates that potentially sensitive visual receptors within a 1km radius of the proposed facility may experience a very high visual impact. The magnitude of visual impact on sensitive visual receptors subsequently subsides with distance to; high within a 1–3km radius (where/if sensitive receptors are present) and moderate within a 3–6km radius (where/if sensitive receptors are present). Receptors beyond 6km are expected to have a low potential visual impact.

Magnitude of the potential visual impact

The PV facility may have a visual impact of **very high** magnitude on the following observers (within a 0-1km radius):

- Observers travelling along the secondary road (site 1)

The PV Facility may have a visual impact of **high** magnitude on the following observers (1 – 3km radius):

- Residents of/visitors to Middelplaas Noord (site 2) and Basberg (site 3)
- Observers travelling along the various secondary roads (site 2)

The PV facility may have a visual impact of **moderate** magnitude impact on the following observers located between a 3 – 6km radius of PV Facility:

- Residents of/visitors to Jakobsrus (site 5), Unknown homestead (site 6) and Vrede (site 7)
- Observers travelling along the various secondary roads (site 4)

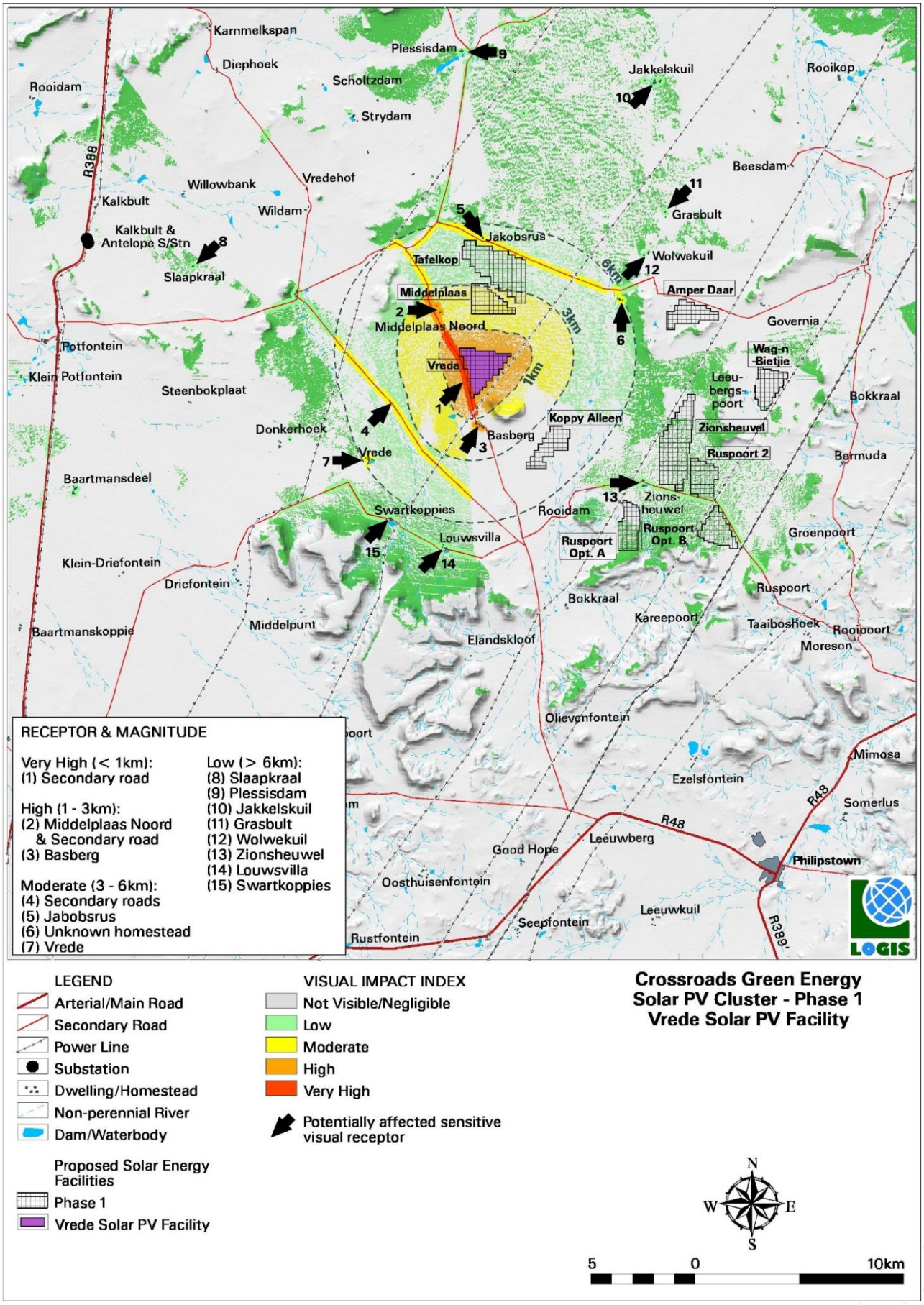

Figure 6.13: Visual impact index and potentially affected sensitive visual receptors

The PV facility may have a visual impact of **low** magnitude impact on the following observers located beyond the 6 km radius of the PV Facility:

- Residents of/visitors to:
  - Slaapkraal (site 8)
  - Plessisdam (site 9)
  - Jakkelskuil (site 10)
  - Grasbult (site 11)
  - Wolwekuil (site 12)
  - Zionsheuwel (site 13)
  - Louwavilla (site 14)
  - Swartkoppies (site 15)
- Observers travelling along the various secondary roads

Note:

Where any of the above-mentioned homesteads are derelict or deserted, the visual impact will be non-existent, until such time as it is inhabited again.

Additionally, some, not all, of the sensitive visual receptors of farm- and homesteads listed above who could be affected visually by the proposed Vrede Solar PV Facility are in fact located on properties involved in either this project or the remaining 8 PV Facilities that make up Phase 1 of the Crossroads Green Energy Cluster.

6.9.2 Description of Visual Impacts

The following list of possible impacts have been identified;

- The proposed development could change the character and sense of place of the landscape setting;
- The proposed development could change the character of the landscape as seen from the local roads;
- The proposed development could change the character of the landscape as seen from local agricultural homesteads;
- The proposed development could change the character of the landscape as seen from private nature reserves;
- Solar glare and glare impacts; and
- Lighting impacts.

6.9.3 Assessment of Potential Impacts and Recommended Mitigation Measures

Construction Phase Impacts

During the construction period it is expected that any visual impact of concern on sensitive visual receptors within the study area will be temporary and limited to a short-term period (2-5 years).

Nature of Impact: Visual impact of construction activities on sensitive visual receptors in close proximity to the proposed PV facility.

During the construction period, there will be an increase in heavy vehicles utilising the roads to the construction sites that may cause, at the very least, a visual nuisance to other road users and landowners in the area in close proximity (within 1km). Additionally, dust as a result of the construction activities and construction equipment (i.e. cranes), temporary laydown areas, construction camps, etc. may also be visible at the site, resulting in a visual impact occurring during construction.

A mitigating factor in this scenario is the low occurrence of receptors within the receiving environment. Additionally observers travelling along the secondary road will only experience a visual impact for a brief period of time.

	Without mitigation	**With mitigation**
Extent	Very Short distance (4)	Very Short distance (4)
Duration	Short term (2)	Short term (2)
Magnitude	Very high (10)	High (8)
Probability	Definite (5)	Highly probable (4)
Significance	**High (80)**	**Moderate (56)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

Planning:

» Retain and maintain natural vegetation in all areas outside of the development footprint, but within the project site.

Construction:

» Ensure that vegetation is not unnecessarily removed during the construction period.
» Plan the placement of laydown areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) where possible.
» Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
» Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed of regularly at licensed waste facilities.
» Reduce and control construction dust using approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).
» Restrict construction activities to daylight hours whenever possible in order to reduce lighting impacts.
» Rehabilitate all disturbed areas immediately after the completion of construction works.

Residual impacts:

None, provided that rehabilitation works are carried out as required.

Operation Phase Impacts

Nature of Impact: Visual impact on observers (residents at homesteads and visitors/tourists) in close proximity (i.e. within 1km) to the PV facility

The operation of the proposed PV facility is expected to have a high visual impact (significance rating = 80) pre-mitigation and a moderate visual impact (significance rating = 42) post mitigation on the residents of Jakobsrus and observers/visitors travelling along the secondary roads within a 1km radius of the PV facility.

A mitigating factor in this scenario is the low occurrence of receptors within the receiving environment and that observers traveling along these roads will only be exposed to the visual intrusion for a short period of time. This reduces the probability of this impact occurring. Mitigation of this impact is possible and both specific measures as well as general "best practice" measures are recommended in order to reduce/mitigate the potential visual impact. The table below illustrates this impact assessment.

	Without mitigation	With mitigation
Extent	Very Short distance (4)	Very Short distance (4)
Duration	Long term (4)	Long term (4)
Magnitude	Very high (10)	Moderate (6)
Probability	Definite (5)	Probable (3)
Significance	**High (80)**	**Moderate (42)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Generic best practise mitigation/management measures:

Planning:

» Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site.
» Consult adjacent landowners (if present) in order to inform them of the development and to identify any (valid) visual impact concerns.

Operations:

» Maintain the general appearance of the facility as a whole.
» Retain/re-establish and maintain natural vegetation (if present) immediately adjacent to the development footprint, where possible.
» Investigate the potential to screen affected receptor sites (if applicable and located within 1km of the facility) with planted vegetation cover.

Residual impacts:

The visual impact will be removed after decommissioning, provided the facility infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

Nature of Impact: Visual impact on observers travelling along the roads and residents at homesteads within a 1 – 3km radius of the facility

The operational facility could have a high visual impact (significance rating = 60) which may be mitigated to moderate (significance rating = 39) on residents/visitors to the homestead of Middelplaas and observers travelling along the various secondary roads within 1 – 3km radius of the facility.

A mitigating factor in this scenario is the low occurrence of receptors within the receiving environment and that observers traveling along these roads will only be exposed to the visual intrusion for a short period of time. This reduces the probability of this impact occurring. Mitigation of this impact is possible and both specific measures as well as general "best practice" measures are recommended in order to reduce/mitigate the potential visual impact. The table below illustrates this impact assessment.

	Without mitigation	With mitigation
Extent	Short distance (3)	Short distance (3)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High (60)**	**Moderate (39)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Generic best practise mitigation/management measures:

Planning:

» Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site.

Operations:

» Maintain the general appearance of the facility as a whole.
» Retain/re-establish and maintain natural vegetation (if present) immediately adjacent to the development footprint, where possible.
» Investigate the potential to screen affected receptor sites (if applicable and located within 1km of the facility) with planted vegetation cover.

Residual impacts:
The visual impact will be removed after decommissioning, provided the facility infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

Nature of Impact: Visual impact on observers travelling along the roads and residents at homesteads within a 3 – 6km radius of the facility

The operational facility could have a moderate visual impact (significance rating = 36) which may be mitigated to low (significance rating = 24) on residents/visitors to the homestead of Wolwekuil and an unknown residence as well as observers travelling along the various secondary roads within 3 – 6km radius of the facility.

A mitigating factor in this scenario is the low occurrence of receptors within the receiving environment and that observers traveling along these roads will only be exposed to the visual intrusion for a short period of time. This reduces the probability of this impact occurring. Mitigation of this impact is possible and both specific measures as well as general "best practice" measures are recommended in order to reduce/mitigate the potential visual impact. The table below illustrates this impact assessment.

	Without mitigation	**With mitigation**
Extent	Medium distance (2)	Medium distance (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Moderate (36)**	**Low (24)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Generic best practise mitigation/management measures:

Planning:

» Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site.

Operations:

» Maintain the general appearance of the facility as a whole.
» Retain/re-establish and maintain natural vegetation (if present) immediately adjacent to the development footprint, where possible.
» Investigate the potential to screen affected receptor sites (if applicable and located within 1km of the facility) with planted vegetation cover.

Residual impacts:
The visual impact will be removed after decommissioning, provided the facility infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

Nature of Impact: Visual impact on observers travelling along the roads, residents at homesteads and protected areas beyond the 6km radius of the facility

The operational facility could have a low visual impact (significance rating = 18) which may be mitigated to low (significance rating = 9) on residents/visitors to various homesteads as well as observers travelling along the various secondary roads beyond the 6km radius of the facility.

A mitigating factor in this scenario is the low occurrence of receptors within the receiving environment and that observers traveling along these roads will only be exposed to the visual intrusion for a short period of time. This reduces the probability of this impact occurring. Mitigation of this impact is possible and both specific measures as well as general "best practice" measures are recommended in order to reduce/mitigate the potential visual impact. The table below illustrates this impact assessment.

	Without mitigation	**With mitigation**
Extent	Long distance (1)	Long distance (1)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Very improbable (1)
Significance	**Low (18)**	**Low (9)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Generic best practise mitigation/management measures:

Planning:

» Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site.

Operations:

» Maintain the general appearance of the facility as a whole.
» Retain/re-establish and maintain natural vegetation (if present) immediately adjacent to the development footprint, where possible.
» Investigate the potential to screen affected receptor sites (if applicable and located within 1km of the facility) with planted vegetation cover.

Residual impacts:

The visual impact will be removed after decommissioning, provided the facility infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

Nature of Impact: Visual impact of lighting at night on sensitive visual receptors.

The area immediately surrounding the proposed facility has a relatively low incidence of receptors and light sources, so light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in the study area

Lighting impacts relate to the effects of glare and sky glow. The source of glare light is unshielded luminaries which emit light in all directions and which are visible over long distances.

Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the number of light sources. Each new light source, especially upwardly directed lighting, contribute to the increase in sky glow. It is possible that the PV facility may contribute to the effect of sky glow within the environment which is currently undeveloped.

Mitigation of direct lighting impacts and sky glow entails the pro-active design, planning and specification of lighting for the facility. The correct specification and placement of lighting and light fixtures for the facility and the ancillary infrastructure (e.g. workshop and storage facilities) will go far to contain rather than spread the light.

This anticipated lighting impact is likely to be of high significance (rating = 60), and may be mitigated to moderate (rating = 39) especially within 0-3 km radius of the PV facility.

	No mitigation	**Mitigation considered**
Extent	Short/Medium (3)	Short/Medium (3)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High (60)**	**Moderate (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

Planning & operation:

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

Cumulative impacts:

The light generated at night locally is very limited. The impact of the proposed Vrede Solar PV Energy Facility in addition to the other 8 proposed PV facilities that form part of Phase 1 of the Crossroads Green energy Cluster certainly will contribute to a local and regional increase in lighting impact.

Residual impacts:

The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

Nature of Impact: The visual impact of solar glint and glare as a visual distraction and possible road travel hazard

Glint and glare occurs when the sun reflects off surfaces with specular (mirror-like) properties. Examples of these include glass windows, water bodies and potentially some solar energy generation technologies (e.g. parabolic troughs and CSP heliostats). Glint is generally of shorter duration and is described as "a momentary flash of bright light", whilst glare is the reflection of bright light for a longer duration.

The visual impact of glint and glare relates to the potential it has to negatively affect sensitive visual receptors in relatively close proximity to the source (e.g. users of the secondary road), or aviation safety risk for pilots (especially where the source interferes with the approach angle to the runway). The Federal Aviation Administration (FAA) of the United States of America have researched glare as a hazard for aviation pilots on final approach and may prescribe specific glint and glare studies for solar energy facilities in close proximity to aerodromes (airports, airfields, military airbases, etc.). It is generally possible to mitigate the potential glint and glare impacts through the design and careful placement of the infrastructure.

PV panels are designed to generate electricity by absorbing the rays of the sun and are therefore constructed of dark-coloured materials, and are covered by anti-reflective coatings. Indications are that as little as 2% of the

incoming sunlight is reflected from the surface of modern PV panels especially where the incidence angle (angle of incoming light) is smaller i.e. the panel is facing the sun directly. This is particularly true for tracker arrays that are designed to track the sun and keep the incidence angle as low as possible.

There are no major roads within a 1km radius of the proposed PV facility. A secondary road is located within 1km of the proposed PV Facility. This approximate distance is recommended as a threshold within which the visual impact of glint and glare (if there is visual line of sight from the road) may influence road users. The potential visual impact related to solar glint and glare as a road travel hazard is therefore expected to be of low significance. No mitigation of this impact is required since the solar reflection is predicted towards a local/secondary road.

	Without mitigation	**With mitigation**
Extent	Very short distance (4)	N.A
Duration	Long term (4)	N.A
Magnitude	Low (4)	N.A
Probability	Improbable (2)	N.A
Significance	**Low (24)**	N.A
Status (positive or negative)	Negative	N.A
Reversibility	Reversible **(1)**	N.A
Irreplaceable loss of resources?	No	N.A
Can impacts be mitigated?	N.A.	
Mitigation: N.A		
Residual impacts: N.A.		

Nature of Impact: The visual impact of solar glint and glare on residents of homesteads in closer proximity to the PV facility

There is a single affected residence, Jakobsrus, within a 1km radius of the proposed PV facility. The potential visual impact related to solar glint and glare on static ground-based receptors (residents of homesteads) is therefore expected to be of moderate significance before mitigation and low post mitigation.

Mitigation of this impact is possible and both specific measures as well as general "best practice" measures are recommended in order to reduce/mitigate the potential visual impact. The table below illustrates this impact assessment.

	Without mitigation	**With mitigation**
Extent	Very short distance (4)	Very short distance (4)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (24)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible **(1)**	Reversible **(1)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Planning & operation: » Use anti-reflective panels and dull polishing on structures, where possible and industry standard. » If specific sensitive visual receptors are identified during operation, investigate screening at the receptor site, where possible.		
Residual impacts:		

The visual impact will be removed after decommissioning, provided the PV facility infrastructure is removed. Failing this, the visual impact will remain.

Nature of Impact: Visual impact of the ancillary infrastructure on observers in close proximity to the structures.

On-site ancillary infrastructure associated with the PV facility includes a substation and collector substation, Battery Energy Storage System (BESS) etc. No dedicated viewshed analyses have been generated for the ancillary infrastructure, as the range of visual exposure will fall within that of the PV facility.

The anticipated visual impact resulting from this infrastructure is likely to be of low significance both before and after mitigation.

	Without mitigation	**With mitigation**
Extent	Very Short distance (4)	Very Short distance (4)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (24)**	**Low (24)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Generic best practise mitigation/management measures:

Planning:

» Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site.

Operations:

» Maintain the general appearance of the facility as a whole.
» Retain/re-establish and maintain natural vegetation (if present) immediately adjacent to the development footprint, where possible.
» Investigate the potential to screen affected receptor sites (if applicable and located within 1km of the facility) with planted vegetation cover.

Residual impacts:

The visual impact will be removed after decommissioning, provided the ancillary infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

Nature of Impact: The potential impact on the sense of place of the region.

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

An impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

In general, the landscape character of the greater study area and site itself presents as largely undeveloped and natural in character. The visual quality of the region is generally high and large tracts of intact vegetation and rolling hills characterise most of the visual environment.

The anticipated significance of the visual impacts on the sense of place within the region (i.e. beyond a 6km radius of the development and within the greater region) is expected to be of moderate significance.		
	No Mitigation	**Mitigation considered**
Extent	Long distance (1)	Long distance (1)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Probable (3)	Probable (3)
Significance	**Moderate (39)**	**Moderate (39)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No, only best practise measures can be implemented	

Generic best practise mitigation/management measures:

Planning:

» Retain/re-establish and maintain natural vegetation in all areas outside of the development footprint/servitude, but within the project site.

Operations:

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

Residual impacts:

The visual impact will be removed after decommissioning, provided the facility infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.

Decommissioning Phase Impacts

Nature of Impact: Visual impact of construction activities on sensitive visual receptors in close proximity to the proposed facility.

During decommissioning there may be a noticeable increase in heavy vehicles utilising the roads to the site that may cause, at the very least, a visual nuisance to other road users and landowners in closer proximity (< 1 km) to the decommissioning activities.

A mitigating factor in this scenario is the low occurrence of receptors within the receiving environment and that observers traveling along these roads will only be exposed to the visual intrusion for a short period of time. This reduces the probability of this impact occurring.

	Without mitigation	**With mitigation**
Extent	Very short distance (4)	Very short distance (4)
Duration	Very Short term (1)	Very Short term (1)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Highly probable (4)
Significance	**High (65)**	**Moderate (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

Decommissioning:

» Remove infrastructure not required for the post-decommissioning use of the site.
» Rehabilitate all areas as per the rehabilitation plan undertaken. Consult an ecologist regarding rehabilitation specifications.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions as required.

Residual impacts:

None, provided rehabilitation works are carried out as specified.

Cumulative Impacts

Cumulative visual impacts can be defined as the additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments. In this case the 'development' would the proposed Vrede Solar PV Facility as seen in conjunction with the other 8 PV facilities that make up Phase 1 of the Crossroads Green Energy Cluster. Phase 1 of the Crossroads Green Energy Cluster consists of the following Solar PV Facilities (refer to **Figure 6.14**):

1. Tafelkop
2. Middelplaas
3. Vrede
4. Koppy Alleen
5. Amper Daar
6. Wag-n-Bietjie
7. Zionsheuwel
8. Ruspoort 1
9. Ruspoort 2

Cumulative visual impacts may be:

» Combined, where several PV facilities are within the observer's arc of vision at the same time;
» Successive, where the observer has to turn his or her head to see the various PV facilities; and
» Sequential, when the observer has to move to another viewpoint to see different developments, or different views of the same development (such as when travelling along a route).

