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WETLAND RISK ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF LEUMAX SOLAR PHOTOVOLTAIC (PV) PLANT (LEUMAX PV 1) ON PORTION 37 OF THE FARM LEEUWBOSCH NO. 44 NEAR LEEUDORINGSTAD, NORTH WEST PROVINCE

Date
09 November 2022

Client
SiVEST Environmental

SPECIALIST ASSESSMENT DETAILS & DECLARATION OF INDEPENDENCE

Document Title	**WETLAND RISK ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF LEUMAX SOLAR PHOTOVOLTAIC (PV) PLANT (LEUMAX PV 1) ON PORTION 37 OF THE FARM LEEUWBOSCH NO. 44 NEAR LEEUDORINGSTAD, NORTH WEST PROVINCE**	
Report No.	**W64**	
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Date	**9 Novemeber 2022**	
Report completed by	**Wayne Jackson** *Cert.Sci.Nat. (Registration 119037)*	
Field of Expertise	**Wetlands & Soil Science**	
Client	**SiVEST Environmental Division**	
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Fieldwork and Report Writing (Wetlands)	**Wayne Jackson**	

I, Wayne Jackson, hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Environmental Affairs.

Wayne Jackson

Wetland & Soils Specialist

Eco-Assist

9th November 2022

Specialist Team Details

Specialist	Role	Details
Wayne Jackson *Cert.Sci.Nat. (Registration 119037)*	**Field work and author (Wetlands)**	Wayne Jackson graduated from the University of KwaZulu-Natal, Pietermaritzburg, with a BSc. degree in Soil Science & Hydrology. Wayne is an experienced Wetlands & Soils Scientist with a demonstrated history of working in the environmental services industry (13 years). He is skilled in Soil Classification, Wetlands, Hydropedology, and Surface Water Hydrology. He has a strong Environmental mitigation and rehabilitation knowledge. He has also gained experience in large post-mining rehabilitation projects, providing specialist inputs on land capability and soil utilisation. He has extensive exposure to a wide range of projects in many sectors across South Africa, and parts of Africa. He is knowledgeable on how soils, wetlands, and hydrological systems are linked in the landscape and how activities could impact all these aspects. Wayne is a registered Natural Scientist with the South African Council for Natural Scientific Professionals (SACNASP) – Registration No. 119037.

The relevant experience of specialist team members involved in the compilation of this report are briefly summarized above. Curriculum Vitae of the specialist team are available on request.

National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	**Table above**
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Submitted separately**
(c) an indication of the scope of, and the purpose for which, the report was prepared;	**Section 1**
(cA) an indication of the quality and age of base data used for the specialist report;	**Section 4, Section 5, and Section 6**
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	**Section 7**
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**Section 6.1.3**
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	**Section 5**
(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;	**Section 6 and Section 7**
(g) an identification of any areas to be avoided, including buffers;	**Section 6.1.3, section 7, and Section 8**
(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;	**Section 6**
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**Section 3**
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	**Section 7 and Section 8**
(k) any mitigation measures for inclusion in the EMPr;	**Section 8**
(l) any conditions for inclusion in the environmental authorisation;	**Section 8 and Section 9**
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**None required**
(n) a reasoned opinion— i. whether the proposed activity, activities or portions thereof should be authorised; 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 or Environmental Authorization, and where applicable, the closure plan;	**Section 9 and Section 10**
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**N/A -No feedback has yet been received from the public participation process regarding the visual environment**
(p) any other information requested by the competent authority	**N/A. No information regarding the visual study has been requested from the competent authority to date.**
(2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	**N/A**

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1 INTRODUCTION

Eco-Assist Environmental Consultants (Here After Eco-Assist) was appointed by SiVEST to conduct a Surface Water (Wetlands) risk assessment for the Proposed Construction of Leeuwbosch Solar Photovoltaic (PV) Plants (Leeuwbosch 3 Solar PV Plant) on Portion 37 of the Farm Leeuwbosch No. 44 near Leeudoringstad, North West Province.

1.1 Project Background

Leeuwbosch PV Generation (Pty) Ltd (hereafter referred to as "Leeuwbosch PV Generation") is proposing to construct a solar photovoltaic (PV) plant and associated infrastructure on Portion 37 of the Farm Leeuwbosch No. 44, approximately 6km north-east of the town of Leeudoringstad in the North West Province (hereafter referred to as the "proposed development"). The proposed development will have a maximum export capacity of up to 15 megawatt (MW) and will be known as the Leeuwbosch 3 Solar PV Plant. The proposed development is located within the Maquassi Hills Local Municipality in the Dr Kenneth Kaunda District Municipality.

At this stage, it is anticipated that the proposed solar PV plant will include PV fields (arrays) comprising multiple PV modules. In addition, the proposed solar PV plant will have a maximum total generation capacity of up to approximately 15 MW. The associated infrastructure would include, but not be limited to, internal access roads, one (1) switching substation, one (1) permanent guard house, and one (1) temporary building zone. As mentioned, the electricity generated by the proposed solar PV plant (part of this application) will be fed into the national electricity grid via the Leeudoringstad Solar Plant Substation.

