PROPOSED SOLAR ENERGY FACILITIES FOR BADENHORST DAM FARM IN DE AAR

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MULILO RENEWABLE ENERGY

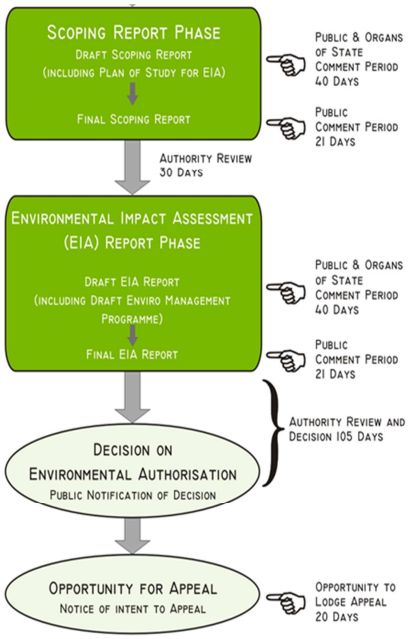
ENVIRONMENTAL IMPACT ASSESSMENT

Non-Technical Summary of the EIA Report

Mulilo Renewable Energy (Pty) Ltd (Mulilo) proposes to construct four separate solar energy facilities, on Badenhorst Dam Farm (Portion 1 of Farm 180), near De Aar in the Northern Cape to generate energy in a renewable manner. In terms of environmental law[1], an Environmental Impact Assessment (EIA) is required and the National Department of Environmental Affairs have to authorise the project before it can go ahead. Aurecon South Africa (Pty) Ltd (Aurecon) is undertaking this EIA study to investigate the environmental and socio-economic issues to facilitate the authority decision making and to inform the design and operation of the proposed solar energy photovoltaic (PV) facilities.

HOW DOES THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS WORK?

An EIA is a process that evaluates the environmental and socio-economic characteristics of proposed projects and the consequences of the project on the environment and the people that live in the area affected by the project activities. Where negative impacts are likely to result from the project, measures can be recommended to avoid or lessen these impacts to a level where the impacts are considered acceptable from an environmental and social perspective. Where positive impacts are likely to result from the project, measures can be recommended to increase these impacts. The EIA process also provides Interested and Affected Parties with an opportunity to comment on the project and to be kept informed about decisions that may impact on them or the environment. The various stages of the process are shown in the figure to the right.



This is a non-technical summary of the Draft EIA Report which includes:

- An introduction to the proposed PV facilities and an overview of the legislative framework;
- An overview of the approach to the EIA describing the public participation to date;
- Description of the proposed projects and the alternatives considered as well as the motivation for the project;
- A description of baseline information of the area and the impacts assessed; and
- Recommendations to conclude the report.

This non-technical summary cannot replace the comprehensive Draft EIA Report and it is recommended that Draft EIA Report is reviewed for more detailed information. This summary document only provides a non-technical overview of what is contained in the full EIA Report.

[1] Namely the National Environmental Management Act (Act No 107 of 1998) (as amended) (NEMA)

WHY ARE THE PV FACILITIES NEEDED?

South Africa currently generates the majority of its required electricity from coal as indicated in Figure 1. South Africa has always been heavily dependent on coal and is currently looking at ways to diversify its power-generating capacity. Concerns on climate change, the on-going exploitation of non-renewable, resources and international pressure to increase renewable energy generation is motivation for diversification in power generation. Renewable energy is recognized internationally as a major contributor in diminishing the effects climate change, as well as providing a wide range of environmental, economic and social benefits that can contribute towards long-term global sustainability. South Africa is subject to some of the highest levels of solar radiation in the world which is why the proposed PV facilities are expected to contribute positively towards climate change mitigation.

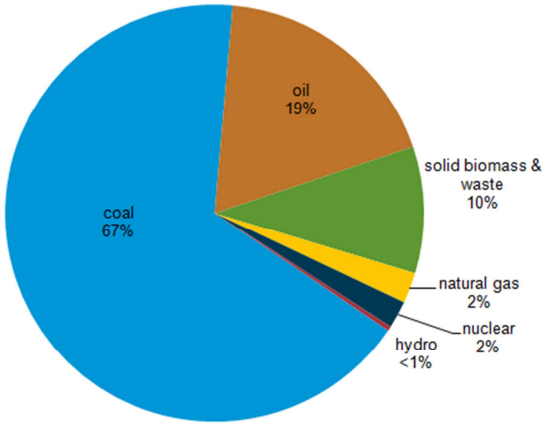


Figure 1 | Total primary energy supply in South Africa during 2010

The establishment of the proposed PV facilities would strengthen the existing electricity grid. Moreover, the projects will contribute towards meeting the national energy target as set by the Department of Energy. The proposed projects would also have international significance as they contribute to South Africa being able to meet some of its international obligations by aligning domestic policy with internationally agreed strategies and standards as set by the Kyoto Protocol and United Nations Convention on Biological Diversity, all of which South Africa is a signatory to.

HOW DOES A TYPICAL PV FACILITY WORK?

Solar panels capture light energy from the sun to generate electricity through a process known as the PV effect, where light energy energise the electrons to produce electricity. There are various types of solar panels including, but not limited to, Concentrated photovoltaic (CPV), Concentrated solar power (CSP) and Conventional PV solar cells.

Figure 2 | Example of a PV facility in a landscape similar to De Aar

CPV technology makes use of optics such as lenses or curved mirrors to concentrate sunlight onto a small area of solar PV cells to generate electricity. This technology type converts the concentrated sunlight directly to electricity via the photovoltaic effect and is considered to be more cost effective than conventional PV solar cells. However, it does require active solar tracking to be effective. Similar to CPV technology, CSPs use mirrors or lenses to concentrate sunlight onto a small area to generate electricity directly via a heat engine, e.g. a steam turbine. Conventional PV technology on the other hand does not make use of any mirrors or lenses and generates electricity by converting solar radiation energy into a DC current which needs to be converted to an AC current to connect to the grid.