The visual impact assessor is required (by the competent authority) to identify and quantify the cumulative visual impacts and to propose potential mitigating measures. This is often problematic as most regulatory bodies do not have specific rules, regulations or standards for completing a cumulative visual assessment, nor do they offer meaningful guidance regarding appropriate assessment methods. There are also not any authoritative thresholds or restrictions related to the capacity of certain landscapes to absorb the cumulative visual impacts of PV facilities.

To complicate matters even further, cumulative visual impact is not just the sum of the impacts of two developments. The combined effect of both may be much greater than the sum of the two individual effects, or even less.

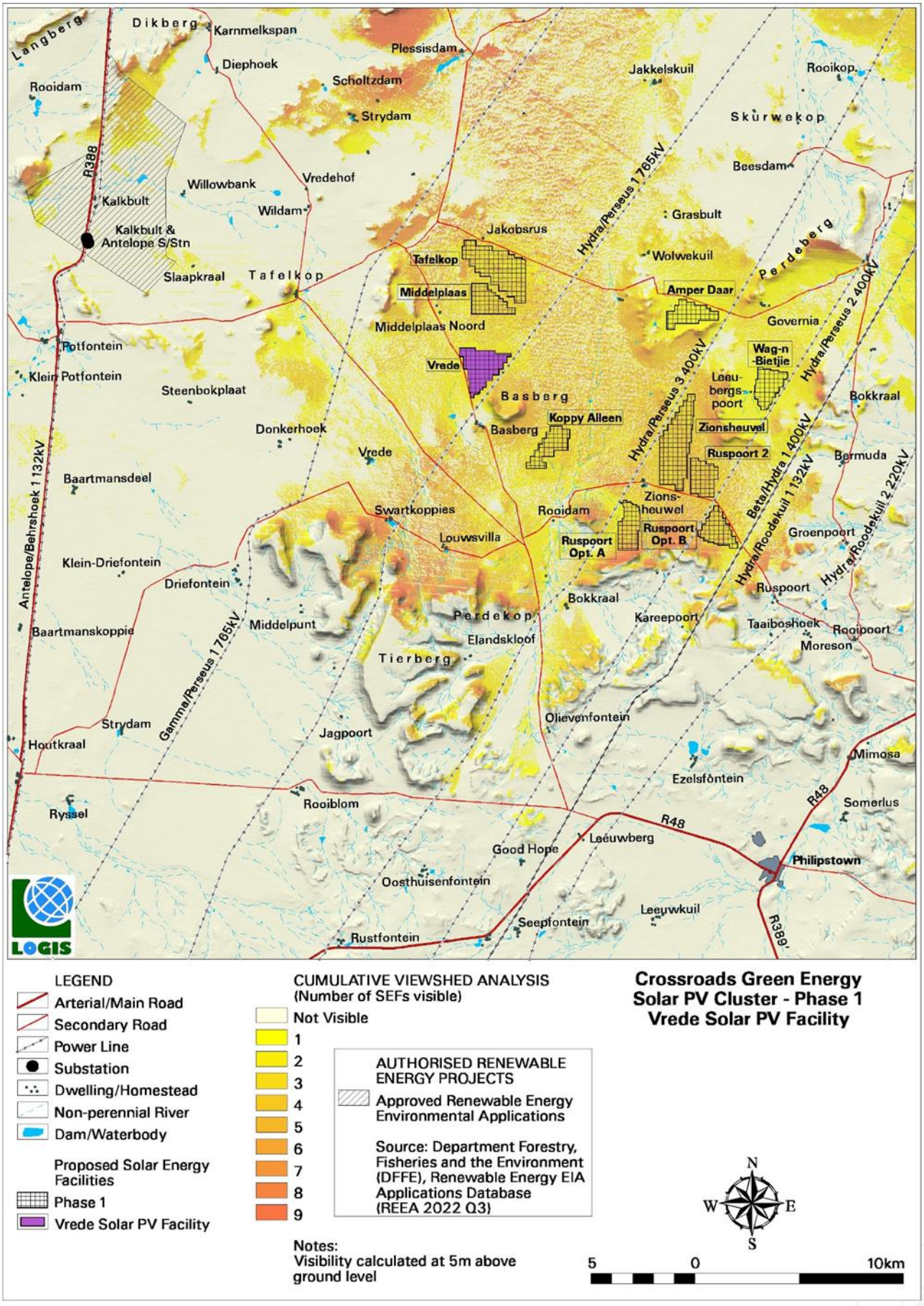

Figure 6.14: Cumulative viewshed analysis for the Crossroads Green Energy Solar Cluster

The cumulative impact of the proposed solar PV and BESS infrastructure on the landscape and visual amenity is a product of:

» The distance between the PV facilities;
» The distance over which the structures are visible;
» The overall character of the landscape and its sensitivity to the structures;
» The siting and design of the facilities; and
» The way in which the landscape is experienced.

The Vrede Solar PV Facility addressed in this report is only one component of Phase 1 which consists of 9 Solar PV Facilities. These in turn form part of a larger solar cluster consisting of up to 21 different facilities known as the Crossroads Green Energy Cluster, within the greater area.

Figure 6.14 illustrates the anticipated cumulative visual impact of Phase 1 of the Crossroads Green Energy Cluster and specifically the anticipated frequency of visual exposure. Areas shaded dark orange are likely to be exposed to 7-9 of the facilities; areas shaded in light orange are likely to be exposed to 4-6 of the facilities, while areas shaded in yellow are likely to be exposed to 1-3 of the facilities.

It is expected that the majority of the visually affected areas will be exposed to between 1-3 facilities. Additionally, areas located along the foothills of the various hills and mountains (i.e. Tierberg, Perdekop, Perdeberg, etc) located to the far north and south of the study area will likely be exposed to between 7-9 facilities, as a result of the topographies higher elevation.

The approach for this assessment also includes all renewable energy projects within 30 km that have received an EA, as well as the proposed project. The information was collected from the National DFFE Renewable Energy EIA Application (REEA) database, 2022 Quarter 3. This is the most accurate and up-to-date data available to the project team. There may be some projects with "in-process" applications for which data is not yet publicly available. This is the data found to be available and efforts were made to determine recent amendments. The REEA database contains land parcels, and not the footprints. In most cases the actual development footprint of the nearby Renewable Energy developments could not be easily quantified or accessed spatially. Hence the land parcels considered, are larger than the land the PV will occupy. It is important to note that the existence of an approved EA does not directly equate to actual development of the project. For these reasons this data tends towards a worst-case scenario. Applications that have been approved include the following PV facilities:

List of renewable energy projects within 30 km from the proposed Crossroads Green Energy Cluster

PROJECT TITLE	DFFE REFERENCE	STATUS
Proposed establishment of photovoltaic (solar power) farms in the Northern Cape Province - Kalkbult	12/12/20/2258/1	Approved
Proposed Swartwtare 75MW Solar PV Power Fcaility in Petrusville within RenosterburgLocal Municipality, Northern Cape	14/12/16/3/3/2/564/AM1	In process

The proposed Crossroads Green Energy Cluster, although in line with current development and land use trends in the region, will certainly contribute to the increased cumulative visual impact of solar energy facilities. The cumulative visual impact of Crossroads Green Energy Cluster is ultimately expected to be of moderate to high significance due to their remote location, fairly constrained visual exposure as a result of

the visual screening effects of the numerous hills and mountains surrounding the proposed sites and the general low occurrence of potential sensitive visual receptors in the area.

Nature of Impact: The potential cumulative visual impact of solar PV facilities on the visual quality of the landscape. The cumulative visual impact of the proposed Vrede Solar PV Facility and the other associated PV facilities in the Cluster and within 30km of the proposed Crossroads Green Energy Cluster will primarily occur on the plains. The anticipated cumulative visual impact of the proposed Phase 1 of the Crossroads Green Energy Cluster is expected to be of high significance.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and Phase 1**
Extent	Medium distance (2)	Medium distance (2)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Very High (10)
Probability	Probable (3)	Highly probable (4)
Significance	**Moderate (42)**	**High (64)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Reversible (1)	Reversible (1)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation measures: N.A.		
Residual impacts: The visual impact will be removed after decommissioning, provided the facility infrastructure is removed and the area rehabilitated. Failing this, the visual impact will remain.		

6.9.4 Overall Result

The findings of the Visual Impact Assessment undertaken for the proposed Vrede Solar PV Facility is that the visual environment surrounding the site, especially within a 1km radius (and potentially up to a radius of 3km) of the proposed facility, may be visually impacted during the anticipated operational lifespan of the facility (i.e. a minimum of 20 years).

The following is a summary of impacts remaining:

- Construction activities may potentially result in a **high** temporary visual impact, that may be mitigated to moderate
- The operation of the proposed PV facility is expected to have a **high** visual impact pre-mitigation and a **moderate** visual impact post mitigation on the residents of Jakobsrus and observers/visitors travelling along the secondary roads within a 1km radius of the PV facility.
- The operational facility could have a **high** visual impact which may be mitigated to **moderate** on residents/visitors to the homestead of Middelplaas and observers travelling along the various secondary roads within 1 – 3km radius of the facility.
- The operational facility could have a **moderate** visual impact which may be mitigated to **low** on residents/visitors to the homestead of Wolwekuil and an unknown residence as well as observers travelling along the various secondary roads within 3 – 6km radius of the facility.
- The operational facility could have a **low** visual impact both pre and post mitigation on residents/visitors to various homesteads as well as observers travelling along the various secondary roads beyond the 6km radius of the facility.

- This anticipated lighting impact is likely to be of **high** significance and may be mitigated to **moderate** especially within 0-3 km radius of the PV facility.
- The potential visual impact related to solar glint and glare as a road travel hazard is therefore expected to be of **low** significance. No mitigation of this impact is required since the solar reflection is predicted towards a local/secondary road.
- There is a single affected residence, Jakobsrus, within a 1km radius of the proposed PV facility. The potential visual impact related to solar glint and glare on static ground-based receptors (residents of homesteads) is therefore expected to be of **moderate** significance before mitigation and **low** post mitigation.
- The anticipated visual impact resulting from ancillary infrastructure is likely to be of **low** significance both before and after mitigation.
- Decommissioning activities may potentially result in a **high**, temporary visual impact that may be mitigated to **moderate**.
- The anticipated significance of the visual impacts on the sense of place within the region (i.e. beyond a 6 km radius of the development and within the greater region) is expected to be of **Moderate** significance.
- The anticipated cumulative visual impact of the proposed facility is expected to be of **high** significance.

The anticipated visual impacts listed above (i.e. post mitigation impacts) range from prominently **moderate** to **low** significance. One visual impact of **high** is anticipated in terms of the cumulative visual impact of the proposed Phase 1 of the Crossroads Green Energy Cluster. Anticipated visual impacts on sensitive visual receptors (if and where present) in close proximity to the proposed Vrede Solar PV Facility are not considered to be fatal flaws for the proposed PV facility.

A number of mitigation measures have been proposed (Section 6.5). Regardless of whether or not mitigation measures will reduce the significance of the anticipated visual impacts, they are considered to be good practice and should all be implemented and maintained throughout the construction, operation and decommissioning phases of the proposed facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. As such, the Vrede Solar PV facility would be considered to be acceptable from a visual impact perspective and can therefore be authorised.

6.10. Potential Social Impacts

Various positive and negative impacts have been identified with the development of the project from a socio-economic perspective. Potential social impacts and the relative significance of the impacts associated with the development of the Project are summarised below (refer to **Appendix K**).

6.10.1 Results of the Social Impact Assessment

The development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all refer to and support renewable energy. The PKSDM SDF and IDP also support the development of renewable energy. The development of the proposed PV facility is therefore supported by key policy and planning documents.

6.10.2 Description of Social Impacts

Impacts are expected to occur with the development of the project during the construction, operation and decommissioning phases. Both positive and negative impacts are identified and assessed.

Impacts during construction include:

- Potential positive impacts
  - Creation of employment and business opportunities, and opportunity for skills development and on-site training.

- Potential negative impacts
  - Impacts associated with the presence of construction workers on local communities.
  - Impacts related to the potential influx of job-seekers.
  - Increased risks to livestock and farming infrastructure associated with the construction related activities and presence of construction workers on the site.
  - Increased risk of grass fires associated with construction related activities.
  - Nuisance impacts, such as noise, dust, and safety, associated with construction related activities and vehicles.
  - Impact on productive farmland.

Impacts during the operation phase include:

- Potential positive impacts
  - The establishment of infrastructure to improve energy security and support renewable sector.
  - Creation of employment opportunities.
  - Benefits to the affected landowners.
  - Benefits associated with the socio-economic contributions to community development.

- Potential negative impacts
  - Visual impacts and associated impacts on sense of place.
  - Impact on property values.
  - Impact on tourism.

6.10.3 Assessment of Potential Impacts and Recommended Mitigation Measures

Construction Phase Impacts

Nature: Creation of employment and business opportunities during the construction phase

The construction phase will extend over a period of approximately 18 months and create in the region of 250 employment opportunities. Approximately 55% of the jobs will benefit low-skilled workers, 30% semi-skilled and 15% high skilled. Members from the local communities in the area, specifically De Aar, Philipstown and Petrusville, would be in a position to qualify for a percentage of the low skilled and semi-skilled employment opportunities. Most of these employment opportunities will accrue to Historically Disadvantaged (HD) members of the community. The wage bill will be in the region of R 50 million (2023 Rand values). A percentage of the wage bill will be spent in the local economy which will also create opportunities for local businesses in the local towns in the area.

Given relatively high local unemployment levels and limited job opportunities in the area, this will represent a significant, if localised, social benefit. The capital expenditure will be approximately R 2.5 billion (2023 Rand value). Due the lack of diversification in the local economy the potential for local companies is likely to be limited. The majority of benefits are

therefore likely to accrue to contractors and engineering companies based outside the RLM and ELM.

The potential benefits for local communities are confirmed by the findings of the Overview of the REIPPPP undertaken by the Department of Mineral Resources and Energy, National Treasury and DBSA (December 2021). The study found that to date, a total of 63 291 job years[10] have been created for South African citizens, of which 48 110 job years were in construction and 15 182 in operations. By the end of December 2021, 85 projects had successfully completed construction and moved into operation. These projects created 44 172 job years of employment, compared to the anticipated 30 488. This was 45% more than planned.

In terms of benefits for local communities, significantly more people from local communities were employed during construction than was initially planned. For active projects, the expectation for local community participation was 13 284 job years. To date 25 272 job years have been realised (i.e. 90% more than initially planned), with 23 projects still in, or entering, construction. The number of black SA citizens employed during construction also exceeded the planned numbers by 74%.

Black South African citizens, youths and rural or local communities have been the major beneficiaries during the construction phases, as they respectively represent 81%, 44% and 48% of total job opportunities created by IPPs to date. However, woman and disabled people could still be significantly empowered as they represent a mere 10% and 0.4% of total jobs created to date, respectively. Nonetheless, the fact that the REIPPPP has raised employment opportunities for black South African citizens and local communities beyond planned targets, indicates the importance of the programme to employment equity and the drive towards more equal societies.

The local service sector will also benefit from the construction phase. The potential opportunities would be linked to accommodation, catering, cleaning, transport, and security, etc. associated with the construction workers on the site.

The hospitality industry in the area will also benefit from the provision of accommodation and meals for professionals (engineers, quantity surveyors, project managers, product representatives etc.) and other (non-construction) personnel involved on the project. Experience from other construction projects indicates that the potential opportunities are not limited to on-site construction workers but also to consultants and product representatives associated with the project.

	Without Enhancement	**With Enhancement**
Extent	Local – Regional (2)	Local – Regional (3)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (40)**	**Medium (44)**
Status	Positive	Positive
Reversibility	N/A	N/A
Irreplaceable loss of resources?	N/A	N/A
Can impact be enhanced?	Yes	

Enhancement Measures:

In order to enhance local employment and business opportunities associated with the construction phase, the following measures should be implemented:

Employment

- Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.
- Where reasonable and practical, the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area.
- Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black

[10] The equivalent of a full-time employment opportunity for one person for one year.

Economic Empowerment (BBBEE) criteria.
- Before the construction phase commences the proponent should meet with representatives from the RLM to establish the existence of a skills database for the area. If such a database exists, it should be made available to the contractors appointed for the construction phase.
- The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project.
- Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
- The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.

Business
- The proponent should liaise with the RLM with regards the establishment of a database of local companies, specifically BBBEE companies, which qualify as potential service providers (e.g., construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction service providers. These companies should be notified of the tender process and invited to bid for project-related work.

Note that while preference to local employees and companies is recommended, it is recognised that a competitive tender process may not guarantee the employment of local labour for the construction phase.

Residual impacts:
Improved pool of skills and experience in the local area.

Nature: Potential impacts on family structures and social networks associated with the presence of construction workers

The presence of construction workers poses a potential risk to family structures and social networks. While the presence of construction workers does not in itself constitute a social impact, the manner in which construction workers conduct themselves can impact on local communities. The most significant negative impact is associated with the disruption of existing family structures and social networks. This risk is linked to potentially risky behaviour, mainly of male construction workers, including:

- An increase in alcohol and drug use.
- An increase in crime levels.
- The loss of girlfriends and/or wives to construction workers.
- An increase in teenage and unwanted pregnancies.
- An increase in prostitution.
- An increase in sexually transmitted diseases (STDs), including HIV.

The proponent has indicated that workers will be accommodated on site.

The objective will be to source as many of the low and semi-skilled workers locally. These workers will be from the local community and form part of the local family and social networks. This will reduce the risk and mitigate the potential impacts on the local community. However, based on experience with renewable energy projects in the area the potential for local employment, specifically for semi and skilled workers, is likely to be limited. The majority of semi and skilled workers will therefore need to be accommodated in the nearby towns of Philipstown, Petrusville and De Aar.

The total number of construction workers employed, and duration of the construction phase will depend on the timing and phasing of the construction of the Crossroads Green Energy Cluster. This will have a bearing on the potential impact on local communities and services. This issue is discussed under cumulative impacts. The assessment below

relates to a single PV SEF.

While the risks associated with construction workers at a community level will be low, at an individual and family level they may be significant, especially in the case of contracting a sexually transmitted disease or an unplanned pregnancy. However, given the nature of construction projects, it is not possible to totally avoid these potential impacts at an individual or family level.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Short term for community as a whole (2)	Short term for community as a whole (2)
Magnitude	Moderate for the community as a whole (6)	Low for community as a whole (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium for the community as a whole (30)**	**Low for the community as a whole (21)**
Status	Negative	Negative
Reversibility	No in case of HIV and AIDS	No in case of HIV and AIDS
Irreplaceable loss of resources?	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming for their livelihoods	
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be eliminated	

Recommended enhancement measures:

» Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.
» Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase.
» The SEP and CHSSP should include a Grievance Mechanism that enables stakeholders to report resolve incidents.
» Where possible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically for semi and low-skilled job categories.
» The proponent should consider the option of establishing a Monitoring Committee (MC) for the construction phase that representatives from local landowners, farming associations, and the local municipality. This MC should be established prior to commencement of the construction phase and form part of the SEP.
» The proponent and contractor should develop a Code of Conduct (CoC) for construction workers. The code should identify which types of behaviour and activities are not acceptable. Construction workers in breach of the code should be subject to appropriate disciplinary action and/or dismissed. All dismissals must comply with the South African labour legislation. The CoC should be signed by the proponent and the contractors before the contractors move onto site. The CoC should form part of the CHSSP.
» The proponent and the contractor should implement an HIV/AIDS, COVID-19 and Tuberculosis (TB) awareness programme for all construction workers at the outset of the construction phase. The programmes should form part of the CHSSP.
» The contractor should provide transport for workers to and from the site on a daily basis. This will enable the contactor to effectively manage and monitor the movement of construction workers on and off the site.
» The contractor must ensure that all construction workers from outside the area are transported back to their place of residence within 2 days for their contract coming to an end.
» No construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.

Residual impacts:

Impacts on family and community relations that may, in some cases, persist for a long period of time. Also, in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.

Nature: Potential impacts on family structures, social networks and community services associated with the influx of job seekers

Large construction projects tend to attract people to the area in the hope that they will secure a job, even if it is a temporary job. These job seekers can in turn become "economically stranded" in the area or decide to stay on irrespective of finding a job or not. While the proposed project on its own does not constitute a large construction project, the establishment of a number of renewable energy projects in the area may attract job seekers to the area. As in the case of construction workers employed on the project, the actual presence of job seekers in the area does not in itself constitute a social impact. However, the way in which they conduct themselves can impact on the local community. The main areas of concern associated with the influx of job seekers include:

» Impacts on existing social networks and community structures.
» Competition for housing, specifically low-cost housing.
» Competition for scarce jobs.
» Increase in incidences of crime.

The potential for economically motivated in-migration and subsequent labour stranding is likely to be negligible. This is due to the isolated location of the area and the limited economic and employment opportunities in the nearby towns of Philipstown, Petrusville and De Aar.