In summary, the following key components are to be constructed as part of the proposed development:

- Solar PV arrays:
  - The proposed solar PV plant will include PV fields (arrays) comprising multiple PV modules.
  - PV panel mountings. PV panels will be single axis tracking mounting, and the modules will be either crystalline silicon or thin film technology.
  - Each PV module will be approximately 2274mm (≈2.3m) long and 1134mm (≈1.1m) wide and mounted on supporting structures above ground. At this stage it is anticipated that the structures will be mono-facial modules. The final design details will become available during the detailed design phase of the proposed development, prior to the start of construction.
  - The foundations will most likely be either concrete or rammed piles. The final foundation design will be determined at the detailed design phase of the proposed development.
- Switching Substation:
  - The proposed development will include the construction of one (1) new on-site switching substation with a capacity of more than 33kV but less than 275kV. The switching substation will occupy an area of up to approximately 0.2ha.
  - The switching substation will contain transformer(s) for voltage step-up from medium voltage to high voltage. DC power from the modules will be converted into AC power in the inverters and the voltage will be stepped up to medium voltage in the inverter transformers.

    - Medium voltage cabling (anticipated to be approx. 0.8m x 0.6m wide at this stage) will link the various PV arrays to the switching substation, as well as the Leeudoringstad Solar Plant Substation. These cables will be laid underground, wherever technically feasible.
- Access Roads:
    - Access to the facility will be via an existing gravel road which connects to the tarred R502 road.
    - Existing internal gravel access roads will be used to access the PV arrays as well as the switching substation.
    - New internal gravel roads of up to approximately 4m wide may however be constructed, where necessary.
- One (1) permanent guard house, occupying a site of approximately 0.0876ha (i.e., 876m^2);
- Fencing will surround the entire proposed solar PV plant. At this stage it is anticipated that the fencing will be approximately 2.1m high and will be made of galvanised steel with electrification on top. In addition, fencing is anticipated to cover an area of up to approximately 18ha.
- Temporary infrastructure:
    - to obtain water from available local sources. Existing boreholes will be utilised. Water will potentially be stored in temporary water storage tanks. The necessary approvals from the Department of Water and Sanitation (DWS) will be applied for separately.
    - One (1) temporary building zone which will occupy a site of up to approximately 0.2944ha (i.e., 2 944m^2).
- It should be noted that the proposed solar PV plant development does not fall within any of the Renewable Energy Development Zones (REDZs) which were formally gazetted on 16 February 2018 (Government Notice 114) for the purpose of development of solar and wind energy generation facilities.
- No layout alternatives are being considered and assessed as part of the current BA process.
- The “No-go” alternative is the option of not implementing the proposed development. This alternative would result in no environmental impacts from the proposed development on the site or surrounding local area. It provides the baseline against which other alternatives are compared and was considered throughout the BA process. Implementing the “no-go” option would entail no development. The development site itself consist mostly of natural grassland. The “no-go” would therefore imply that the land would remain as per the status quo, undeveloped the natural grassland will be maintained.
- The “no-go” option is a feasible option, however, this would prevent the proposed solar PV plant from contributing to the environmental, social and economic benefits associated with the development of the renewables sector within the local and district municipalities, as well as the North West province. It will also prevent the electricity generated by the proposed solar PV plant being fed into the national transmission and distribution network and being sold to consumers within the Maquassi Hills Local Municipality.”

1.2 Scope of Work

The following shows the scope of work for the project.

Wetlands Risk Assessment

- Provide an overview of relevant legislative requirements specifically relating to wetlands and watercourses.
- Delineate of all wetlands present in accordance with the DWS wetland delineation guideline – A practical field procedure for the identification and delineation of wetland and riparian areas. As part of the delineation, wetlands must be divided and classified into Hydrogeomorphic (HGM) units.
- Carry out a Level 2 Wetland Health and Functional Assessment of all systems identified.
- Recommend suitable setback buffers.
- Assess the impact on the wetland and recommend mitigation measures (which may include offsets) for likely impacts.
- Provide a comprehensive report that includes the methodology and findings of the work undertaken.
- Produce a detailed map using recognised GIS software compatible with the ArcGIS program.
- Generate data that is compatible with existing Municipal GIS systems (ArcView) to allow the resulting data to be distributed and incorporated into other GIS data sets.
- Compile the findings of the Wetland Risk Assessment into a report.

2 KEY LEGISLATION

Relevant environmental legislation pertaining to the protection and use of water resources in South Africa has been included in Table 2-1.

Table 2-1: Relevant Legislation.