The conventional PV and CPV technologies require significantly less water per day (19ℓ/MWh) than the CSP system which needs approximately 3,420ℓ/MWh of water per day during the operational period.

WHAT IS PROPOSED AND WHERE?

Mulilo proposes to construct four PV facilities, each with a generation capacity of 75MW Alternative Current on Badenhorst Dam farm (Portion 1 of farm 180), near De Aar. The total extent of the four proposed facilities would be approximately 1,118.68ha. Each of the proposed PV facilities would consist of:

- A photovoltaic component comprising of many rows of PV panels and associated support infrastructure to generate up to 75MW through the PV effect.
- **Transmission lines**: 132kV overhead transmission lines to connect each facility to the central onsite substation or a transmission line connecting to an existing off-site Eskom substation.
- **Facility substations**: An onsite 132kV, 3 bay substation.
- **Boundary fence**: Each 75MW facility will be fenced for health, safety and security reasons.

It is proposed that the following infrastructures be shared between the four facilities to lessen the impact on the surrounding environment:

- **Central substation:** One central 132kV substation and connection to Eskom grid.
- **Roads:** Access road and internal access roads for servicing and maintenance of the site.
- **Water supply infrastructure:** It is proposed that potable water will be obtained from the Emthanjeni Local Municipality. Water will be conveyed to the site via the municipal pipeline from the nearest municipal supply point and will be contained onsite in a jo-jo tank.
- **Stormwater infrastructure and buildings**.

WHAT ALTERNATIVES ARE BEING CONSIDERED?

An important part of an EIA is to consider alternatives to achieve the most environmentally and socially responsible development. A number of project related alternatives were considered in this EIA, as outlined below:

- **Location alternative:** Badenhorst Dam Farm (Portion 1 of Farm 180)
- **Layout alternatives:** Two layout alternatives, referred to as Alternative 1 and Alternative 2, are proposed.

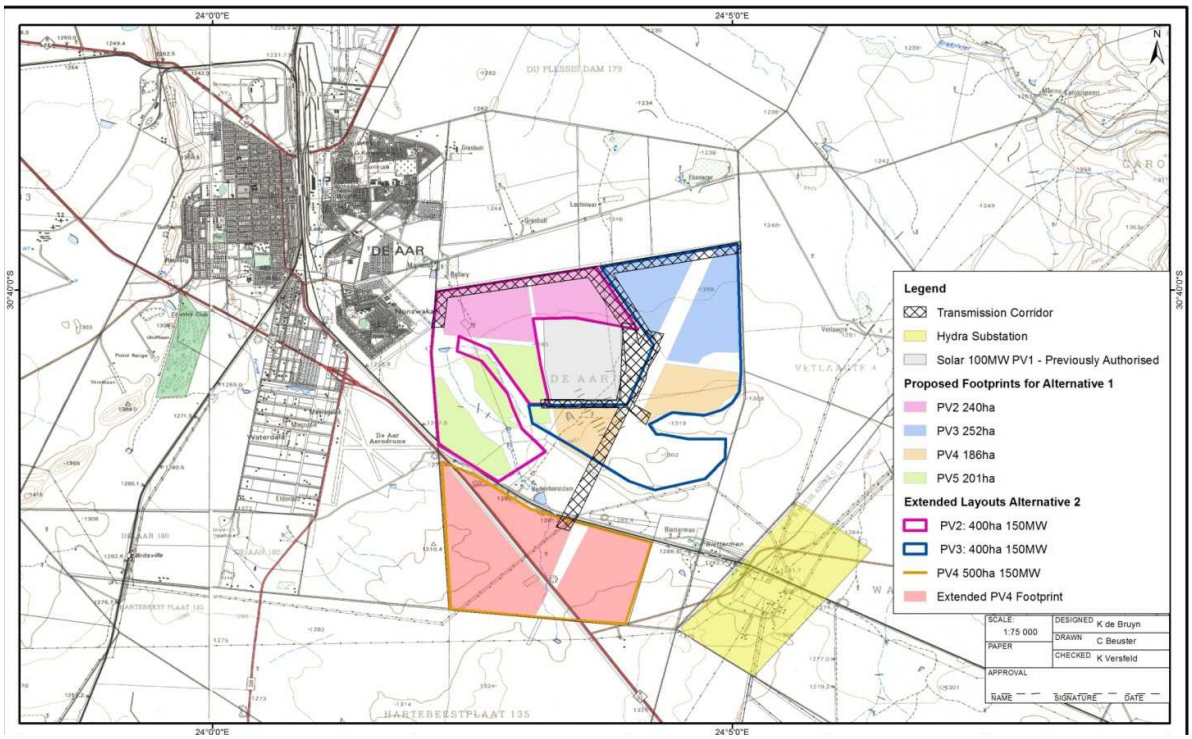


Figure 3 | Layout Alterative 1 and Layout Alternative 2 proposed

The Department of Energy introduced a capacity limit of 75MW for solar facilities. Therefore **Layout Alternative 1** consists of the four proposed 75MW PV facilities and associated infrastructure as indicated in Figure 3. **Layout Alternative 2** consists of three 150MW PV facilities as indicated in Figure 3. This alternative is not limited to the 75MW cap per project. By increasing the generation capacities it lowers associated development and construction costs.

