iWink Consulting
Traffic & Transport Engineering
Road Safety

LUCKHOFF SOLAR 2 PHOTOVOLTAIC SOLAR ENERGY FACILITY FREE STATE

Transport Impact Assessment

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LUCKHOFF SOLAR 2 PHOTOVOLTAIC SOLAR ENERGY FACILITY TRANSPORT IMPACT ASSESSMENT

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EXECUTIVE SUMMARY

This report serves as the Transport Impact Assessment aimed at determining the traffic impact of the proposed Luckhoff Solar 2 Photovoltaic (PV) Solar Energy Facility to be located on a site near Luckhoff in the Free State Province. The Luckhoff Solar 2 PV facility forms part of the Luckhoff Solar PV Cluster, which comprises:

- Luckhoff Solar 1;
- Luckhoff Solar 2; and
- Luckhoff Solar 3.

The above solar projects are proposed to be located within the Xhariep District Municipality and Letsemeng Local Municipality in the Free State Province of South Africa. The respective site will accommodate a solar power facility, including associated support structures and facilities to allow for the generation and evacuation of electricity.

The recommended access route was assessed considering sight lines, access spacing requirements and road safety aspects. It is recommended to ensure that the access points are kept clear of vegetation and any other obstructions to ensure sight lines are kept. It is recommended to access the site via the S572 from the R48 at Luckhoff. Should more than one of the Luckhoff Solar facilities be developed at the same time, it is advised to provide a secondary access as described in this report.

In general, non-motorised transportation (NMT) is a dominant mode of transportation in rural areas, with private cars and minibus/taxis being the second-most used mode of transport, followed by buses. Currently, there are no known future planned public transport facilities in the vicinity of the site. However, generally the developer of a renewable energy project will provide shuttle busses for workers during the construction phase.

The highest trip generator for the project is expected during the construction phase. The actual construction stage peak hour trips are dependent on the construction period, construction programming, material availability, component delivery, abnormal load permitting etc. The decommissioning phase is expected to generate similar trips as the construction phase. The traffic impact during the operational phase is considered negligible.

For the construction, operational and decommissioning phases, the impact expected to be generated by the vehicle trips is an increase in traffic and the associated noise, dust, and exhaust pollution. Based on the high-level screening of impacts and mitigation, the project is expected to have a negative low impact during the construction and decommissioning stages.

1 INTRODUCTION

1.1 Project Description

Luckhoff Solar 2 (Pty) Ltd is proposing the development of a commercial solar PV energy facility, namely Luckhoff Solar 2 Photovoltaic Solar Energy Facility (short: Luckhoff Solar 2), and associated infrastructure on a site located approximately 5 kms north of Luckhoff within the Letsemeng Local Municipality and the Xhariep District Municipality in the Free State Province (see **Figure 1-1**). Luckhoff Solar 2 will comprise of a contracted capacity of up to 240 MW.

The Luckhoff Solar 2 project forms part of the proposed Luckhoff Solar PV Cluster, which comprises a total of three solar developments (i.e., Luckhoff Solar 1, Luckhoff Solar 2 and Luckhoff Solar 3 (see **Figure 1-2)**. Development areas have been identified for each of these three proposed developments. Within these identified development areas, development footprints have been defined in a manner which has considered the environmental sensitivities present on the affected property and intentionally remains outside of highly sensitive areas.

The preferred project site is 480 ha for Luckhoff Solar 2 and the affected farm is:

- Farm Mooidoorns No. 1224.

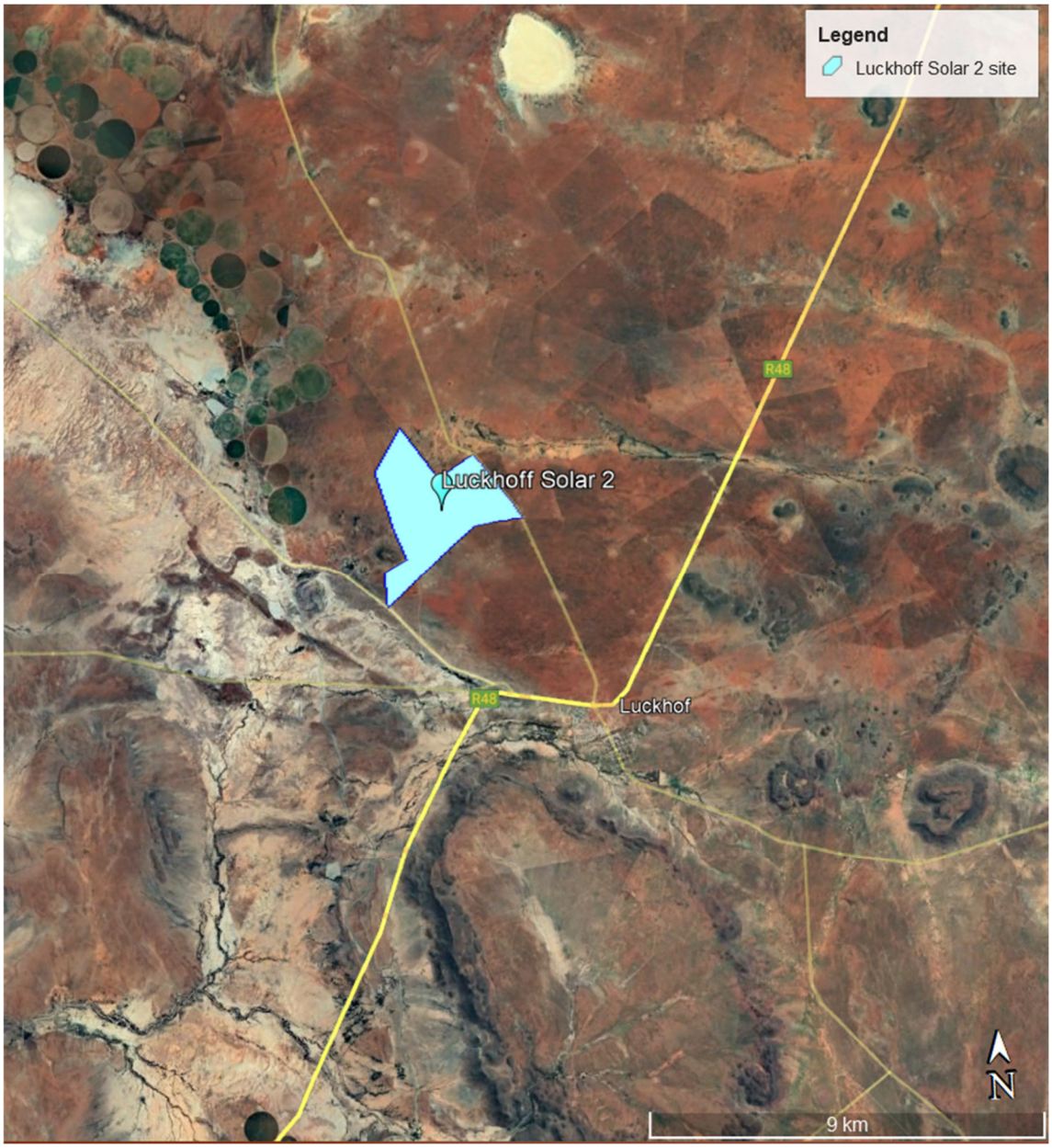

Figure 1-1: Aerial View of Location of proposed Luckhoff Solar 2 site

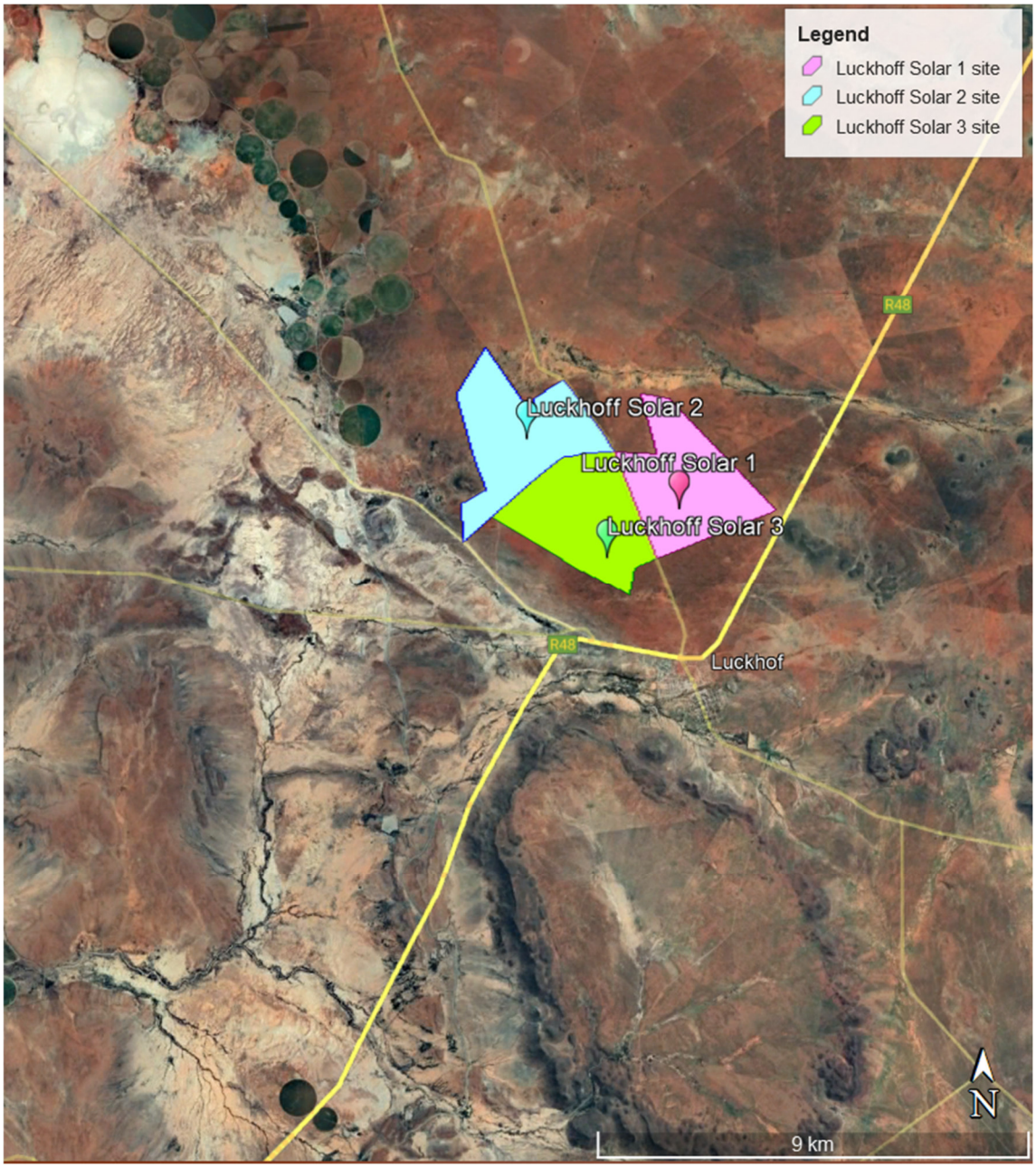

Figure 1-2: Aerial View of Luckhoff Solar PV Cluster

The proposed projects details are summarized in **Table 1-1.**

Table 1-1:Project information

Facility Name:	Luckhoff Solar 2 Photovoltaic Solar Energy Facility
Applicant:	Luckhoff Solar 2 (Pty) Ltd
Municipality:	Letsemeng Local Municipality Xhariep District Municipality
Affected Farms for the solar component:	Farm Mooidoorns No. 1224
Extent:	480 ha / Area of PV array – 480 ha (development footprint)
Capacity:	Up to 240 MW
Number of panels:	Estimated 600 000 panels
Type of Technology:	Photovoltaic
Structure height:	PV Panels: up to 6 m Battery Energy Storage System (BESS): ≤ 8m Buildings: up to 6 m
Structure orientation:	The panels will either be fixed to a single-axis horizontal tracking structure where the orientation of the panel varies according to the time of the day, as the sun moves from east to west or tilted at a fixed angle equivalent to the latitude at which the site is located in order to capture the most sun.
Area for Inverter / Transformer / BESS:	BESS: up to ± 5 ha Facility substation: up to 1 ha
BESS:	The preferred technology is solid state battery electrolytes.
Inverter:	Sections of the PV array will be wired to inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency.
Operations and Maintenance (O&M) building footprint:	A 33 kV switch room, a gate house, ablutions, workshops, storage and warehousing areas, site offices and a control centre (around 1 ha).
Batching plant (temporary):	It is expected that gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo.
Internal Roads:	Internal roads will be provided to the site and between project components inclusive of stormwater infrastructure. The majority of the access roads will follow existing gravel farm roads, which may require widening (up to 10 m). Further internal roads will need to be constructed with a preferred width of 6 m. The length of internal roads will be approximately 33 kms.

	Where required for turning circle/bypass areas, access or internal roads need to be up to 20 m wide to allow for larger component transport to navigate safely.
Fencing height:	Approximately 3.5 m
Grid infrastructure / Substation:	Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation will be required to step the voltage up to 132kV, after which the power will be evacuated into the national grid. It is expected that the generation from the facility will tie in with the proposed Luckhoff Grid Connection 132kV Overhead Power Line. The Project will inject up to 240MW into the National Grid. The installed capacity will be approximately 240MW.
Site access:	Recommended access via S572 from R48.

1.2 Scope and Objectives

The Transport Impact Assessment is aimed at determining the traffic impact of the proposed land development proposal and whether such development can be accommodated by the external transportation system.

The report deals with the items listed below and focuses on the surrounding road network in the vicinity of the site:

- The proposed development;
- The existing road network and any future road planning proposals;
- Trip generation for the proposed development during the construction, operation, and decommissioning phases of the facility;
- Anticipated traffic impact of the proposed development;
- Access requirements and feasibility of proposed access points;
- Determine a main route for the transportation of components to the proposed project site;
- Determine a preliminary transportation route for the transportation of materials, equipment and people to site;
- Recommend alternative or secondary routes, where possible and required;
- Assess Public Transport accessibility;
- Assess Non-motorised Transport availability; and
- Recommended high-level upgrades to the road network, if necessary.

1.3 Details of Specialist

Iris Sigrid Wink of iWink Consulting (Pty) Ltd. is the Traffic & Transportation Engineering Specialist appointed to provide a Transport Impact Assessment for the proposed Luckhoff Solar 2 PV Facility. Iris Wink is registered with the Engineering Council of South Africa (ECSA), with Registration Number 20110156. A curriculum vitae is included in **Appendix A** of this report.

A signed Specialist Statement of Independence is included in **Appendix B**.

1.4 Terms of Reference

A specialist report prepared in terms of the Regulations must contain the following:

(a) details of-
  (i) the specialist who prepared the report; and
  (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;
(c) an indication of the scope of, and the purpose for which, the report was prepared;
  (cA) an indication of the quality and age of base data used for the specialist report
  (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;
(d) the duration date and season of the site investigation and the relevance of the season to the outcome of the assessment;
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;
(g) an identification of any areas to be avoided, including buffers;
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;
(k) any mitigation measures for inclusion in the EMPr;
(l) any conditions for inclusion in the environmental authorisation;
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;
(n) a reasoned opinion-
  (i) whether the proposed activity, activities or portions thereof should be authorised; and (considering impacts and expected cumulative impacts).
  (iA) regarding the acceptability of the proposed activity or activities, and
  (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;

(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and
(q) any other information requested by the competent authority.