Legislation	Description of relevant portions
The National Water Act 36 of 1998.	This Act imposes 'duty of care' on all landowners, to ensure that water resources are not polluted. The following Clause in terms of the National Water Act is applicable in this case: **19 (1)** *"An owner of land, a person in control of land or a person who occupies or uses the land on which (a) any activity or process is or was performed or undertaken; which causes, has caused or likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring"* Chapter 4 of the National Water Act is of particular relevance to wetlands and addresses the use of water and stipulates the various types of Licenced and unlicensed entitlements to the use water. Water use is defined very broadly in the Act and effectively requires that any activities with a potential impact on wetlands (within a distance of 500m upstream or downstream of a wetland) be authorized.
General Authorisations (GAs).	These have been promulgated under the National Water Act and were published under GNR 398 of 26 March 2004. Any uses of water which do not meet the requirements of Schedule 1 or the GAs, require a Licence which should be obtained from the Department of Water and Sanitation (DWS).

Legislation	Description of relevant portions
Environmental Impact Assessment (EIA) Regulations.	New regulations have been promulgated in terms of Chapter 5 of NEMA and were published on 4 December 2014 in Government Notice No. R. 32828. In addition, listing notices (GN 983-985) lists activities which are subject to an environmental assessment.
National Environmental Management Act 107 of 1998.	This is a fundamentally important piece of legislation and effectively promotes sustainable development and entrenches principles such as the 'precautionary approach', 'polluter pays', and requires responsibility for impacts to be taken throughout the life cycle of a project.
South African Constitution 108 of 1996.	This includes the right to have the environment protected through legislative or other means.
National Environmental Management: Biodiversity Act No. 10 of 2004.	The intention of this Act is to protect species and ecosystems and promote the sustainable use of indigenous biological resources. It addresses aspects such as protection of threatened ecosystems and imposes a duty of care relating to listed invasive alien plants.
Conservation of Agricultural Resources Act 43 of 1967.	The intention of this Act is to control the over-utilization of South Africa's natural agricultural resources, and to promote the conservation of soil and water resources and natural vegetation. This includes wetland systems and requires authorizations to be obtained for a range of impacts associated with cultivation of wetland areas.

3 ASSUMPTIONS & LIMITATIONS

The following limitations are applicable to this project:

- It has been assumed that the extent of the development area provided by the responsible party is accurate;
- Only wetlands that were likely to be impacted by proposed development activities were assessed in detail during the field survey. Wetlands located within a 500m radius of the sites but not in a position within the landscape to be measurably affected by the development were not considered as part of this assessment;
- The GPS used for ground truthing is accurate to within five meters. Therefore, the observation site's delineation plotted digitally may be offset by up to five meters to either side;
- The assessment of potential impacts was informed by site-specific environmental conditions at the time of the site visit and ecological concerns based on the investigator's working knowledge and experience with similar projects; and
- Information used to inform the assessment was limited to data and GIS coverage's available for the province at the time of the assessment.

4 PROJECT LOCALITY

4.1 Locality

The project area is located on Portion 37 of the Farm Leeuwbosch No. 44, approximately 6km north-east of the town of Leeudoringstad within the Maquassi Hills Local Municipality in the Dr Kenneth Kaunda District Municipality of the North West Province (see Figure 4-1 and Figure 4-2).

4.2 Hydrological Context

The project area is located in the C25A quaternary catchment. The study site falls within the Middle Vaal Water Management Area (WMA). The project area is situated on the crest landscape position on a south-east facing slope. The slope is fairly flat. The overall topographical landscape features are shown in Figure 4-3.