The potential for an influx of job seekers may also be affected by the timing and phasing of the timing and phasing of the construction of the Crossroads Green Energy Cluster. This issue is discussed under cumulative impacts. The assessment below relates to a single PV facility.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Short term (2)	Short term (2)
Magnitude	Low (2)	Low (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (18)**	**Low (15)**
Status	Negative	Negative
Reversibility	No in case of HIV and AIDS	No in case of HIV and AIDS
Irreplaceable loss of resources?	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming for their livelihoods	
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be eliminated	

Recommended mitigation measures:

It is impossible to stop people from coming to the area in search of employment. However, as indicated above, the proponent should ensure that the employment criteria favour residents from the area. In addition:

» Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.
» Preparation and implementation of a Community Health, Safety and Security Plan (CHSSP) prior to and during the construction phase.
» The proponent, in consultation with the DBNLM should investigate the option of establishing a MC to monitor and identify potential problems that may arise due to the influx of job seekers to the area.
» The proponent should implement a "locals first" policy, specifically with regard to unskilled and low skilled opportunities.
» The proponent should implement a policy that no employment will be available at the gate.
» The contractor must ensure that all construction workers from outside the area are transported back to their place of residence within 2 days for their contract coming to an end.
» No construction workers, with the exception of security personnel, should be permitted to stay over-night on the

site.

Residual impacts:
Impacts on family and community relations that may, in some cases, persist for a long period of time. Also, in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.

Nature: Potential risk to safety of farmers and farm workers, livestock and damage to farm infrastructure associated with the presence of construction workers on site

The presence on and movement of construction workers on and off the site poses a potential safety threat to local famers and farm workers in the vicinity of the site. In addition, farm infrastructure, such as fences and gates, may be damaged and stock losses may also result from gates being left open and/or fences being damaged, or stock theft linked either directly or indirectly to the presence of farm workers on the site. Based on feedback from interviews with local farmers, stock theft and security during the construction phase were identified as issue.

The potential risks (safety, livestock, and farm infrastructure) can be effectively mitigated by careful planning and managing the movement of construction on and off the site workers during the construction phase.

	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Medium (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock losses and damage to farm infrastructure etc.	Yes, compensation paid for stock losses and damage to farm infrastructure etc.
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	Yes

Recommended mitigation measures:

» The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase commences.
» All farm gates must be closed after passing through.
» Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site.
» The proponent should consider the option of establishing a MF (see above) that includes local farmers and develop a Code of Conduct for construction workers. This committee should be established prior to commencement of the construction phase. The Code of Conduct should be signed by the proponent and the contractors before construction activities commence.
» The proponent should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors, and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below).
» The Environmental Management Programme (EMPr) must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested.
» Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained in the Code of Conduct, specifically consequences of stock theft and

trespassing on adjacent farms.
» Contractors appointed by the proponent must ensure that construction workers who are found guilty of stealing livestock and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation.
» It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.

Residual impacts:
None, provided losses are compensated.

Nature: Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of grass fires

The presence of construction workers and construction-related activities on the site poses an increased risk of grass fires that could, in turn pose, a threat to livestock, crops, wildlife and farm infrastructure. The potential risk of grass fires will be higher during the dry, windy winter months from May to October.

The potential risk of grass fires and the impact on grazing and farming operations was raised as a concern by local farmers.

	Without Mitigation	**With Mitigation**
Extent	Local (4)	Local (2)
Duration	Short term (2)	short term (2)
Magnitude	Moderate due to reliance on agriculture for maintaining livelihoods (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock and crop losses etc.	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	

Recommended mitigation measures:
» The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc., during the construction phase will be compensated for. The agreement should be signed before the construction phase commences.
» Contractor should ensure that open fires on the site for cooking or heating are not allowed except in designated areas.
» Smoking on site should be confined to designated areas.
» Contractor should ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the high-risk dry, windy winter months.
» Contractor should provide adequate fire-fighting equipment on-site, including a fire fighting vehicle.
» Contractor should provide fire-fighting training to selected construction staff.
» No construction staff, with the exception of security staff, to be accommodated on site overnight.
» As per the conditions of the Code of Conduct, in the advent of a fire being caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused to their farms. The contractor should also compensate the fire-fighting costs borne by farmers and local authorities.

Residual impacts:
None, provided losses are compensated for.

Nature: Potential noise, dust and safety impacts associated with construction related activities

Construction related activities, including the movement of heavy construction vehicles of and on the site, has the potential to create dust, noise and safety impacts and damage roads. The impacts will be largely local and can be effectively mitigated. The number of potentially sensitive social receptors, such as farmsteads, will also be low due to the sparse settlement patterns and small number of farmsteads in the area.

Damage to local public and internal farm roads was raised as concern by local farmers and will need to be addressed during the construction phase. Local landowners also indicated that dust generated by the construction traffic associated with the establishment of the Kalkbult SEF along the De Aar-Kimberley railway line impacted on the veld.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Short Term (2)	Short Term (2)
Magnitude	Medium (6)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Medium (30)**	**Low (15)**
Status	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	

Recommended mitigation measures:

The potential impacts associated with heavy vehicles can be effectively mitigated. The mitigation measures include:

- The movement of construction vehicles on the site should be confined to agreed access road/s.
- Establishment of a Grievance Mechanism that provides local farmers and other road users with an effective and efficient mechanism to address issues related to construction related impacts, including damage to local gravel farm roads.
- The movement of heavy vehicles associated with the construction phase should be timed to avoid times and days of the week, such as weekends, when the volume of traffic travelling along the access roads may be higher.
- Establishment of a Grievance Mechanism that provides local farmers and other road users with an effective and efficient mechanism to address issues related to construction related impacts, including damage to local gravel farm roads.
- Dust suppression measures should be implemented, such as wetting on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers.
- All vehicles must be road worthy, and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.

Residual impacts:

If damage to local farm roads is not repaired then this will affect the farming activities in the area and result in higher maintenance costs for vehicles of local farmers and other road users. The costs will be borne by road users who were no responsible for the damage.

Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the project etc. will damage farmlands and result in a loss of farmlands for grazing.

The activities associated with the construction phase and establishment of the proposed project and associated infrastructure will result in the disturbance and loss of land available for grazing. The impact on farmland associated with the construction phase can be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase. Existing internal roads

should be used where possible. This requires careful site planning and management of operations. In the event that new roads are required, these roads should be rehabilitated on completion of the construction phase. In addition, the landowners will be compensated for the loss of land.

No footprint related issues were raised by the landowners affected by the Crossroads Phase 1 projects. Approximately 10% (or less) of the relevant farming operations would be affected by site footprints. All the relevant landowners indicated that the loss of grazing would be unlikely to have any noticeable adverse effects on their operations.

The potential impact on the local groundwater table has been raised by landowners as concern during the Kudu Project Scoping Phase. This issue is also likely to apply to the Crossroads projects given that most farming operations are reliant on groundwater.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long term-permanent if disturbed areas are not effectively rehabilitated (5)	Short term if damaged areas are rehabilitated (2)
Magnitude	Medium (6)	Minor (2)
Probability	Probable (3)	Highly Probable (4)
Significance	**Medium (36)**	**Low (20)**
Status	Negative	Negative
Reversibility	Yes, disturbed areas can be rehabilitated	Yes, disturbed areas can be rehabilitated
Irreplaceable loss of resources?	Yes, loss of farmland. However, disturbed areas can be rehabilitated	Yes, loss of farmland. However, disturbed areas can be rehabilitated
Can impact be mitigated?	Yes, however, loss of farmland cannot be avoided	Yes, however, loss of farmland cannot be avoided

Recommended mitigation measures:

The potential impacts associated with damage to, and loss of farmland can be effectively mitigated. The aspects that should be covered include:

- An Environmental Control Officer (ECO) should be appointed to monitor the construction phase.
- Existing internal roads should be used where possible. In the event that new roads are required, these roads should be rehabilitated on completion of the construction phase.
- The footprint associated with the construction related activities (access roads, construction camps, workshop etc.) should be minimised.
- All areas disturbed by construction related activities, such as access roads on the site, construction camps etc., should be rehabilitated at the end of the construction phase.
- The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed. The specifications for the rehabilitation programme should be included in the EMPr.
- The implementation of the Rehabilitation Programme should be monitored by the ECO.

Residual impacts:

Overall loss of farmland could affect the livelihoods of the affected farmers, their families, and the workers on the farms and their families. However, disturbed areas can be rehabilitated.

Operation Phase Impacts

Nature: Development of infrastructure to improve energy security and support the renewable sector

The primary goal of the proposed project is to improve energy security in South Africa by generating additional energy. The proposed PV SEF will also reduce the carbon footprint associated with energy generation. The project should therefore be viewed within the context of the South Africa's current reliance on coal powered energy to meet the majority of its energy needs, and secondly, within the context of the success of the REIPPPP.

Improved energy security

South Africa's energy crisis, which started in 2007 and is ongoing, has resulted in widespread rolling blackouts (referred to as load shedding) due to supply shortfalls. The load shedding has had a significant impact on all sectors of the economy and on investor confidence. The mining and manufacturing sector have been severely impacted and will continue to be impacted until such time as there is a reliable supply to energy. Load shedding in the first six months of 2015 was estimated to have cost South African businesses R13.72 billion in lost revenue with an additional R716 million was spent by businesses on backup generators. A survey of 3 984 small business owners found that 44% said that they had been severely affected by load shedding with 85% stating that it had reduced their revenue, with 40% of small businesses losing 20% or more or revenue during due to load shedding period.

Impact of a coal powered economy

The Green Jobs study (2011) notes that South Africa has one of the most carbon-intensive economies in the world, thus making the greening of the electricity mix a national imperative. The study notes that renewable energy provides an ideal means for reaching emission reduction targets in a relatively easy manner. In addition, and of specific relevance to South Africa renewable energy is not as dependent on water compared to the massive water requirements of conventional power stations, has a limited footprint and therefore does not impact on large tracts of land, poses limited pollution and health risks, specifically when compared to coal and nuclear energy plants.

The Greenpeace Report (powering the future: Renewable Energy Roll-out in South Africa, 2013), also notes that within a broader context of climate change, coal energy does not only have environmental impacts, it also has socio-economic impacts. These include acid mine drainage from abandoned mines in South Africa and the risk this poses on the country's limited water resources.

Benefits associated with REIPPPP

Through the competitive bidding process, the REIPPPP has effectively leveraged rapid, global technology developments and price trends, buying clean energy at lower and lower rates with every bid cycle, resulting in SA getting the benefit of renewable energy at some of the lowest tariffs in the world. The price for wind power has dropped by 50% to R0.94/kWh, while solar PV has dropped with 75% to R1.14/kWh between BW1 and BW4.

Prices contracted under the REIPPPP for all technologies are well below the published REFIT prices. The REIPPPP has effectively translated policy and planning into delivery of clean energy at very competitive prices. As such it is contributing to the national aspirations of secure, affordable energy, lower carbon intensity and a transformed 'green' economy.

	Without Enhancement	**With Enhancement**
Extent	Local, Regional and National (4)	Local, Regional and National (5)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Highly Probable (4)	Definite (5)
Significance	**High (64)**	**High (85)**
Status	Positive	Positive
Reversibility	Yes	
Irreplaceable loss of resources?	Yes, impact of climate change on ecosystems	Reduced CO_2 emissions and impact on climate change
Can impact be mitigated?	Yes	

Recommended mitigation measures

The proponent should:

» Implement a skills development and training programme aimed at maximizing the number of employment opportunities for local community members.
» Maximise opportunities for local content, procurement, and community shareholding.

Residual impacts: Overall reduction in CO_2 emission, reduction in water consumption for energy generation, contribution to establishing an economically viable commercial renewables generation sector in the Northern Cape

and South Africa.

Nature: Creation of employment and business opportunities associated with the operational phase

The proposed development will create ~ 40-50 full-time employment opportunities during the operational phase, of which 55% will be unskilled, 35% semi-skilled, and 15% skilled. The annual operating budget will be in the region of R 50 million (2023 Rand values), including wages. A percentage of the annual operating budget will be spent in the local economy which will benefit local businesses.

	Without Enhancement	**With Enhancement**
Extent	Local and Regional (1)	Local and Regional (2)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Low (28)**	**Medium (40)**
Status	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of resources?	No	
Can impact be enhanced?	Yes	

Enhancement Measures:

In order to enhance local employment and business opportunities associated with the construction phase, the following measures should be implemented:

Employment

- Preparation and implementation of a Stakeholder Engagement Plan (SEP) prior to and during the construction phase.
- Where reasonable and practical, the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area.
- Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria.
- Before the construction phase commences the proponent should meet with representatives from the DM to establish the existence of a skills database for the area. If such a database exists, it should be made available to the contractors appointed for the construction phase.
- The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project.
- Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
- The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.

Business

- The proponent should liaise with the DBNLM with regards the establishment of a database of local companies, specifically BBBEE companies, which qualify as potential service providers (e.g., construction companies, catering companies, waste collection companies, security companies etc.) prior to the commencement of the tender process for construction service providers. These companies should be notified of the tender process and invited to bid for project-related work.

Note that while preference to local employees and companies is recommended, it is recognised that a competitive tender process may not guarantee the employment of local labour for the construction phase.

Residual impacts:
Creation of permanent employment and skills development opportunities for members from the local community and creation of additional business and economic opportunities in the area

Nature: The generation of additional income represents a significant benefit for the local affected farmer(s) and reduces the risks to their livelihoods posed by droughts and fluctuating market prices for sheep and farming inputs, such as feed etc.

The proponent will enter into rental agreements with the affected landowners for the use of the land for the establishment of the proposed SEF. In terms of the rental agreement, the affected landowner will be paid an annual amount dependent upon the revenue generated from PV SEFs located on the property. The additional income will reduce the risk to their livelihoods posed by droughts and fluctuating market prices for sheep and farming inputs, such as fuel, feed etc. Given the low carrying capacity of the veld, the additional income represents a significant benefit for the affected landowners.

	Without Enhancement	**With Enhancement**
Extent	Local (1)	Local (3)
Duration	Long term (4)	Long term (4)
Intensity	Low (4)	Moderate (6)
Likelihood	Probable (3)	Definite (5)
Significance	**Low (27)**	**High (65)**
Status	Positive	Positive
Reversibility	Yes	Yes
Can impact be enhanced?	Yes	

Recommended enhancement measures

» Implement agreements with affected landowners.

Residual impacts:
Support for local agricultural sector and farming

Nature: Benefits associated with support for local community's form SED contributions

The REIPPPP has been designed not only to procure energy but has also been structured to contribute to the broader national development objectives of job creation, social upliftment and broadening of economic ownership. Socio-economic development (SED) contributions are an important focus of the REIPPPP and are aimed at ensuring that local communities benefit directly from the investments attracted into the area. These contributions create an opportunity to generate a steady revenue stream over an extended period. This revenue can be used to fund development initiatives in the area and support the local community. The long-term duration of the revenue stream also allows local municipalities and communities to undertake long term planning for the area. The revenue from the proposed SEF can be used to support a number of social and economic initiatives in the area, including:

» Creation of jobs.
» Education.
» Support for and provision of basic services.
» School feeding schemes.
» Training and skills development.
» Support for SMMEs.

The minimum compliance threshold for SED contributions is 1% of the revenue with 1.5% the targeted level over the 20–25-year project operational life. For the current portfolio of projects, the average commitment level is 2%, which is 101% higher than the minimum threshold level. To date (across BW1-4) a total contribution of R22.8 billion has been committed

to SED initiatives. Assuming an even, annual revenue spread, the average contribution per year would be R1.1 billion. Of the total commitment, R18.5 billion is specifically allocated for local communities where the IPPs operate. With every new IPP on the grid, revenues and the respective SED contributions will increase.

As a percentage of revenue, SED obligations become effective only when operations commence, and revenue is generated. Of the 91 IPPs that have reached financial close (BW1–BW4), 85 are operational. The SED contributions associated with these 85 projects has amounted to R 1.8 billion to date.

In terms of ED and SED spend, education, social welfare, and health care initiatives have a SED focus. SED spend on education has been almost double the expenditure on enterprise development. In this regard IPPs have supported 1 388 education institutions with a total of R437 million in contributions, from 2015 to the end of June 2021. A total of 1 276 bursaries, amounting to R210.8 million, have been awarded by 67 IPPs from 2015 until the end of June 2021. The largest portion of the bursaries were awarded to African and Coloured students (97.4%), with women and girls receiving 56.3% of total bursaries. The Northern Cape province benefitted most from the bursaries awarded, with 57.2%, followed by the Eastern Cape (20.2%) and Western Cape (14.1%). Enterprise development and social welfare are the focus areas that have received the second highest share of the contributions to date.

The Green Jobs study (2011) found that the case for renewable energy is enhanced by the positive effect on rural or regional development. Renewable energy facilities located in rural areas create an opportunity to benefit the local and regional economy through the creation of jobs and tax revenues.

	Without Enhancement	**With Enhancement[11]**
Extent	Local and Regional (2)	Local and Regional (3)
Duration	Long term (4)	Long term (4)
Intensity	Low (4)	Moderate (6)
Likelihood	Probable (3)	Definite (5)
Significance	**Medium (30)**	**High (65)**
Status	Positive	Positive
Reversibility	Yes	Yes
Can impact be enhanced?	Yes	

Recommended enhancement measures

To maximise the benefits and minimise the potential for corruption and misappropriation of funds the following measures should be implemented:

- The proponents should liaise with the RLM to identify projects that can be supported by SED contributions.
- Clear criteria for identifying and funding community projects and initiatives in the area should be identified. The criteria should be aimed at maximising the benefits for the community as a whole and not individuals within the community.
- Strict financial management controls, including annual audits, should be instituted to manage the SED contributions.

Residual impacts:

Promotion of social and economic development and improvement in the overall well-being of the community

Nature: Visual impact associated with the proposed facility and associated infrastructure and the potential impact on the area's rural sense of place.

The proposed PV SEF has the potential to impact on the areas existing rural sense of place. The findings of the Visual Impact Assessment (VIA) (Logis, March 2023) are presented in Section 6.8 above. The conclusion of the VIA is that the overall, the significance of the visual impacts is expected to range from moderate to low, as a result of the very low occurrence of sensitive visual receptors, with the exception of the cumulative impacts which is anticipated to be of

[11] Enhancement assumes effective management of the SED contributions

high significance. The VIA notes that if mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. As such, the Vrede Solar PV facility would be considered to be acceptable from a visual impact perspective and can therefore be authorised.

Based on the findings of the SIA none of the affected landowners raised concerns about the potential impact on the area's sense of place as a key concern. The perception of what constitutes a visual impact is therefore subjective and varies from person to person.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low-Moderate (4-6)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Low (27)-Medium (36)**
Status	Negative	Negative
Reversibility	Yes, SEF components and other infrastructure can be removed.	
Irreplaceable loss of resources?	No	
Can impact be mitigated?	Yes	

Mitigation
The recommendations contained in the VIA should be implemented.

Residual impacts:
Potential impact on current rural sense of place.

Nature: Potential impact of the facility on property values

The potential visual impacts associated with the proposed PV SEF have the potential to impact on property values. Based on the results of a literature review undertaken for wind farms the potential impact on property values in rural areas is likely to be limited. In this regard a study undertaken in Australia in 2016 (Urbis Pty Ltd) found that:

» Appropriately located wind farms within rural areas, removed from higher density residential areas, are unlikely to have a measurable negative impact on surrounding land values.
» There is limited available sales data to make a conclusive finding relating to value impacts on residential or lifestyle properties located close to wind farm turbines, noting that wind farms in NSW have been constructed in predominantly rural areas.

The impact of SEFs on property values is likely to be lower than the impact of WEFs due to the reduced visual impact. The Impact of the proposed PV SEF on property values is therefore likely to be low. In addition, none of the landowners interviewed raised concerns about potential impact on property values.

	Without Mitigation	**With Enhancement / Mitigation**
Extent	Local (2)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (24)**	**Low (21)**
Status	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impact be enhanced?	Yes	

Mitigation
» The recommendations contained in the VIA should be implemented.

Residual impacts:

Linked to visual impact on sense of place.

Nature: Potential impact of the facility on local tourism

The potential visual impacts associated with the PV SEF have the potential to impact on tourism facilities and tourism in the area. Based on the findings of the literature review there is limited evidence to suggest that the proposed SEF would impact on the tourism in the PKSDM and RLM at a local and regional level. At a local level there are a limited number of tourism faculties located in the study area. Based on the findings of the site visit the impact on these facilities is likely to be limited. These facilities are also likely to benefit from providing accommodation to contractors and workers during both the construction and operational phase.

The owner of the only trophy hunting operation in the broader study area, Jakkalskuil, has indicated that the Middelplaas and Vrede PV sites would not have a significant impact on the operation (visual or restrictions on hunting/ setback) (Venter, pers. comm). The owner of the Wag 'n Bietjie and Amper Daar sites (Fourie), and that of the Ruspoort 1 and 2 sites (du Plessis) have indicated that commercial (biltong) hunting on their properties would not be affected, as the game could simply be moved to other camps on the property (du Plessis, Fourie, pers. comm).

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (24)**	**Low (21)**
Status	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impact be enhanced?	Yes	

Mitigation

» The recommendations contained in the VIA should be implemented.

Residual impacts:
Linked to visual impact on sense of place.

Decommissioning Phase Impacts

Nature: Social impacts associated with retrenchment including loss of jobs, and source of income. Decommissioning will also create temporary employment opportunities, which would represent a positive temporary impact

Typically, the major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. However, in the case of the proposed facility the decommissioning phase is likely to involve the disassembly and replacement of the existing components with more modern technology. This is likely to take place in the 20 - 25 year's post commissioning. The decommissioning phase is therefore likely to create additional construction type jobs, as opposed to the jobs losses typically associated with decommissioning.