Specific:

- Extent of the transport study and study area;
- The proposed development;
- Trip generation for the facility during construction and operation;
- Traffic impact on external road network;
- Accessibility and turning requirements;
- National and local haulage routes;
- Assessment of internal roads and site access;
- Assessment of freight requirements and permitting needed for abnormal loads; and
- Traffic accommodation during construction**.**

2 APPROACH AND METHODOLOGY

The report deals with the traffic impact on the surrounding road network in the vicinity of the site during the:

- Construction phase;
- Operational phase; and
- Decommissioning phase.

This transport study includes the following tasks:

Project Assessment

- Communication with the project team to gain sound understanding of the projects.
- Overview of available project background information including, but not limited to, location maps, site development plans, anticipated vehicles to the site (vehicle type and volume), components to be transported and any resulting abnormal loads.
- Research of all available documentation and information relevant to the proposed facility.

Access and Internal Roads Assessment

- Assessment of the proposed access points including:
  - Feasible location of access points
  - Motorised and non-motorised access requirements
  - Queuing analysis and stacking requirements, if required
  - Access geometry
  - Sight distances and required access spacing
  - Comments on internal circulation requirements and observations

Haulage Route Assessment

- Determination of possible haulage routes to site regarding:
  - National routes
  - Local routes
  - Site access points
  - Road limitations due to abnormal loads

Traffic Estimation and Impact

- Construction, operational, and decommissioning phase vehicle trips
  - Generated vehicles trips
  - Abnormal load trips
  - Access requirements
- Investigation of the impact of the development traffic generated during construction, operation, and decommissioning.

Report (Documentation)

- Reporting on all findings and preparation of the report.

2.1 Information Sources

The following guidelines have been used to determine the extent of the traffic study:

- Project Information provided by the Client;
- Google Earth.kmz provided by the Client;
- Google Earth Pro Satellite Imagery;
- Road Traffic Act, 1996 (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
- Manual for Traffic Impact Studies, Department of Transport, 1995;
- TRH26 South African Road Classification and Access Management Manual, COTO; and
- TMH 16 South African Traffic Impact and Site Traffic Assessment Manual (Vol 1/Vol2), COTO, August 2012.

2.2 Assumptions, Knowledge Gaps and Limitations

The following assumptions and limitations apply:

- This study is based on the project information provided by the client as available at commencement of the Scoping Phase.
- According to the Eskom Specifications for Power Transformers (Eskom Power Series, Volume 5: Theory, Design, Maintenance and Life Management of Power Transformers), the following dimensional limitations need to be kept when transporting the transformer – total maximum height 5 000 mm, total maximum width 4 300 mm and total maximum length 10 500 mm.
  It is envisaged that for this project the inverter, transformer, and switchgear will be transported to site in containers on a low bed truck and trailer. The transport of a mobile crane and the transformer are the only abnormal loads envisaged. The crane will be utilised for offloading equipment, such as the transformer.
- Maximum vertical height clearances along the haulage route are 5.2 m for abnormal loads.
- If any elements are manufactured within South Africa, these will be transported from their respective manufacturing centres, which would be either in the greater Cape Town area, Johannesburg, or possibly in Pinetown/Durban.
- All haulage trips will occur on either surfaced national and provincial roads or existing gravel roads.
- Material for the construction of internal access roads will be sourced locally as far as possible.
- The final access points are to be determined during the detailed design stage. Only recommended access points at conceptual level can be given at this stage.
- Projects in the vicinity of the site to be considered as part of the EIA cumulative impacts are listed in Table 6-3.
- An 18-months construction period is assumed with some of the construction period dedicated to site prep and civil works.

2.3 Consultation Processes Undertaken

The Transport Impact Assessment is based on available project information and consultation with the developer.

3 LEGISLATIVE AND PERMIT REQUIREMENTS

Key legal requirements pertaining to the transport requirements for the proposed project are:

- Abnormal load permits, (Section 81 of the National Road Traffic Act 93 of 1996 and National Road Traffic Regulations, 2000),
- Port permit (Guidelines for Agreements, Licenses and Permits in terms of the National Ports Act No. 12 of 2005), and
- Authorisation from Road Authorities to modify the road reserve to accommodate turning movements of abnormal loads at intersections.

4 DESCRIPTION OF THE PROPOSED DEVELOPMENT

4.1 General Description

The site for the proposed Luckhoff Solar 2 PV Facility is located approximately 5 kms north of Luckhoff within the Letsemeng Local Municipality and the Xhariep District Municipality in the Free State Province on the following farm (see **Figure 4-1**):

- Farm Mooidoorns No. 1224.

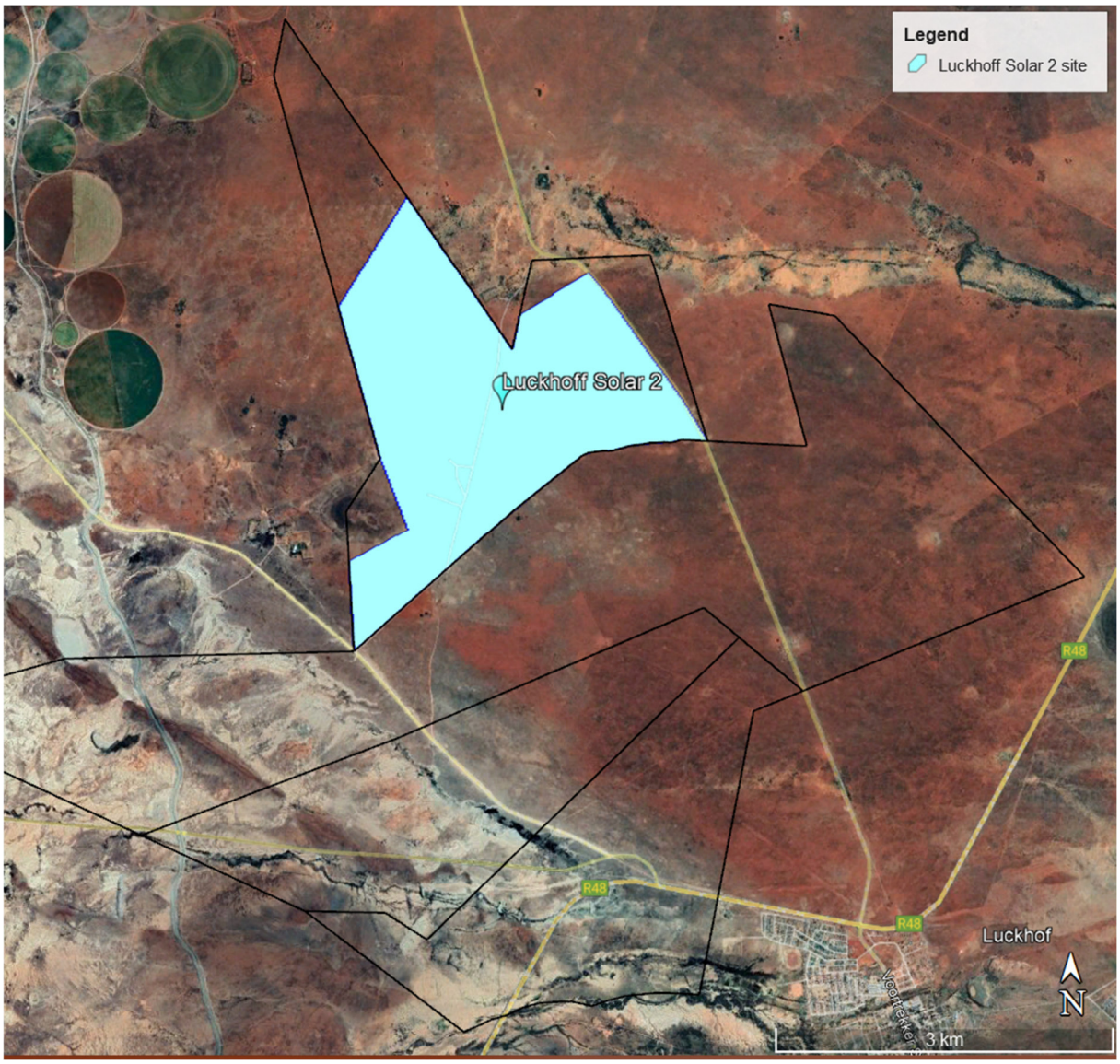

Figure 4-1: Aerial View of the proposed Luckhoff Solar 2 site and Farm properties

The development footprint will contain the following infrastructure to enable the Luckhoff Solar 2 PV facility to generate up to 240 MW:

- PV modules and mounting structures

- Inverters and transformers
- Battery Energy Storage System (BESS)
- Site and internal access roads (up to 8m wide)
- Operation and Maintenance buildings including a gate house and security building, control centre, offices, warehouses and workshops for storage and maintenance.
- Temporary and permanent laydown area
- Grid connection infrastructure, including:
  - A collector switching station (up to 132kV);
  - A ~2.5 km 132 kV single/double circuit overhead powerline linking the collector switching station to the proposed Luckhoff Main Transmission Substation (MTS);
  - A new 132 kV / 400 kV MTS; and
  - Three 400kV Loop-in-Loop Out power lines from the existing Eskom powerlines (Hydra/Perseus 2, Hydra/Perseus 3 and Beta/Hydra 1) to the MTS.

4.2 Alternatives

The Department of Environmental Affairs and Tourism (DEAT) 2006 guidelines on 'assessment of alternatives and impacts' proposes the consideration of four types of alternatives, namely, the no-go, location, activity, and design alternatives. It is, however, important to note that the regulation and guidelines specifically state that only 'feasible' and 'reasonable' alternatives should be explored. It also recognizes that the consideration of alternatives is an iterative process of feedback between the developer and EAP, which in some instances culminates in a single preferred project proposal. An initial site assessment was conducted by the developer and the farm portion was found favorable due to its proximity to grid connections, solar radiation, site access and relative flat terrain. These factors were then taken into consideration and avoided as far as possible, where required.

The following alternatives were considered in relation to the proposed activity:

Location Alternatives

The location identified for the proposed development is based on various aspects considered by the Applicant from a technical, economic, and environmental perspective. This includes the solar radiation values of the area, proximity to the national grid, available grid connection capacity in the national grid, readily available access to the development, landowner support, terrain characteristics and the absence of potentially sensitive environmental features and areas.

No other possible sites were identified on Farm Mooidoorns No. 1224. This site is referred to as the preferred site. Some limited sensitive features occur on the site. The size of the site makes provision for the exclusion of any sensitive environmental features that may arise through the EIA proses.

Design and layout alternatives

Design alternatives will be considered at planning and design stage.

Technology alternatives: Solar panels

There are several types of semiconductor technologies currently available and in use for PV solar panels. Two, however, have become the most widely adopted, namely crystalline silicon (Mono-facial and Bi-facial) and thin film. The technology that (at this stage) proves more feasible and reasonable with respect to the proposed solar facility is crystalline silicon panels, due to it being non-reflective, more efficient, and with a higher durability. However, due to the rapid technological advances being made in the field of solar technology the exact type of technology to be used, such as bifacial panels, will only be confirmed at the onset of the project.

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No-go alternative

This alternative considers the option of 'do nothing' and maintaining the status quo. The site is currently zoned for agricultural and mining land uses. Should the proposed activity not proceed, the site will remain unchanged and will continue to be used for agricultural purposes. The potential opportunity costs in terms of alternative land use income through rental for energy facility and the supporting social and economic development in the area would be lost if the status quo persist.

4.2.1 Specialist comment regarding alternatives

From a transport engineering perspective, the alternatives listed above (i.e., electrical infrastructure location alternatives and the technology options for the BESS) are equally acceptable as it does have a nominal impact on the traffic on the surrounding road network.

4.3 Proposed Access

Suitable accessibility to the site from the external road network is assessed in line with access spacing requirements, required sight lines and road safety considerations.

For Luckhoff Solar 2, it is recommended to gain access to the site via the intersection of S572 and the R48 at Luckhoff and then travel on S572 northwards towards the site approximately 2.2 kms (see **Figure 4-2**).

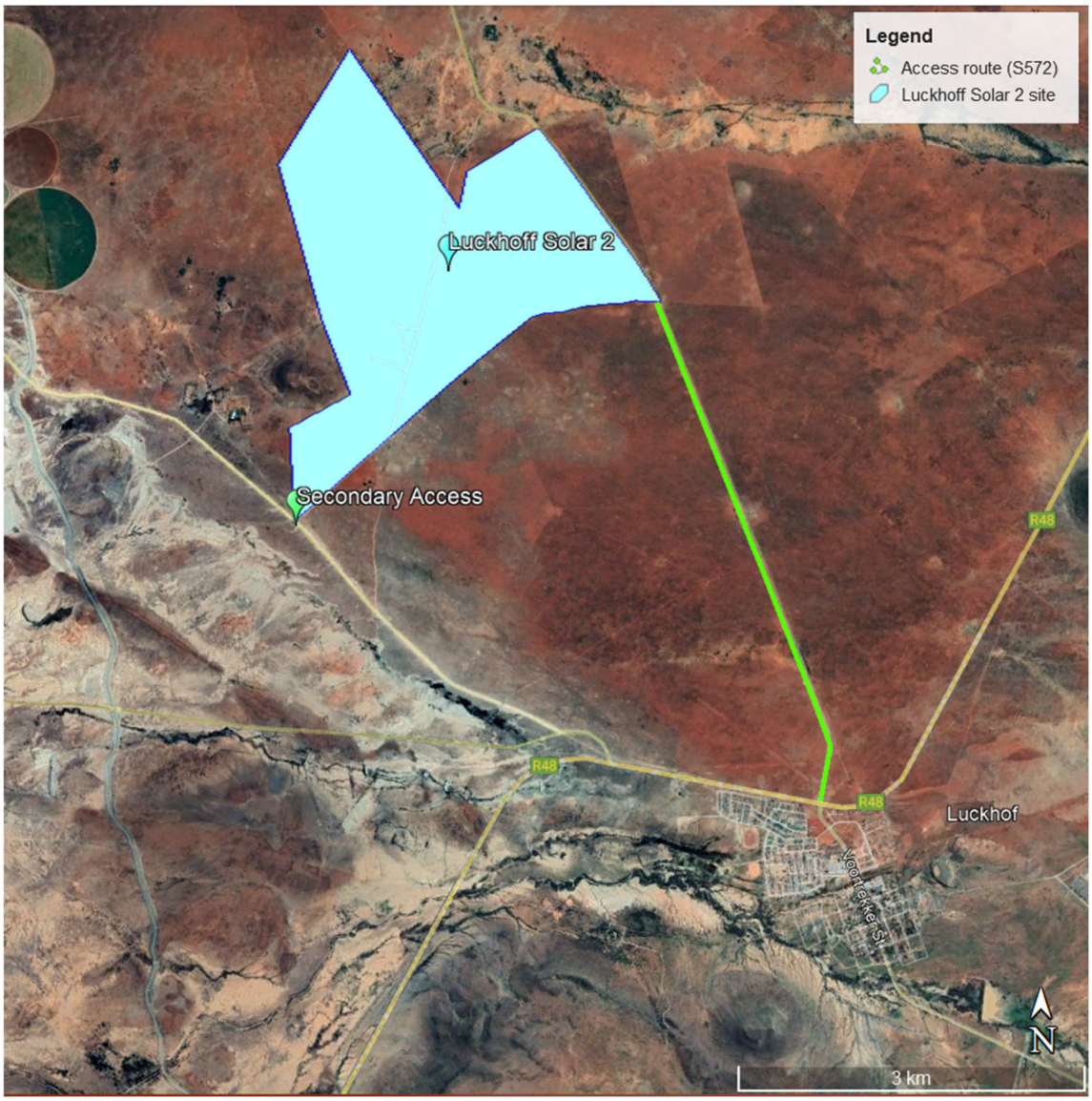

Figure 4-2: Aerial view of the recommended access towards Luckhoff Solar 2

The S572 is an approximately 8 m wide gravel road intersecting with the R48 as shown in **Figure 4-3**. The road opposite the S572 is surfaced and leading into Luckhoff (see **Figure 4-4**). The R48 and the road leading into Luckhoff show road surface failure, with potholes, cracking, edge breaking and

bleeding, which can have a negative effect on construction vehicles traveling on the R48. It is therefore recommended to upgrade the intersection at the turn-off towards the side.