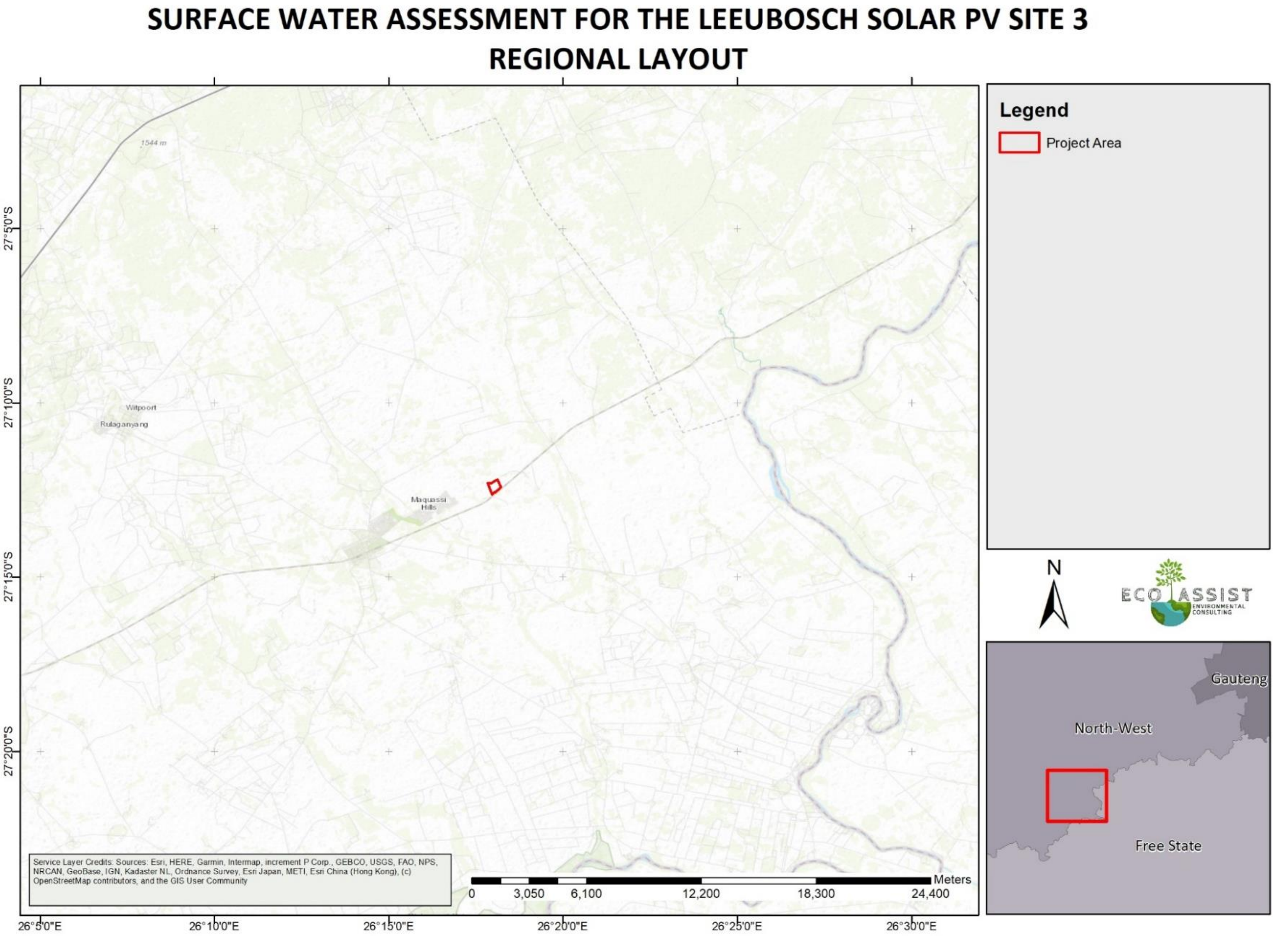

Figure 4-1: Map illustrating the regional context of the proposed project area.