Layout Alternatives	Capacity per facility	Total Footprint (ha)	% of land remaining undeveloped
Layout Alternative 1 (PV 2, 3, 4 & 5)	75MW	879	66%
Layout Alternative 2 (Extended PV 2, 3 &4)	150MW	1816	30%

- **Additional routing infrastructure:** One routing alternative for access roads and water pipeline
- **Transmission line routing:** One transmission corridor as indicated in Figure 3.
- **Technology alternatives: Solar Panel alternative**: CPV and conventional PV; **Mounting Alternatives** to secure the panels to the ground: single axis tracking system (a) and Fixed axis tracking system (b).

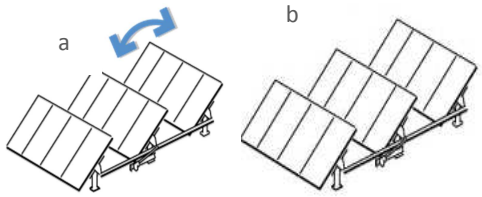


Figure 4 | Mounting Alternatives

In a fixed axis tracking system the PV panels are installed at a set tilt and cannot move, whereas in a single axis tracking system the panels follow the sun to ensure maximum exposure to sunlight as indicated in Figure 4.

- **No-Go Alternative**: Furthermore, in terms of the legislation, the alternative of no development must also be considered.

WHAT KIND OF IMPACTS IS EXPECTED?

The proposed PV facilities and associated infrastructure will result in a range of environmental and socio-economic impacts. This scoping stage identifies the potential impacts that could be expected. Based on site specific characteristics, certain impacts will be more significant than others. The types of impacts expected are indicated in the table below.

Potential impacts	Assessments undertaken
• Disturbance of flora, fauna and avifauna	• Botanical Impact Assessment
• Impact on agricultural resources	• Avifauna Impact Assessment
• Impacts on surface water resources including riparian vegetation	• Agricultural Impact Assessment
• Stormwater impacts including sedimentation and erosion	• Surface water Impact Assessment
• Impacts on palaeontology and heritage resources	• Stormwater Impact Assessment
• Visual impacts	• Palaeontology and Heritage Impact Assessment
• Social impacts (positive and negative)	• Visual Impact Assessment
• Noise and dust pollution	• Social Impact Assessment
• Impact on energy production	• Noise Impact Assessment
• Increased traffic	• Dust Impact Assessment
• Storage of hazardous substances on site	• Assessment of energy production
• Cumulative impacts	• Traffic Assessment
	• Storage of hazardous substances on site

During the EIA, the team of specialists assessed the significance of the relevant impacts of the alternatives identified. This is done by means of specific methodology developed for assessment of significance of impacts, based on the specific characteristics of the site and the proposed development. The findings are presented in the EIA and briefly repeated below.

Botanical Impact Assessment

The study area falls within the Nama-Karoo Biome with one vegetation type namely the Northern Upper Karoo, which is considered to be a Least Threatened vegetation type. Potential impacts to the ecology of the study area and the significance thereof is indicated below:

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Loss or fragmentation of indigenous natural vegetation	Alternative 1 and 2: Medium (-) Associated infrastructure: Low (-)	Alternative 1 and 2: Medium (-) Associated infrastructure: Low (-)
Establishment and spread of declared weeds and alien invader plants	Alternative 1 and 2: Medium (-) Associated infrastructure: Low (-)	Alternative 1 and 2: Very low (-) Associated infrastructure: Very Low (-)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are proposed to mitigate these impacts:

- Unnecessary impacts on surrounding natural vegetation must be avoided.
- The construction impacts must be contained to the footprint of the PVs and associated infrastructure.
- Areas outside the construction footprint should be fenced and access should be limited as much as possible.
- Unnecessary impacts on surrounding natural vegetation must be avoided and where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible.
- Any alien plants within the project area must be immediately controlled.
- An on-going monitoring programme should be implemented to detect and quantify any aliens.
- Existing access roads must be used, where possible.
- Service roads in the servitude must be properly maintained to avoid erosion impacts.

Avifauna Impact Assessment

The site falls within the Platberg-Karoo Conservancy Important Bird Area, which supports critical or regionally significant populations of a number of potentially collision prone or otherwise sensitive species.

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Habitat destruction (construction phase)	Alternative 1 (including associated infrastructure): Low- medium (-) Alternative 2 (including associated infrastructure): Medium (-)	Alternative 1 (including associated infrastructure): Low (-) Alternative 2 (including associated infrastructure): Low- medium (-)
Disturbance (construction phase)	Alternative 1 and 2 (including associated infrastructure): Medium (-)	Alternative 1 and 2 (including associated infrastructure): Low- medium (-)
Habitat loss and disturbance (operational phase)	Alternative 1 (including associated infrastructure): Low- medium (-) Alternative 2 (including associated infrastructure): Medium (-)	Alternative 1 (including associated infrastructure): Low- medium (-) Alternative 2- Medium (-)
Mortality (operational phase)	Alternative 1 and 2 – Medium- high (-)	Alternative 1 and 2 (including associated infrastructure): Medium- high (-)
Disturbance (decommissioning phase)	Alternative 1 (including associated infrastructure): Low- medium (-) Alternative 2 (including associated infrastructure): Medium (-)	Alternative 1 (including associated infrastructure): Low (-) Alternative 2 (including associated infrastructure): Low- medium (-)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are recommended:

- Minimise the inclusive construction footprint of the development and abbreviate construction time.
- Minimise noise and disturbance associated with maintenance activities at the PV facilities once they become operational.
- Minimise the length of any new transmission lines installed and bury lines wherever possible. If lines cannot be buried, ensure that all new lines are marked with bird flight diverters along their entire length, and that all new transmission line infrastructures are adequately insulated and bird friendly in configuration.
- Minimise the amount of fencing used to enclose the development areas, given that these may present a collision risk for collision-prone birds.
- Instituting a comprehensive impact monitoring scheme, and using the results of this scheme to (i) develop the collective understanding of the actual impact of solar PV developments on the region's birds, and (ii) to inform and refine a dynamic and pre-emptive approach to mitigation.