Sight distances from the S572 turning into the R48 are good in a western direction (see **Figure 4-5**) and limited in an eastern direction (see **Figure 4-6**) due to a horizontal curve. However, due to little vegetation, the sight lines are currently acceptable. It is advised that the sight lines in an eastern direction from S572 are kept clear of any vegetation or signage. Additionally, temporary road signage needs to be provided along the R48 approaching the Luckhoff intersection, alerting drivers of larger construction vehicles using the access route (S572) ahead and turning slowly.

As construction vehicles will drive past developed land on their last section on the R48 before turning off towards the site (for approximately 900 m arriving from a western direction and approximately 500 m arriving from an eastern direction), road safety measures need to be in place (i.e., temporary signage alerting pedestrians and vehicles driving from Luckhoff towards the R48 of construction vehicle traffic ahead).

Figure 4-3: S572 – Access route towards Luckhoff Solar 2

Figure 4-4: Towards Luckhoff at intersections with R48 and S572

Figure 4-5: Sight distance on R48 in a western direction from S572

Figure 4-6: Sight distance on R48 in an eastern direction from S572

As this access route is recommended for Luckhoff Solar 1 and Luckhoff Solar 3 as well, it is advised to provide a secondary access point during the construction period to limit congestion. The access location shown in **Figure 4-7** is suitable from a sight distance point of view and located at an existing farm path.

Figure 4-7: Recommended secondary access

4.4 Internal Roads

The geometric design and layout for the internal roads from the recommended access points need to be established at detailed design stage. Existing structures and services, such as drainage structures, signage and pipelines will need to be evaluated if impacting on the roads. It needs to be ensured that the gravel sections remain in good condition and will need to be maintained during the additional loading of the construction phase and then reinstated after construction is completed.

The geometric design constraints encountered due to the terrain should be taken into consideration by the geometric designer. Preferably, the internal roads need to be designed with smooth, relatively flat gradients (recommended to be no more than 8%) to allow a larger transport load vehicle to ascend to the respective laydown areas.

4.4.1 Transportation of Materials, Plant and People to the proposed site

It is assumed that the materials, plant, and workers will be sourced from the surrounding towns as far as possible, such as the Luckhoff area.

4.4.2 Public Transport and Non-Motorised Transport

In terms of the National Land Transport Act (NLTA) (Act No.5 of 2009), the assessment of available public transport services is included in this report. It is expected that minibus taxis travel on the R48. However, the developer of a large-scale project, such as many renewable energy projects, will provide shuttle buses or similar for workers during the construction phase.

5 DESCRIPTION OF THE TRANSPORT ROUTES TO SITE

5.1 Port of Entry

It is envisaged that the components to be imported to South Africa, will arrive either via the Port of Ngqura or the Port of Durban, as these two ports are the closest to the site.

5.1.1 Port of Richards Bay

The Port of Ngqura is located in the Eastern Cape and is a world-class deep-water trans-shipment hub offering an integrated, efficient, and competitive port service for containers on transit. The Port forms part of the Coega Industrial Development Zone (CIDZ) and is operated by Transnet National Ports Authority. The Port of Ngqura is located approximately 570 km travel distance from the proposed site (travel route via the N10, N9, N1 and R48 (see **Figure 5-1**).

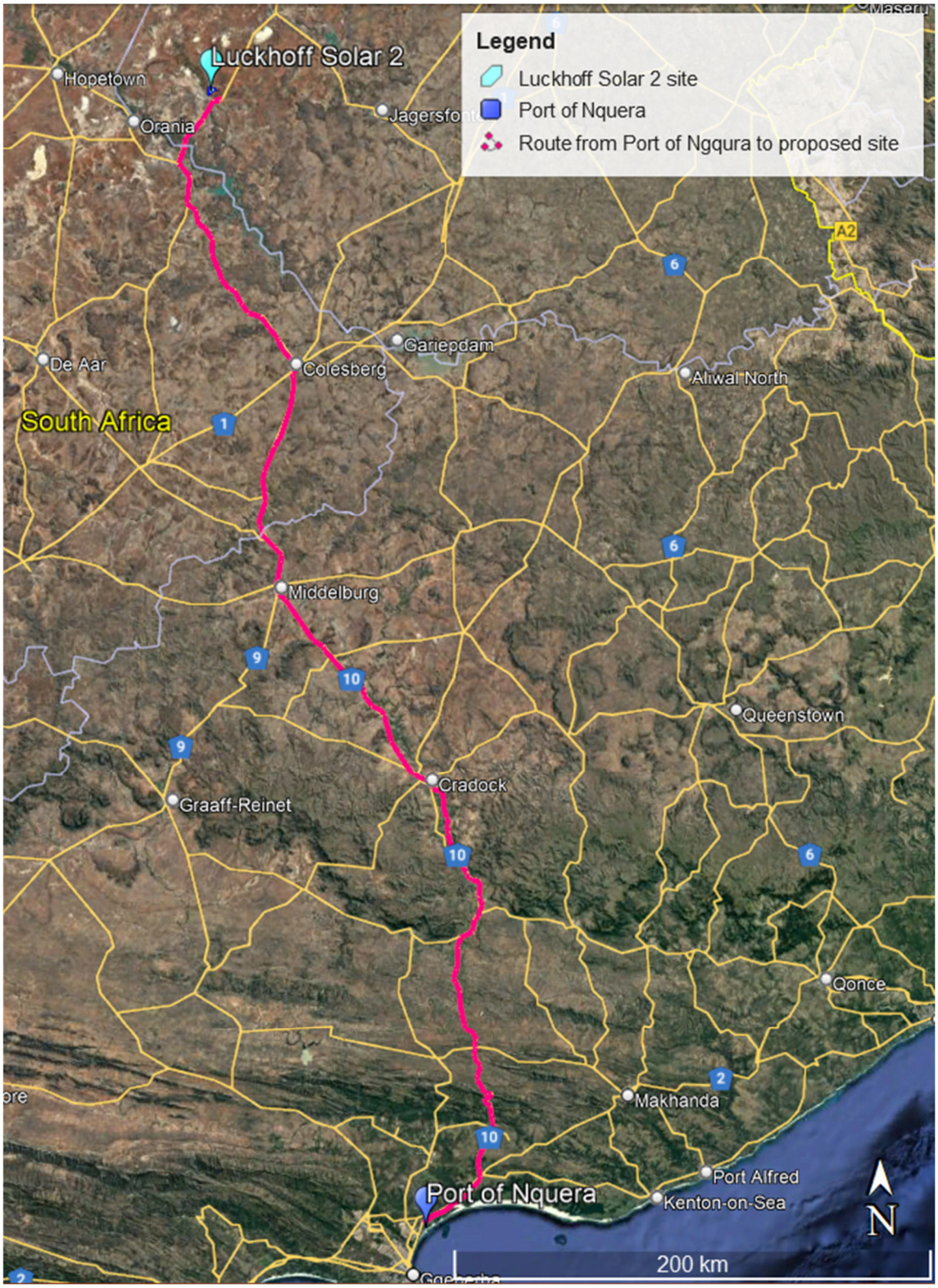

Figure 5-1: Route from Port of Ngqura to proposed site

5.1.2 The Port of Durban

The Durban container terminal is one of the largest container terminals in the African continent and operates as two terminals Pier 1 and Pier 2. It is ideally located to serve as a hub for containerized cargo from the Indian Ocean Islands, Middle East, Far East and Australia. Various capacity creation projects are currently underway, including deepening of berths and operational optimization. The terminal currently handles 65% of South Africa's container volumes. (Transnet Port Terminals, n.d).

The Port of Durban is located approximately 820 kms travel distance from the proposed site via the N3 and N5 (**Figure 5-2**).

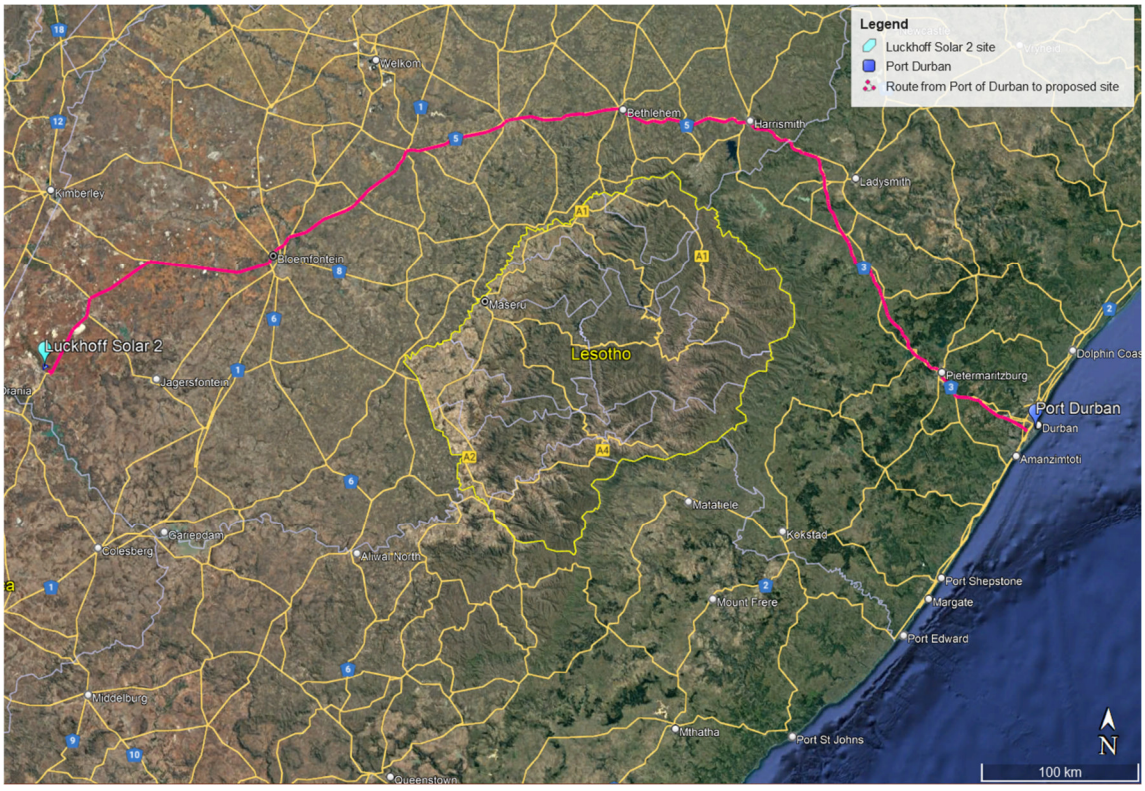

Figure 5-2: Route from Port of Durban to proposed site

5.2 Transportation requirements

It is anticipated that the following vehicles will access the site during construction:

Solar PV:

- Conventional trucks within the freight limitations to transport building material to the site;
- 40ft container trucks transporting solar modules, frames, and the inverter, which are within freight limitations;
- Flatbed trucks transporting the solar modules and frames, which are within the freight limitations;
- Light Differential Vehicle (LDV) type vehicles transporting workers from surrounding areas to site;
- Drilling machines and other required construction machinery being transported by conventional trucks or via self-drive to site; and
- The transformers will be transported as abnormal loads.

Grid/power Line:

- Conventional trucks within the freight limitations to transport building material to the site,
- Light vehicles and buses transporting workers from surrounding areas to site,
- Drilling machines and other required construction machinery being transported by conventional trucks or via self-drive to the site,
- The transformer transported in an abnormal load,
- Abnormal mobile crane for assembly on site, and
- Transmission tower sections transported by abnormal load.

5.3 Abnormal Load Considerations

Abnormal permits are required for vehicles exceeding the following permissible maximum dimensions on road freight transport in terms of the Road Traffic Act (Act No. 93 of 1996) and the National Road Traffic Regulations, 2000:

- Length: 22 m for an interlink, 18.5 m for truck and trailer and 13.5 m for a single unit truck
- Width: 2.6 m Height: 4.3m measured from the ground. Possible height of load – 2.7 m.
- Weight: Gross vehicle mass of 56t resulting in a payload of approximately 30t
- Axle unit limitations: 18t for dual and 24t for triple-axle units
- Axle load limitation: 7.7t on the front axle and 9t on the single or rear axles

Any dimension / mass outside the above will be classified as an Abnormal Load and will necessitate an application to the Department of Transport and Public Works for a permit that will give authorisation for the conveyance of said load. A permit is required for each Province that the haulage route traverses.

In addition to the above, the preferred routes for abnormal load travel 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, which may require modification. After the road modifications have been implemented, it is recommended to undertake a “dry-run” with the largest abnormal load vehicle, to ensure that the vehicle can travel without disruptions. It needs to be ensured that gravel sections (if any) 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.

There are bridges and culverts along the National and Provincial routes, which need to be confirmed for load bearing capacity and height clearances. However, there are alternative routes which can be investigated if the selected route or sections of the route should not be feasible.

Any low hanging overhead lines (lower than 5.1 m), e.g., Eskom and Telkom lines, along the proposed routes will have to be moved to accommodate the abnormal load vehicles.

5.4 Further Guideline Documentation

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” outlines the rules and conditions that 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 Road Traffic Act and the relevant regulations.

5.5 Permitting – General Rules

In general, the limits recommended in TRH 11 are intended to serve as a guide to the Permit Issuing Authorities. It must be noted that each Administration has the right to refuse a permit application or to modify the conditions under which a permit is granted. It is understood that:

a) A permit is issued at the sole discretion of the Issuing Authority. The permit may be refused because of the condition of the road, the culverts and bridges, the nature of other traffic on the road, abnormally heavy traffic during certain periods or for any other reason.
b) A permit can be withdrawn if the vehicle upon inspection is found in any way not fit to be operated.
c) During certain periods, such as school holidays or long weekends an embargo may be placed on the issuing or permits. Embargo lists are compiled annually and are obtainable from the Issuing Authorities.

5.6 Load Limitations

The maximum load that a road vehicle or combination of vehicles will be allowed to carry legally under permit on a public road is limited by:

- the capacity of the vehicles as rated by the manufacturer,
- the load which may be carried by the tyres,
- the damaging effect on pavements,
- the structural capacity on bridges and culverts,
- the power of the prime mover(s),
- the load imposed by the driving axles, and
- the load imposed by the steering axles.

5.7 Dimensional Limitations

A load of abnormal dimensions may cause an obstruction and danger to other traffic. For this reason, all loads must, as far as possible, conform to the legal dimensions. Permits will only be considered for indivisible loads, i.e., loads that cannot, without disproportionate effort, expense, or risk of damage, be divided into two or more loads for the purpose of transport on public roads. For each of the characteristics below there is a legally permissible limit and what is allowed under permit:

- Width,
- Height,
- Length,
- Front Overhang,
- Rear Overhang,
- Front Load Projection,
- Rear Load Projection,
- Wheelbase,
- Turning Radius, and
- Stability of Loaded Vehicles.

5.7.1 Route for Components manufactured within South Africa

In South Africa, more than half (52%) of the manufacturing industry's national workforce resides in three metros - Johannesburg, Cape Town, and eThekwini. It is therefore anticipated that elements ,that can be manufactured within South Africa, will be transported to the site from the Cape Town, Johannesburg, or Pinetown/Durban areas. Components will be transported to site using appropriate National and Provincial routes. It is expected that the components will generally be transported to site with normal heavy load vehicles.