Given the moderate number of people employed during the operational phase (~ 40-50), the social impacts at a community level associated with decommissioning can be effectively managed with the implementation of a retrenchment and downscaling programme. With mitigation, the impacts are assessed to be Low (negative). Decommissioning will also create temporary employment opportunities, which would represent a positive temporary impact. The significance would be Low (positive) with enhancement due to limited opportunities and short duration.

	Without Mitigation	**With Mitigation**
Extent	Local (4)	Local (2)

Duration	Short term (2)	short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
Status	Negative	Negative
Reversibility	N/A	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	

Mitigation:

» The proponent should ensure that retrenchment packages are provided for all staff retrenched when the plant is decommissioned.
» All structures and infrastructure associated with the proposed facility should be dismantled and transported off-site on decommissioning.

Residual impacts
No, provided effective retrenchment package.

Cumulative Impacts

Nature: Visual impacts associated with the establishment of more than one PV SEF and the potential impact on the area's rural sense of place and character of the landscape.

The potential cumulative impacts on the areas sense of place will be largely linked to potential visual impacts. In this regard the Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts associated with wind farms on landscapes. These issues are also likely to be relevant to solar facilities and associated infrastructure. The relevant issues identified by Scottish Natural Heritage study include:

» Combined visibility (whether two or more solar farms will be visible from one location).
» Sequential visibility (e.g. the effect of seeing two or more solar farms along a single journey, e.g. road or walking trail).
» The visual compatibility of different solar farms in the same vicinity.
» Perceived or actual change in land use across a character type or region.
» Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location. The viewer may only see one renewable energy facility and the associated infrastructure at a time, but if each successive stretch of the road is dominated by views of renewable energy facilities, then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, DRAFT - July 2010).

As indicated above, the impact of a single PV SEF and associated infrastructure on the areas sense of place is likely to be limited. However, the cumulative impacts associate with the Crossroads Green Energy Cluster are likely to be significant given the number of projects involved.

The findings of the VIA (Logis 2023) notes the cumulative visual impact is expected to be high. However, despite this the cumulative visual impact is still considered to be within acceptable limits. As indicated above, none of the affected landowners raised concerns about the potential impact on the area's sense of place. In this regard the perception of what constitutes a visual impact is subjective and varies from person to person.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**

Extent	Local (1-2)	Local and regional (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	High (8)
Probability	Probable (3)	Highly Probable (4)
Significance	**Low-Medium (27-30)**	**High (64)**
Status (positive/negative)	Negative	Negative
Reversibility	Yes. SEF components and other infrastructure can be removed.	
Loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: The recommendations of the VIA should be implemented.		

Nature: The establishment of a number of renewable energy facilities and associated projects, such as the proposed PV SEF, in the RLM and ELM has the potential to place pressure on local services, specifically medical, education and accommodation.

The establishment of the Crossroads Green Energy Cluster has the potential to place pressure on local services and accommodation, specifically during the construction phase. The objective will be to source as many low and semi-skilled workers for the construction phase from the RLM and ELM. This will reduce the pressure on local services and accommodation and the nearby towns of Philipstown, Petrusville and De Aar. The total number of construction workers that required accommodation will depend on the timing and phasing of the construction of the individual PV SEFs associated with the Crossroads Green Energy Cluster. Based on the findings of the site visit there is limited accommodation available in Philipstown and Petrusville. Accommodation is available in De Aar and the town has experience with the construction of renewable energy facilities. However, there is unlikely to be sufficient accommodation in De Aar and the surrounding towns if the construction phase of 3 or more renewable energy facilities overlaps. This issue will need to be addressed in the planning of the construction phase. The potential impact should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of the proposed facility and associated renewable energy projects in the RLM and ELM. These benefits will create opportunities for investment in the RLM and ELM, including the opportunity to up-grade and expand existing services and the construction of new houses.

However, the potential impact should also be viewed within the context of the potential positive cumulative impacts for the local economy associated with the establishment of the proposed facility and associated renewable energy projects in the RLM and ELM. These benefits will create opportunities for investment in the RLM and ELM., including the opportunity to up-grade and expand existing services and the construction of new houses. Socio-economic development (SED) contributions also represent an important focus of the REIPPPP and is aimed at ensuring that the build programme secures sustainable value for the country and enables local communities to benefit directly from the investments attracted into the area. The SED contributions will extend over a period of 20-25 years and provide revenue that can be used by the RLM and ELM to invest in up-grading local services where required. In should also be noted that it is the function of national, provincial, and local government to address the needs created by development and provide the required services. The additional demand for services and accommodation created by the establishment of development renewable energy projects should therefore be addressed in the Integrated Development Planning process undertaken by the RLM and ELM.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (1)	Local and regional (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)

Significance	**Low (27)**	**Medium (30)[12]**
Status (positive/negative)	Negative	Negative
Reversibility	Yes. SEF components and other infrastructure can be removed.	
Loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: The proponent should liaise with the RLM and ELM to address potential impacts on local services.		

Nature: The establishment of renewable energy facilities and associated projects, such as the PV SEF, in the RLM and ELM will create employment, skills development and training opportunities, creation of downstream business opportunities.

In addition to the potential negative impacts, the establishment of the Crossroads Green Energy Cluster and associated infrastructure will also create several socio-economic opportunities for the RLM and ELM. The positive cumulative opportunities include creation of employment, skills development and training opportunities, and downstream business opportunities.

The review of the REIPPPP (December 2021) indicates that to date (across BW1-4) a total contribution of R22.8 billion has been committed to SED initiatives. Assuming an even, annual revenue spread, the average contribution per year would be R1.1 billion. Of the total commitment, R18.5 billion is specifically allocated for local communities where the IPPs operate. With every new IPP on the grid, revenues and the respective SED contributions will increase.

The potential cumulative benefits for the local and regional economy are therefore associated with both the construction and operational phase of renewable energy projects and associated infrastructure and extend over a period of 20-25 years. However, steps must be taken to maximise employment opportunities for members from the local communities in the area and support skills development and training programmes.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (1)	Local and regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	High (8)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (36)**	**High (60)**
Status (positive/negative)	Positive	Positive
Reversibility	Yes. SEF components and other infrastructure can be removed.	
Loss of resources?	No	No
Can impacts be enhancement?	Yes	
Enhancement: The proposed establishment of suitably sited renewable energy facilities and associated projects, such as the proposed PV SEF, within the RLM and ELM should be supported.		

6.10.4 Overall Result

The findings of the SIA indicate that the proposed Vrede PV SEF will result in several social and socio-economic benefits, including creation of employment and business opportunities during both the construction and operational phases. The project will also create economic development opportunities for

[12] With effective mitigation and planning, the significance will be Low Negative.

the local community. The enhancement measures listed in the report should be implemented in order to maximise the potential benefits. The significance of this impact is rated as High Positive. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the negative environmental and socio-economic impacts associated a coal-based energy economy and the challenges created by climate change, represents a significant positive social benefit for society as a whole. The Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits, both at a national level and at a local, community level. These benefits are linked to foreign Direct Investment, local employment and procurement and investment in local community initiatives.

The findings also indicate that the potential negative impacts associated with both the construction and operational phase are likely to be Low Negative with mitigation. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented.

On the basis of the above conclusion, the establishment of the proposed Vrede PV SEF and associated infrastructure is supported.

6.11. Potential Traffic Impacts

Various positive and negative impacts have been identified with the development of the project in terms of traffic. Potential traffic impacts and the relative significance of the impacts associated with the development of the Project are summarised below (refer to **Appendix I**).

6.11.1 Results of the Traffic Impact Assessment

National Route to Site for Imported Components

There are two viable options for the port of entry for imported components - the Port of Ngqura in the Eastern Cape and the Port of Saldanha in the Western Cape. The Port of Ngqura is located approximately 530km travel distance from the proposed site whilst the Port of Saldanha is located approximately 865km travel distance from the proposed site. The Port of Ngqura is the preferred port of entry, however, the Port of Saldanha can be used as an alternative should the Port of Ngqura not be available.

The preferred route from the Port of Ngqura is 530km and follows the N10 north to De Aar, passing Cradock and Middelburg, and onto the R48 towards the proposed site. The alternative route from the Port of Saldanha will follow the R45 east to Moorreesburg before taking the R46 east to Ceres. Vehicles will head east on the N1, passing Laingsburg and Beaufort West, and north on the N12 towards Britstown. At Britstown, vehicles will head east on the N10, before heading north on the R48 at De Aar towards the proposed site.

It is critical to ensure that the abnormal load vehicle will be able to move safely and without obstruction along the preferred route. The preferred route should be surveyed prior to construction to identify any problem areas, e.g., intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification. After the road modifications have been implemented, it is recommended to undertake a "dry-run" with the largest abnormal load vehicle, prior to the transportation of any components, to ensure that the delivery will occur without disruptions.

It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will need to be maintained during the additional loading of the construction phase and reinstated after construction is completed.

Route for Components manufactured locally

It is anticipated that elements manufactured within South Africa will be transported to the site from the Cape Town, Johannesburg and Pinetown/Durban areas. It is also assumed that the transformer, which will be transported with an abnormal load vehicle, will be transported from the Johannesburg area and therefore it needs to be verified that the route from the manufacturer to the site does not have any load limitations for abnormal vehicles.

Components, such as PV panels, manufactured in Cape Town will be transported to site via the N1, passing Laingsburg and Beaufort West, before heading north on the N12 towards Britstown. At Britstown, vehicles will head east on the N10, before heading north on the R48 at De Aar towards the proposed site. Haulage vehicles will mainly travel on the national highway and the total distance to the proposed site is approximately 825km.

It is assumed that the inverter and support structure will be manufactured in the Johannesburg area and transported to site. The travel distance is around 690km, and no road limitations are expected on this route for normal loads vehicles as it will mainly follow national and provincial roads.

If the PV panels are manufactured in South Africa, they could possibly be manufactured in the Pinetown area, close to Durban and transported to site via road. These elements are normal loads and no road limitations are expected along the routes. Haulage vehicles will mainly travel on national and provincial roads and the total distance to the proposed site is approximately 935km.

It is assumed that the transformer will be manufactured locally in South Africa and be transported from the Johannesburg area to site. As the transformer will be transported with an abnormal load vehicle, the route planning needs a more detailed investigation of the feasible routes considering any limitations due to existing road features. Furthermore, a load of abnormal dimensions may cause an obstruction and danger to other traffic and therefore the transformer needs to be transported as far as possible on roads that are wide enough for general traffic to pass. It is expected that the transformer can be transported to site via the same route used for normal loads. There are several bridges and culverts along this route, which need to be confirmed for load bearing and height clearances. There are several turns along the way and small towns to pass through. According to the desktop study, all turning movements along the route are manageable for the abnormal vehicle. However, there are many alternative routes which can be investigated if the above route or sections of the route should not be feasible.

Proposed main access road to the Proposed Development

The proposed main access road to the site is an existing gravel road located off the R48 at Philipstown. An existing gravel road between the proposed site and Petrusville can be considered as an alternative access road. The proposed access road will link to the internal road network of the facility. The proposed access road to the development is deemed suitable as it is an existing gravel road.

Proposed Access Point to the Proposed Development

The proposed main access point to the site will be located on an existing gravel farm access road. The proposed access point is deemed suitable from a transport engineering perspective.

Main Route for the Transportation of Materials, Plant and People to the proposed site

The nearest towns in relation to the proposed development site are Philipstown and De Aar. It is envisaged that most materials, water, plant, services and people will be procured within a 100km radius of the proposed facility.

Concrete batch plants and quarries in the vicinity could be contracted to supply materials and concrete during the construction phase, which would reduce the impact on traffic on the surrounding road network. Alternatively, mobile concrete batch plants and temporary construction material stockpile yards could be commissioned on vacant land near the proposed site. Delivery of materials to the mobile batch plant and the stockpile yard could be staggered to minimise traffic disruptions.

6.11.2 Description of Traffic Impacts

Impacts are expected to occur with the development of the project during the construction and operation phases.

Impacts during construction include:
- Construction related traffic
- The construction traffic would also lead to noise and dust pollution.
- This phase also includes the construction of roads, excavations, trenching for electrical cables and other ancillary construction works that will temporarily generate the most traffic.

Impacts during the operation phase include:
- During operation, it is expected that staff and security will visit the facility.
- Maintenance vehicles are expected on site at times.
- Should municipal water not be available, water will have to be transported to the site.

Cumulative Impacts
- Traffic congestion/delays on the surrounding road network.
- Noise and dust pollution

6.11.3 Assessment of Potential Impacts and Recommended Mitigation Measures

Construction Phase

Nature: **Traffic congestion during the construction phase**			
Impact description: The impact will occur due to added pressure on the road network due to the increase in traffic associated with the transport of equipment, material and staff to site during the construction phase.			
	Rating	**Motivation**	**Significance**
Prior to Mitigation			
Duration	Short-term (2)	The construction period is expected to last between 1 – 2 years.	**Medium Negative (40)**
Extent	Local (2)	Pressure will only be added on the local road network.	
Magnitude	Moderate (6)	The increase in traffic will have a moderate	

		impact on traffic operations.	
Probability	Highly Probable (4)	The possibility of the impact on the traffic operations is highly probable.	

Mitigation:

- » Stagger component delivery to site
- » Reduce the construction period
- » Source mobile batch plants and quarries in close proximity to the site
- » Staff and general trips should occur outside of peak traffic periods as much as possible
- » Conduct regular maintenance of gravel roads by the Contractor during the construction phase and by Client/Facility Manager during operation phase.

Post Mitigation/Enhancement Measures

Duration	Short-term (2)	The construction period is expected to last between 1 – 2 years.	**Low Negative (15)**
Extent	Local (2)	Pressure will only be added on the local road network.	
Magnitude	Low (2)	The increase in traffic will have a low impact on traffic operations.	
Probability	Probable (3)	The possibility of the impact on the traffic operations is probable.	

Cumulative impacts:

The duration of the construction phase is short term (i.e., the impact of the generated traffic on the surrounding road network is temporary and renewable energy facilities, when operational, do not add any significant traffic to the road network). Even if all renewable energy projects within the area are constructed at the same time, the roads authority will consider all applications for abnormal loads and work with all project companies to ensure that loads on the public roads are staggered and staged to ensure that the impact will be acceptable.

Residual Risks:

Traffic will return to normal levels after construction is completed.

Nature:

Air quality will be affected by dust pollution

Impact description: The impact will occur due to the increase in construction traffic associated with the transport of equipment, material and staff to site during the construction phase.

	Rating	**Motivation**	**Significance**
Prior to Mitigation			
Duration	Short-term (2)	The construction period is expected to last between 1 – 2 years.	**Medium Negative (36)**
Extent	Local (2)	Pressure will only be added on the local road network.	
Magnitude	Moderate (5)	The increase in traffic will have a moderate impact on traffic operations.	
Probability	Highly Probable (4)	The possibility of the impact on the traffic operations is highly probable.	

Mitigation:

- » Dust suppression of gravel roads during the construction phase, as required.
- » Regular maintenance of gravel roads by the Contractor during the construction phase and by Client/ Facility Manager during operation phase.

Post Mitigation/Enhancement Measures

Duration	Short-term (2)	The construction period is expected to last between 1 – 2 years.	**Low Negative (15)**

Extent	Local (2)	Pressure will only be added on the local road network.	
Magnitude	Low (2)	The increase in traffic will have a low impact on traffic operations.	
Probability	Probable (3)	The possibility of the impact on the traffic operations is probable.	

Cumulative impacts:

The duration of the construction phase is short term (i.e., the impact of the generated traffic on the surrounding road network is temporary and renewable energy facilities, when operational, do not add any significant traffic to the road network). Even if all renewable energy projects within the area are constructed at the same time, the roads authority will consider all applications for abnormal loads and work with all project companies to ensure that loads on the public roads are staggered and staged to ensure that the impact will be acceptable.

Residual Risks:

Traffic will return to normal levels after construction is completed.

Dust pollution during the construction phase cannot be completely mitigated but mitigation measures will significantly reduce the impact. Dust pollution is limited to the construction period.

Nature:

Noise pollution due to the increase in traffic

Impact description: The impact will occur due to the increase in construction traffic associated with the transport of equipment, material and staff to site during the construction phase.

	Rating	**Motivation**	**Significance**
Prior to Mitigation			
Duration	Short-term (2)	The construction period will last between 1 – 2 years.	**Medium Negative (36)**
Extent	Local (2)	Pressure will only be added on the local road network.	
Magnitude	Moderate (5)	The increase in traffic will have a moderate impact on traffic operations.	
Probability	Highly Probable (4)	The possibility of the impact on the traffic operations is highly probable.	

Mitigation:

- » Stagger component delivery to site
- » Reduce the construction period as far as possible
- » The use of mobile batch plants and quarries in close proximity to the site
- » Staff and general trips should occur outside of peak traffic periods

Post Mitigation/Enhancement Measures			
Duration	Short-term (2)	The construction period will last between 1 – 2 years.	**Low Negative (15)**
Extent	Local (2)	Pressure will only be added on the local road network.	
Magnitude	Low (2)	The increase in traffic will have a low impact on traffic operations.	
Probability	Probable (3)	The possibility of the impact on the traffic operations is probable.	

Cumulative impacts:

The duration of the construction phase is short term (i.e., the impact of the generated traffic on the surrounding road network is temporary and renewable energy facilities, when operational, do not add any significant traffic to the road network). Even if all renewable energy projects within the area are constructed at the same time, the roads authority will consider all applications for abnormal loads and work with all project companies to ensure that loads on the public roads

are staggered and staged to ensure that the impact will be acceptable.
Residual Risks: » Traffic will return to normal levels after construction is completed. » Noise pollution during the construction phase cannot be completely mitigated but mitigation measures will significantly reduce the impact. Noise pollution is limited to the construction period.

Operational Phase

IMPACT TABLE – OPERATIONAL PHASE
The traffic generated during this phase will be minimal and will have not have any impact on the surrounding road network. However, the Client/Facility Manager is to ensure that regular maintenance of gravel roads occurs during operation phase to minimize/mitigate dust pollution.

Decommissioning Phase

IMPACT TABLE – DECOMMISSIONING
This phase will have a similar impact as the Construction Phase i.e. traffic congestion, air pollution and noise pollution, as similar trips/movements are expected.

Cumulative Impacts

To assess the cumulative impact, it was assumed that all proposed and authorized renewable energy projects within 50 km be constructed at the same time. This is a precautionary approach, as in reality these projects would be subject to a highly competitive bidding process. Only a handful of projects would be selected to enter into a power purchase agreement with Eskom, and construction is likely to be staggered depending on project−specific issues.

The construction and decommissioning phases are the only significant traffic generators for renewable energy projects. The duration of these phases is short term (i.e., the impact of the generated traffic on the surrounding road network is temporary and renewable energy facilities, when operational, do not add any significant traffic to the road network). Even if all renewable energy projects within the area are constructed at the same time, the roads authority will consider all applications for abnormal loads and work with all project companies to ensure that loads on the public roads are staggered and staged to ensure that the impact will be acceptable.

Nature: Traffic generated by the proposed development and the associated noise and dust pollution.		
	Overall impact of the proposed project considered in isolation (post mitigation)	**Cumulative impact of the project and other projects in the area**
Extent	Low (1)	High (5)
Duration	Short (2)	Medium-term (3)
Magnitude	Low (4)	High (8)
Probability	Probable (3)	Improbable (2)
Significance	**Low (21)**	**Medium (32)**
Status (positive/negative)	Negative	Negative
Reversibility	Completely reversible	High
Loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation:		

- » Stagger component delivery to site
- » Dust suppression
- » Reduce the construction period
- » The use of mobile batch plants and quarries in close proximity to the site
- » Staff and general trips should occur outside of peak traffic periods

6.11.4 Overall Result

The construction and decommissioning phases of a development is the only significant traffic generator and therefore noise and dust pollution will be higher during this phase. The duration of this phase is short term i.e., the impact of the traffic on the surrounding road network is temporary and solar facilities, when operational, do not add any significant traffic to the road network.

The development is supported from a transport perspective provided that the recommendations and mitigations contained in this report are adhered to.

The impacts associated with the facility are acceptable with the implementation of the recommended mitigation measures and can therefore be authorised.

6.12. Risks Associated with the Battery Energy Storage System

A Battery Energy Storage Systems (BESS) will allow for energy storage for an extended period. The general purpose and utilisation of the BESS will be to save and store excess electrical output from the facility as it is generated, allowing for a timed release to the national grid when the capacity is required the most and the provision of ancillary services to ensure reliable operation of power networks during normal operation and contingency events.

The technologies: liquid metal, flow and lithium-ion batteries provide renewable energy storage solutions. One of the key considerations when determining technology includes costs. Flow batteries have relatively low charge and discharge rates that require a relatively large surface area to occur. This, along with more pumps, plumbing and maintenance than lithium-ion batteries, and the industry immaturity of flow batteries makes them the more expensive option[13]. Other considerations include environmental and safety risk.

All types of batteries can be hazardous and can pose a safety risk. The risks associated with battery technologies are generally well understood and researched. The primary risks for all BESS technologies relate to fire hazards and the potential for a condition known as 'thermal runaway'. Thermal runaway occurs in situations where an increase in temperature changes the conditions in a way that causes a further increase in temperature, often leading to fires and/or explosions. Lithium-ion batteries and flow batteries in fire scenarios may generate toxic gas from the combustion of hydrocarbons, plastics, or acidic electrolytes. Physical damage to the battery can also lead to problems as this can allow the electrolyte inside to leak potentially resulting in toxic chemical exposure or pollution.