Fauna Impact Assessment

The removal of vegetation could potentially result in habitat loss. Although any affected fauna would generally be largely mobile and would be able to relocate, this impact was nonetheless assessed.

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Impact on fauna during the construction phase and decommissioning	Alternative 1 and 2 (including associated infrastructure): Low (-)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)
Impact on fauna during the operational phase	Alternative 1 and 2 (including associated infrastructure): Low (-)	Alternative 1 and 2 (including associated infrastructure): Low (-)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are recommended for the construction phase for all project alternatives:

- The construction of access roads must be designed for minimal impact. All construction must take place within the footprint of the proposed PV facilities.
- Compile and implement a vegetation rehabilitation plan with the aid of a rehabilitation specialist, for inclusion in the LEMP.
- The construction phase must be closely monitored by an ECO who needs to identify any areas that would require rehabilitation in the post-construction phase. The restoration of those areas must follow the construction phase.
- The site must be cleared in sections as required for construction and not all at once.

The following mitigation measure is recommended for the operational phase (for all project alternatives):

- Small ground level openings, 20-30 cm in height, should be allowed for in the electrical fence to facilitate the movement of small mammals and reptiles through the site.

Agriculture Impact Assessment

Badenhorst Dam Farm is 2,588ha in extent and is zoned as agricultural land. The farm is currently used as extensive grazing land for cattle and game. The farm is considered to have low agricultural value which is replaceable when assessed within the context of the proposed development. However, the site does contain small areas of cultivation, near the homestead representing less than 1% of the site. Currently, these areas of cultivation are excluded from development layouts.

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Loss of agricultural land and degradation of soil resources (construction phase)	Alternative 1 and 2 (including associated infrastructure): Low (-)	Alternative 1 and 2 (including associated infrastructure): Low (-)
Loss of agricultural land and degradation of soil resources (operational phase)	Alternative 1 and 2 (including associated infrastructure): Medium (-)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)

	Transmission lines: Very-low (-)	Transmission lines: Very-low (-)
Soil Disturbance, temporary disturbance to grazing regime (decommissioning phase)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are required during the construction phase to mitigate the loss of agricultural land and degradation of soil resources for both layout alternatives:

- A planned phased approach must be adopted.
- Allow normal agricultural activities to continue in unaffected areas. Stocking rates will need to be reduced during the respective construction phases in order to reduce the risk of overgrazing the remaining land portions.
- Initiate land rehabilitation and re-vegetation as soon as possible.
- Due to the overarching site characteristics, and the nature of the proposed development, the remaining viable mitigation measures are limited and will most likely revolve around erosion control:
  - The soil erosion plan and associated recommendations should be employed.
  - Clearing activities should be kept to a minimum.
  - In the unlikely event that heavy rains are expected, activities should be put on hold to reduce the risk of erosion.
  - If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should be armoured with structures used for the strengthening of earthen structures or embankments. If earth works are required then storm water control and wind screening should be undertaken to prevent soil erosion.

The following mitigation measures are required during the operational phase:

- Initiate land rehabilitation and re-vegetation as soon as possible and continue to visually monitor land for early detection of degradation.
- It is recommended that more palatable species form part of the re-vegetation plan to enable faster stocking initiation. Pertinent plant species should be included in the site specific Environmental Management Plan.
- Allow normal agricultural activities to continue in unaffected areas.
- Allow periodic grazing within the PV facilities (sheep and wildlife).
- The impacted areas should revert back to sheep production and the proposed PV facilities used as rotational grazing camps.

Erosion control:

- Clearing activities should be kept to a minimum.
  - In the unlikely event that heavy rains are expected, activities should be put on hold to reduce the risk of erosion.
  - If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should be armoured with fascine like structures.
  - If earth works are required then storm water control and wind screening should be undertaken to prevent soil erosion.
  - Interact with landowners during the routing process

A soil erosion management plan is included in the Agricultural Impact Assessment which should be implemented at all times.

Surface water Impact Assessment

The main water feature in the study area is the Brak River, a seasonal tributary within the Orange River System. The river flows along the northern boundary of the study area with a number of its tributaries crossing the site as they flow in a northerly direction. The Sandsloot River which originates near Badenhorst Dam Farm and flows through the town of De Aar is the most notable of the tributaries. The following impacts are anticipated:

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Proposed PV facilities, substations and Laydown Areas (construction phase)	Alternative 1 and 2 (including associated infrastructure): Low (-)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)
Proposed transmission lines, access roads and water pipeline (construction phase)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)
Maintenance of PV facilities and associated infrastructure (operational phase)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are proposed for the construction phase:

- A buffer of 30m should be maintained adjacent to the identified streams for the proposed PV footprint areas as well as the substations.
- Construction activities for the proposed infrastructure that will need to take place within the river channels and riparian zone (i.e. linear development components including roads, transmission lines and water pipeline) should transect the streams at right angles and be limited as far as possible to ensure minimum disturbance of this area.
- Disturbed areas within the riparian zones and stream beds should be rehabilitated as soon as possible after construction has been completed and revegetated with suitable indigenous vegetation according to the approved rehabilitation plan. Where possible previously disturbed areas, such as existing roads or transmission line routes, should be utilised. Disturbed areas should be visually monitored every three months and kept free of invasive alien plant growth and to ensure that these areas do not become subject to erosion. Any regrowth of invasive alien plants should be removed.
- Construction should preferably take place during the low flow period to minimise the risk of erosion and contaminated runoff from construction site into freshwater systems.
- All rubble, sand and waste material resulting from the construction activities should be removed from any stream and drainage channels to ensure that flow in these channels are not impeded.
- Invasive alien plants should be removed from the disturbed areas within the drainage channels.
- Contaminated runoff from the construction site should be prevented from entering the streams.
- All materials on the construction site should be appropriately stored and contained.
- Disposal of waste should be properly managed.
- Construction workers should be provided with ablution facilities at the construction site which are located at least 100m away from the river systems or freshwater features and regularly serviced.
- The laydown area(s) should be cleaned and rehabilitated after construction is complete according to the approved rehabilitation plan.
- There should be an approved storm water management plan in place for the operation phase of the project. Storm water runoff from the constructed areas should also be visually monitored after large rainfall events to ensure that eroded areas do not develop, particularly within the drainage channels.
- Invasive alien plant growth within the disturbed areas should be visually monitored at least every three months and any regrowth of invasive alien plants removed.
- A decommission plan should be drawn up and approved for the site that addresses the removal of the PV facilities and infrastructure post operation phase. The decommission plan should address aspects such as

monitoring and management of invasive alien plants and erosion of the site after the activities on the site are complete.

Hydrology Impact Assessment

The proposed PV facility sites for both layout alternatives overlap three different catchments. Therefore the effect on stormwater runoff needs to consider the increase in runoff that would be generated of each layout alternative as it could impact the three catchments.

The following mitigation measures are recommended (for all project components and all alternatives):

- The topography would determine the actual placement of drainage spines. As such, a detailed survey is required to place the drainage spines.
- Cross drainage in the form of v-drains should be provided to intercept overland flow and to direct this to the spines.
- Concrete aprons with rip-rap, no less than 12m long, should be used at the multiple outlets. This would prevent erosion, assist in moving the runoff from channelled flow back to overland flow would dissipate energy.
- Erosion around concrete plinths and supporting structures is a concern and is dependent on the erodibility of the material.
- It is recommended that the surfaces around plinths be compacted well graded gravel with a 38mm gravel capping.
- Erosion protection in the form of rip-rap with average diameters of 200mm is required at the drain outfalls from the solar facility for a distance of no less than 12m.
- Straw barriers should be installed in drainage paths to act as a check dam, i.e. to reduce velocity, and as a sediment trap during construction.
    - The sediment and erosion control measures should remain in place until construction is complete.
    - The sediment traps would require regular monitoring during construction and reinstatement as necessary.
- A detailed drainage layout would need to be developed when a detailed topographic survey for the site is available. The minor drainage channel that starts in the south of the farm and exits in the south-east of the farm would have to be evaluated as part of the detailed design.
- Packed stone, also known as rip-rap, must be placed as liners for channel spines.
- Earth cut-off channels should be constructed at the boundaries of each of the proposed facilities.
- Provide erosion protection at channel outfalls and positions of high flow concentration.

In addition to the mitigation measure proposed above, the following mitigations are proposed to manage increase runoff post-development for Catchment 1 the following is proposed:

- Attenuation ponds and energy dissipaters should be used.
- A possible mitigation measure could be to rehabilitate the Badenhorst Farm Dam and use it as an attenuation pond.
- Once a detailed survey is available the impact on the road and rail culverts needs to be investigated.
- Cut-off drains should be provided along the outside boundaries of the PV sites that receive overland flow from areas upstream. The cut-off drains would typically be at least 300mm deep and v-shaped as described above.

The gravel roads should have the following:

- a crowned driving surface,
- a shoulder area that slopes directly away from the edge of the driving surface, and
- a ditch.

Where the roads intersect drainage lines, a suitably sized culvert should be used. It is important that ditches and culverts be kept clear from obstructions.

Palaeontology Impact Assessment

The proposed PV facilities are located in the south-eastern outskirts of the town of De Aar, in an area of the Main Karoo Basin of South Africa that is underlain by potentially fossiliferous sedimentary rocks of the Karoo Supergroup that are of Permian age. The proposed developments may adversely affect potential fossil heritage within the study area by destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good.

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Disturbance, damage or destruction of fossils preserved at or below the ground surface	Alternative 1 and 2 (including associated infrastructure): Low (-)	Alternative 1 and 2 (including associated infrastructure): Low (-)
Proposed transmission lines	Alternative 1 and 2 (including associated infrastructure): Very-low (-)	Alternative 1 and 2 (including associated infrastructure): Very-low (-)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are recommended (for all project components and all alternatives):

- During the construction phase all substantial bedrock excavations should be monitored for fossil remains by the responsible Environmental Control Officer (ECO).
- Should significant fossil remains such as vertebrate bones and teeth, shells, plant-rich fossil lenses, sizeable petrified wood specimens or dense fossil burrow assemblages be exposed during construction, the responsible Environmental Control Officer should safeguard these, preferably in situ, and alert SAHRA.
- Appropriate action could be taken by a professional palaeontologist at the developer's expense.
- All South African fossil heritage is protected by law and fossils cannot be collected, damaged or disturbed without a permit from SAHRA or the relevant Provincial Heritage Resources Agency.
- The palaeontologist concerned with mitigation work would need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (e.g. museum or university collection).
- All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (e.g. data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013).

Heritage Impact Assessment

Impacts to archaeological heritage resources primarily occur during the construction phase and thereafter remain unchanged through the operational and decommissioning phases. This is because once they are destroyed they cannot be recreated. For cultural landscapes impacts would be experienced during construction and operation but then, with rehabilitation, would revert to the status quo (assessed as the No-Go alternative) after decommissioning.