5.7.1.1 Route from Cape Town Area to Site – Locally sourced materials and equipment

Cape Town has a large manufacturing sector with twenty-six (26) industrial areas located throughout the metro. The proposed industrial hubs being considered to source the required materials and components is currently unknown. With quite an extensive and widespread industrial market, a specific route to the site cannot be considered at this point in time, but it is expected that a majority of the route length will be similar to the routes considered for the haulage of imported materials and equipment. No road limitations are envisaged along the route for normal load freight. The estimated route with a travel distance of around 870 kms via the N1 is shown in **Figure 5-3**.

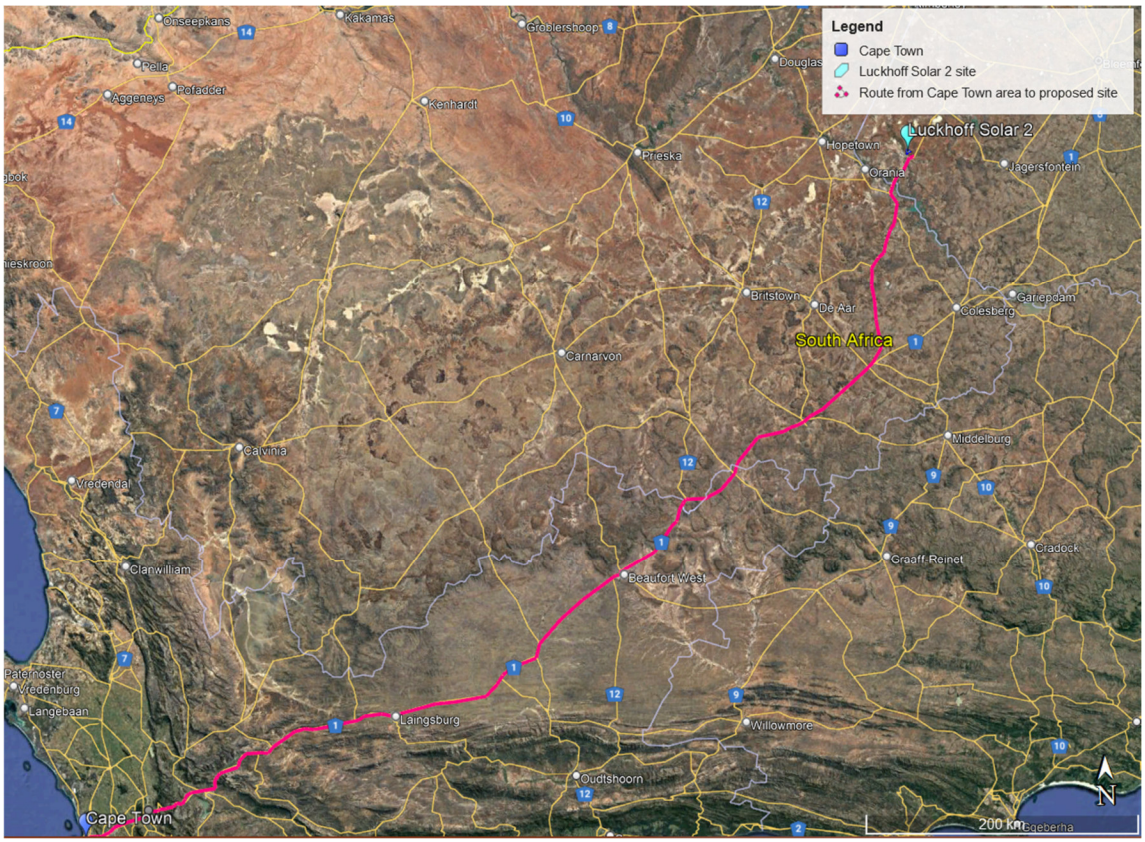

Figure 5-3: Route from Cape Town area to proposed site

5.7.1.2 Route from Johannesburg Area to Site – Locally sourced materials and equipment

If components from Johannesburg are considered, normal loads from Johannesburg to the proposed site can be transported via the route as shown in **Figure 5-4** below. No road limitations are envisaged

along the route for normal load freight. The distance from the Johannesburg area to the site is approximately 570 kms via the N1.

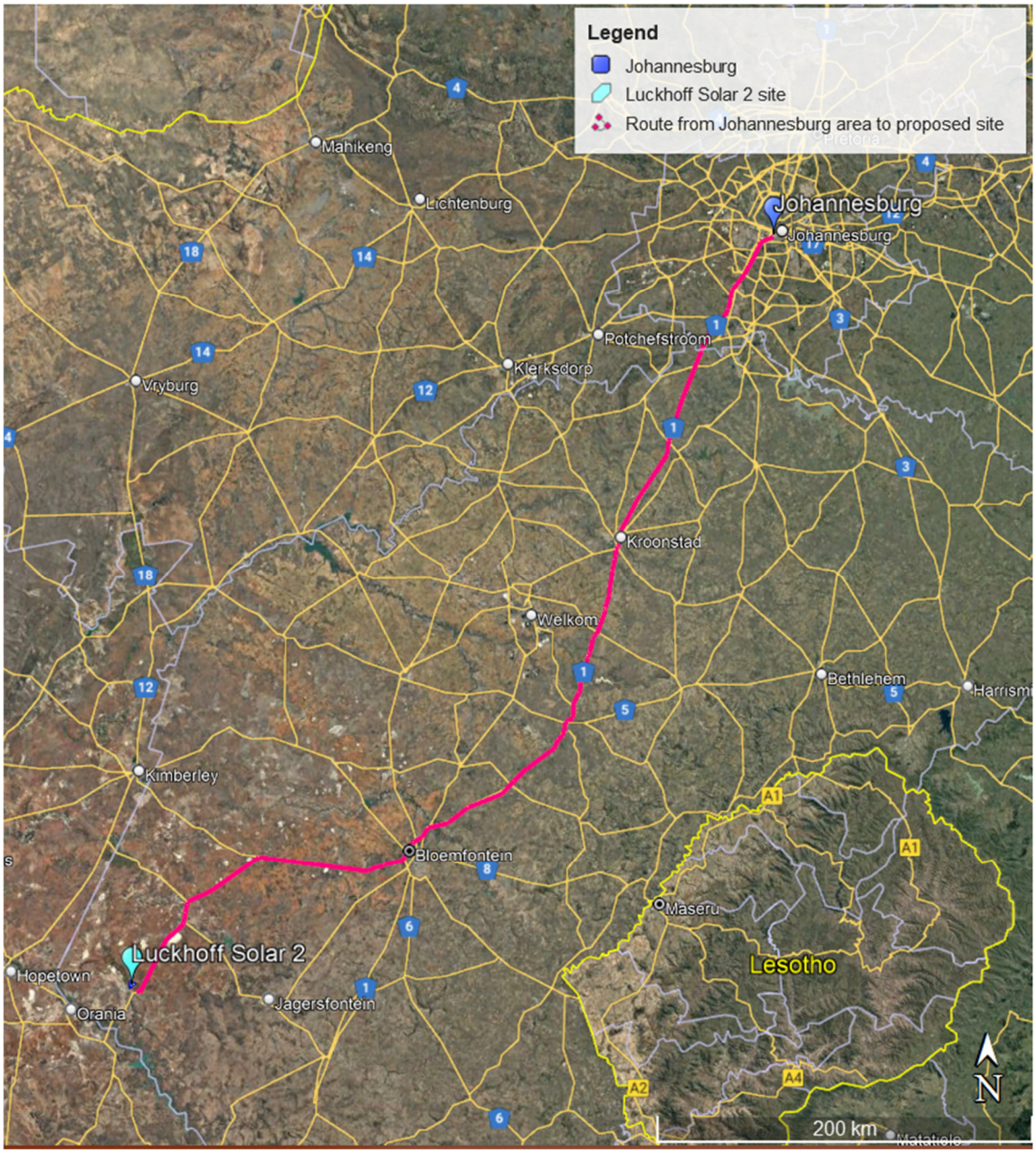

Figure 5-4: Route from Johannesburg area to proposed site

5.7.1.3 *Route from Pinetown / Durban to Site - Locally sourced materials and equipment*

Normal loads can transport elements via two potential routes from Durban and Pinetown to the site. No road limitations are envisaged along the route for normal load freight. The shortest distance from Pinetown to the site is via the National Routes N3 and N5 with approximately 790 kms as shown in **Figure 5-5**.

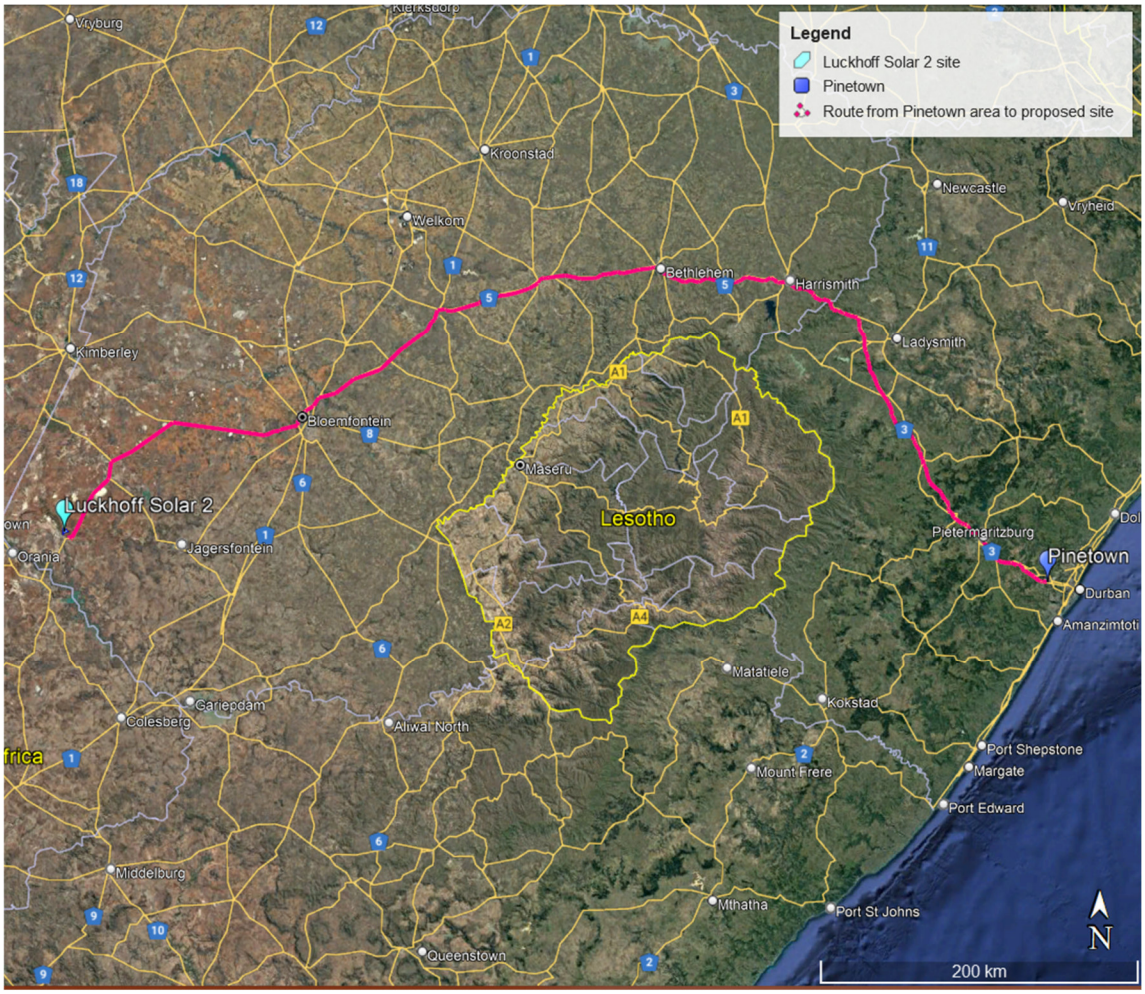

Figure 5-5: Route from Pinetown to the proposed site

5.7.2 Surrounding road network

The construction vehicles for the proposed Luckhoff Solar 2 PV Facility will take access from the R48 onto the ungraveled road S572 as described under 4.3.

According to the road classification of the surrounding road network as per the *Road Infrastructure Strategic Framework for South Africa (RISFSA)* and *COTO's TRH26 South African Road Classification and Access Management Manual*, the R48 can be classified as a **Class 2 rural major arterial**, which typically carries inter-regional traffic between:

- Smaller cities and medium to large towns;
- Smaller border posts;

- Class 1 and Class 2 arterials; and
- Smaller centres when travel distances are very long (i.e., longer than 200 km).

Construction vehicles will travel to the site via several National Routes, i.e., the N1, N3 or N5 depending on origin of their trip. These roads can be classified as a Class 1 rural principal arterial, which typically carries countrywide traffic between:

- Metropolitan areas and large cities;
- Larger border posts;
- Other Class 1 arterials; and
- Smaller centres when travel distances are very long (i.e., longer than 500 km).

6 ISSUES, RISKS AND IMPACTS

6.1 Identification of Potential Impacts/Risks

The potential impact on the surrounding environment is expected to be generated by the development traffic, of which traffic congestion and associated noise, dust, and exhaust pollution form part. It must be noted that the significance of the impact is expected to be higher during the construction and decommissioning phases because these phases generate the highest development traffic.

6.2 Construction phase

This phase includes the transportation of people, construction materials and equipment to the site. This phase also includes the construction of the solar power facility and associated infrastructure, including grid connections, construction of footings, roads, excavations, trenching, and ancillary construction works. This phase will temporarily generate the most development traffic.

6.2.1 Nature of impact

The nature of the impact expected to be generated at this phase would be traffic congestion and delays on the surrounding road network as well as the associated noise, dust, and exhaust pollution due to the increase in traffic.

6.2.2 Significance of impact without mitigation measures

Traffic generated by the construction of the solar facility will have a notable impact on the surrounding road network. The exact number of trips generated during construction can only be determined later in the project when the contractor and the haulage company are appointed and once more detail is available regarding the staff requirements and where equipment is sourced from. In the interim, an estimate will be made as follows for the purpose of this report.

6.2.3 Estimated peak hour traffic for the solar panel components

From experience with renewable energy projects of a similar nature, the number of heavy vehicles per 7MW installation is estimated to range between 200 and 300 trips depending on the site conditions and requirements. For 240 MW, the trips can therefore be estimated to be between 6 857 and 10 286 heavy vehicle trips. It is assumed that the construction period will be around 18-months. Choosing the worst-case scenario of 10 286 construction vehicles trips over the 18-month period, travelling on an average of 22 working days per month, **the resulting daily number of vehicle trips for the solar panel components is 26**. Considering that the number of vehicle trips during peak hour traffic can roughly be estimated to be around 20-40% of the average daily traffic, the resulting peak hour vehicle trips for the construction phase are between 5 and 11 trips.

If the panels are imported instead of manufactured within South Africa, the respective shipping company will be able to indicate how the panels can be packed (for example using 2 MW packages and 40 ft containers). These can then be stored at the port and repacked onto flatbed trucks.

6.2.4 Estimated staff trips

From experience with similar project, a maximum of 500 workers will be active on-site during construction and **the resulting daily staff trips are then 66** (shown in **Table 6-1)**.

Table 6-1: Estimation of daily staff trips

Vehicle Type	Number of vehicles	Max. Number of Employees
Car	20	20 (assuming 1 occupant)
Bakkie	25	38 (assuming 1.5 occupants)
Taxi – 15 seats	19	285
Bus – 80 seats	2	157
Total	***66***	***500***

6.2.5 Estimated material trips

The exact number of vehicle trips for the transportation of materials during the construction phase depends on the type of vehicles, planning of the construction, source/location of construction material, etc. However, for the purpose of this study, it was estimated that at the peak of construction, **approximately 150 construction vehicle trips will access the site per day**.