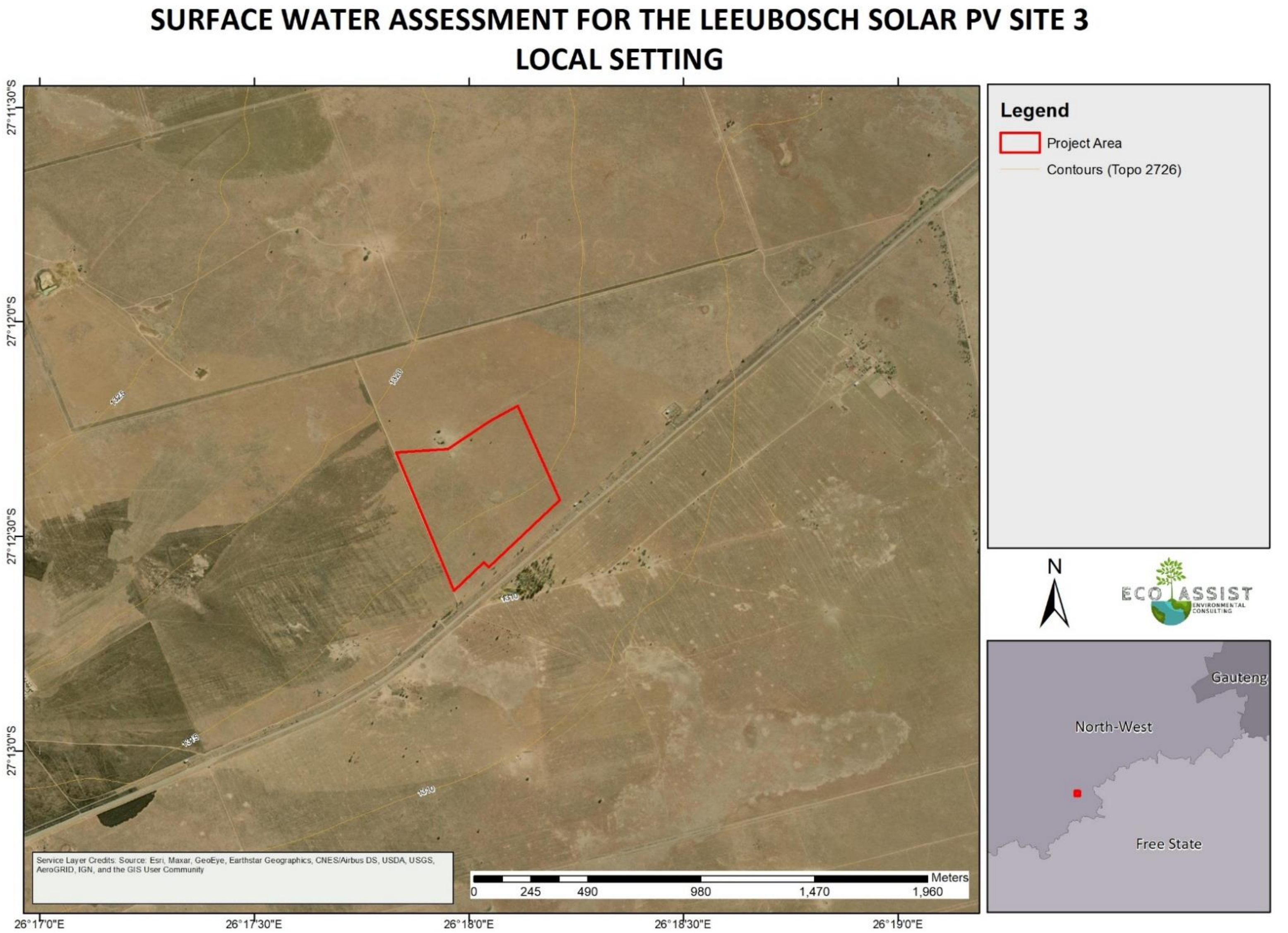

Figure 4-2: Local setting of the proposed project area.

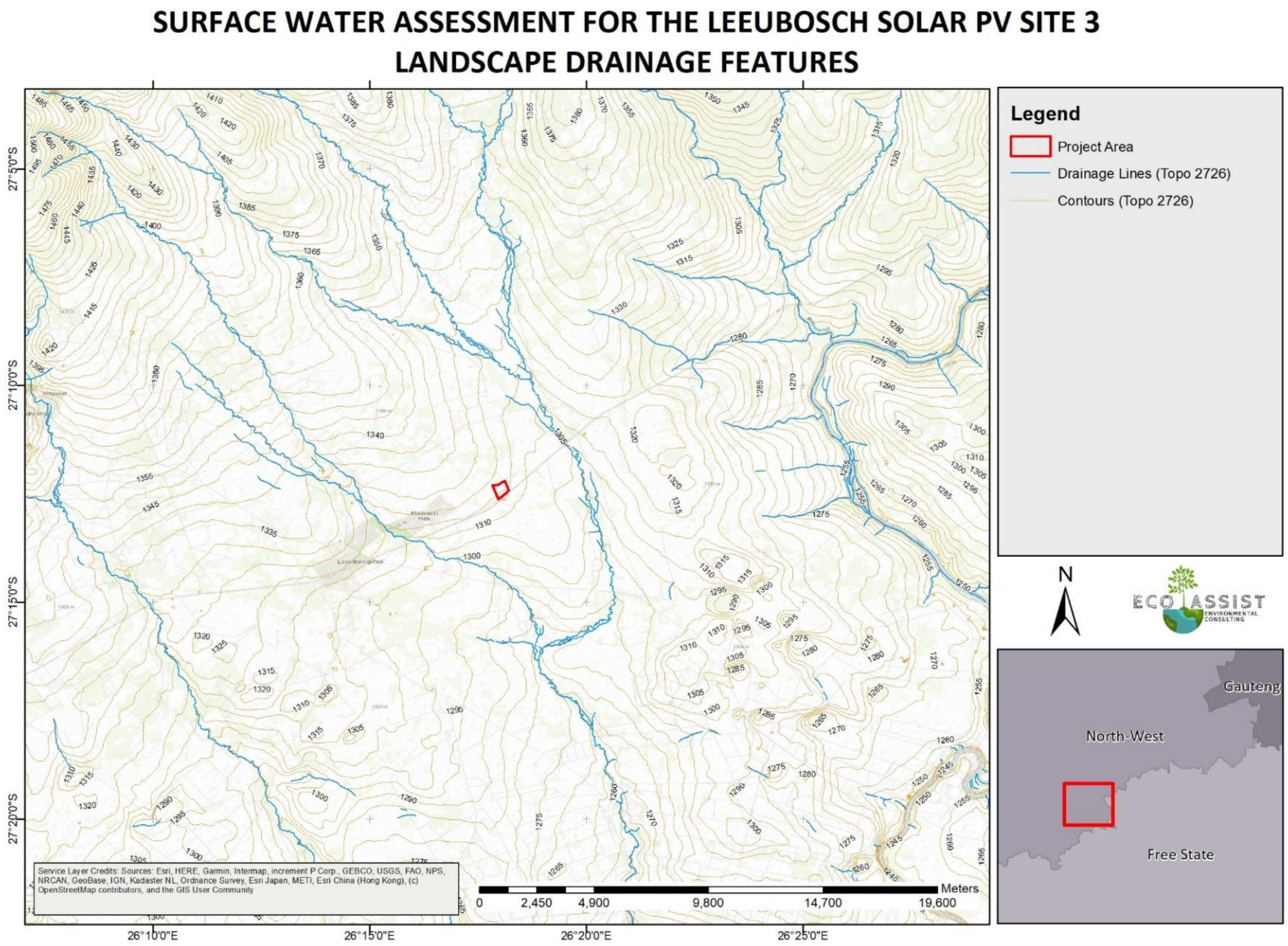

Figure 4-3: The drainage features and topographical features of the project area.