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Archaeology impacts	Alternative 1 PV2, PV4*: Very-low (-) Alternative 1 PV3: Medium (-) Alternative 1 PV5: Low (-) Alternative 2 PV2: Low (-) Alternative 2 PV3, PV4: Medium (-)	Alternative 1 PV2, PV4: Very-low (-) Alternative 1 PV3: Very-low (-) Alternative 1 PV5: Very-low (-) Alternative 2 PV2: Very-low (-) Alternative 2 PV3, PV4: Very-low (-)
Impact on cultural landscape	Alternative 1 PV2, PV5: Medium (-) Alternative 1 PV3, PV4: Low (-) Alternative 2 PV2, PV3: Medium (-)	Alternative 1 PV2, PV5: Medium (-) Alternative 1 PV3, PV4: Low (-) Alternative 2 PV2, PV3: Medium (-)

	Alternative 2 PV4: High (-)	Alternative 2 PV4: High (-)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are recommended:

- All PV layouts for both alternatives should avoid the dolerite ridge which has a high density of archaeological remains associated with it. **This has already been factored into the design**.
- For Alternative 1 PV3 and PV5 archaeological mitigation in the form of excavation, sampling and analysis should be carried out for artefacts. Note that avoiding and protecting these sites is always preferred when feasible.
- If Alternative 2 (PV4) is to be constructed then this area will need to be checked for archaeological remains. The rocky hill located in the southern section of the site should be avoided.
- Once the exact lines have been identified for the linear components of the project, they should subject to a desktop evaluation and depending on the findings, a walk-down of the route may be required.
- Where archaeological sites cannot be avoided, mitigation in the form of excavation and collection of artefacts must be carried out.
- If any human remains are encountered during the development they must be cordoned off and protected from further harm until they can be inspected and removed by an archaeologist under a permit.
- All mitigation-worthy archaeological sites that are avoided by the development and are not mitigated should be protected from incidental damage by demarcating them as no-go areas.
- Any dense subsurface concentrations of artefacts found during excavations should be protected *in situ* and immediately reported to an archaeologist for assessment.
- Any areas of the landscape, particularly the rocky hills that are not to be developed, should be protected so as to minimise unnecessary landscape scarring.

Visual Impact Assessment

Badenhorst Dam Farm is located on the open plains and it is therefore anticipated that the visibility of project components may impact on the visual quality of the area.

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Construction phase impacts (summary)	Alternative 1 and 2: High (-)	Alternative 1 and 2: Medium- high (-)
Operational phase impacts (summary)	Alternative 1 and 2: High (-)	Alternative 1 and 2: Medium- high (-)
Decommissioning phase impacts (summary)	Alternative 1 and 2: High (-)	Alternative 1 and 2: Low (-)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are required during the construction phase:

- Surface topsoil should be scraped off, conserved and used for rehabilitation. The remainder could be used for site development, and any surplus disposed of in a manner that appears natural.
- The top 50mm to 100mm of naturally occurring substrate should be separated and then spread over finished levels.
- The laydown area should preferably be located outside of direct view of the N10 and should be screened with shade cloth.
- Site offices and structures should be limited to single storey and they should be sited carefully to reduce visual intrusion. Colours should reflect hues of the surrounding vegetation and/or the ground. Roofs should be grey and non-reflective. Door and window frame colour should reference either the roof or wall colours.
- Litter is to be regarded as a serious offence and no contaminants are to be allowed to enter the environment.
- Road construction and management must take run-off into consideration in order to prevent soil erosion.
- Access roads are to be kept clean, and measures taken to minimise dust from construction traffic.

- The footprint areas of all impact sites utilised in construction should be rehabilitated in during the construction phase, and not during operation. Disturbed areas should be restored as near as possible to previous natural vegetation.
- The visual impact recommendation is that pylons are constructed of wooden poles. *This is not in line with what Eskom requires and would therefore not be implemented.*
- The fencing should be grey in colour and located as close as possible around the PV site.
- If possible, natural waterways and drainage lines indicated as sensitive should not be fenced in.
- Rocky outcrops should be excluded from the development zone.

The following mitigation measures are required during the operational phase:

- All lighting is to be kept to a minimum, within the requirements of safety and efficiency.
- Where such lighting is deemed necessary, low-level lighting, which is shielded to reduce light spillage and pollution, should be used.
- No naked light sources are to be directly visible from a distance.
- Any necessary aircraft warning lights are to be installed as per the relevant authority requirements.
- External lighting must use down-lighters shielded in such a way as to minimise light spillage and pollution beyond the extent of the area that needs to be lit.
- Security and perimeter lighting must also be shielded so that no light falls outside the area needing to be lit. Unnecessarily tall light poles are to be avoided.
- To limit the potential of sunlight reflecting off the panels creating glint and glare impacts, it is recommended that the Fixed Tilt structure is utilised. With the tilt access aligned north south, the panels will always be facing towards the sun which reduces the potential for impacts of reflection.

The following mitigation measures are required during the decommissioning phase:

- All PV structures, associated structures and fencing should be removed and recycled.
- Internal roads should be ripped and then rehabilitated.
- All impacted footprint areas should be rehabilitated and restored to indigenous, endemic vegetation.

Social Impact Assessment

The proposed PV facilities would impact on the socio-economic *status quo* through job creation, indirect effects of additional workers onsite, impacts of a non-local workforce on society and disruption or damage to adjacent properties.