The total estimated daily site trips, at the peak of construction, are shown in **Table 6-2** below.

Table 6-2: Estimation of daily site trips

Activity	Number of daily trips
Solar panel component delivery	26
Staff transport	66
Material delivery	150
Total	**242**

The impact on the surrounding road network and the general traffic is deemed nominal, with mitigation, as the 242 trips will be distributed over a 9-hour workday. The majority of the trips will occur outside the peak hours.

It must also be noted that vehicle trips from material delivery vary depending on the construction task/program, fuel supply arrangements, as well as distance from the material source to the site. Project planning can be used to reduce material delivery during peak hours.

The development traffic impact during the construction phase can be assessed as manageable, considering that the construction phase is temporary in nature and mitigation measures, mentioned in this report, are adhered to and keep the impact level low.

6.3 Operational Phase

This phase includes the operation and maintenance of the Luckhoff Solar 2 PV Facility throughout its life span.

6.3.1 Nature of impact:

The nature of the impact expected to be generated at this phase would be traffic and the associated noise, dust and exhaust pollution due to the operational traffic trips.

6.3.2 Estimated peak hour traffic generated during operation

The exact number of permanent staff expected for the operational phase is still unknown. Based on similar studies, it can be estimated that approximately 50 full-time employees will be stationed on site. Assuming a worst-case scenario of 40% of the trips occurring during peak traffic periods, approximately 20 peak hour trips are estimated for the operational phase, which will have a nominal impact on the external road network.

It is assumed that the solar modules would need to be cleaned twice a year. No further information on which cleaning method and technology will be used is available at this point in time. The following assumptions have been made to estimate the resulting trips generated from transporting water to the site:

- 5 000-liter water bowsers to be used for transporting the water;
- Approximately 5 litres of water needed per panel;
- Assuming that a maximum of 600 000 panels are used, this would amount to approximately 600 vehicle trips; and
- Solar modules will be cleaned twice a year.

To limit any traffic impact on the surrounding road network, it is recommended to schedule these trips outside of peak traffic periods and to clean the solar modules over the course of a few days i.e., spread the trips over a work week, which would reduce the daily trips to 120. Additionally, the provision of rainwater tanks on site or borehole water would decrease the number of trips.

6.3.3 Proposed general mitigation measures

The following are general mitigation measures to reduce the impact that the additional traffic will have on the road network and the environment:

- The delivery of components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
- Dust suppression of gravel roads located within the site boundary, including the main access road to the site and the site access roads, during the construction phase, if required.
- Regular maintenance of gravel roads located within the site boundary, including the access roads to the site, by the Contractor during the construction phase and by the Owner/Facility Manager during the operational phase, if required.
- The use of mobile batch plants and quarries near the site would decrease the traffic impact on the surrounding road network, if available and feasible.
- Staff and general trips should occur outside of peak traffic periods as far as possible.
- The Contractor is to ensure that all drivers entering the site adhere to the traffic laws.
- Vehicular movements within the site boundary are the responsibility of the respective Contractor and the Contractor must ensure that all construction road traffic signs and road markings (where applicable) are in place. It should be noted that traffic violations on public roads is the responsibility of Law Enforcement, and the public should report all transgressions to Law Enforcement and the Contractor.
- If required, low hanging overhead lines (lower than 5.1m) e.g., Eskom and Telkom lines, along the proposed routes will have to be moved (to be arranged by haulage company) to accommodate the abnormal load vehicles. The Contractor and the Developer is to ensure that the haulage company is aware of this requirement.

- The haulage company is to provide evidence to the Contractor and the Developer that any affected overhead lines have been moved or raised.
- The preferred route should be surveyed to identify problem areas (e.g., intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, which 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 delivery will occur without disruptions. This process is to be undertaken by the haulage company transporting the components and the contractor, who will modify the road and intersections to accommodate abnormal vehicles. The "dry-run" should be undertaken within the same month that components are expected to arrive. The haulage company is to provide evidence that the route has been surveyed and deemed acceptable for the transportation of the abnormal load.
- The Contractor needs to ensure that the gravel sections of the haulage routes (i.e., the site access road and the main access road to the site) remain in good condition and will need to be maintained during the additional loading of the construction phase and reinstated after construction is completed.
- Design and maintenance of internal roads. The internal gravel roads will require grading with a grader to obtain a camber of between 3% and 4% (to facilitate drainage) and regular maintenance blading will also be required. The geometric design of these gravel roads needs to be confirmed at detailed design stage. This process is to be undertaken by a civil engineering consultant or a geometric design professional.

6.3.4 Significance of impact with mitigation measures

It should be noted that the construction phase is temporary and short term in nature and the associated impacts can be mitigated to an acceptable level.

The proposed mitigation measures for the construction traffic will result in a reduction of the impact on the surrounding road network and the impact on the local traffic will be low as the existing traffic volumes are deemed to be low. Dust suppression will result in significantly reducing the impact.

6.3.5 Decommissioning phase

This phase will have similar impacts and generated trips as the Construction Phase.

6.3.6 Cumulative Impacts

To assess a cumulative impact, it is generally assumed that all currently approved and authorized projects within a 30 km radius would be constructed at the same time (see **Figure 6-1**).

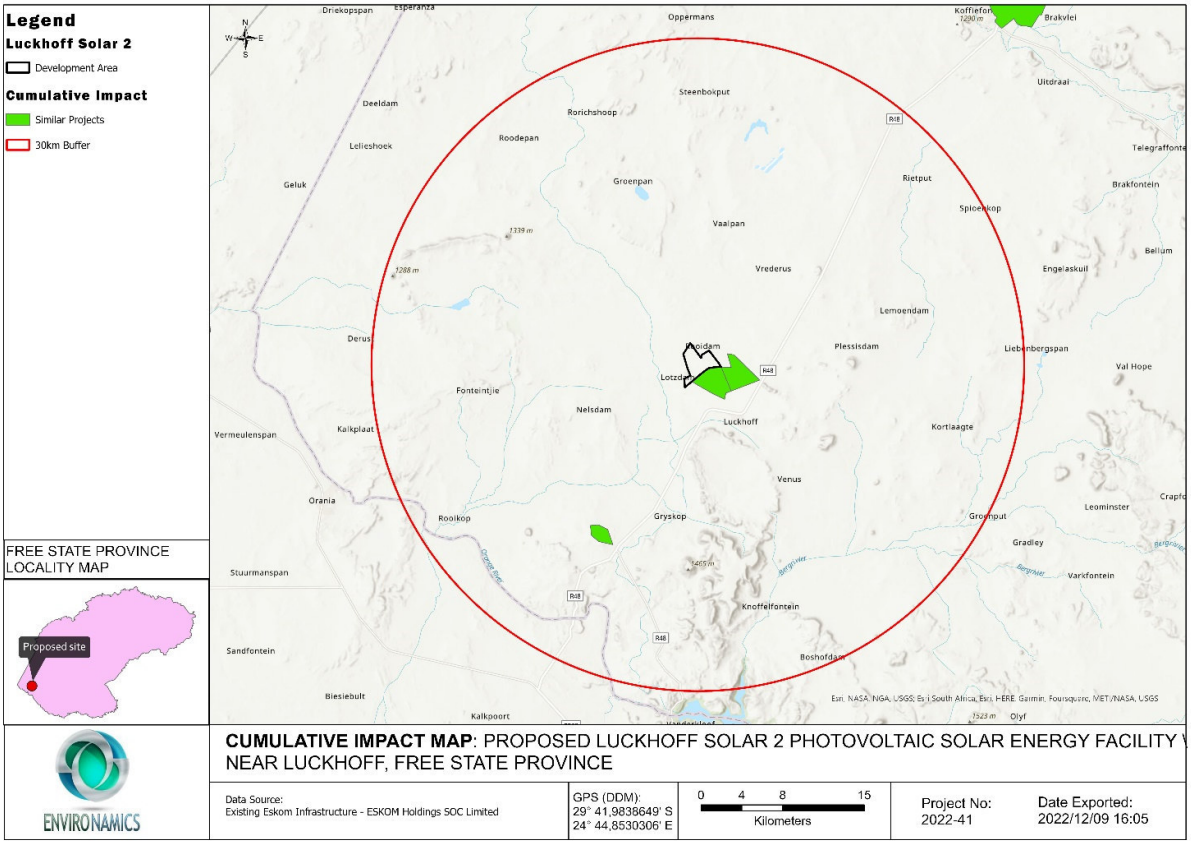

Figure 6-1: Geographic area showing 30 km radius around the proposed Luckhoff Solar 2 site

This is a precautionary approach as in reality, these projects would be subject to a highly competitive bidding process and not all the projects may be selected to enter into a Power Purchase Agreement. Even if all the facilities are constructed and/or decommissioned 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.

The construction and decommissioning phases of a renewable energy project are the only significant traffic generators. The duration of these phases is short term, i.e., the potential impact of the traffic generated during the construction and decommissioning phases on the surrounding road network is temporary and solar projects, when operational, do not add any significant traffic to the road network.

At the time of preparing this report, the projects shown in **Table 6-3** were considered.

Table 6-3: Approved and planned development projects in a 30 km radius of the proposed Luckhoff Solar 2 site

No.	Site name	Distance from study area	Proposed generating capacity	DFFE reference	EIA process	Project status
1	Luckhoff Solar 1	0 km	240 MW	Tbc	Scoping and EIA	In Process
2	Luckhoff Solar 3	0km	240 MW	Tbc	Scoping and EIA	In Process
3	Grootpoort PV	16 km	100 MW	14/12/16/3/3/2/835	Scoping and EIA	Approved

Luckhoff Solar 1 and 3 form part of the Luckhoff Solar PV Cluster and are investigated in separate reports.

For the purpose of this study, it is assumed that Luckhoff Solar 1 and 3 will generate similar construction trips, as they are of similar size (240 MW each → ~240 daily construction trips) and that Grootpoort PV will generate around 110 daily construction trips (100MW development). At the time of conducting this report, Grootpoort PV had progressed further in the EA process than Luckhoff solar and may hence be ready for construction earlier (depending on the progress of a number of licenses / permits).

It is further noted that it is unlikely that all above developments will be constructed at the same time. However, for the event that the developments have similar construction periods, it is recommended to agree on a delivery schedule between the projects to reduce development trips and consequently the impact on the external road network.

7 IMPACT ASSESSMENT

7.1 Potential Impact during the Construction Phase

The construction phase will generate traffic including transportation of people, construction materials, water, and equipment (abnormal trucks transporting the transformers). The exact number of trips generated will be determined at a later stage. Based on the high-level screening of impacts, a negative low impact rating can be expected during the construction phase with mitigation measures.

Nature of the impact

- Temporary increase in traffic, noise and dust pollution associated with potential traffic

The impact methodology as attached in Annexure C and provided by the Environmental consulting company has been used to determine the rating shown in **Table 7-2**.

7.2 Potential Impact (Operational Phase)

Nature of the impact

- Noise and dust pollution associated potential traffic

The traffic generated during this phase will have a nominal impact on the surrounding road network. The impact evaluation is shown in **Table 7-3** . The following items need to be clarified:

- The number of permanent employees
- Water source to be clarified – borehole or transported to site
- Size of water tankers if water is to be delivered on site

7.3 Potential Impacts during the Decommissioning Phase

This phase will have a similar impact as the construction phase (i.e., traffic congestion, air pollution and noise pollution) as similar trips/movements and associated noise and pollution are expected (see **Table 7-2**).

7.4 Cumulative Impacts during the Construction Phase

For the cumulative impact during the construction phase, the projects as per Table 6-3 have been considered. However, it is unlikely that these developments and the proposed Luckhoff Solar 2 development will exactly overlap with their construction period but for the purpose of this assessment, please see **Table 7-4**.

7.5 Impact Assessment Summary

The overall impact significance findings, following the implementation of the proposed mitigation measures, are shown in **Table 7-1** below.

Table 7-1: Overall Impact Significance for Construction Phase

Luckhoff Solar 2 PV Facility	Overall Impact Rating
Construction (Pre-mitigation measures)	Negative Medium
Operational	Negative Low
Construction (Post-mitigation measures)	Negative Low

Table 7-2: Impact Table – Construction Phase / Decommissioning Phase

Potential Impacts		Significance and Magnitude of Potential Impacts							Mitigation of potential Impacts			Specialist Study
Development Impact	Impact description	Geographical Extent	Probability	Duration	Intensity	Reversibility	Irreplaceability	Level of Residual Risk pre mitigation	Mitigation possible?	Possible mitigation measures	Level of residual risk post mitigation	
TRAFFIC IMPACT	Increase in development trips for the duration of the construction Phase Associated noise, dust and exhaust pollution	Local/District	Definite	Medium term	Medium	Completely reversible	No loss of resources	Medium	YES	▪ Stagger component delivery to site. ▪ Reduce the construction period where possible. ▪ Stagger the construction Phase. ▪ The use of mobile batch plants and quarries in close proximity to the site would decrease the impact on the surrounding road network ▪ Staff and general trips should occur outside of peak traffic periods as much as possible. ▪ Maintenance of haulage routes. ▪ Design and maintenance of internal roads. ▪ Provide two access points to the site to split construction vehicle trips. ▪ Provide a secondary access for the site to alleviate development traffic and reduce the risk of congestion.	Low	Transport Impact Assessment

Table 7-3: Impact Table – Operational Phase

Potential Impacts		Significance and Magnitude of Potential Impacts							Mitigation of potential Impacts			Specialist Study
Receptor	Impact description	Extent	Probability	Duration	Intensity	Reversibility	Irreplaceability	Level of Residual Risk pre mitigation	Mitigation possible?	Possible mitigation measures	Level of residual risk post mitigation	
TRAFFIC IMPACT	Slight increase in trips due to permanent staff on site. Increase in trips around twice a year for transport of water to site for the cleaning of solar panels (water source to be clarified – borehole or transported to site / size of water tankers if water is to be delivered on site).	Local	Probable	Short term	Low	Completely reversible	No loss of resources	Low	YES	▪ Source on-site water supply if possible. ▪ Utilise cleaning systems for the panels needing less vehicle trips. ▪ Schedule trips for the provision of water for the cleaning of panels outside peak traffic times as much as possible.	Low	Transport Impact Assessment

Table 7-4: Impact Table – Cumulative Assessment

Potential Impacts		Significance and Magnitude of Potential Impacts							Mitigation of potential Impacts			Specialist Study
Receptor	Impact description	Extent	Probability	Duration	Intensity	Reversibility	Irreplaceability	Level of Residual Risk pre mitigation	Mitigation possible?	Possible mitigation measures	Level of residual risk post mitigation	
TRAFFIC IMPACT	Further increase of development trips during construction phase if the developments listed in Table 6.3 will be constructed at the same time as the proposed Luckhoff Solar 2 PV Facility.	Local/District	Unlikely	Medium term	High	Completely reversible	No loss of resources	Medium	YES	▪ Same mitigation measures as Table 7-1. ▪ It is noted that it is unlikely that all developments will be constructed at the same time. However, for the event that the developments have similar construction periods, it is recommended to agree on a delivery schedule between the respective projects.	Medium	Transport Impact Assessment

8 NO-GO ALTERNATIVE

The no-go alternative implies that the proposed Luckhoff Solar 2 PV Facility as well as the associated infrastructure do not proceed. This would mean that there will be no negative environmental impacts and no traffic impact on the surrounding network during the construction and decommissioning phases. However, this would also mean that there would be no socio-economic benefits to the surrounding communities, and it will not assist government in meeting its targets for renewable energy. Hence, the no-go alternative is not a preferred alternative.