The risks detailed in **Table 6.5** overleaf considers only the risks associated with on-site use of battery energy storage system. Mitigation measures have been included within the project EMPr (refer to **Appendix M**).

[13] https://goenergylink.com/blog/differences-between-flow-batteries-and-lithium-ion/

Flow batteries are generally considered the safer technology because they do not contain flammable materials, and the materials that they do contain, such as vanadium, are often environmentally friendly. However, lithium-ion batteries are easier to install (i.e. usually housed within containers as opposed to formal building structures) and require fewer staff to operate.

Liquid metal batteries are a good alternative battery solution to Lithium Ion and Redox. Liquid metal batteries are safe to transport, being in a solid state when not in use. This new technology utilises environmentally friendly materials which are recyclable after decommissioning and do no emit any toxic gases when operating. Because of the abundance of materials used in liquid metal batteries, the costs are also generally lower than lithium-ion and are much better equipped for stressed environments especially considering that liquid metal batteries can be exposed to harsh overcharging and discharging cycles without impacting on their capacities[14].

All of the listed battery technologies will require strict adherence to supplier Standard Operating Procedures to minimise risks to workers. The BESS will be compliant with all local laws and regulations such as NFPA 855 (Standard for the Installation of Stationary Energy Storage Systems), NFPA 68 (Standard on Explosion protection by deflagration) and NFPA 69 (Standard on explosion prevention systems, as well as health and safety requirements governing battery facilities. Over and above that, they will comply with international standards such as UN 38.3 (Transportation Testing for Lithium Batteries), UL 1642 (Standard for Safety – Lithium-ion Batteries), EN 14491 (European Standards for Dust Explosion Venting Protective Systems), and IEC 62619 (Secondary cells and batteries containing alkaline or other non-acid electrolytes Safety requirements for secondary lithium cells and batteries, for use in industrial applications). Furthermore, the battery facility will also conform to standards such as UL 1973 (Batteries for Use in Stationary Applications) and IEC 62619-2017 including thermal runaway non-propagation and safety zone region operation limits and a failure mode analysis. The design will be compliant with UL 9540 (Energy Storage Systems and Equipment) which defines the safety requirements for battery installation in industrial and grid connected applications.

The Vrede Solar PV Facility development site is not located in close proximity to residences or water resources. The development of the BESS (regardless of technology selected) is therefore not expected to raise any unacceptably high-risk issues, i.e. the BESS facility of either technology type is not a No-Go option and **all technologies are considered acceptable**.

[14] https://www.energy-storage.news/ambri-gets-ul-1973-safety-certification-for-liquid-metal-battery-storage-tech/

Table 6.5: Risks associated with Battery Energy Storage Systems (all technologies)

Nature of Risk	Likelihood	Impact	Mitigation / Management of Risk
Lithium-ion Technology			
1. <u>Mechanical breakdown/ Exposure to high temperatures</u> » Incidents where the batteries are broken or exposed to temperature above room temperature could lead to overheating as well as fires which can affect infrastructure components of the BESS. » Leakages of substances contained within the battery cells (should they not be assembled off-site).	Low	» Fires, electrocutions and spillage of toxic substances into the surrounding environment. » Spillage of hazardous substances into the surrounding environment. » Soil contamination – leachate from spillages which could lead to an impact of the productivity of soil forms in affected areas. » Water pollution – spillages into surrounding watercourses as well as groundwater. » Health impacts – on the surrounding communities, particularly those relying on watercourses (i.e. rivers, streams, etc) as a primary source of water.	The design of the Li-ion system includes the following: » To address temperature fluctuations: * Insulated containers * High powered HVAC (Heating, Ventilation and Air-Conditioning) System, monitored centrally * Multiple temperature sensors for both the cells and air temperature * Automated shut down mechanism if temperatures get too high * Containers sealed and douse in case of fire to prevent the spread * Battery management system to prevent overuse and maintain good battery condition » To address fire and dangerous chemicals: * Fire detection and suppressant systems * Gas level monitoring for several different gases (related to degradation of the batteries that increases risk of fire) * Heat sensors * Battery condition monitoring * Dousing mechanism for emergency cooling and fire suppression Management measures to be implemented include: » Operators are trained and competent to operate the BESS. Training should include the discussion of the following: * Potential impact of electrolyte spills on groundwater; * Suitable disposal of waste and effluent; * Key measures in the EMPr relevant to worker's activities; * How incidents and suggestions for improvement can be reported. » Training records should be kept on file and be made available during audits.

Nature of Risk	Likelihood	Impact	Mitigation / Management of Risk
			» Battery supplier user manuals safety specifications and Material Safety Data Sheets (MSDS) are filed on site at all times. » Compile method statements for approval by the Technical/SHEQ Manager for the operation and management and replacement of the battery units / electrolyte for the duration of the project life cycle. Method statements should be kept on site at all times. » Provide signage on site specifying the types of batteries in use and the risk of exposure to hazardous material and electric shock. Signage should also specify how electrical and chemical fires should be dealt with by first responders, and the potential risks to first responders (e.g. the inhalation of toxic fumes, etc.). » Appropriate firefighting equipment should readily be available at the BESS area and within the site. » Maintain strict access control to the BESS area. » Ensure all maintenance contractors / staff are familiar with the supplier's specifications. » Undertake daily risk assessment prior to the commencement of daily tasks at the BESS. This should consider any aspects which could result in fire or spillage, and appropriate actions should be taken to prevent these. » Standard Operating Procedures (SOPs) should be made available by the Supplier to ensure that the batteries are handled in accordance with required best practices. » Spill kits must be made available to address any incidents associated with the flow of chemicals from the batteries into the surrounding environment. » The assembly of the batteries on-site should be avoided as far as possible. Activities on-site for the BESS should only be limited to the placement of the container wherein the batteries are placed. » Undertake periodic inspections on the BESS to ensure issues are identified timeously and addressed with the supplier where relevant.

Nature of Risk	Likelihood	Impact	Mitigation / Management of Risk
			» The applicant in consultation with the supplier must compile and implement a Leak and Detection Monitoring Programme during the project life cycle of the BESS. » Batteries must be strictly maintained by the supplier or suitably qualified persons for the duration of the project life cycle. No unauthorised personnel should be allowed to maintain the BESS.
2. Generation of hazardous waste » The incorrect disposal of the batteries and the associated components could have an adverse impact on the environment.	Medium	» Spillage of hazardous substances into the surrounding environment. » Soil contamination – leachate from the disposed batteries into the soil, which could lead to an impact of the productivity of soil forms in affected areas. » Water pollution – leachate from the disposed batteries spilling into surrounding watercourses as well as groundwater. » Health impacts – on the surrounding communities, particularly those relying on watercourses (i.e. rivers, streams, etc) as a primary source of water.	» Damaged and used batteries must be removed from site by the supplier or any other suitably qualified professional for recycling or appropriate disposal. » The applicant should obtain a cradle to grave battery management plan from the supplier during the planning and design phase of the system. The plan must be kept on site and adhered to.
Redox Flow Technology			
3. Mechanical breakdown/ Exposure to high temperatures » Incidents where the batteries are broken or exposed to temperature above room temperature could lead to overheating as well as fires which can affect infrastructure	Low	» Fires, electrocutions and spillage of toxic substances into the surrounding environment. » Spillage of hazardous substances into the surrounding environment. » Soil contamination – leachate from spillages which could lead to an impact of the productivity of soil forms in affected areas. » Water pollution – spillages into surrounding watercourses as well as groundwater.	The design of the Redox Flow system includes the following: » To address Fire or explosion: * Battery condition monitoring * A Major Hazards Risk Assessment must be undertaken prior to construction and the recommendations of the assessment implemented. * Fire detection and suppressant systems. » To address accidental leak or spillage of electrolytes * Electrolyte solutions stored on site should be stored away from incompatible materials (as per the Material Safety Data Sheet)

Nature of Risk	Likelihood	Impact	Mitigation / Management of Risk
components of the BESS. » Leakages of substances contained within the battery cells (should they not be assembled off-site).		» Health impacts – on the surrounding communities, particularly those relying on watercourses (i.e. rivers, streams, etc) as a primary source of water.	* Leak detection and monitoring system * A secondary containment to prevent the spillage of electrolyte into the environment during operation (storage and refilling when required). * Berms with sufficient storage/containment capacity Management measures to be implemented include: » Operators are trained and competent to operate the BESS. Training should include the discussion of the following: * Potential impact of electrolyte spills on groundwater; * Suitable disposal of waste and effluent; * Key measures in the EMPr relevant to worker's activities; * How incidents and suggestions for improvement can be reported. » Training records should be kept on file and be made available during audits. » Battery supplier user manuals safety specifications and Material Safety Data Sheets (MSDS) are filed on site at all times. » Compile method statements for approval by the Technical/SHEQ Manager for the operation and management and replacement of the battery units / electrolyte for the duration of the project life cycle. Method statements should be kept on site at all times. » Provide signage on site specifying the types of batteries in use and the risk of exposure to hazardous material and electric shock. Signage should also specify how electrical and chemical fires should be dealt with by first responders, and the potential risks to first responders (e.g. the inhalation of toxic fumes, etc.). » Appropriate firefighting equipment should readily be available at the BESS area and within the site. » Maintain strict access control to the BESS area. » Ensure all maintenance contractors / staff are familiar with the supplier's specifications. » Undertake daily risk assessment prior to the commencement of daily tasks at the BESS. This should consider any aspects which

Nature of Risk	Likelihood	Impact	Mitigation / Management of Risk
			could result in fire or spillage, and appropriate actions should be taken to prevent these. » Standard Operating Procedures (SOPs) should be made available by the Supplier to ensure that the batteries are handled in accordance with required best practices. » Spill kits must be made available to address any incidents associated with the flow of chemicals from the batteries into the surrounding environment. » The assembly of the batteries on-site should be avoided as far as possible. Activities on-site for the BESS should only be limited to the placement of the container wherein the batteries are placed. » Undertake periodic inspections on the BESS to ensure issues are identified timeously and addressed with the supplier where relevant. » The applicant in consultation with the supplier must compile and implement a Leak and Detection Monitoring Programme during the project life cycle of the BESS. » Batteries must be strictly maintained by the supplier or suitably qualified persons for the duration of the project life cycle. No unauthorised personnel should be allowed to maintain the BESS.
4. <u>Generation of hazardous waste</u> » The incorrect disposal of the batteries and the associated components could have an adverse impact on the environment.	Medium	» Spillage of hazardous substances into the surrounding environment. » Soil contamination – leachate from the disposed batteries into the soil, which could lead to an impact of the productivity of soil forms in affected areas. » Water pollution – leachate from the disposed batteries spilling into surrounding watercourses as well as groundwater. » Health impacts – on the surrounding communities, particularly those relying	» Damaged and used batteries must be removed from site by the supplier or any other suitably qualified professional for recycling or appropriate disposal. » The applicant should obtain a cradle to grave battery management plan from the supplier during the planning and design phase of the system. The plan must be kept on site and adhered to.

Nature of Risk	Likelihood	Impact	Mitigation / Management of Risk
		on watercourses (i.e. rivers, streams, etc) as a primary source of water.	
Liquid Metal			
5. <u>Mechanical breakdown/ Exposure to high temperatures</u> » Incidents where the batteries are broken or exposed to temperature above room temperature could lead to overheating as well as fires which can affect infrastructure components of the BESS. » Leakages of substances contained within the battery cells (should they not be assembled off-site).	Low	» Fires, electrocutions and spillage of toxic substances into the surrounding environment. » Spillage of hazardous substances into the surrounding environment. » Soil contamination – leachate from spillages which could lead to an impact of the productivity of soil forms in affected areas. » Water pollution – spillages into surrounding watercourses as well as groundwater. » Health impacts – on the surrounding communities, particularly those relying on watercourses (i.e. rivers, streams, etc) as a primary source of water.	The design of the Liquid Metal system includes the following: » To address Fire or explosion: ∗ Batteries designed to operate at a temperature of 500°C but unlike lithium-ion batteries are not at risk of thermal runaway, electrolyte decomposition or off-gassing. » To address accidental leak or spillage of liquid metals and/or electrolytes ∗ Electrolyte solutions stored on site should be stored away from incompatible materials (as per the Material Safety Data Sheet) ∗ Leak detection and monitoring system ∗ A secondary containment to prevent the spillage of electrolyte/liquid metals into the environment during operation (storage and refilling when required). ∗ Berms with sufficient storage/containment capacity Management measures to be implemented include: » Operators are trained and competent to operate the BESS. Training should include the discussion of the following: ∗ Potential impact of electrolyte spills on groundwater; ∗ Suitable disposal of waste and effluent; ∗ Key measures in the EMPr relevant to worker's activities; ∗ How incidents and suggestions for improvement can be reported. » Training records should be kept on file and be made available during audits. » Battery supplier user manuals safety specifications and Material Safety Data Sheets (MSDS) are filed on site at all times. » Compile method statements for approval by the Technical/SHEQ Manager for the operation and management and replacement

Nature of Risk	Likelihood	Impact	Mitigation / Management of Risk
			of the battery units / electrolyte for the duration of the project life cycle. Method statements should be kept on site at all times. » Provide signage on site specifying the types of batteries in use and the risk of exposure to hazardous material and electric shock. Signage should also specify how electrical and chemical fires should be dealt with by first responders, and the potential risks to first responders (e.g. the inhalation of toxic fumes, etc.). » Appropriate firefighting equipment should readily be available at the BESS area and within the site. » Maintain strict access control to the BESS area. » Ensure all maintenance contractors / staff are familiar with the supplier's specifications. » Undertake daily risk assessment prior to the commencement of daily tasks at the BESS. This should consider any aspects which could result in fire or spillage, and appropriate actions should be taken to prevent these. » Standard Operating Procedures (SOPs) should be made available by the Supplier to ensure that the batteries are handled in accordance with required best practices. » Spill kits must be made available to address any incidents associated with the flow of chemicals from the batteries into the surrounding environment. » The assembly of the batteries on-site should be avoided as far as possible. Activities on-site for the BESS should only be limited to the placement of the container wherein the batteries are placed. » Undertake periodic inspections on the BESS to ensure issues are identified timeously and addressed with the supplier where relevant. » The applicant in consultation with the supplier must compile and implement a Leak and Detection Monitoring Programme during the project life cycle of the BESS.

Nature of Risk	Likelihood	Impact	Mitigation / Management of Risk
			» Batteries must be strictly maintained by the supplier or suitably qualified persons for the duration of the project life cycle. No unauthorised personnel should be allowed to maintain the BESS.

6.12.1 Overall Result

The development site is not located in close proximity to residences or water resources. The development of the BESS (regardless of technology selected) is therefore not expected to raise any unacceptably high-risk issues, i.e. the BESS facility of all technology types are not a No-Go option and **all technologies are considered acceptable**.

6.13. Assessment of the 'Do Nothing' Alternative

The 'do-nothing' alternative (i.e. no-go alternative) is the option of not constructing the Vrede Solar PV Facility. Should this alternative be selected, there would be no environmental impacts on the site or to the surrounding local area due to the construction and operation activities of a solar facility. All baseline information provided in this report relates to the current situation on site and in the surrounding area and can be considered the no-go alternative. Impacts are limited to the status quo. All negative impacts, specifically related to the development of the solar facility discussed in this report will not materialise. In addition, positive impacts identified to be associated with the project will be foregone. These are described below.

a) Land use and agriculture

The land capability sensitivity (DAFF, 2017) indicates a range of sensitivities expected throughout the project focus area, which predominantly covers "Low" to "Moderate" sensitivities. In the assessment area there is no segregation of agricultural lands or crop fields with high potential. There will therefore be no loss of high potential agricultural land as a result of the proposed project. As the property is used for livestock farming, these practices can continue on the remainder of the property together with the PV facility operation. The implementation of the 'do nothing' alternative would retain the current land-use, fore-going the opportunity to generate renewable energy from the sun and at the same time continue the current agricultural activities on areas that fall outside of the solar energy facility footprint.

In addition, the directly affected landowners would obtain an income from the solar farm (as the developer would pay a percentage of the revenue generated to the landowner in accordance with the lease agreement for the use of the land). This would contribute towards the financial stability of the landowners which would in turn contribute to the financial viability of the farming practices on the property. A study undertaken by Prof Johann Kirsten of Stellenbosch University for the proposed Crossroads Green Energy Cluster (**Appendix G**) provides an indication of the financial impact on Gross Farm Income of the farms in question. He indicates that the solar PV developments proposed as part of the cluster will pay land rental (increasing with inflation every year) for a minimum of 20 years to a total of 17 farm entities. This will benefit all these farming operations, their families and the workers and their families. It is obvious that this will be a major cash injection which will contribute to the financial survival of these farm businesses and the protection of the associated livelihoods. In addition, farmers will be able to invest in farming systems, kraals, fencing, irrigation systems, etc. to prevent stock losses on the remaining parts of the farm and thereby improve efficiency and additional financial gains. This will bring into play additional gains for the farming operation and the broader community. In addition, the new and large revenue stream for the farmers emanating from the solar farms will have a greater benefit for the broader community as farmers will be helping more people in need. The 'do nothing' alternative would result in a lost opportunity for the landowners (in terms of implementing a compatible land use option, while still retaining the current land use, as well as a loss in long-term revenue) and the country (in terms of renewable energy). From this perspective the no-go alternative

is not preferred when considering land use and agricultural aspects of the project site. Use of the identified site for the development of the proposed solar energy facility is considered to be a preferred land use as the benefits will outweigh the impacts.

From a visual perspective, however, the implementation of the 'do-nothing' alternative will conserve the landscape as it currently is. Transformation will lead to a change in the sense of place for the area; however, no fatal flaws have been identified in this regard.

b) Socio-economic impact

Social: The impacts of pursuing the no-go alternative are both positive and negative as follows:

- The benefits would be that there is no disruption from an influx of jobseekers into the area, nuisance impacts (noise and dust during construction), visual impacts and safety and security impacts. The impact is therefore neutral.
- There would however be an opportunity lost in terms of job creation, skills development and associated economic business opportunities for the local economy, as well as a loss of the opportunity to generate energy from a renewable resource without creating detrimental effects on the environment.

New Business: Some of the positive spin off effects that are to ensue from the project expenditure will be localised in the communities located near the site. The local services sector and specifically the trade, transportation, catering and accommodation, renting services, personal services and business services are expected to benefit the most from the project activities during the construction phase. New business sales that will be stimulated as a result of the establishment of the solar farm, albeit for a temporary period, will be lost with the implementation of the 'do nothing' alternative. Therefore, from a business perspective, the 'do-nothing' alternative is not preferred as there is a loss of new business opportunities.

Employment: The development of the project within the Renosterberg Local Municipality will aid in a reduction of the unemployment rate, however if the solar facility is not developed then the unemployment rate will not be positively influenced by the proposed development. The sale, development, installation, maintenance, and management of renewable energy facilities have significant potential for job creation in South Africa. The Green Jobs Study (2011), IDC, DBSA Ltd and TIPS reveals the potential of an unfolding green economy to lead to the creation of approximately 98 000 new direct jobs, on average, in the short term, almost 255 000 in the medium term and around 462 000 employment opportunities in the formal economy in the long term. The number of jobs linked to the power generation was estimated to be ~ 12 500 in the short term, 57 500 in the medium term and 130 000 in the long term. Power generation jobs therefore account for 28% of the employment opportunities created in the long term. However, the report notes that the contribution made by a progressively expanding green energy generation segment increases from 14% of the total in the short term, or just over 13 500 jobs, to more than 28% in the long term (166 400) (Table 2.3). The study also found that energy generation is expected to become an increasingly important contributor to green job creation over time, as projects are constructed or commissioned.

Skills development: The establishment of the project will offer numerous opportunities for skills transfer and development. This is relevant for both on-site activities and manufacturing activities. Various renewable energy facilities are proposed to be developed in the area and in the Northern Cape Province, which means that the transfer of skills from foreign experts to the local engineers and construction workers will take place, similar to what has taken place where other renewable energy facilities have been constructed and

operated within the Province. The skills training and transfer benefits for individuals within local communities would be forfeited with the implementation of the 'do nothing' alternative.

Renewable energy goals: The opportunity to contribute to the innovative energy sourcing methods as identified by the Renosterberg Local Municipality as per a draft policy which sets out the criteria which will enable the evaluation of renewable energy generation infrastructure to be developed in a manner that will limit the potential negative impacts thereof will not be met should the project not be constructed with the implementation of the 'do nothing' alternative.

Foregoing the proposed development would not necessarily compromise the development of renewable energy facilities in South Africa. However, the socio-economic benefits for local communities at this location and within the surrounding area would be forfeited. The SIA concluded that there would be greater social benefits associated with the project than the 'do nothing' alternative. Therefore, from a socio-economic perspective, the 'do-nothing' alternative is not preferred due to the loss of socio-economic benefits associated with the project when considering the current socio-economic conditions of the area.

c) Impact on electricity supply and targets regarding renewable energy

The primary goal of the Project is to assist in providing additional capacity to Eskom to assist in addressing the current energy supply constraints. The project also aims to reduce the carbon footprint associated with energy generation. As indicated above, energy supply constraints and the associated load shedding have had a significant impact on the economic development of the South African economy. South Africa also relies on coal-powered energy to meet more than 90% of its energy needs. South Africa is therefore one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions.