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Direct employment and skills development, economic multiplier (construction phase)	Alternative 1 and 2- Low (+)	Alternative 1 and 2- Low- medium (+)
Indirect effects of additional workers on site, Impacts of a non-local workforce on society and disruption or damage to adjacent properties (construction phase)	Alternative 1 and 2- Low (-)	Alternative 1 and 2- Very-low (-)
Direct Employment and Skills Development, Economic Multiplier Effects, Landowner revenue Diversification of the local economy (operational phase)	Alternative 1 and 2- Low (+)	Alternative 1 and 2- Low (+)
Potential negative or positive cumulative effects within the region (operational phase)	Alternative 1 and 2- Medium (+)	Alternative 1 and 2- Medium-high (+)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are proposed to be implemented during the construction phase for all alternatives:

- It is recommended that the local employment policy, as stated by the proponent, be implemented, audited and accompanied by a training programme. The policy must be based on a 'local's first' policy, specifically for low skilled jobs and should aim to recruit at least 20% of the jobs from the local community. This should also apply to all contracting firms.
- A local procurement policy should be adopted by the applicant to maximise the benefit to the local economy.
- Implement a policy of "no employment at the gate" to prevent loitering.
- The site should be secured.
- A comprehensive employee induction programme would cover land access protocols and fire management. This was addressed in the LEMP.
- A comprehensive employee induction programme would address issues such as HIV/ AIDS and Tuberculosis, as well as alcohol and substance abuse. The induction should also address a code of behaviour for employees that would align with community values.
- The LEMP also addressed noise and dust control. A 24 hour system for receiving and addressing complaints should be established before the commencement of the construction phase. Local farmers and residents should be informed of the contact number.
- Housing has to be restricted to the approved laydown areas.

The following operational mitigation measures are proposed for all project alternatives:

- It is recommended that the local employment policy as stated by the proponent is implemented, audited and accompanied by a training programme. The policy must be based on a 'local's first' policy, specifically for low skilled jobs and should aim to recruit at least 20% of the jobs from the local community. This should also apply to all contracting firms.
- It is recommended that the developer adopts a local procurement policy which would maximise the benefit to the local economy and minimise leakage.

Noise

Noise will be generated during the construction operation and decommissioning phases of the proposed projects. Construction and decommissioning activities are often similar. Potential sources of noise during the construction phase are increased traffic, operation of heavy machinery during the construction period and additional people in the area. In order to assess the noise impacts of the PV facilities, qualitative noise assessment was undertaken.

The noise mitigation measures to be considered during the construction phase are as follows (for all alternatives):

- Construction site yards, workshops, concrete batching plants, and other noisy fixed facilities should be located well away from noise sensitive areas.
- Stationary noisy equipment such as compressors and pumps should be encapsulated in acoustic covers, screens or sheds where possible. Portable acoustic shields should be used in the case where noisy equipment is not stationary (i.e. angle grinders, chipping hammers).
- Vehicles should avoid unnecessary use of the reverse gear to minimise annoyance caused by reverse sirens. Consideration of alternative safety measures may be necessary when taking such a measure.
- All diesel powered equipment must be regularly maintained and kept at a high level of maintenance. This must particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance.
- Truck traffic should be routed away from noise sensitive areas, where possible.
- Noisy operations should be combined so that they occur where possible at the same time.
- Instruction of employees on low-noise work methods, for example, the handling of structural steel and the use radiotelephony rather than shouting for communication.

- Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum.
- Construction activities are to be contained to reasonable hours during the day and early evening.
- Night-time activities near noise sensitive areas should not be allowed. No construction should be allowed on weekends from 14h00 on Saturday afternoons to 06h00 the following Monday morning.
- With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents and owners on how best to minimise impact, and the local population should be kept informed of the nature and duration of intended activities.

The noise mitigation measures to be considered during the construction phase are as follows (for all alternatives):

- The design of all major plant components should incorporate all the necessary acoustic design aspects required to ensure that the generated noise level from the Project does not exceed the SANS 10103 maximum equivalent continuous day/night rating level (LRdn) of 70dBA for industrial areas at the project boundary.
- The design should also to take into account the maximum allowable equivalent continuous day and night rating levels of the potentially impacted sites outside the project boundary. Where the noise level at such an external site is presently lower than the maximum allowed, the maximum shall not be exceeded. Where the noise level at the external site is presently at or exceeds the maximum, the existing level shall not be increased by more than what is considered as acceptable in SANS 10103.
- The latest technology incorporating maximum noise mitigation measures for components of the project should be designed into the system. The sound power level of each piece of equipment should be such that the sound pressure level (LP – i.e. the noise level) measured at 1m from the surface of the given plant/equipment should not exceed 85dBA. When ordering plant and machinery, manufacturers should be requested to provide details of the sound power level. Where possible, those with the lowest sound power level (most quiet) should be selected.
    - The design process is to consider, inter alia, the following aspects:
        - The position and orientation of buildings on the site.
        - The design of the buildings to minimise the transmission of noise from the inside to the outdoors.
        - The insulation of particularly noisy plant and equipment.
        - All plant, equipment and vehicles are to be kept in good repair.
        - Where possible, very noisy activities should not take place at night.
        - Noise levels from the high-pressure hose system (compressor) on the trucks used for the cleaning of PV panels should be minimised.

It is recommended that ambient noise measurements are conducted during the pre-construction, construction, operational and decommissioning phases to assess the Project's impact area. In addition to the measurement of sound pressure levels, the 3rd octave band frequency spectra should also be recorded. Frequency spectra data can provide useful insight into the nature of recorded sound pressure levels and assist with distinguishing between potential sources of noise that contribute to noise levels at a certain location. Source noise measurements could be conducted to confirm equipment manufacturer sound power data. All measurements should be conducted in accordance with SANS 10103 and be representative of day and night-time noise levels.