9 CONCLUSION AND RECOMMENDATIONS

The potential traffic and transport related impacts for the construction, operation and decommissioning phases of the proposed Luckhoff Solar 2 PV Facility plant were identified and assessed.

- The main impact on the external road network will be during the construction phase. This phase is temporary in comparison to the operational period. The number of abnormal loads vehicles was estimated and to be found to be able to be accommodated by the road network.
- During operation, it is expected that maintenance and security staff will periodically visit the facility and water be transported to site possibly twice a year for the cleaning of panels. The generated trips can be accommodated by the external road network and the impacts are rated **negative low**.
- The traffic generated during the construction phase, although significant, will be temporary and impacts are considered to be of **negative low impact** after mitigation.
- The traffic generated during the decommissioning phase will be similar to or even less than the construction phase traffic and the impact on the surrounding road network will also be considered to be of **negative low impact** after mitigation.
- For the cumulative impact, it was assumed that all listed developments in a radius of 30 km from the site will be developed at the same time (which will in reality be unlikely). After mitigation, a rating of a **negative medium impact** is given.

The potential mitigation measures mentioned in the construction and decommissioning phases are:

- Dust suppression of internal gravel roads and the access roads.
- Component delivery to/ removal from the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
- The use of mobile batching plants and quarries near the site would decrease the impact on the surrounding road network, if available and feasible.
- Staff and general trips should occur outside of peak traffic periods.
- A “dry run” of the preferred route. Should the haulage company be familiar with the route, evidence is to be provided to the Client and the Contractor.
- Design and maintenance of the internal gravel roads and maintenance of the access roads.
- If required, any low hanging overhead lines (lower than 5.1m) e.g., Eskom and Telkom lines, along the proposed routes will have to be moved (to be arranged by haulage company) or raised to accommodate the abnormal load vehicles.

The construction and decommissioning phases of a solar power facility are the only significant traffic generators and therefore noise and dust pollution will be higher during these phases. The duration of

these phases is of temporary nature, i.e., the impact of the solar power facility on the external traffic on the surrounding road network is temporary and solar facilities, when operational, do not add any significant traffic to the road network.

From a transport engineering perspective, the proposed development alternatives (i.e., electrical infrastructure compound location alternatives and the technology options for the BESS) are acceptable as they do not have any relevant impact on the traffic on the surrounding road network and the proposed development is supported to be approved.

10 REFERENCES

- Road Traffic Act, 1996 (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
- Transnetportterminals.net. n.d. *Transnet Port Terminals*. [online] Available at: <https://www.transnetportterminals.net/Ports/Pages/default.aspx>
- 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

Annexure A: Specialist Expertise

SUMMARY OF EXPERIENCE

Iris is a Professional Engineer registered with ECSA (20110156) and obtained her Master of Science degree in Civil Engineering in Germany in 2003. She has more than 20 years of experience in a wide field of traffic and transport engineering projects.

Iris left Germany in 2003 and has gained work experience as a traffic and transport engineer in South Africa and Germany. She has technical and professional skills in traffic impact studies, public transport planning, non- motorised transport planning and design, design and development of transport systems, project planning and implementation for residential, commercial, and industrial projects.

Her passions are the renewable energies and road safety, and she is highly experiences in providing traffic and transport engineering advise.

Iris is registered with the International Road Federation as a Global Road Safety Audit Team Leader and is a regular speaker at conferences, seminars and similar.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

PrEng	Registered with the Engineering Council of South Africa No. 20110156 Registered Mentor with ECSA
MSAICE	Member of the South African Institution of Civil Engineers
ITSSA	Member of ITS SA (Intelligent Transport Systems South Africa)
SAWEA	Member of the South African Wind Energy Association
SARF	South African Road Federation: Committee Member of Council
SARF WR	South African Road Federation Western Region – Chair
SARF RSC	South African Road Federation National Road Safety Committee
IRF	Registered as International Road Safety Audit Team Leader

EDUCATION

1996 – Matric (Abitur)	Carl Friedrich Gauss Schule, Hemmingen, Germany
1998 - Diploma (Draughtsperson)	Lower Saxonian State Office for Road Engineering
2002 – BSc Eng (Civil)	Leibniz Technical University of Hannover, Germany
2003 - MSc Eng (Civil & Transpt)	Leibniz Technical University of Hanover, Germany

Master Thesis on the Investigation of the allocation of access rights *to the European rail network infrastructure - Research of the feasibility of the different bidding processes to allocate access rights of railway operators in the European railway market. Client: Technical University of Berlin and German Railway Company.*

SUMMARY OF EXPERIENCE

iWink Consulting (Pty) Ltd – Independent Consultant

2022 – present
Position: Independent Consultant – working as an independent Specialist in the field of Traffic & Transport Engineering, Renewable Energies and Road Safety.

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd)

2016 – 2022
Position: Associate / Division Head: Traffic & Transport Engineering

Jeffares & Green (Pty) Ltd

2012 – 2016
Position: Senior Traffic & Transport Engineer

Arup (Pty) Ltd

2010 - 2012
Position – Senior Traffic & Transport Engineer

Arup (Pty) Ltd

2004 - 2010
Position – Traffic & Transport Engineer

Schmidt Ingenieursbüro, Hannover, Germany

2000
Position – Engineering Assistant

Leibniz University of Hannover, Germany

2000 - 2003
Position – Engineering Researcher - Institute for Road & Railway Engineering

SELECTION OF PROJECTS

Please note: The below lists show only a *selection* of projects that Iris has been involved in over the last 20 years. More information and a complete Schedule of Experience can be made available on request.

RENEWABLE ENERGY PROJECTS

Transport Impact Assessments /Traffic Management Plans for:

- Mayogi Solar PV Project
- AGV Red Sands Solar Project
- Cradock – Kaladokhwe WEFs
- Britstown WEFs
- Highveld Solar Cluster
- Dealsville & Bloemfontein Solar PV
- Great Karroo Wind and Solar Cluster
- Ummbila Emoyeni Solar Project
- Poortjie Wind&Solar
- Hydra B Solar Cluster
- Choje Windfarm, Eastern Cape
- Richards Bay Gas to Power Project
- Oya Black Mountain Solar Project
- De Aar Solar Project
- Euronotus Wind & Solar Cluster
- Pienaarspoort Wind Energy Project
- Karreebosch Wind Energy Project
- Dyasonsklip Solar Project
- Kuruman Windfarm
- Bloemsmond Solar Farms
- Hendrina Wind Energy Project
- Orkney Solar Project
- Bulskop Solar Project
- Hyperion Solar & Thermal Project
- Gromis & Komas Wind Energy Projects
- Kudusberg & Rondekop Wind Energy Projects
- Bayview Windfarm
- Coega West Windfarm
- Suikerbekkie Solar Project
- Poortjie Solar Project

- Northam Solar Project
- Sibanye Solar Project
- Du Plessis Dam Solar Project
- Mercury Solar Project
- Aberdeen Wind Energy Project
- Saldanha Wind and Solar Projects
- Ummbila Emoyeni Wind Energy Project
- Springhaas Solar Project

Clients:

- G7 Energies
- ABO Wind Renewable Energies
- Atlantic Renewable Energy Partners
- Mulilo
- Acciona
- Enel
- Engie
- DNV GL
- Enertrag
- Scatec Solar
- Red Rocket Energies
- Windlab
- Mainstream
- Africoast

FURTHER PROJECTS

Traffic Impact Studies & Site Development Plan Input:

- Nooiensfontein Housing Development, City of Cape Town
- Belhar Housing Development, City of Cape Town
- Baredale Phase 7, City of Cape Town
- Beau Constantia Wine Farm
- Constantia Glen Wine Farm
- Eagles Nest Wine Farm
- Groenvallei Parking Audit, City of Cape Town
- Kosovo Housing Development, Western Cape Government
- Enkanini Housing Development, Stellenbosch
- Delft Housing Development, City of Cape Town
- Secunda Sasol, Free State
- Marula Platinum Mine
- InnerCity Transport Plan, City of Cape Town
- Stellenbosch Road Master Plan
- Nyanga Public Transport Interchange
- Crawford Campus Cape Town

- Durban RoRo Car Terminal, Transnet
- Durban Farewell Container Site
- Msunduzi Waterfront Housing Development
- Transnet Park Site – Traffic Management and Evacuation Plans
- UWC Bellville Medical Campus
- Bloekombos District Hospital
- Malabar Extension 3, Port Elizabeth

Traffic Engineering for Roads Projects:

- Ekhurhuleni Bus Stops and Intersection Safety Assessments
- Namibia Noordoewer to Rosh Pina, Road Agency Namibia
- N2 Section 19 Mthatha – NMT Studies
- R63 Alice to Fort Beaufort – NMT, Road Link and Intersection Studies
- N2 Kangela to Pongola Upgrade
- Cofimvaba Eastern Cape – NMT, Road and Intersection Upgrades
- Stellenbosch R44 Traffic Signals
- Secunda Traffic Signals
- Fezile Dabi District Gravel Roads Upgrade, Free State Province
- Zambia RD Rehabilitation Project
- R61 Eastern Cape – NMT Studies, SANRAL

CONTINUED PROFESSIONAL DEVELOPMENT (CPD)

*Last five years*full CPD list available*

2023 – International Traffic Safety Conference, Doha – Speaker

2022 – 7th Regional Conference for Africa & PIARC International Seminar on Rural Roads and Road Safety - Speaker

2022 – Non-motorised Transport Seminar (SARF) – Co-Organizer / Speaker

2021 – SARF KZN Road Safety Considerations (SARF) – Guest Speaker

2021 – Road Safety Audit Course (IRF) – Guest Speaker

2021 – Legal Obligations / Road Safety Act (SARF) – Presenter

2020 – Understanding Road Accidents (SARF)

2020 – Road Safety Auditor Course (SARF) – Co-Lecturer

2018 – African Road Conference (IRF/SARF/PIARC)

2018 – Road Safety in Engineering (SARF) – Presenter

2016 - SATC Road Safety Audit Workshop Pretoria (SARF)

2015 - Non-motorised Transport Planning (SARF

Annexure B: Specialist Statement of Independence

I, Iris Sigrid Wink, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations, and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan, or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist: _____

Name of Company: iWink Consulting (Pty) Ltd

Date: 16-01-2023

Appendix Annexure C: Impact Assessment Methodology

PROJECT DESCRIPTION DOCUMENT: TECHNICAL DETAILS

9 December 2022

THE DEVELOPMENT OF THE LUCKHOFF SOLAR 2 PHOTOVOLTAIC SOLAR ENERGY FACILITY NEAR LUCKHOFF, FREE STATE PROVINCE

ENVIRONAMICS

PROJECT DETAIL

DFFE Reference No's.	**:**	To be obtained
Project Title	**:**	The Development of the Luckhoff Solar 2 Photovoltaic Solar Energy Facility, near Luckhoff, Free State Province
Authors	**:**	Mrs. Bianca Gilfillian
Client	**:**	Luckhoff Solar 2 (Pty) Ltd
Report Status	**:**	Project Description Document: Technical Details
Submission date	**:**	9 December 2022

When used as a reference this report should be cited as: Project Description Document: The Development of the Luckhoff Solar 2 Photovoltaic Solar Energy Facility, near Luckhoff, Free State Province

TABLE OF CONTENTS

1 INTRODUCTION

This document provides the technical details of the project description for the proposed Luckhoff Solar 2 to be assessed and considered as part of the Scoping and EIA processes.

1.1 PROJECT SCHEDULE

Table 1.1 provides a summary of the EIA process and future steps to be taken. It is envisaged that the EIA process should be completed by October 2023.

Table 1.1: Project schedule

Activity	Prescribed timeframe	Timeframe
Site visits	-	October 2022
Public participation (BID)	30 Days	Nov. - Dec. 2022
Submit pre-application meeting request	-	Nov. 2022
Pre-application meeting	-	N/A
Conduct specialist studies	-	Oct. 2022 – Jan. 2023
Submit application form and DSR	-	Jan. 2023
Public participation (DSR)	30 Days	Jan. – Feb. 2023
Submit FSR	44 Days	Feb. 2023
Approval of Final Scoping Report	43 Days	April 2023
Submit Draft EIR & EMPr	106 Days	April 2023
Public participation (DEIR)	30 Days	April – May 2023
Submission of FEIR & EMPr	-	May 2023
Decision	107 Days	September2023
Public participation (decision) & submission of appeals	20 Days	October 2023

2 TECHNICAL DETAILS

This section aims to provide a description of the technical details of each proposed project.

2.1 LUCKHOFF SOLAR 2, FREE STATE PROVINCE

2.1.1 THE LOCATION OF THE ACTIVITY AND PROPERTY DESCRIPTION

Table 2.1: General site information

Description of affected farm portion	Solar Power Plant Mooidoorns No. 1224
Province	Free State
District Municipality	Xhariep District Municipality
Local Municipality	Letsemeng Local Municipality
Ward numbers	
Closest towns	The town of Luckhoff is located approximately 5km south.
21 Digit Surveyor General codes	Solar Power Plant Farm No. 1224- F01100000000122400000
Type of technology	Photovoltaic solar facility
Structure Height	Panels ~6m, buildings ~ 6m, and battery storage facility ~8m height
Battery storage	Within a 5-hectare area
Surface area to be covered (Development footprint)	Approximately 480 ha
Laydown area dimensions (EIA footprint)	Assessed 480 ha
Structure orientation	The panels will either be fixed to a single-axis horizontal tracking structure where the orientation of the panel varies according to the time of the day, as the sun moves from east to west or tilted at a fixed angle equivalent to the latitude at which the site is in order to capture the most sun.
Generation capacity	Up to 240MW

Expected production	N/A - this will be dependent on the chosen technology.

2.1.2 TECHNICAL DETAILS

The term photovoltaic describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun through a process known as the Photovoltaic Effect. This refers to light energy placing electrons into a higher state of energy to create electricity. Each PV cell is made of silicon (i.e. semiconductors), which is positively and negatively charged on either side, with electrical conductors attached to both sides to form a circuit. This circuit captures the released electrons in the form of an electric current (direct current). The key components of the proposed project are described below:

- PV Panel Array - To produce up to 240MW, the proposed facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility. The PV panels will be tilted at a northern angle in order to capture the most sun or using one-axis tracker structures to follow the sun to increase the Yield.

- Wiring to Inverters - Sections of the PV array will be wired to inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency.

- Connection to the grid - Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation will be required to step the voltage up to 132kV, after which the power will be evacuated into the national grid. Whilst Luckhoff 2 Solar Power Plant has not yet received a cost estimate letter from Eskom, it is expected that generation from the facility will tie in with the proposed Luckhoff Grid Connection 132kV Overhead Power Line. The Project will inject up to 240MW into the National Grid. The installed capacity will be approximately 240MW.

  In order to evacuate the energy generated by the facilities to the national grid, Luckhoff Solar 2 (Pty) Ltd is proposing to develop a grid connection which consists of the following Electrical Grid Infrastructure (EGI); 132kV single/double-circuit overhead power line (with the associated infrastructure) to enable the connection and evacuation of the generated electricity of the proposed Luckhoff Solar 1, 2, 3 and 4 Photovoltaic Solar Energy Facilities, to the national grid network:

  • A collector switching station (up to 132kV);
  • A ~2.5 km 132 kV single/double circuit overhead powerline linking the collector switching station to the proposed Luckhoff Main Transmission Substation (MTS)(see below);
  • A new 132 kV / 400 kV MTS; and

• Three 400kV Loop-in-Loop Out power lines from the existing Eskom powerlines (Hydra/Perseus 2, Hydra/Perseus 3 and Beta/Hydra 1) to the MTS.

- Electrical reticulation network – An internal electrical reticulation network will be required and will be lain ~2-4m underground as far as practically possible.