The No-Development option would represent a lost opportunity for South Africa to improve energy security and supplement is current energy needs with clean, renewable energy. The benefits of additional capacity to the electricity grid and those associated with the introduction of renewable energy would not be realised. Although the Vrede Solar PV Facility is only proposed to contribute a contracted capacity of up to 150MW to the grid capacity, this would assist in meeting the government's goal for renewable energy and the energy mix. The generation of electricity from renewable energy resources offers a range of potential socio-economic and environmental benefits for South Africa. These benefits include:

- Increased energy security;
- Resource saving (i.e. fossil fuels and water);
- Exploitation of South Africa's significant renewable energy resource;
- Pollution reduction;
- Climate friendly development;
- Support for international agreements;
- Employment creation;
- Acceptability to society; and
- Support to a new industry sector.

At present, South Africa is some way off from fully exploiting the diverse gains from renewable energy and from achieving a considerable market share in the renewable energy industry. South Africa's electricity supply remains heavily dominated by coal-based power generation, with the country's significant

renewable energy potential largely untapped to date. The Integrated Resource Plan (IRP) (2019) provides for the development of 6 000MW of capacity from large scale solar energy facilities by 2030. The IRP essentially drives the assortment of energy to be implemented for South Africa which is known as the energy mix of the country, considering various generation technologies.

Given South Africa's current energy security challenges and its position as one of the highest per capita producers of carbon emissions in the world, the implementation of the Do Nothing Alternative would represent a significant negative social cost.

6.13.1 Conclusion

The no-go is the continuation of the existing land use, i.e. maintain the status quo. As detailed in the sections above, there would be no environmental impacts on the site or to the surrounding local area due to the construction and operation activities of a solar farm with the implementation of this alternative. All negative impacts, specifically related to the development of the solar farm, discussed in this report will not materialise.

The 'do-nothing' alternative will do little to influence the renewable energy targets set by government. However, as the project site experiences ample solar resource and optimal grid connection opportunities, not developing the Vrede Solar PV Facility would see such an opportunity being lost. In addition, the Northern Cape Province will not benefit from additional generated power being evacuated directly into the Province's grid. As current land use activities can continue on the site once the project is operational, the loss of the land to this project during the operation phase is not considered significant. Therefore, from a regional perspective, the 'do-nothing' alternative is not preferred as there is a perceived loss of benefits for the regional area.

From the specialist studies undertaken, no environmental fatal flaws were identified to be associated with the project subject to implementation of the recommended mitigation measures. All impacts associated with the project can be mitigated to acceptable levels. Environmental costs identified for the project include:

- Destruction, fragmentation and degradation of habitats and ecosystems.
- Spread and/or establishment of alien and/or invasive species.
- Direct mortality of fauna and avifauna.
- Impacts on faunal and avifaunal habitats.
- Impacts on localised visual quality.

Positive impacts identified to be associated with the Project include:

- Job creation from the construction and operation phases.
- Alternative income for affected landowners, providing an opportunity to diversify land use and continue agricultural practices on unaffected land portions.
- Provision of clean, renewable energy in an area where it is optimally available.
- Assisting the country to meet the energy generation mix in a most economic and rapid manner.

The costs associated with the project are anticipated to occur at a site-specific level. The significance can be largely reduced through the application of appropriate mitigation measures; and the appropriate placement of infrastructure within areas of lower sensitivity identified on site. The project's benefits are

expected to occur at a larger scale (i.e., national, regional, and local level) and will partially offset the localised environmental costs of the project.

As detailed above, the 'do-nothing' alternative will result in a number of lost opportunities. The 'do nothing' alternative is therefore not preferred and not proposed to be implemented for the development of Takelkop Solar PV Facility.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

Vrede Solar Energy proposes to develop the Vrede Solar PV Facility and its associated electrical infrastructure on ortion 5 of the Farm Bas Berg 88 in the Renosterberg Local Municipality in the greater Pixley ka Seme District Municipality in the Northern Cape Province. The project site is located approximately 20km north of Philipstown and 30km west of Petrusville.

The Vrede Solar PV Facility is part of a cluster of solar facilities known as the Crossroads Green Energy Cluster. The Cluster entails the development of up to 21 solar energy facilities, each up to 240MW in capacity, and each including grid connection infrastructure connecting the facilities to the proposed Hydra B Substation (refer to Figure 1.2)[15]. Each solar energy facility will be constructed as a separate stand-alone project and therefore, separate Scoping and Environmental Impact Assessment (S&EIA) processes will be undertaken for each of the renewable energy facilities. The projects will be considered through the EIA process in batches, with Batch 1 consisting of 9 projects, Batch 2 consisting of 6 projects and Batch 3 consisting of 6 projects. Vrede Solar PV Facility forms part of the EIA process for Batch 1 consisting of 9 projects to be undertaken in 2023.

It is the developer's intention to bid the Vrede Solar PV Facility in terms of a regulated power purchase procurement process (e.g., the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme) to evacuate the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP), with the Vrede Solar PV Facility set to inject up to 150MW into the national grid.

A project site with an extent of ~1 101ha has been identified as a technically suitable area for the development of the Project. A development footprint of ~400ha has been identified for the development and assessed within this EIA Report. Infrastructure associated will the Solar PV Facility to enable the facility to generate up to 150MW will include the following:

- Solar PV array comprising PV modules and mounting structures (monofacial or bifacial and of fixed-tilt, single-axis tracking, and/or double-axis tracking PV technology)
- Inverters and transformers
- Cabling between the project components
- Battery Energy Storage System (BESS)
- On-site facility substation
- Site offices, Security office, operations and control, and maintenance and storage laydown areas
- Access roads, internal distribution roads

The overarching objective for the Vrede Solar PV Facility is to maximise electricity production through exposure to the available solar resource, while minimising infrastructure, operational and maintenance costs, as well as potential social and environmental impacts in accordance with the principles of sustainable development. Local level environmental and planning issues have been assessed through the EIA process

[15] The PV facility includes the IPP portion of the onsite substation. The Eskom-owned portion of the grid connection infrastructure is the subject of a separate Application for Authorisation and as such the Eskom Switching Station and overhead power line do not form part of this development.

with the aid of site-specific specialist studies in order to delineate areas of sensitivity within the project site. These site-specific specialist studies have assisted in informing and optimising the design of the solar facility. A summary of the recommendations and conclusions for the proposed project is provided in this chapter.

7.1. Legal Requirements as per the EIA Regulations, 2014 (as amended), for the undertaking of an Environmental Impact Assessment Report

This chapter of the EIA Report includes the following information required in terms of Appendix 3: Scope of Assessment and Content of Environmental Impact Assessment Reports:

Requirement	Relevant Section
3(1)(k) where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report.	A summary of the findings of the specialist studies undertaken for The Project has been included in **Section 7.2**.
3(1)(l) an environmental impact statement which contains (i) a summary of the key findings of the environmental impact assessment, (ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted scoping report indicating any areas that should be avoided, including buffers and (iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives.	An environmental impact statement containing the key findings of the environmental impacts of The Project has been included as **Section 7.5**. An Environmental Sensitivity and Layout map of the project has been included as **Figure 7.2** which overlays the development footprint (as assessed within the EIA) of the solar facility with the environmental sensitive features located within the development area. A summary of the positive and negative impacts associated with the project has been included in **Section 7.2**.
3(1)(o) any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation.	All conditions required to be included in the Environmental Authorisation of The Project have been included in **Section 7.6**.
3(1)(q) a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.	A reasoned opinion as to whether The Project should be authorised has been included in **Section 7.5**.

7.2 Evaluation of The Project

The preceding chapters of this report, together with the specialist studies contained within **Appendices D-K** provide a detailed assessment of the potential impacts that may result from the development of the Project. This chapter concludes the environmental assessment of the Project by providing a summary of the results and conclusions of the assessment. In so doing, it draws on the information gathered as part of the EIA process, the knowledge gained by the environmental specialists and the EAP and presents a combined and informed opinion of the environmental impacts associated with the project.

No environmental fatal flaws or unacceptable impacts were identified in the detailed specialist studies conducted, provided that the recommended mitigation measures are implemented. These measures include, amongst others, the avoidance of sensitive features within the development footprint as specified by the specialists.

The potential environmental impacts associated with The Project assessed through the EIA process include:

» Impacts on terrestrial ecology (flora and fauna)
» Impacts on freshwater ecology
» Impacts on avifauna
» Impacts on soils and agricultural potential
» Heritage Impacts
» Visual impacts on the area imposed by the components of the facility
» Positive and negative social impacts
» Traffic impacts
» Risks associated with the BESS

The development footprint, as assessed in the EIA Report is presented in **Figure 7.1**.

7.2.1 Impacts on Terrestrial Ecology (including flora and fauna)

The project area is situated in the Northern Upper Karoo vegetation type according to SANBI (2018). The project area is homogenous in terms of vegetation with a low karroid scrub grassland occurring throughout. One vegetation community type can be found in the project area: Karoo Grassland, which approximates Northern Upper Karoo. The project area includes ESA. Development of this nature (i.e.: Solar PV facilities and associated infrastructure) may occur in an ESA area provided all mitigation measures are adhered to. No Species of Conservation Concern (SCC) were recorded from the project area.

The main impact to the vegetation and habitat types within and surrounding the project area is grazing. Much of the project area comprises large areas of intact indigenous vegetation with little to no existing degradation, making these areas suitable for a wide variety of plant species (not all of which could be identified as a result of the seasonality of the site visit) as well as suitable habitat for a suite of faunal species, most notably various mammals. Based on the ecological assessment, all habitats within the project area of the proposed development were allocated a sensitivity category or Site Ecological Importance (SEI), which is considered a combined SEI for Terrestrial Biodiversity, Animal Species and Plant Species Themes.

The main expected impacts of the proposed infrastructure will include the following:

» Habitat loss and fragmentation as well as degradation of surrounding habitat;
» Disturbance and displacement caused during the construction and maintenance phases; and
» Direct mortality during the construction phase.

The primary expected impacts of the proposed project will be the loss of habitat and emigration of fauna. Based on the outcomes of the SEI determination, the study area is considered to have a Medium SEI which indicates that minimisation mitigation must be applied to the site.

It must be noted, when taken into consideration in conjunction with the other Solar PV facilities planned for all three phases of the overall proposed development, that the cumulative fragmentation of the ESA is very high. The associated cumulative fragmentation impacts are expected to be high for the overall development. This project should ideally not be considered in insolation but rather as a part of the full proposed development when considering impacts to the ESA.

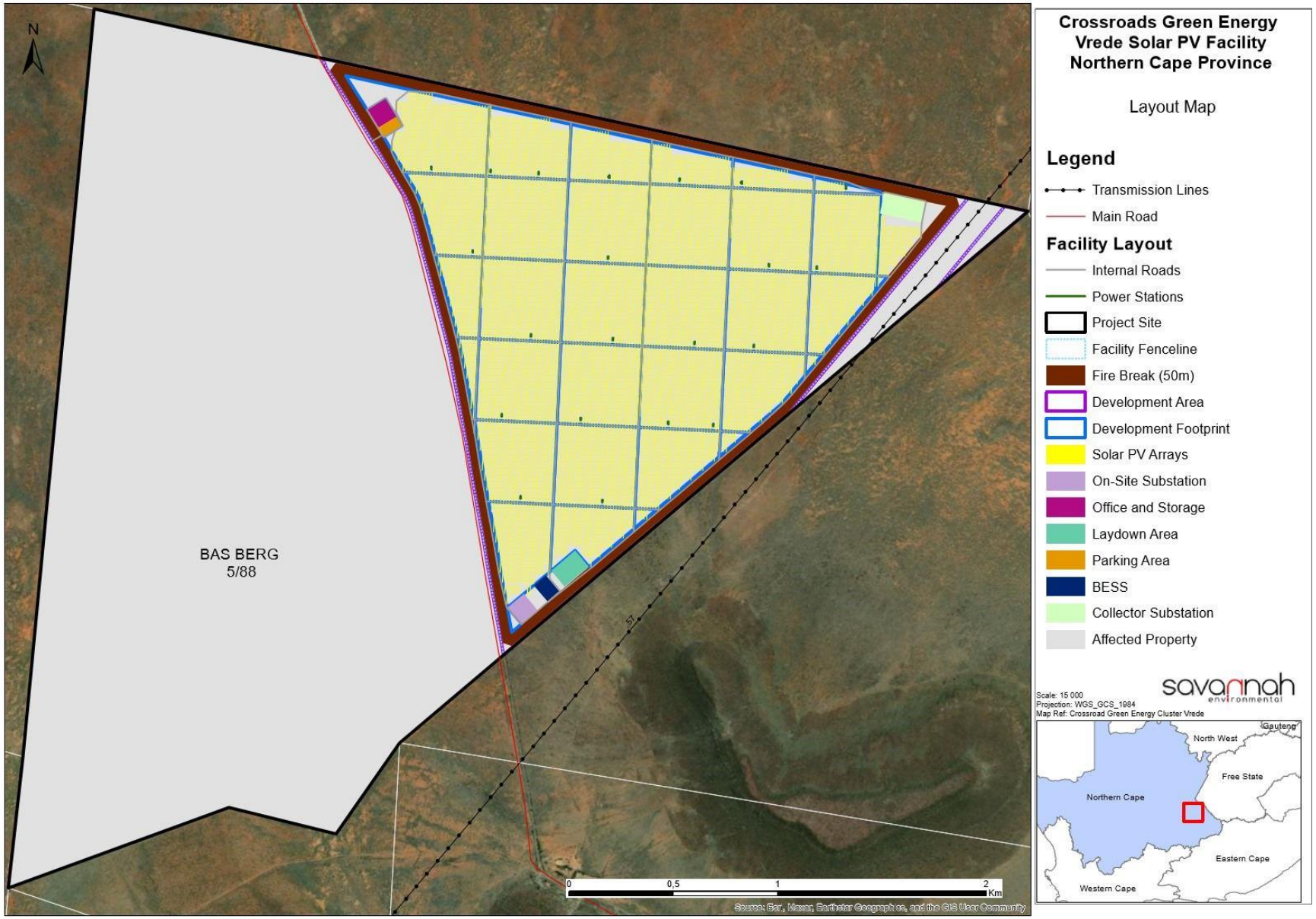

Figure 7.1: The development footprint of The Project, as assessed within the EIA Report

Considering that this area has been identified as being of significance for biodiversity maintenance and ecological processes (ESA), development may proceed but with caution and only with the implementation of mitigation measures. Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinion of the specialists that the project may be favourably considered, on condition that all prescribed mitigation measures and supporting recommendations are implemented.

7.2.2 Impacts on Freshwater Ecology

One (1) form of a watercourse was identified and delineated within the regulated area (Refer to **Figure 6.6**). This includes an ephemeral river (watercourse). No natural wetland systems, or even cryptic wetlands were identified for the area. The proposed development area is more than 650 m south of the watercourse. A borrow bit with no drainage was identified within the project area, but this is not considered to be a natural water resource. The results of the habitat assessment indicates natural (class A) and largely natural (class B) instream and riparian conditions for the watercourse catchment respectively. The recommended buffer was calculated to be 20 m for the river.

A site sensitivity verification forms part of reporting requirements. In this regard, the allocated sensitivities of low for the general area and medium sensitivity for the drainage features agrees with the Environmental Screening Tool. The project must take cognisance of this and avoid any unnecessary disturbance of the drainage features and adjacent habitat. Therefore, the aforementioned post-mitigation buffer should be implemented and treated as 'no go areas'.

The development footprint is not located within 100 m of the delineated water resource [as per the National Water Act, 1998 (Act No. 36 of 1998) in accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i)]. However, the closest water resource (ephemeral river) is rated as Very High sensitivity, and no development activities should take place within the delineated buffer zone. Since the development footprint is outside of the regulation zone and buffer zone, no risks to the freshwater systems are foreseen for the proposed project. Therefore, no impacts or risks were anticipated to the freshwater systems and therefore not assessed in this report. A Compliance Statement was prepared by the specialist in accordance with the specialist protocols.

As a result of the absence of impacts or risks to freshwater systems, the contribution of the project to cumulative impacts in the region are expected to be low.

No fatal flaws were identified for the project, and the development may be favourably considered and all prescribed mitigation measures must be considered by the issuing authority. No monitoring measures are deemed necessary for the development.

7.2.3 Impacts on Avifauna

The SABAP2 Data lists 234 avifauna species that could be expected to occur within the area. Eleven (11) of these expected species are regarded as SCC. One hundred and twenty-four (124) bird species were recorded across all properties within the Crossroads Green Energy Cluster in the first survey undertaken during 25 April- 6 May 2022, with Pied Crow, Red-billed Quelea, Spiked-heel Lark and Pink-billed Lark being the most abundant species. A number of species were found during the survey that would be regarded as 'high risk' species.

One hundred and two (102) bird species were recorded during the second survey across all properties within the Crossroads Green Energy Cluster in the second survey which was conducted from 1-10 July 2022. Nine of the species recorded were SCC on a national or international scale. They were found in varying degrees of frequency. During the second survey similar SCCs were recorded with the exception of the Karoo Korhaan and Lanner Falcon.

The assessment area overlaps is located within the Platberg–Karoo Conservancy IBA and includes with three habitat types namely, Grassland Karoo, Shrubland Karoo and Water Resources (Dams, drainage lines and river). These habitats were based on the species compositions in the various areas.

Three active Verreaux's Eagle nests were observed and an additional two inactive nests were also noted. Two active Secretarybird nests were also recorded (refer to Figure 6.9). As per the Species Environmental Assessment Guidelines (2020) a core area of 1km (core buffer) surrounding the nests must be treated as a no-go area, an additional area of 5.2km (seasonal buffer) was also placed around the nest as per the Birdlife Verreaux's Eagle and Wind Farms Guidelines (2021). This 5.2km area is based on the average home range of the Verreaux's Eagle during the breeding season, and as such this area must be avoided during the breeding season of the species which stretches from April to July to avoid disturbing the species. As per the guidelines, buffers were also placed around the inactive nests. For the Secretarybird nests a 4 km buffer was placed around the nests, of which 2km must be treated as no go (core buffer), while the other 2 km must be low impact development (low impact buffer) (pers comms Birdlife, 2022). Secretarybirds breeds year around therefore low impact development is required and a breeding season limitation will not suffice.

Sensitivities were compiled by the specialist for the avifauna study based on the field results and desktop information. The Water resources and Nest buffers were given a very high sensitivity based on the low receptor resilience these areas and species will have to change. The Karoo scrubland and Karoo Grasslands all support a large number of SCCs (9 species), the biodiversity importance of these areas are thus high.

Apart from the disruption of the nests, habitat loss, collisions and electrocutions are regarded as the main impacts. Should the mitigations, monitoring and avoidance guidelines be followed the impacts can be reduced to a Moderate-Low level.

The following is concluded by the specialist:

- The development within the area of the nest core buffers is regarded as a fatal flaw and no development is to be allowed in these areas.
- Construction is permitted In the seasonal/low impact buffer areas, however must be considered with caution based on the high number of species of conservation concern and 'risk' species present. It is recommended that should development take place in the seasonal/ low impact buffers that the rest of the property remain undeveloped.

The Vrede PV facility development footprint falls outside of the identified core buffers and a small portion of the PV facility falls within the seasonal/low impact buffer areas. With the implementation of the recommended mitigation measures, the project is considered to be acceptable as proposed.

7.2.4 Impacts on Soils and Agricultural Potential

The developable area is located in the Ae138 land type. The Ae land types are characterized with Hutton, Oakleaf and Mispah soil forms according to the Soil Classification Working Group, (1991) with the possibility of other soils and bare rocky areas. The Ae land type consists of red to yellow apedal soils which are freely drained. The soils tend to have a high base status and are deeper than 300 mm.

Fifteen land capabilities have been digitised by (DAFF, 2017) across South Africa, of which two are located within the proposed development area, including:

» Land Capability 1 to 5 (Very Low to Low Sensitivity); and
» Land Capability 6 to 8 (Low/Moderate to Moderate Sensitivity).

It is the specialist's opinion that the baseline findings concur with the land capabilities identified by means of the DAFF (2017) desktop findings regarding land capability sensitivities. No "High" land capability sensitivities were identified within the developable area. Considering the relatively medium to low sensitivities, it is the specialist's opinion that the proposed activities will have an acceptable level of impact on agricultural productivity for the area. Furthermore, no measures regarding moving components in their micro-setting are required to avoid or minimise fragmentation and disturbances of agricultural activities.

No fatal flaws were identified for the project. It is the specialist's opinion that the proposed activities may proceed as have been planned without the concern of loss of high sensitivity land capabilities or agricultural productivity for the developable area.

7.2.5 Heritage Impacts

The overall archaeological sensitivity of the development area with regard to the preservation of Early, Middle and Later Stone Age archaeology as well as Khoe and San heritage, early colonial settlement is regarded as very high. Despite this, the field assessment conducted for this project has demonstrated that the specific areas proposed for development have an overall low sensitivity for impacts to significant archaeological heritage.