4.3 Climate

The climate of the vegetation unit is warm-temperate, with summer rainfall climate, with overall Mean Annual Precipitation (MAP) of 530mm. The unit is characterised by high summer temperatures. Severe frost (37 days per year on average) occurs in winter (Mucina & Rutherford, 2006).

4.4 Regional Vegetation

The project area falls within the Dry Highveld Grassland bioregion of the Grassland Biome and was within the Vaal-Vet Sandy Grassland vegetation unit.

The vegetation and landscape features of the Vaal-Vet Sandy Grassland vegetation unit is characterised by a plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. The dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally, the low cover of *T. triandra* and the associated increase in *Elionorus muticus, Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall (Mucina & Rutherford, 2006).

4.5 Desktop Soils & Geology

Existing Land Type data was used to obtain generalised soil patterns and terrain types for the site. Land Type data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of similar terrain types, pedosystems (uniform terrain and soil pattern) and climate (Land Type Survey Staff, 1972 - 2006).

The project falls within the Bd12 land type. The land type is dominated by the footslopes landscape position as shown in Figure 4-4. The footslopes are dominated by Glenrosa, Glencoe, and Avalon soil forms, with some Valsrivier and Arcadia soil forms present as well. The valley bottoms are dominated by the Willowbrook and Arcadia soil forms. The slopes in the land type range from 0% to 3% indicating a flat area.

The geology for this land type is mainly Ventersdorp lava. Pans occupy 1% of land type (Land Type Survey Staff, 1972 - 2006).

According to Mucina and Rutherford, (2006) the geology and soils of the vegetation unit comprise Aeolian and colluvial sand overlying sandstone, mudstone, and shale of the Karroo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north (Mucina & Rutherford, 2006).

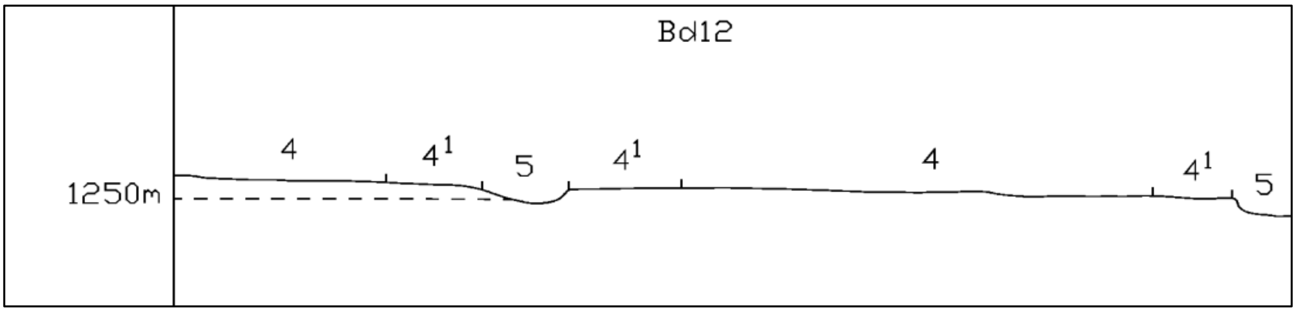

Figure 4-4: The hillslope catena of land type Bd12.

5 SITE SENSITIVITY VERIFICATION (IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

Part A of the Assessment Protocols published in GN 320 on 20 March 2020 (i.e. Site sensitivity verification is required where a specialist assessment is required but no specific assessment protocol has been prescribed) is applicable where the DEFF Screening Tool has the relevant themes to verify.

In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

5.1 Site Sensitivity Verification

The site sensitivity according to DFFE is shown in Figure 5-1. The screening tool was used for the 500m regulated area of the proposed PV site and shows that the site including the regulated area has a low sensitivity.

The site verification was conducted by using satellite imagery as well as a field assessment for the site which is described in detail in the subsequent sections.