- Supporting Infrastructure – The following auxiliary buildings with basic services including water and electricity will be required on site:

    - A 33 kV switch room,
    - A gate house, ablutions, workshops, storage and warehousing areas, site offices and a control centre.

- Battery storage – A Battery Storage Facility with a maximum height of 8m and a maximum volume of 1,740 m^3 of batteries and associated operational, safety and control infrastructure.

- Roads - Access will be obtained via the S572 secondary road, off the R48 regional road, an existing gravel road located adjacent to the site. An internal site road network will also be required to provide access to the solar field and associated infrastructure.

- Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm. Fencing with a height of 3.5 meters will be used.

Table 2.2: Technical details for the proposed facility

Component	Description / dimensions
Height of PV panels	6 meters
Area of PV Array	480 Hectares (Development footprint)
Area occupied by inverter / transformer stations / substations / BESS	BESS: up to ± 5 ha Facility substation: up to 1 ha
Capacity of on-site substation	132kV
Capacity of the power line	132kV
Area occupied by both permanent and construction laydown areas	Permanent Laydown Area: 480 Hectares Construction Laydown Area: ~20 Hectares
Area occupied by buildings	A 33 kV switch room, a gate house, ablutions, workshops, storage and warehousing areas, site offices and a control centre: ~ 1Hectares
Battery storage facility	Maximum height: 8m Maximum volume: 1740 m^3
Length of internal roads	Approximately 33 km

2.1.3 CONSIDERATION OF ALTERNATIVES

The DEAT 2006 guidelines on 'assessment of alternatives and impacts' proposes the consideration of four types of alternatives namely, the no-go, location, activity, and design alternatives. It is, however, important to note that the regulation and guidelines specifically state that only 'feasible' and 'reasonable' alternatives should be explored. It also recognizes that the consideration of alternatives is an iterative process of feedback between the developer and EAP, which in some instances culminates in a single preferred project proposal. An initial site assessment was conducted by the developer the affected properties and the farm portions were found favorable due to its proximity to grid connections, solar radiation, ecology and relative flat terrain. These factors were then taken into consideration and avoided as far as possible.

The following alternatives were considered in relation to the proposed activity and all specialists should also make mention of these:

No-go alternative

This alternative considers the option of 'do nothing' and maintaining the status quo. The site is currently zoned for agricultural and mining land uses. Should the proposed activity not proceed, the site will remain unchanged and will continue to be used for agricultural purposes. The potential opportunity costs in terms of alternative land use income through rental for energy facility and the supporting social and economic development in the area would be lost if the status quo persist.

Location alternatives

No other possible sites were identified on Farm No. 1224. This site is referred to as the preferred site. Some limited sensitive features occur on the site. The size of the site makes provision for the exclusion of any sensitive environmental features that may arise through the EIA proses.

Battery storage facility

It is proposed that a nominal up to 240 MW Battery Storage Facility for grid storage would be housed in stacked containers, or multi-storey building, with a maximum height of 8m and a maximum volume of 1,740m^3 of batteries and associated operational, safety and control infrastructure. Three types of battery technologies are being considered for the proposed project: Lithium-ion, Sodium-sulphur or Vanadium Redox flow battery. The preferred battery technology is Lithium-ion.

Battery storage offers a wide range of advantages to South Africa including renewable energy time shift, renewable capacity firming, electricity supply reliability and quality improvement, voltage regulation, electricity reserve capacity improvement, transmission congestion relief, load following and time of use energy cost management. In essence, this technology allows renewable energy to enter the base load and peak power generation market and therefore can compete directly with fossil fuel sources of power generation and offer a truly sustainable electricity supply option.

Design and layout alternatives

Design alternatives will be considered throughout the planning and design phase and specialist studies are expected to inform the final layout of the proposed development.

Technology alternatives

There are several types of semiconductor technologies currently available and in use for PV solar panels. Two, however, have become the most widely adopted, namely crystalline silicon (Mono-facial and Bi-facial) and thin film. The technology that (at this stage) proves more feasible and reasonable with respect to the proposed solar facility is crystalline silicon panels, due to it being non-reflective, more efficient, and with a higher durability. However, due to the rapid technological advances being made in the field of solar technology the exact type of technology to be used, such as bifacial panels, will only be confirmed at the onset of the project.

3 LEGAL MADATE

3.1 LEGAL MANDATE AND PURPOSE OF THE REPORT

The National Environmental Management Act identifies listed activities (in terms of Section 24) which are likely to have an impact on the environment. These activities cannot commence without obtaining an EA from the relevant competent authority. Sufficient information is required by the competent authority to make an informed decision and the project is therefore subject to an environmental assessment process which can be either a Basic Assessment Process or a full Scoping and Environmental Impact Assessment process.

The EIA Regulations No. 324, 325, and 327 outline the activities that may be triggered and therefore require EA. The following listed activities with special reference to the proposed development is triggered:

Table 3.1: Listed activities (SPPs)

Relevant notice:	**Activity No (s)**	**Description of each listed activity as per project description**:
GNR. 327 (as amended in 2017)	Activity 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."* • Activity 11(i) is triggered as the proposed photovoltaic solar facility will transmit and distribute electricity of 132 kilovolts outside an urban area.
GNR. 327 (as amended in 2017)	Activity 28(ii)	• *"Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare."* • Activity 28(ii) is triggered as portions of the affected farm has been previously used for grazing and the property will be re-zoned to "special" use.
GNR. 327 (as amended in 2017)	Activity 24(ii)	• *"The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters;*

		• Activity 24(ii) is triggered as the internal roads will vary between 6 and 12 meters in width.
GNR. 327 (as amended in 2017)	Activity 56 (ii):	• *"The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres…"* • Activity 56 (ii) is triggered as the existing access to the affected property does not have a reserve and will need to be widened by more than 6 metres.
GNR. 325 (as amended in 2017)	Activity 1	• *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."* • Activity 1 is triggered since the proposed photovoltaic solar facility will generate up to 240 megawatts electricity through the use of a renewable resource.
GNR. 325 (as amended in 2017)	Activity 15	• *"The clearance of an area of 20 hectares or more of indigenous vegetation."* • More than 20 hectares of indigenous vegetation will be cleared.
GNR. 324 (as amended in 2017)	Activity 4 (b)(i)(ee)	• *The development of a road wider than 4 metres with a reserve less than 13,5 metres, (b) Free State, (i) outside urban area, (ee) within Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority.* • Activity 4(b)(i)(ee) is triggered as the internal roads will vary between 6 and 12 meters in width.
GNR. 324 (as amended in 2017)	Activity 10 (b)(i)(ee)	• *The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) Free State, (i) outside urban area, (ee) within Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority.* • Activity 10 (b)(i)(ee) will be triggered since more than 30 cubic metres of fuel will be stored on site.

GNR. 324 (as amended in 2017)	Activity 12 (b)(i)	• *The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation in (b) Free State (i) within Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority.* • Activity 12 (b)(i) is triggered since approximately 480 hectares of indigenous vegetation will be cleared.
GNR. 324 (as amended in 2017)	Activity 18 (b)(i)(ee)	• *The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre in (b) Free Stat, (i) outside urban areas, within (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority* • Activity 18 (b)(i)(ee) is triggered as the existing access to the affected property does not have a reserve and will need to be widened by more than 6 metres.

The activities triggered under Listing Notice 1, 2 and 3 (Regulation 327, 325 and 324) for the project implies that the development is considered as potentially having an impact on the environment and therefore require the implementation of appropriate mitigation measures.

4 ASSESSMENT METHODOLOGY

4.1 METHOD OF ENVIRONMENTAL ASSESSMENT

The environmental assessment aims to identify the various possible environmental impacts that could results from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e., site, local, national or global whereas intensity is defined by the severity of the impact e.g., the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 4.1.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

4.1.1 Impact Rating System

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the project phases:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

Table 6.7: The rating system

NATURE
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.

GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).

4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.

IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.

29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

***Each specialist should use the rating system supplied to conduct their impact assessment.*

Table 4.1: Matrix analysis

For ease of reference the significance of the impacts is colour-coded as follow:

Low significance	Medium significance	High significance	Positive impact

LISTED ACTIVITY (The Stressor)	ASPECTS OF THE DEVELOPMENT /ACTIVITY	POTENTIAL IMPACTS			SIGNIFICANCE AND MAGNITUDE OF POTENTIAL IMPACTS							MITIGATION OF POTENTIAL IMPACTS			SPECIALIST STUDIES / INFORMATION
		Receptors		Impact description / consequence	Minor	Major	Extent	Duration	Probability	Reversibility	Irreplaceable loss of resources	Possible Mitigation	Possible mitigation measures	Level of residual risk	
CONSTRUCTION PHASE															
Activity 11(i) (GN.R. 327): *"The development of facilities or infrastructure for the transmission and distribution of electricity outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."* Activity 24 (ii) (GN.R 327): *"The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters"* Activity 28 (ii) (GN.R. 327): *"Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for*	Site clearing and preparation Certain areas of the site will need to be cleared of vegetation and some areas may need to be levelled. Civil works The main civil works are: • Terrain levelling if necessary– Levelling will be minimal as the potential site chosen is relatively flat. • Laying foundation- The structures will be connected to the ground through cement pillars, cement slabs or metal screws. The exact method will depend on the detailed geotechnical analysis. • Construction of access and inside roads/paths –	BIOPHYSICAL ENVIRONMENT	Fauna & Flora			-	S	L	D	PR	ML	Yes		L	Terrestrial biodiversity, plant and animal impact assessment (Section 4.3 P25-30)
			Wetland/ Riparian areas			-									Wetland Assessment
			Avifauna			-									Avifaunal Assessment
			Air	• Air pollution due to the increase of traffic of construction vehicles and the undertaking of construction activities.	-		S	S	D	CR	NL	Yes	• A speed limit should be enforced on dirt roads (preferably 30-40km/h). • Implement standard dust control measures, including periodic spraying	L	Terrestrial biodiversity, plant and animal impact assessment

agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare." Activity 56 (ii) (GN.R 327): *"The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres…"* Activity 1 (GN.R 325): *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."* Activity 15 (GN.R 325): *"The clearance of an area of 20 hectares or more of indigenous vegetation."* Activity 4 (b)(i)(ee)(GN.R 324): " *"The development of a road wider than 4 metres with a reserve less than 13,5 metres (b) in the Free State, (i) outside urban areas and within (ee)*	existing paths will be used were reasonably possible. Additionally, the turning circle for trucks will also be taken into consideration. Transportation and installation of PV panels into an Array The panels are assembled at the supplier's premises and will be transported from the factory to the site on trucks. The panels will be mounted on metal structures which are fixed into the ground either through a concrete foundation or a deep-seated screw. Wiring to the Central Inverters Sections of the PV array would be wired to central inverters which have a maximum rated power of 2000kW each. The inverter is a pulse width mode inverter that converts DC electricity to alternating electricity (AC) at grid frequency.												(frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.		
			Soil			-										Agricultural Agro-Ecosystem Specialist Assessment
			Existing services infrastructure	• Generation of waste that need to be accommodated at a licensed landfill site. • Generation of sewage that need to be accommodated by the local sewage plant. • Increase in construction vehicles on existing roads.		-	L	S	D	PR	ML	Yes	-	L	Confirmation from the Local Municipality to provide services
			Groundwater	• Pollution due to construction vehicles and the storage and handling of dangerous goods.	-		S	S	Pr	CR	ML	Yes	• A groundwater monitoring programme (quality and groundwater levels) should be designed and installed for the site. Monitoring boreholes should be securely	L	-

critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans." Activity 10 (b)(i)(ee)(hh) (GN.R 324): *""The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans."* Activity 12 (b)(i)(ii)(iv) (GN.R 324): *"The clearance of an area of 300 square metres or more of indigenous vegetation… …(b) in the Free State (i) within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity*												capped (where used), and must be fitted with a suitable sanitary seal to prevent surface water flowing down the outside of the casing. Full construction details of monitoring boreholes must be recorded when they are drilled (e.g. screen and casing lengths, diameters, total depth, etc). • Sampling of monitoring boreholes should be done according to recognised standards.		
			Surface water / Riparian			-									Wetland Assessment
		SOCIAL/ECONOMIC ENVIRONMENT	Local unemployment rate			+									Social Impact Assessment
			Visual landscape		-										Visual Impact Assessment
			Traffic volumes		-										Traffic Impact Assessment
			Health & Safety			-								L	Social Impact Assessment

Assessment 2004, (ii) within critical biodiversity areas identified in bioregional plans." <u>Activity 18 (b)(i)(ee)(hh) (GN.R 324):</u> *"The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre (b) in the Free State (i) outside urban areas and within (ee) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans."*														
			Noise levels		-									Social Impact Assessment
			Tourism industry	• Since there are no tourism facilities in close proximity to the site, the proposed activities will not have an impact on tourism in the area.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Heritage resources			-								Heritage Impact Assessment
			Paleontological Heritage			-								Paleontological Impact Assessment
OPERATIONAL PHASE														
<u>Activity 11(i) (GN.R. 327):</u> *"The development of facilities or infrastructure for the transmission and distribution of electricity outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."* <u>Activity 1 (GN.R 325):</u> *"The development of facilities or infrastructure for the*	The key components of the proposed project are described below: • <u>PV Panel Array</u> - To produce 150 MW, the proposed facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays	BIOPHYSICAL ENVIRONMENT	Fauna and Flora			-								L	Terrestrial biodiversity, plant and animal impact assessment
			Avifauna	•		-								M	Avifaunal Impact Assessment
			Air quality	• The proposed development will not result in any air	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

generation of electricity from a renewable resource where the electricity output is 20 megawatts or more." Activity 10 (b)(i)(ee)(hh) (GN.R 324): *"The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans."*	which will comprise the PV facility. The PV panels will be tilted at a northern angle in order to capture the most sun. • Wiring to Central Inverters - Sections of the PV array will be wired to central inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency. • Connection to the grid - Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation and switching station will be required on the site to step the voltage up to 132kV, after which the power will be evacuated into the national grid. • Supporting Infrastructure – Auxiliary buildings with			pollution during the operational phase.											
			Soil and Agriculture			-								Agricultural Agro-Ecosystem Specialist Assessment
			Groundwater	• Leakage of hazardous materials. The development will comprise of a distribution substation and switching station and will include transformer bays which will contain transformer oils. Leakage of these oils can contaminate water supplies.	-		L	L	Po	PR	ML	Yes	- All areas in which substances potentially hazardous to groundwater are stored, loaded, worked with or disposed of should be securely bunded (impermeable floor and sides) to prevent accidental discharge to groundwater.	L	-
			Surface water / wetlands			-								Wetland Assessment
		SOCIAL/ECONOMIC	Visual landscape			-								Visual Impact Assessment
			Traffic volumes		-									Traffic Impact Assessment	L
			Health & Safety	• The proposed development will not result in any health	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A

	basic services such as water and electricity will be constructed on the site and will have an approximate footprint 820m². Other supporting infrastructure includes voltage and current regulators, protection circuitry and Battery Energy Storage Systems (BESS). • <u>Roads</u> – Access will be obtained via …..An internal site road network will also be required to provide access to the solar field and associated infrastructure. All site roads will require a width of approximately 6 m – 12 m. • <u>Fencing</u> - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm.			and safety impacts during the operational phase.												
			Noise levels	• The proposed development will not result in any noise pollution during the operational phase.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Heritage resources		-										Heritage Impact Assessment
			Electricity supply	• Generation of additional electricity. The power line will transport generated electricity into the grid.	+		I	L	D	I	N/A	Yes	-	N/A	-
			Electrical infrastructure	• Additional electrical infrastructure. The proposed solar facility will add to the existing electrical infrastructure and aid to lessen the reliance of electricity generation from coal-fired power stations.	+		I	L	D	I	N/A	Yes	-	N/A	-
DECOMMISSIONING PHASE																
-	<u>Dismantlement of infrastructure</u> During the decommissioning phase the Solar PV Energy facility and its associated infrastructure will be dismantled. <u>Rehabilitation of biophysical environment</u>	BIOPHYSICAL ENVIRONMENT	Fauna and Flora	• Habitat destruction caused by clearance of vegetation • Soil and water pollution • Spread and establishment of alien invasive species • Negative effect of human activities on fauna and road mortalities		-									Terrestrial biodiversity, plant and animal impact assessment