The results of this assessment align with the findings of other specialists such as Morris (2011) who notes that ephemeral MSA and LSA scatters are the dominant archaeological signature of the area and are therefore not archaeologically significant. Specific mitigation measures are proposed for the few sensitive sites identified. Often, rock engravings and some archaeological sites from this area are associated with dolerite outcrops as these outcrops provide the raw material resource for rock engravings. The dolerite outcrops that are present within the areas proposed for development therefore have high levels of archaeological sensitivity and impacts to these outcrops must be avoided. No archaeological resources of significance were identified within the area proposed for the Vrede Solar PV Facility.

Based on previous surveys in the area, the land use (for grazing by sheep), the presence of superficial deposits (probable Pleistocene to Recent age) covering the fossiliferous sediments (probably Ecca and Beaufort Groups), as well as the extensive network of intrusive dolerite dykes and sills that bake (thermally metamorphose) adjacent mudrocks, it is anticipated that the impact of the development will mainly be low to moderate. However, any excavations > 1m could disrupt Ecca and Beaufort Group sediments which are highly fossiliferous and would increase the impact of the development to moderate to high. There are no objections on palaeontological heritage grounds, granted the excavations do not exceed 1m in depth. Any

fossil finds, most likely in the superficial Quaternary sediments, are to be reported by the developer. Should important fossil material be found during excavations, a Fossil Finds Procedure must be implemented.

In terms of cultural landscape, the following recommendations are adapted from Winter and Wilson (2021) in terms of Solar PV placement ("where" and "how"). The following general principles apply to the PV layout:

» Avoid steep slopes.
» Avoid proximity to historic corridors.
» Avoid placement within viewshed of farmsteads.

The layout provided comply with the above general principles. The impact tables for this impact are fully addressed in the VIA.

There is no objection to the proposed development in terms of impacts to heritage resources on condition that:

» There are no objections on palaeontological heritage grounds, granted the excavations do not exceed 1m in depth. Any fossil finds, most likely in the superficial Quaternary sediments, are to be reported by the developer. Should important fossil material be found during excavations, an appropriate Fossil Finds Procedure must be implemented.
» A 100m Buffer is implemented around site TK001 (which is located outside of the development footprint)
» Should any buried archaeological resources or human remains or burials be uncovered during the course of development activities, work must cease in the vicinity of these finds. The South African Heritage Resources Agency (SAHRA) must be contacted immediately in order to determine an appropriate way forward.

7.2.6 Visual Impacts

Despite the significant industrial type infrastructure which is present in the area, the greater landscape of the study area is characterised by wide-open spaces and otherwise very limited development. The study area is sparsely populated outside of the Philipstown (i.e. less than two people per km^2 within the district municipality). A number of isolated homesteads occur throughout the study area. The study area is characterised by wide-open spaces and otherwise very limited development. It should however be noted that there are a number of authorised (and current) renewable energy applications within the study area and the greater region, that may change the landscape to some degree in the future. There are no formally protected or conservation areas within the study area. Sensitive visual receptors include residents or visitors to the area and users of local roads. Potential impacts include:

» The proposed development could change the character and sense of place of the landscape setting;
» The proposed development could change the character of the landscape as seen from the local roads;
» The proposed development could change the character of the landscape as seen from local agricultural homesteads;
» The proposed development could change the character of the landscape as seen from private nature reserves;
» Solar glare and glare impacts; and
» Lighting impacts.

The findings of the Visual Impact Assessment undertaken for the proposed Vrede Solar PV Facility is that the visual environment surrounding the site, especially within a 1km radius (and potentially up to a radius of 3km) of the proposed facility, may be visually impacted during the anticipated operational lifespan of the facility (i.e. a minimum of 20 years).

The following is a summary of impacts remaining:

- Construction activities may potentially result in a high temporary visual impact, that may be mitigated to moderate
- The operation of the proposed PV facility is expected to have a high visual impact pre-mitigation and a moderate visual impact post mitigation on the residents of Jakobsrus and observers/visitors travelling along the secondary roads within a 1km radius of the PV facility.
- The operational facility could have a high visual impact which may be mitigated to moderate on residents/visitors to the homestead of Middelplaas and observers travelling along the various secondary roads within 1 – 3km radius of the facility.
- The operational facility could have a moderate visual impact which may be mitigated to low on residents/visitors to the homestead of Wolwekuil and an unknown residence as well as observers travelling along the various secondary roads within 3 – 6km radius of the facility.
- The operational facility could have a low visual impact both pre and post mitigation on residents/visitors to various homesteads as well as observers travelling along the various secondary roads beyond the 6km radius of the facility.
- This anticipated lighting impact is likely to be of high significance and may be mitigated to moderate especially within 0-3 km radius of the PV facility.
- The potential visual impact related to solar glint and glare as a road travel hazard is therefore expected to be of low significance. No mitigation of this impact is required since the solar reflection is predicted towards a local/secondary road.
- There is a single affected residence, Jakobsrus, within a 1km radius of the proposed PV facility. The potential visual impact related to solar glint and glare on static ground-based receptors (residents of homesteads) is therefore expected to be of moderate significance before mitigation and low post mitigation.
- The anticipated visual impact resulting from ancillary infrastructure is likely to be of low significance both before and after mitigation.
- Decommissioning activities may potentially result in a high, temporary visual impact that may be mitigated to moderate.
- The anticipated significance of the visual impacts on the sense of place within the region (i.e. beyond a 6 km radius of the development and within the greater region) is expected to be of Moderate significance.
- The anticipated cumulative visual impact of the proposed facility is expected to be of high significance.

The anticipated visual impacts listed above (i.e. post mitigation impacts) range from prominently moderate to low significance. One visual impact of high is anticipated in terms of the cumulative visual impact of the proposed Phase 1 of the Crossroads Green Energy Cluster. Anticipated visual impacts on sensitive visual receptors (if and where present) in close proximity to the proposed Vrede Solar PV Facility are not considered to be fatal flaws for the proposed PV facility.

A number of mitigation measures have been proposed. Regardless of whether or not mitigation measures will reduce the significance of the anticipated visual impacts, they are considered to be good practice and

should all be implemented and maintained throughout the construction, operation and decommissioning phases of the proposed facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. As such, the Vrede Solar PV facility would be considered to be acceptable from a visual impact perspective and can therefore be authorised.

7.2.7 Social Impacts

The development of and investment in renewable energy is supported by the National Development Plan (NDP), New Growth Path Framework and National Infrastructure Plan, which all refer to and support renewable energy. The PKSDM SDF and IDP also support the development of renewable energy. The development of the proposed PV facility is therefore supported by key policy and planning documents.

The findings of the SIA indicate that the proposed Vrede PV SEF will result in several social and socio-economic benefits, including creation of employment and business opportunities during both the construction and operational phases. The project will also create economic development opportunities for the local community. The enhancement measures listed in the report should be implemented in order to maximise the potential benefits. The significance of this impact is rated as High Positive. The proposed development also represents an investment in clean, renewable energy infrastructure, which, given the negative environmental and socio-economic impacts associated a coal-based energy economy and the challenges created by climate change, represents a significant positive social benefit for society as a whole. The Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits, both at a national level and at a local, community level. These benefits are linked to foreign Direct Investment, local employment and procurement and investment in local community initiatives.

The findings also indicate that the potential negative impacts associated with both the construction and operational phase are likely to be Low Negative with mitigation. The potential negative impacts can therefore be effectively mitigated if the recommended mitigation measures are implemented.

On the basis of the above conclusion, the establishment of the proposed Vrede PV SEF and associated infrastructure is supported.

7.2.8 Traffic Impacts

The Traffic Impact Assessment concluded the following regarding key issues and alternatives to be considered for the proposed Vrede Solar PV Facility:

- The preferred Port of Entry for imported components is the Port of Ngqura.
- The proposed access road located off the R48 is deemed a suitable access road as it is an existing gravel road i.e., less expensive to upgrade.
- It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will hence need to be maintained during the additional loading of the construction phase and then reinstated after construction is completed. The gravel roads will require grading with a grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage.

- The construction phase traffic, although significant, will be temporary and can be mitigated to an acceptable level.
- During operation, it is expected that staff and security will periodically visit the facility. The traffic generated during this phase will be minimal and will not have an impact on the surrounding road network.
- The construction and decommissioning phases of a development is the only significant traffic generator and therefore noise and dust pollution will be higher during this phase. The duration of this phase is short term i.e., the impact of the traffic on the surrounding road network is temporary and solar facilities, when operational, do not add any significant traffic to the road network.

Impacts are expected to occur with the development of the project during the construction and operation phases.

Impacts during construction include:
- Construction related traffic
- The construction traffic would also lead to noise and dust pollution.
- This phase also includes the construction of roads, excavations, trenching for electrical cables and other ancillary construction works that will temporarily generate the most traffic.

Impacts during the operation phase include:
- During operation, it is expected that staff and security will visit the facility.
- Maintenance vehicles are expected on site at times.
- Should municipal water not be available, water will have to be transported to the site.

Cumulative Impacts
- Traffic congestion/delays on the surrounding road network.
- Noise and dust pollution

The construction and decommissioning phases of a development is the only significant traffic generator and therefore noise and dust pollution will be higher during this phase. The duration of this phase is short term i.e., the impact of the traffic on the surrounding road network is temporary and solar facilities, when operational, do not add any significant traffic to the road network.

The development is supported from a transport perspective provided that the recommendations and mitigations contained in this report are adhered to.

The impacts associated with the facility are acceptable with the implementation of the recommended mitigation measures and can therefore be authorised.

7.2.9 Risks Associated with the BESS

All types of batteries can be hazardous and can pose a safety risk. The risks associated with battery technologies are generally well understood and researched. The primary risks for all BESS technologies relate to fire hazards and the potential for a condition known as 'thermal runaway'. Thermal runaway occurs in situations where an increase in temperature changes the conditions in a way that causes a further increase in temperature, often leading to fires and/or explosions. Lithium-ion batteries and flow batteries in fire scenarios may generate toxic gas from the combustion of hydrocarbons, plastics, or acidic electrolytes.

Physical damage to the battery can also lead to problems as this can allow the electrolyte inside to leak potentially resulting in toxic chemical exposure or pollution.

Flow batteries are generally considered the safer technology because they do not contain flammable materials, and the materials that they do contain, such as vanadium, are often environmentally friendly. However, lithium-ion batteries are easier to install (i.e. usually housed within containers as opposed to formal building structures) and require fewer staff to operate.

Liquid metal batteries are a good alternative battery solution to Lithium Ion and Redox. Liquid metal batteries are safe to transport, being in a solid state when not in use. This new technology utilises environmentally friendly materials which are recyclable after decommissioning and do no emit any toxic gases when operating. Because of the abundance of materials used in liquid metal batteries, the costs are also generally lower than lithium-ion and are much better equipped for stressed environments especially considering that liquid metal batteries can be exposed to harsh overcharging and discharging cycles without impacting on their capacities[16].

All of the listed battery technologies will require strict adherence to supplier Standard Operating Procedures to minimise risks to workers.

The Vrede Solar PV Facility development site is not located in close proximity to residences or water resources. The development of the BESS (regardless of technology selected) is therefore not expected to raise any unacceptably high-risk issues, i.e. the BESS facility of either technology type is not a No-Go option and **all technologies are considered acceptable**.

7.2.10 Assessment of Cumulative Impacts

Cumulative impacts are expected to occur with the development of the project throughout all phases of the project life cycle and within all areas of study considered as part of this EIA report. The main aim for the assessment of cumulative impacts considering the Project is to test and determine whether the development will be acceptable within the landscape proposed for the development, and whether the loss, from an environmental and social perspective, will be acceptable without whole-scale change.

The following conclusions can be drawn regarding the cumulative impacts associated with the project when considered together with impacts of similar industrial-type projects in the area:

- There will be no unacceptable loss or impact on ecological aspects (vegetation types, species and ecological processes), provided the recommended mitigation measures are implemented. This is due to the moderate sensitivity of the site and the acceptability of solar development within an ESA.
- There will be no significant loss of sensitive and significant aquatic features as the project is located outside of any freshwater resources.
- There will be no unacceptable loss or impact to avifauna or avifaunal habitats, provided the recommended mitigation measures are implemented. This is due to the location of the project infrastructure outside of identified no-go areas and the fact that solar development is considered to be low impact in terms of the BirdLife species specific guidelines.
- The project will not impact on any high potential agricultural land and will therefore not contribute to impacts on this resource or food security.

[16] https://www.energy-storage.news/ambri-gets-ul-1973-safety-certification-for-liquid-metal-battery-storage-tech/

- Change to the sense of place and character of the area is expected with the development of the proposed Vrede Solar Energy Facility and other renewable energy facilities within a 30km radius of the site. Other industrial type infrastructure in the region include numerous power lines and substations. Whilst the proposed project will create a new large scale industrial operation and change the character of an area of rural landscape, this is not entirely out of character with the region. The cumulative impact is therefore considered to be acceptable.
- There will be no loss of heritage resources of significance due to the absence of any areas of sensitivity from the development footprint.
- No unacceptable social impacts are expected to occur.

A summary of the cumulative impacts is included in **Table 7.1** below.

Table 7.1: Summary of the cumulative impact significance for the project.

Specialist assessment	Overall significance of impact of the proposed project considered in isolation	Cumulative significance of impact of the project and other projects in the area
Terrestrial Ecology	Low	High
Freshwater Ecology	None	Low
Avifauna	Medium	Medium
Soils and Agricultural Potential	Low	Low
Heritage	None	Medium
Visual	Moderate	High
Social	Low to Medium (positive and negative)	Medium to High (positive and negative)
Traffic	Low	Medium

Based on the specialist cumulative assessment and findings, the development of the Vrede Solar PV Facility and its contribution to the overall impact of all renewable energy projects to be developed within a 30km radius, it can be concluded that the cumulative impacts associated with the project will be of a low to high significance depending on the impact being considered. Based on all areas of study considered as part of this EIA report, the development of Vrede Solar PV Facility will not result in unacceptable, high cumulative impacts and will not result in a whole-scale change of the environment.

7.3 Assessment of Alternatives

As per the approved Plan of Study for EIA, and described in Chapter 2 of this report, the following alternatives were considered within this EIA Report

Type of Alternatives Considered	Description of the Alternative relating to the Vrede Solar PV facility
Site-specific Alternatives	Privately owned farm portions have been identified for the development of the Vrede Solar PV facility, taking advantage of the site-specific characteristics such as the solar irradiation. The study area which is ~1101 ha in extent and in which a development area (~400ha) has been identified, is considered to be large enough for the development of a PV facility with a contracted capacity of up to 150MW, while allowing for avoidance of environmental sensitivities, as may be required in line with the mitigation hierarchy.
Layout Footprint Design Alternatives	The layout for the development of the Vrede Solar PV facility will be designed taking cognisance of the environmental sensitivities identified during the scoping phase. The

Type of Alternatives Considered	Description of the Alternative relating to the Vrede Solar PV facility
	detailed facility layout will be made available for assessment and ground-truthing by the independent specialists in the EIA phase. Where further conflicts are predicted, a mitigation strategy will be developed to meet the objectives of the mitigation hierarchy (avoid, minimise, mitigate).
Technology Alternatives	Consideration of the following technology alternatives: » PV Technology: ∗ Bifacial PV panels ∗ Monofacial PV panels ∗ Fixed mounted PV systems (static / fixed-tilt panels). ∗ Single-axis tracking or double-axis tracking systems (with solar panels that rotate around a defined axis to follow the sun's movement). » BESS Technology: ∗ Lithium-Ion technology (e.g. Lithium Ferrophosphate (LFP), Nickel Manganese Cobalt Oxide (NMC) or similar technology and chemistries); and ∗ Redox-flow technology (e.g. vanadium flow battery, or similar technology and chemistries).
'Do-nothing' Alternative	The option to not construct the Vrede Solar PV facility. The 'do-nothing' alternative assumes that the site remains in its current state, that is status quo, and that the current land use practises only continue.

7.3.1. Assessment of the Facility Layout

The facility layout/development footprint assessed within this EIA Report (**Figure 7.2**) was designed by the project developer in order to respond to and avoid the sensitive environmental and social features located within the project site, which were identified by the specialists during the Scoping Phase of the EIA process. This approach ensured the application of the mitigation hierarchy (i.e., avoid, minimise, mitigate, and offset) to the proposed project, which ultimately ensures that the development is appropriate from an environmental perspective and is suitable for development within the project site.

Based on the findings as documented in this EIA report, it was concluded that this layout avoids areas of sensitivity and recommended no-go areas, and therefore no further optimisation was recommended. As such, the impact of this proposed Facility Layout is considered to be acceptable and the layout is recommended for approval. Final micro-siting must however be undertaken prior to construction considering all mitigation measures recommended within this EIA Report and associated specialist studies.

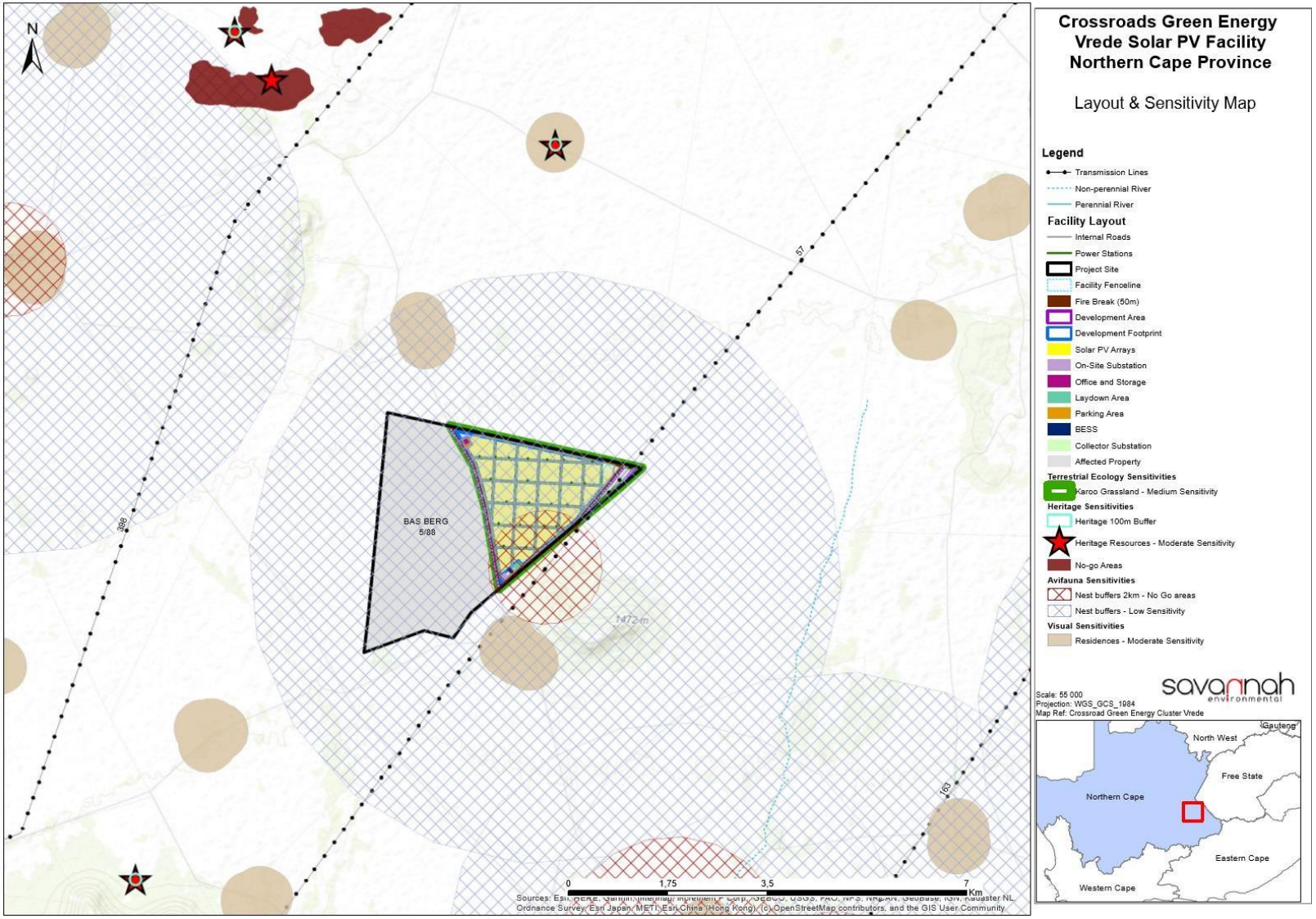

Figure 7.2: The development footprint of Vrede Solar PV Facility, as assessed within this EIA Report, overlain on the identified sensitive environmental features (also refer to **Appendix L**)

7.3.2 Assessment of Technology Alternatives

iii) PV Technology

The primary difference between PV technologies available relate to the extent of the facility, as well as the height of the facility (visual impacts), however the potential for environmental impacts remains similar in magnitude. Fixed mounted PV systems are able to occupy a smaller extent and have a lower height when compared to tracking PV systems, which require both a larger extent of land, and are taller in height. However, both options are considered to be acceptable for implementation from an environmental perspective. Regardless of the technology implemented, the development will be restricted to the footprint considered within this EIA report and the impacts assessed will not differ. Therefore, there is no preference regarding the technology to be implemented.

iv) BESS Technology

The development site is not located in close proximity to residences or water resources. The development of the BESS (regardless of technology selected) is therefore not expected to raise any unacceptably high-risk issues, i.e. the BESS facility of either technology type is not a No-Go option and either technology is considered acceptable.