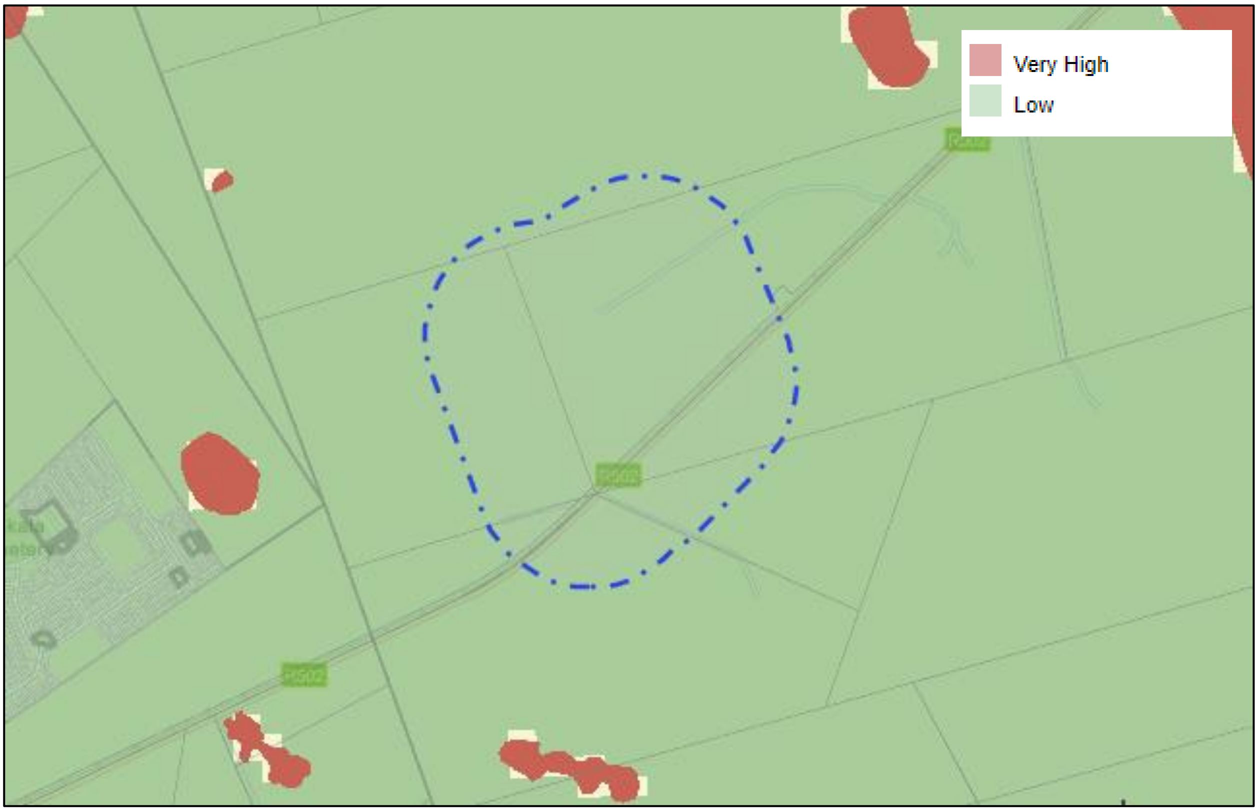

Figure 5-1: Site sensitivity as per the DFFE screening tool on the 500m regulated area of the Leumax PV 1 site.

5.2 Outcome of Site Sensitivity Verification

The site verification assessment shows that no wetlands are at risk from the proposed development and the summarised findings are as follows;

- No National Freshwater Ecosystem Priority Areas NFEPA wetlands or watercourses could be identified directly on the study site or within the 500m regulated area.
- No South African Inventory of Inland Aquatic Ecosystems (SAIIAE) wetlands or watercourses could be identified directly on the study site or within the 500m regulated area.
- The wetland survey was conducted on the 23rd of July 2022 which is within the dry season. The wetland delineation for the 500m regulated area is shown in Figure 7-3. The wetland delineation identified three (3) depression wetland units and were categorised into 3 HGM units based on the similarities and impacts within these wetlands.
- Only HGM 3 was located within the 500m regulated area, however this wetland is approximately 185m away from the proposed project infrastructure and is buffered by the main road. Even with a strict buffer zone the proposed infrastructure will not have any impacts on this wetland.

5.3 National Environmental Screening Tool

Construction Phase:

During the construction phase the Solar PV as well as the access road footprints will be cleared and then excavated for the construction of foundations and the levelling of the road. The clearing of the footprint will increase the bare surface area increasing the runoff potential which will increase the risk of potential erosion and sedimentation into the wetland areas. The risk associated with the clearing is rated as being Low as the wetland HGM 3 is 185m away from the proposed infrastructure, and no impacts are anticipated to impact the wetlands.

Operational Phase:

During the operational phase the major concerns are that of the change in surface and sub-surface flows. With the increase in hardened surfaces within the wetland catchment, the volume and velocity of stormwater runoff will increase significantly and with it the risk of erosion. The risk was rated as Low as the wetland HGM 3 is 185m away from the proposed infrastructure, and no impacts are anticipated to impact the wetlands.