Dust

Solar technologies results in negligible emissions since no fuels are combusted. However, air pollution in the form of dust emissions will occur during the construction phase.

The following mitigations are provided to address potential dust generation throughout the project lifecycle:

- Water sprays to be applied at the area to be cleared should significant amounts of dust be generated. Moist topsoil will reduce the potential for dust generation when tipped onto stockpiles.

- Ensure travel distance between clearing area and topsoil piles to be at a minimum.
- Ensure exposed areas remain moist through regular water spraying during dry, windy periods.
- Reshape all disturbed areas to their natural contours.
- Cover disturbed areas with previously collected topsoil and replant native species.
- A dust monitoring network should be established comprising of four single dust fallout units following the following the American Society for Testing and Materials standard method for collection and analysis of dust fall (ASTM D1739). Dust fallout at the site should not exceed 1,200mg/m^2/day, and not exceed 600mg/m^2/day off-site in the direction of the town and the farm Wag-'n-Bietjie, for any three months in a calendar year or for two consecutive months. The main focus areas for dust bucket placement should be:
    - One to be placed downwind to the north-west of the proposed development (dust fallout limit 1,200mg/m²/day).
    - One to the south-east of the proposed development (dust fallout limit 1,200mg/m²/day).
    - One dust fallout unit should be placed between the proposed development and the town of De Aar on the western side of the development (dust fallout limit 600mg/m²/day).
    - A fourth unit should be placed on the eastern boundary of the proposed development, in the direction of the farm Wag-'n-Bietjie (dust fallout limit 600mg/m²/day).

Energy production

The proposed PV facilities would be able to provide power to assist in meeting the energy demand within South Africa. The potential impact of the proposed project on energy production is considered to be low (+) significance, without or with mitigation measures, and therefore no mitigation measures are recommended.

Traffic Impact Assessment

Construction vehicles are likely to make use of the existing roads, including the N10, to transport equipment and material to the construction site. Approximately 450 truckloads transporting in total 900 40-foot containers would be required during the construction period. These truckloads would be distributed throughout the construction period (12 to 24 months per 75MW facility). The associated impacts along with the assessment thereof are indicated below.

Impact	Significance (without Mitigation)	Significance (with Mitigation)
Accidents and or traffic congestion (Construction phase)	Alternative 1 and 2: Medium (-)	Alternative 1 and 2: Low (-)
Accidents and or traffic congestion (Operational phase)	Alternative 1 and 2: Very-low (-)	Alternative 1 and 2: Very-low (-)
Accidents and or traffic congestion (Decommissioning phase)	Alternative 1 and 2: Medium (-)	Alternative 1 and 2: Medium (-)

* All alternatives assessed includes associated infrastructure

The following mitigation measures are recommended:

- Ensure that road junctions have good sightlines.
- Transport the materials in the least amount of trips as possible.
- Adhere to the speed limit.
- Implement traffic control measures where necessary.
- Transport components overnight as far as possible.

Storage of hazardous substances

Hazardous substances would be stored on site during the operational phase. These substances may include amongst other things, hydrocarbons (i.e. fuel), curing compounds, shutter oil, and cement. The use of hazardous substances at a site is controlled by various pieces of legislation. Approximately 500ℓ of fuel and 50ℓ of lubrication oil would be stored on site. This volume falls well below the triggers as listed activity in terms of NEMA.

The following mitigation measures are proposed in the LEMP:

- The management and protection of the environment would be achieved through the implementation of the LEMP, which *inter alia* specify the storage details of hazardous compounds and the emergency procedures to follow in the event of a spillage.
- Typical mitigation measures include storage of the material in a bunded area, with a volume of 110% of the largest single storage container or 25% of the total storage containers whichever is greater, refuelling of vehicles in designated areas that have a protective surface covering and utilisation of drip trays for stationary plant.

Proposed way forward

Based on the outcome of this EIA, we are of the opinion that the proposed PV projects should be authorised as the incremental local and regional benefits outweigh negative impacts and the proposed project substantially meets the NEMA principles as well as the Need and Desirability criteria. The significance of negative impacts can be reduced with effective and appropriate mitigation. If authorised, the implementation of an LEMP should be included as a Condition of Approval.

The recommendation of this EIA is to authorise the following project alternatives:

- **Location alternative:** Badenhorst Dam Farm (Portion 1 of Farm 180)
- **Layout alternatives** as determined by scale and magnitude alternatives: Alternative 1 (including PV2, PV3, PV4 and PV5)
- **Additional routing infrastructure:** One routing alternative for access roads and water pipeline
- **Technology alternatives:**
  - Solar Panel alternative: conventional PV
  - Mounting Alternatives: single axis tracking system
- **Transmission line routing:** one transmission corridor

WHAT IS PUBLIC PARTICIPATION AND HOW DO YOU GET INVOLVED?

Public participation is an important part of the EIA process, as it allows the public to get information about the proposed project, to view documentation, to make input and voice any concerns.

The full Draft EIA Report for the proposed PV facilities is available for review from 19 September 2013 until 29 October 2013 at the following venues:

- De Aar Public Library (Station Street);
- The Emthanjeni municipal offices (contact person: Ms Kloppers) in Vootrekker Road; and
- Accessible from the Aurecon website (www.aurecongroup.com – please change the current location to "South Africa" and follow the "public participation"- link).

The comments and concerns raised on the Draft and Final Scoping Reports were incorporated into a Comments and Responses Report which is attached to the Draft EIA Report. The public is given the opportunity to submit comments and concerns until close of business 29 October 2013. The comments on the Draft EIA Report will be used to update this draft document to a final document, which will be submitted to the authorities for authorisation.

Comments can be submitted to the EIA PPP team from 19 September 2013 until 29 October 2013:

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