7.3.3 Assessment of 'Do nothing' Alternative

The no-go is the continuation of the existing land use, i.e. maintain the status quo. There would be no environmental impacts on the site or to the surrounding local area due to the construction and operation activities of a solar farm with the implementation of this alternative. All negative impacts, specifically related to the development of the solar facility, discussed in this report will not materialise.

The 'do-nothing' alternative will do little to influence the renewable energy targets set by government. However, as the project site experiences ample solar resource and optimal grid connection opportunities, not developing the Vrede Solar PV Facility would see such an opportunity being lost. In addition, the Northern Cape Province will not benefit from additional generated power being evacuated directly into the Province's grid. As current land use activities can continue on the site once the project is operational, the loss of the land to this project during the operation phase is not considered significant. Therefore, from a regional perspective, the 'do-nothing' alternative is not preferred as there is a perceived loss of benefits for the regional area.

From the specialist studies undertaken, no environmental fatal flaws were identified to be associated with the Vrede Solar PV Facility subject to implementation of the recommended mitigation measures. All impacts associated with the project can be mitigated to acceptable levels. If the solar energy facility is not developed, the following positive impacts will not be realised:

- Job creation from the construction and operation phases.
- Economic benefit to participating landowners due to the revenue that will be gained from leasing the land to the developer.
- Meeting of energy generation mix in a most economic and rapid manner.
- Provision of clean, renewable energy in an area where it is optimally available.

As detailed above, the 'do-nothing' alternative will result in a number of lost opportunities. The 'do nothing' alternative is therefore not preferred and not proposed to be implemented for the development of the Vrede Solar PV Facility.

7.4. Environmental Costs versus Benefits of The Project

Environmental costs (including those to the natural environment, economic and social environment) can be anticipated at a local and site-specific level and are considered acceptable provided the mitigation measures as outlined in the EIA Report and the EMPr are implemented and adhered to. No fatal flaws have been identified. These environmental costs could include:

- *Loss of biodiversity, flora and fauna due to the clearing of land for the construction and utilisation of land for the solar facility* – The cost of loss of biodiversity have been minimised through the location of the project infrastructure outside of areas of high sensitivity. Costs can be further reduced through the implementation of the recommended mitigation measures.
- *Impacts on freshwater resources* – As a result of the proposed Facility Layout avoiding direct impacts on aquatic resources, the establishment of the proposed project will not pose a significant threat to local watercourses. All anticipated impacts have a Low residual risk rating.
- *Impacts on birds*– loss of bird species due to collision with infrastructure and disturbance associated with construction and operation of the facility has been minimised through the location of the facility outside of identified no-go areas. Mitigation measures as described in this report can be implemented to reduce the significance of the risk but there is still a possibility of impacts.
- *Visual Impacts* – Overall, the significance of the visual impacts is expected to range from moderate to low, as a result of the very low occurrence of sensitive visual receptors. Cumulative impacts is however anticipated to be of high significance. It should be noted that of the receptors located within a 6km radius of the proposed site, a number of the homesteads are located on farms that already have authorization to construct renewable energy developments or where processes are underway for such facilities.

Benefits of the project include the following:

- The project will result in important economic benefits at the local and regional scale through job creation, income and other associated downstream economic development, supporting the Just Energy Transition in the region. These will persist during the pre-construction, construction, operation and decommissioning phases of the project.
- The project provides an opportunity for a new land use on the affected properties which would result in additional financial benefits to the directly affected landowners through compensation. It is important to note that the construction and operation of a solar facility can occur in tandem with crop production.
- The project contributes towards the Provincial and Local goals for the development of renewable energy as outlined in the respective IDPs.
- The project serves to diversify the economy and electricity generation mix of South Africa through the addition of solar energy, in line with national policy regarding energy generation.
- The water requirement for a solar facility is negligible compared to the levels of water used by coal-based technologies. This generation technology is therefore supported in dry climatic areas.
- South Africa's per capita greenhouse gas emissions are amongst the highest in the world due to the reliance on fossil fuels. The Vrede Solar PV Facility will contribute to achieving goals for implementation of renewable energy and sustaining a 'green' economy within South Africa.

The benefits of the project are expected to occur at a national, regional and local level. As the costs to the environment at a site-specific level can be appropriately managed and minimised, the benefits of the project are expected to partially offset the localised environmental costs of the solar facility, provided that the mitigation measures, as recommended by the specialists are adhered to.

7.5. Overall Conclusion (Impact Statement)

The preferred activity was determined by the developer to be the development of a renewable energy facility on site using solar as the preferred technology, due to the availability of a strong solar resource, land availability, available grid capacity, benign topography, and good access. A technically viable development footprint was proposed by the developer considering environmental sensitivities identified in the scoping study and assessed as part of the EIA process. The assessment of the development footprint within the project site was undertaken by independent specialists and their findings have informed the results of this EIA Report.

From a review of the relevant policy and planning framework, it was concluded that the project is well aligned with the policy framework, and a clear need for the project is seen from a policy perspective at a local, provincial and National level.

The specialist findings from the EIA studies undertaken have indicated that there are no identified fatal flaws associated with the implementation of the development footprint within the project site subject to implementation of the recommended mitigation measures. The developer has designed a project development footprint in response to the identified sensitive environmental features and areas present within the project site. This approach is in line with the application of the mitigation hierarchy, where all the sensitive areas which could be impacted by the development have been avoided (i.e., tier 1 of the mitigation hierarchy). The impacts that are expected to remain after the avoidance of the sensitive areas by the facility layout have been reduced to acceptable levels through the recommendation of specific mitigation measures by the specialists. The minimisation of the significance of the impacts is in line with tier 2 of the mitigation hierarchy. Therefore, impacts can be mitigated to acceptable levels or enhanced through the implementation of the recommended mitigation or enhancement measures. The layout for the PV facility assessed within this EIA Report is located outside of the very high sensitivity areas and features regarded to be no-go for development and is therefore considered to be acceptable for implementation.

As detailed in the cost-benefit analysis, the benefits of the Vrede Solar PV Facility are expected to occur at a national, regional and local level. As the costs to the environment at a site-specific level can be appropriately managed and minimised, the benefits of the project are expected to partially offset the localised environmental costs of the solar facility. From a social perspective, both positive and negative impacts are expected. The implementation of the 'do-nothing' alternative will result in a number of lost opportunities. The 'do nothing' alternative is therefore not preferred and not proposed to be implemented for the development of The Project.

Through the assessment of the development footprint within the project site, it can be concluded that the development of the Vrede Solar PV Facility will not result in unacceptable environmental impacts (subject to the implementation of the recommended mitigation measures).

7.6. Overall Recommendation

Considering the findings of the independent specialist studies, the impacts identified, the development footprint proposed by the developer and the potential to minimise the impacts to acceptable levels through mitigation, it is the reasoned opinion of the EAP that the Vrede Solar PV Facility is acceptable within the landscape and can reasonably be authorised subject to implementation of the avoidance of the sensitive areas identified through the EIA process and the implementation of mitigation and enhancement measures recommended by the specialists. The following project details should be included within the EA for the Project:

» The Vrede Solar PV Facility with a contracted capacity of up to 150MW, to be located on ortion 5 of the Farm Bas Berg 88 in the Renosterberg Local Municipality in the greater Pixley ka Seme District Municipality in the Northern Cape Province. The project site is located approximately 20km north of Philipstown and 30km west of Petrusville.

The following infrastructure is to be included within an authorisation issued for the project:

» Solar PV array comprising PV modules and mounting structures (monofacial or bifacial and of fixed-tilt, single-axis tracking, and/or double-axis tracking PV technology)
» Inverters and transformers
» Cabling between the project components
» Battery Energy Storage System (BESS) (Lithium-ion or Redox Flow)
» On-site facility substation
» Site offices, Security office, operations and control, and maintenance and storage laydown areas
» Access roads, internal distribution roads

The following key conditions would be required to be included within an authorisation issued for The Project:

» All mitigation measures detailed within this EIA Report, as well as the specialist reports contained within **Appendices D to K** are to be implemented.
» The EMPrs (for the facility and onsite substation) as contained within **Appendices M and N** of this EIA Report should form part of the contract with the Contractors appointed to construct and maintain the solar facility in order to ensure compliance with environmental specifications and management measures. The implementation of these EMPrs for all life cycle phases of the Project is considered key in achieving the appropriate environmental management standards as detailed for this project.
» Micro-siting must be undertaken for the final facility layout and must take all recommended mitigation measures into consideration. No development is permitted within the identified no-go areas as detailed in **Figure 7.2**.
» An Environmental Site Officer (ESO) must form part of the on-site team to ensure that the EMPrs are implemented and enforced and an Environmental Control Officer (ECO) must be appointed to monitor compliance for the duration of the construction phase.
» Preconstruction walk-through of the final development footprint must be undertaken for protected species that would be affected and that can be translocated must be undertaken. The survey must also cover sensitive habitats and species that are required to be avoided. Permits from the relevant provincial authorities, will be required to relocate and/or disturb listed plant species.
» All other relevant environmental permits must be obtained prior to the construction of the facility.

A validity period of 10 years of the Environmental Authorisation is requested, should the project obtain approval from DFFE.

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Heritage Impact Assessment Report

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
104574	Heritage Scoping	Wouter Fourie	10/10/2012	Heritage Scoping Report for the Proposed Wind Farm Facility Renosterberg Wind Energy Company (RWEC) near Petrusville, North Cape Province
104576	Heritage Scoping	Wouter Fourie	10/10/2012	Heritage Scoping Report for the Proposed Solar PV Facility Renosterberg Wind Energy Company (RWEC) near Petrusville, North Cape Province
104804	PIA Desktop	John E Almond	01/09/2012	Palaeontological specialist assessment: desktop study PROPOS RENOSTERBERG SOLAR PV AND WIND ENERGY FACILITIES NEAR DE A NORTHERN CAPE PROVINCE
109347	AIA Phase 1	David Morris	01/12/2012	ARCHAEOLOGY SPECIALIST INPUT ON THE PROPOSED ACCESS RO FOR THE VANDERLINDESKRAAL PHOTOVOLTAIC SITE SITUATED NE HANOVER, NORTHERN CAPE
109627	PIA Phase 1	Gideon Groenewald	24/01/2013	PALAEONTOLOGICAL FIELD INVESTIGATION PHASE 1 REPORT FOR T PROPOSED ACCESS ROAD ON THE REMAINDER OF THE FARM VAN D LINDES KRAAL NO. 79, HANOVER, NORTHERN CAPE
126242	HIA Phase 1	Anton van Vollenhoven	30/07/2013	A REPORT ON A CULTURAL HERITAGE IMPACT ASSESSMENT FOR T PROPOSED SWARTWATER SOLAR PV POWER FACILITY, CLOSE PETRUSVILLE, NORTHERN CAPE PROVINCE
127514	Palaeontological Specialist Reports	Robert Gess	13/08/2013	Palaeontological Impact Assessment for Proposed establishment of t Swartwater Solar energy Facility, Eastern Cape
151280	Archaeological Specialist Reports	Jaco van der Walt	26/08/2013	Archeological Scoping Report for the Proposed Castle WEF near Aar, Northern Cape Province
151284	PIA Desktop	John E Almond	31/08/2013	Palaeontological Heritage Assessment: Desktop Study
160512	Archaeological Monitoring	Lita Webley, Dave Halkett	17/03/2014	HERITAGE IMPACT ASSESSMENT: WALKDOWN OF FINAL LAYOUT OF T LONGYUAN MULILO DE AAR 2 NORTH WIND ENERGY FACIL NORTHERN CAPE PROVINCE
163994		Wouter Fourie	03/08/2013	Proposed PV Facility: Heritage Impact Report
183142	Archaeological Specialist Reports	Jaco van der Walt	30/10/2014	Archaeological Impact Assessment Report for the Proposed Cas Wind Energy Facility, De Aar, Northern Cape
183143	Heritage Impact Assessment Specialist Reports	Barry Millsteed	24/11/2014	Full Palaeontological Heritage Impact Assessment Report on a Porti of a Proposed Wind Energy Generation Facility (The Castle Project); T Being on the Eastern Extent of the Farm Knapdaar 8 near De A Northern Cape Province
339820	Heritage Impact Assessment Specialist	Lita Webley, Jayson Orton	01/12/2011	Proposed De Aar Wind Energy Facility on the North and South Plate Northern Cape Province

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
	Reports			
339824	Heritage Impact Assessment Specialist Reports	Lita Webley, David Halkett	01/06/2015	Addendum: Proposed Wind Energy Facility situated on the Easte plateau (South) near De Aar, Northern Cape Province.
384330	HIA Letter of Exemption	John Almond	01/10/2016	Proposed Kloofsig 1 Solar PV Energy Facility on the remainder of Fa Kalkpoort 18, Renosterberg Local Municipality near Petrusville, North Cape
384331	HIA Letter of Exemption	John Almond	01/10/2016	Proposed Kloofisg 2 Solar PV Energy Facility on the remainder of Fa Kalkpoort 18, Renosterberg Local Municipality near Petrusville, North Cape
384332	HIA Letter of Exemption	John Almond	01/10/2016	Proposed Kloofsig 3 Solar PV Energy Facility on the remainder of fa Kalkpoort 18, Resnosterberg Local Municipality near Petrusvi Northern Cape
384452	Palaeontological Specialist Reports	John E Almond	01/06/2015	Palaeontological Impact Assessment Screening of the propos Kloofsig 1 Solar PV Energy Facility on the remainder of the Fa Kalkpoort 18, Petrusville area, REsnosterberg Local Municipal Northern Cape.
384456	Archaeological Specialist Reports	Madelon Tusenius	24/10/2016	Archaeological Impact Assessment of the proposed Kloofsig 1 Solar Energy Facility on the remainder of the Farm Kalkpoort 18, Petrusv area, REsnosterberg Local Municipality, Northern Cape.
384469	Palaeontological Specialist Reports	John E Almond	01/06/2015	Palaeontological Impact Screening Assessment - Proposed Kloof Solar Pv Facility On The Remainder Of Farm Kalk Poort 18, Renosterbe Local Municipality Near Colesberg, Northern Cape
384497	Archaeological Specialist Reports	Madelon Tusenius	24/10/2016	Archaeological Impact Assessment of the proposed Kloofsig 2 Solar Energy Facility on the remainder of the Farm Kalkpoort 18, Petrusv area, REsnosterberg Local Municipality, Northern Cape.
384552	Palaeontological Specialist Reports	John E Almond	01/06/2015	Palaeontological Impact Assessment: Basic Assessment Study Proposed Exemption From Further Specialist Palaeontological Studies Proposed Kloofsig Solar PV Facility On The Remainder Of Farm Kalk Poort 18, Renosterberg Local Municipality Near Colesberg, Northern Cape
384554	Archaeological Specialist Reports	Madelon Tusenius	24/10/2016	Archaeological Impact Assessment of the proposed Kloofsig 1 Solar Energy Facility on the remainder of the Farm Kalkpoort 18, Petrusv area, REsnosterberg Local Municipality, Northern Cape.
4052	HIA Phase 1	Albert van Jaarsveld	01/03/2006	Hydra-Perseus and Beta-Perseus 765 kV Transmission Power Lin Environmental Impact Assessment. Impact on Cultural Herita Resources
4555	AIA Phase 1	Cobus Dreyer	10/06/2005	Archaeological and Historical Investigation of the Proposed Pipel Installation at Philipstown, Northern Cape
4556	AIA Phase 1	Cobus Dreyer	29/05/2006	Archaeological and Cultural Heritage Investigation of the Propos Eskom Hydra-Perseus & Beta-Perseus Transmission Line at the Fa Jackalskuil 21, Petrusville, Northern Cape
4558	AIA Phase 1	Cobus Dreyer	27/02/2008	First Phase Archaeological and Cultural Heritage Investigation of t Vanderkloof Dam - Petrusville Main Water Supply Scheme, North Cape
6970	AIA Phase 1	David	02/09/2011	Paarde Valley. Ilanga Lethemba PV Solar Energy Facility. Speca

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
		Morris		input for the environmental impact asssessment phase a environmental management programme for the proposed Ilan Lethemba Solar Energy Facility, near De Aar, Northern Cape provinc
6971	AIA Desktop	Johnny Van Schalkwyk	30/04/2011	Heritage Impact Scoping report for the proposed establishment of t Ilanga Lethemba PV Solar Energy Facility, near De Aar, Northern Ca Province.
7020	AIA Phase 1	David Morris	03/09/2011	Archaeology specialist input on the site of the proposed Kalkb Photovoltaic construction site north of De Aar, Northern Cape
8023	AIA Phase 1	David Morris	03/09/2011	Archaeology specialist input on the site of the propos Taaiboschfontein Photovoltaic construction site between De Aar a Hanover, Northern Cape
8167	AIA Phase 1	David Morris	03/09/2011	Archaeology specialist input on the site of the propos Vanderlindeskraal Photovoltaic construction site near Hanov Northern Cape
8992	PIA Phase 1	John E Almond	29/01/2012	Palaeontological Specialist Study: Combined Desktop and Field -bas Assessments. Two wind energy facilities on the Eastern Plateau near Aar, Northern Cape Province proposed by Mulilo Renewable Enee (Pty) Ltd
116245	AIA Phase 1	David Morris	08/01/2013	ARCHAEOLOGY SPECIALIST INPUT ON THE SITE OF THE PROPOS POTFONTEIN PHOTOVOLTAIC CONSTRUCTION SITE NORTH OF DE A/ NORTHERN CAPE
118851	PIA Desktop	Gideon Groenewald	29/04/2013	PALAEONTOLOGICAL DESKTOP REPORT PROPOSED POTFONTI PHOTOVOLTAIC FACILITY Potfontein Photovoltaic Facility, Farm: Koe Draai 36, Emthanjeni Local Municipality, Pixley ka Seme Distr Municipality, Northern Cape Province of South Africa
356810	HIA Phase 1	Lita Webley	15/02/2016	Desktop Heritage Impact Assessment: Proposed mining of two borr pits on the remainder of farm Enkeldebult 150, south of Phillipstov Northern Cape
108972	PIA Desktop	Gideon Groenewald	18/12/2012	Palaeontological Desktop Assessment - Proposed construction of t 132kV transmission lines from the South & North Wind Energy Facilities the Eastern Plateau (De Aar 2) near De Aar, Northern Cape
108995	HIA Phase 1	Wouter Fourie	10/01/2013	HIA - 132kV transmission lines from the South & North Wind Ener Facilities on the Eastern Plateau (De Aar 2)
108996	HIA Phase 1	Wouter Fourie	10/01/2013	HIA - Addendum - 132kV transmission lines from the South & North Wi Energy Facilities on the Eastern Plateau (De Aar 2)
114648	PIA Desktop	John E Almond	01/09/2012	Palaeontological specialist assessment: desktop study PROPOSED 16 MTPA EXPANSION OF TRANSNETâ€™S EXISTIN MANGANESE ORE EXPORT RAILWAY LINE & ASSOCIAT INFRASTRUCTURE BETWEEN HOTAZEL AND THE PORT OF NGQUR NORTHERN & EASTERN CAPE. Part 1: Hotazel to Kimberley, Northern Cape
114929	HIA Phase 1	Elize Becker	25/02/2013	Transnet Capital Projects Ngqura 16 Mtpa Manganese Rail Phase Heritage Impact Assessment Rail Kimberley to De Aar
115026	PIA Phase 1	John E Almond	01/02/2013	Proposed 16 Mtpa expansion of Transnet's existing manganese e export railway line and associated infrastructure between Hotazel a the Port of Ngqura, Northern and Eastern Cape. Part 3: Kimberley to De Aar, Northern Cape
121518	HIA Phase 1	Elize Becker	28/01/2013	Phase 1 Heritage Impact Assessment - Borrow Pit areas betwe Kimberley to De Aar

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
129751	HIA Phase 1	Elize Becker	20/02/2013	Phase 1 Heritage Impact Assessment Hotazel to Kimberley and De A to Port of Ngqura
151768	PIA Phase 1	John E Almond	01/11/2013	Palaeontological specialist assessment: combined desktop and fie based study: PROPOSED 16 MTPA EXPANSION OF TRANSNETâ€ EXISTING MANGANESE ORE EXPORT RAILWAY LINE & ASSOCIAT INFRASTRUCTURE BETWEEN HOTAZEL AND THE PORT OF NGQUR NORTHERN & EASTERN CAPE.
163451	Archaeological Specialist Reports	Wouter Fourie	27/03/2014	Proposed construction of a 132kV transmission line from the Longyu Mulilo De Aar 2 North Wind Energy Facility on the Eastern Plateau (Aar 2) near De Aar, Northern Cape
8086	AIA Phase 1	Johan Nel	14/11/2008	Final Report Heritage Resources Scoping Survey & Prelimin Assessment Transnet Freight Line EIA, Eastern Cape and Northern Ca
92575	HIA Phase 1	Elize Becker	10/10/2012	Phase 1 Heritage Impact Assessment Kimberley to De Aar
93185	HIA Phase 1	Elize Becker	01/11/2012	Phase 1 Heritage Impact Assessment Hotazel to Kimberley and De A to Port Ngqura

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National Road Traffic Act (Act No. 93 of 1996)
National Road Traffic Regulations, 2000
SANS 10280/NRS 041-1:2008 - Overhead Power Lines for Conditions Prevailing in South Africa
The Technical Recommendations for Highways (TRH 11): <Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads
The Technical Recommendations for Highways (TRH 17): Geometric Design of Rural Roads

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