	The biophysical environment will be rehabilitated.														
			Air quality	• Air pollution due to the increase of traffic of construction vehicles	-		S	S	D	CR	NL	Yes	- Regular maintenance of equipment to ensure reduced exhaust emissions.	L	-
			Soil			-							-	L	Agriculture and Soils Compliance Statement
			Existing services infrastructure	• Generation of waste that needs to be accommodated at a licensed landfill site • Generation of sewage that needs to be accommodated by the municipal sewerage system and the local sewage plant • Increase in construction vehicles	-		L	S	D	I	NL	Yes	-	L	-
			Groundwater	• Pollution due to construction vehicles	-		S	S	Pr	CR	ML	Yes	- All vehicles should be inspected for oil and fuel leaks on a regular basis. - Vehicle maintenance yards on site should make provision for drip trays that will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.	L	-
			Surface water / riparian			-									Wetland Assessment

			Visual landscape		-										Visual Impact Assessment
			Traffic volumes		-										Traffic Impact Assessment
			Health & Safety		-										Social Impact Assessment
			Noise levels		-										Social Impact Assessment
			Tourism industry	• Since there are no tourism facilities in close proximity to the site, the decommissioning activities will not have an impact on tourism in the area.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Heritage resources		-										Heritage Impact Assessment

Nature of the impact:	(N/A) No impact	(+) Positive Impact	(-) Negative Impact		
Geographical extent:	(S) Site;	(L) Local/District;	(P) Province/Region;	(I) International and National	
Probability:	(U) Unlikely;	(Po) Possible;	(Pr) Probable;	(D) Definite	
Duration:	(S) Short Term;	(M) Medium Term;	(L) Long Term;	(P) Permanent	
Intensity / Magnitude:	(L) Low;	(M) Medium;	(H) High;	(VH) Very High	
Reversibility:	(CR) Completely Reversible;	(PR) Partly Reversible;	(BR) Barely Reversible;	-	
Irreplaceable loss of resources:	(IR) Irreversible	(NL) No Loss;	(ML) Marginal Loss;	(SL) Significant Loss;	(CL) Complete Loss
Level of residual risk:	(L) Low;	(M) Medium;	(H) High;	(VH) Very High	-

An Environmental Awareness and Fire Management Plan is included in Appendix I as part of the EMPr

4.2 KEY ISSUES IDENTIFIED

From the above it is evident that mitigation measures should be available for potential impacts associated with the proposed activity and development phases. The scoping methodology identified the following key issues which were addressed in more detail in the BA report as appendix E2 to the report.

4.2.1 Impacts during the construction phase

During the construction phase the following activities will have various potential impacts on the biophysical and socio-economic environment:

Table 6.3: Impacts and the mitigation measures during the construction phase

SPECIALIST STUDY	IMPACT	PRE-MITIGATION RATING	POST MITIGATION RATING	SUMMARY OF MITIGATION MEASURES
Terrestrial biodiversity, plant and animal impact assessment	Habitat destruction caused by clearance of vegetation	Negative Medium	Negative Low	• Peripheral impacts around the development footprint, on the surrounding vegetation of the area, should be avoided and a monitoring programme should be implemented to ensure the impacts are kept to a minimum, while the rehabilitation of the site should be prioritised after construction has been completed. • During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place. • All development activities should be restricted to specific recommended areas. The Environment Control Officer (ECO) should control these areas. Storage of equipment, fuel and other materials should be limited to demarcated areas. Layouts should be adapted to fit natural patterns rather than imposing rigid geometries. The entire

				development footprint should be clearly demarcated prior to initial site clearance and prevent construction personnel from leaving the demarcated area. This would only be applicable to the construction phase of the proposed development. • The Environmental Site Officer (ESO) should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The ECO should enforce any measures that he/she deem necessary. Regular environmental training should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation. • A percentage (at least 30 %) of the *Aloe zebrina* plants in the proposed development area should be relocated to suitable habitat on the same farm or to another farm nearby. They are mostly found in rocky areas. A walkthrough survey should be conducted to determine the number and location of individuals. Then a translocation management plan should be written, and plants translocated before development commences. • Where holes for poles pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling during planting of the poles along the lines. • Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for birds of prey. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.

				• Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications. • Monitoring should be implemented during the construction phase of the development to ensure that minimal impact is caused to the fauna and flora of the area.
	Habitat fragmentation caused by clearance of vegetation			
	Increased soil erosion and sedimentation			
	Soil and water pollution			
	Air pollution			
	Spread and establishment of alien invasive species			
	Negative effect of human activities on fauna and road mortalities			

Wetland Assessment	Soil compaction, erosion and sedimentation of the river and riparian area			
	Soil and water pollution of the river and riparian area			
	Spread and establishment of alien invasive species in the river and riparian area			
Avifaunal Assessment	Displacement of priority avian species from important habitats (PV array			

	and associated infrastructure)			
	Displacement of resident avifauna through increased disturbance (PV array and associated infrastructure)			
	Loss of important avian habitats (PV array and associated infrastructure)			
	Displacement of priority avian species from important habitats (Power Line)			
	Displacement of resident avifauna through increased disturbance (Power Line)			
	Loss of important avian habitats (Power Line)			

Agricultural Agro-Ecosystem Specialist Assessment	Loss of agricultural potential by occupation of land			
	Loss of agricultural potential by soil degradation			
	Loss of agricultural potential by dust generation			
Heritage Impact Assessment	Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries – Grave/ Burial sites and Farmstead			
Palaeontological Impact Assessment	Disturbance, damage or destruction of legally protected fossil heritage within the development footprint during the construction phase			

Visual Impact Assessment	Visual impact of construction activities on sensitive visual receptors in close proximity to the proposed Paleso SPP			
Social Impact Assessment	Direct and indirect employment opportunities and skills development			
	Economic Multiplier effect			
	Potential loss of productive farmland			
	Influx of jobseekers and change in population			
	Safety and security impacts			
	Impacts on daily living and movement patterns			
	Nuisance impacts (noise and dust)			

	Increased risk of potential veld fires			
	Visual and sense of place impacts			
Traffic Impact Assessment	Increased construction traffic			

4.2.2 Impacts during the operational phase

During the operational phase the study area will serve as a solar plant. The potential impacts will take place over a period of 20 – 25 years. During the operational phase the following activities will have various potential impacts on the biophysical and socio-economic environment:

Table 6.4: Impacts and the mitigation measures during the operational phase

SPECIALIST STUDY	IMPACT	PRE-MITIGATION RATING	POST MITIGATION RATING	SUMMARY OF MITIGATION MEASURES
Terrestrial biodiversity, plant and animal impact assessment (Appendix D1)	Habitat destruction caused by clearance of vegetation	Negative Medium	Negative Low	• Peripheral impacts around the development footprint, on the surrounding vegetation of the area, should be avoided and a monitoring programme should be implemented to ensure the impacts are kept to a minimum, while the rehabilitation of the site should be prioritised after construction has been completed. • Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for birds of prey. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist. • Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
	Soil and water pollution			
	Air Pollution			

	Spread and establishment of alien invasive species			
	Negative effect of human activities on fauna and road mortalities			
Wetland Assessment (Appendix D9)	Soil compaction, erosion and sedimentation of the river and riparian area			
	Soil and water pollution of the river and riparian area			
	Spread and establishment of alien invasive species in the river and riparian area			
Avifaunal Assessment (Appendix D2)	Displacement of priority avian species from important habitats			
	Displacement of resident avifauna through increased disturbance			
	Collisions with PV panels leading to injury or loss of avian life			
	Displacement of priority avian species from important habitats (Power Line)			

	Displacement of resident avifauna through increased disturbance (Power Line)			
	Collision when flying into power line infrastructure			
	Electrocution when perched on power line infrastructure			
Agricultural Agro-Ecosystem Specialist Assessment (Appendix D4)	Increased financial security for farming operations			
	Impacts on agricultural production and employment			
Heritage Impact Assessment (Appendix D5)	Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries – Grave/ Burial sites and Farmstead			
Visual Impact Assessment (Appendix D3)	Potential visual impacts on sensitive visual receptors located within a 5km radius of the SPP			
	Visual impact on observers travelling along the roads and residents at homesteads within a 5-10km radius of the SPP.			

	Visual impacts of lighting at night on sensitive visual receptors in close proximity to the proposed facility.			
	Visual impacts of solar glint and glare as a visual distraction and possible air travel hazard.			
	Visual impact on sensitive visual receptors in close proximity to the 132kV overhead power line – Option 1			
	Visual impact on sensitive visual receptors in close proximity to the 132kV overhead power line – Option 2			
	Visual impact and impacts on sense of place			
Social Impact Assessment (Appendix D7)	Direct and Indirect employment opportunities and skills development			
	Development of non-polluting, renewable energy infrastructure			

	Potential loss of agricultural land			
	Contribution to Local Economic Development (LED) and social upliftment			
	Impact on tourism			
	Visual and sense of place impacts			
Traffic Impact Assessment (Appendix D8)	Increased commuter traffic			

4.2.3 Impacts during the decommissioning phase

The physical environment will benefit from the closure of the solar facility since the site will be restored to its natural state. Table 6.5 provides a summary of the impacts during the decommissioning phase. The decommissioning phase will however potentially result in impact on soils, pressure on existing service infrastructure, surface water and the loss of permanent employment. Skilled staff will be eminently employable, and a number of temporary jobs will also be created in the process. Decommissioning of a PV facility will leave a positive impact on the habitat and biodiversity in the area as the area will be rehabilitated to its natural state.

Table 6.5: Impacts and the mitigation measures during the decommissioning phase

SPECIALIST STUDY	IMPACT	PRE-MITIGATION RATING	POST MITIGATION RATING	SUMMARY OF MITIGATION MEASURES
Wetland Assessment (Appendix D9)	Soil compaction, erosion and sedimentation of the river and riparian area	Negative Low	Negative Low	• Compaction of soils should be limited and / or avoided as far as possible. Compaction will reduce water infiltration and will result in increased runoff and erosion. Where any disturbance of the soil takes place (have taken place in the past), these areas must be stabilised and any alien plants which establish should be cleared and follow-up undertaken for at least 2 years thereafter and preferably longer. Where compaction becomes apparent, remedial measures must be taken (e.g., "ripping" the affected area). • Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion. • A stormwater plan must be developed with the aid of an engineer to ensure that water runoff is diverted off the site without pooling and stagnation or erosion. Financial provision for closure will include the estimated costs for erosion control post-construction and post-decommissioning.

				• If compaction occurs, rectification can be done by application and mixing of manure, vegetation mulch or any other organic material into the area. Use of well cured manure is preferable as it will not be associated with the nitrogen negative period associated with organic material that is not composted. • Vehicle traffic should not be allowed on the rehabilitated areas, except on allocated roads. It will have a negative impact due to the dispersive/compaction characteristics of soils and its implications on the long term.
	Soil and water pollution of the river and riparian area			
	Spread and establishment of alien invasive species in the river and riparian area			
Avifaunal Assessment (Appendix D2)	Displacement of priority avian species from important habitats			
	Displacement of resident avifauna through increased disturbance			

Agricultural Agro-Ecosystem Specialist Assessment (Appendix D4	Loss of agricultural potential by occupation of land			
	Loss of agricultural potential by soil degradation			
	Loss of agricultural potential by dust generation			

5 CUMMULATIVE EFFECTS ASSESSMENT

5.1 INTRODUCTION

The EIA Regulations (as amended in 2017) determine that cumulative impacts, "*in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities*." Cumulative impacts can be incremental, interactive, sequential or synergistic. EIAs have traditionally failed to come to terms with such impacts, largely as a result of the following considerations:

- Cumulative effects may be local, regional or global in scale and dealing with such impacts requires coordinated institutional arrangements;
- Complexity - dependent on numerous fluctuating influencing factors which may be completely independent of the controllable actions of the proponent or communities; and
- Project level investigations are ill-equipped to deal with broader biophysical, social and economic considerations.

Despite these challenges, cumulative impacts have been afforded increased attention in this Basic Assessment Report and for each impact a separate section has been added which discusses any cumulative issues, and where applicable, draws attention to other issues that may contextualise or add value to the interpretation of the impact – refer to Appendix E. This chapter analyses the proposed project's potential cumulative impacts in more detail by: (1) defining the geographic area considered for the cumulative effects analysis; (2) providing an overview of relevant past and present actions in the project vicinity that may affect cumulative impacts; (3) presenting the reasonably foreseeable actions in the geographic area of consideration; and (4) determining whether there are adverse cumulative effects associated with the resource areas analysed.

The term "Cumulative Effect" has for the purpose of this report been defined as: the summation of effects over time which can be attributed to the operation of the project itself, and the overall effects on the ecosystem of the site that can be attributed to the project and other existing and planned future projects.

5.2 GEOGRAPHIC AREA OF EVALUATION

The geographic area of evaluation is the spatial boundary in which the cumulative effects analysis was undertaken. The spatial boundary evaluated in this cumulative effects analysis generally includes an area of a 30km radius surrounding the proposed development – refer to below.

Figure 1: Luckhoff Solar 2 Geographic area of evaluation with utility-scale renewable energy generation sites and power lines

The geographic spread of PV solar projects, administrative boundaries and any environmental features (the nature of the landscape) were considered when determining the geographic area of investigation.

It was argued that a radius of 30km would generally confine the potential for cumulative effects within this particular environmental landscape. The geographic area includes projects located within the Free State Province. A larger geographic area may be used to analyse cumulative impacts based on the specific temporal or spatial impacts of a resource. For example, the socioeconomic cumulative analysis may include a larger area, as the construction workforce may draw from a much wider area. The geographic area of analysis is specified in the discussion of the cumulative impacts for that resource where it differs from the general area of evaluation described above.

5.3 TEMPORAL BOUNDARY OF EVALUATION

A temporal boundary is the timeframe during which the cumulative effects are reasonably expected to occur. The temporal parameters for this cumulative effects analysis are the anticipated lifespan of the Proposed Project, beginning in 2022 and extending out at least 20 years, which is the minimum expected project life of the proposed project. Where appropriate, particular focus is on near-term cumulative impacts of overlapping construction schedules for proposed projects in the area of evaluation.

5.4 OTHER PROJECTS IN THE AREA

The following section provides details on existing and project being proposed in the geographical area of evaluation.

5.4.1 Existing projects in the area

Table 5.1: A summary of related facilities that may have a cumulative impact, in a 30 km radius of the **Luckhoff Solar 2**

Site name	Distance from study area	Proposed generating capacity	DFFE reference	EIA process	Project status
Luckhoff Solar 1	0km	240MW	To be confirmed	S&EIA	In Process
Luckhoff Solar 3	0km	240MW	To be confirmed	S&EIA	In Process
Grootpoort PV	16km	100MW	14/12/16/3/3/2/835	S&EIA	Approved

It is unclear whether other projects not related to renewable energy is or has been constructed in this area, and whether other projects are proposed. In general, development activity in the area is focused on agriculture and mining. It is quite possible that future solar farm development may take place within the general area.

The next section of this report will aim to evaluate the potential for solar projects for this area in the foreseeable future.

***It is important that each specialist consider the possible cumulative impacts that the project could have if all the projects within the geographical area where to be approved.*