The impact assessment has determined that the activities are rated as a Low as the wetland HGM 3 is 185m away from the proposed infrastructure, and no impacts are anticipated to impact the wetlands.

5.4 Verification Statement

The Leeuwbosch Solar PV site 3 project does not show wetlands within the boundary of the proposed footprint; however, one (1) wetland (HGM 3) was found within the 500m regulated area. The wetland was located south of the project area approximately 185m away. The wetland is also buffered by the main road. The impact assessment concluded that the wetland will not be impacted by the proposed project and that the impact was rated as Low or no perceived impact.

It is the opinion of the Specialist that the proposed development may proceed this is based on the above findings and recommendations.

6 METHODOLOGY

6.1 Wetland Assessment

6.1.1 Wetland Delineation

A wetland is defined as: Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil (from the South African National Water Act; Act No. 36 of 1998).

The **Hydrogeomorphic** (**HGM**) Classification identifies groups of wetlands that function similarly using three criteria that fundamentally influence how wetlands function. These criteria are geomorphic setting, water source, and hydrodynamics. Geomorphic setting refers to the landform in which the wetland occurs, its geologic evolution, and its topographic position in the landscape. Water source refers to the primary source of the water entering the wetland. The three primary water sources are precipitation, overbank surface flow, or groundwater. Hydrodynamics refers to the level of energy and the direction that water takes as it moves into and through the wetland.

The wetlands are delineated in accordance with the (Department of Water Affairs (DWAF), 2005) guidelines, a cross section is presented in Figure 6-1. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;
- The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group 1991):
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

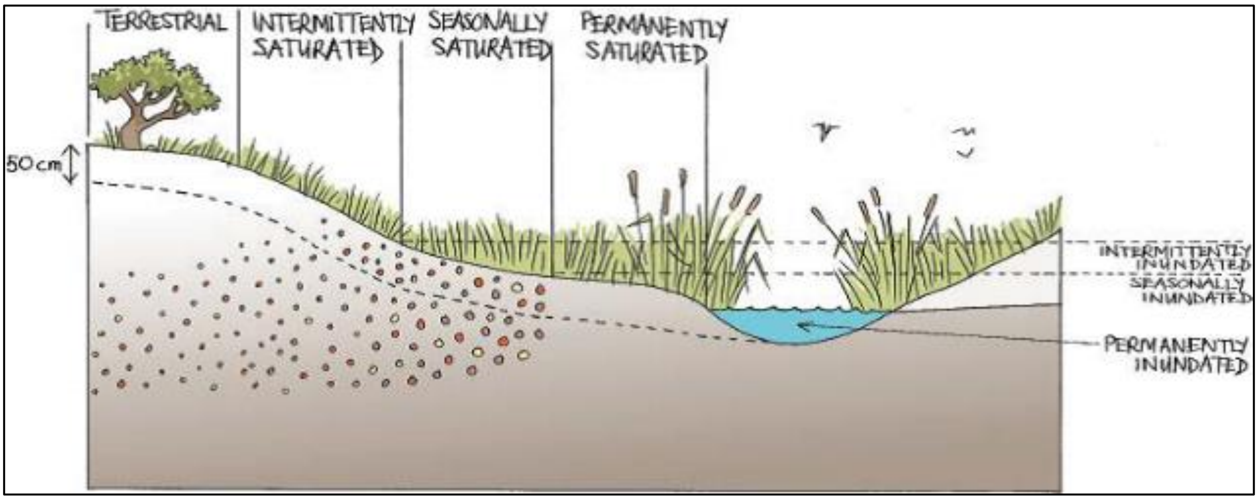

Figure 6-1: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al, 2013).

6.1.2 Present Ecological State

The Present Ecological State (PES) was determined by using the Wet-Health (Version 2.0) guidelines (Macfarlane, et al., 2020). WET-Health Version 2 consists of a series of three tools developed to assess the Present Ecological State (PES) or "ecological health" of wetland ecosystems of different hydrogeomorphic types at three different levels of detail/resolution.

PES is then assessed by evaluating the extent to which anthropogenic activities have altered wetland characteristics across the four inter-related components of wetland health, as follows:

Hydrology is defined in this context as the distribution and movement of water through a wetland and its sediments. This component focuses on (i) changes in water inputs that result from human alterations to the catchment which affect water inflow quantity and pattern, and (ii) modifications within the wetland itself that alter the water distribution and retention patterns of the wetland (e.g., artificial drainage channels). These aspects are then integrated into a composite score that reflects the overall change in wetland hydrology.

Geomorphology in this context is assessed by assessing changes to (i) geomorphic processes and (ii) the geomorphic structure of the wetland. Geomorphic processes in this context, refers to those physical processes that are currently shaping and modifying wetland form and evolution, whilst geomorphic structure refers to the three-dimensional shape of sediment deposits on which wetland habitat is established. Whilst catchment drivers (similar to those assessed in the hydrology module) are integrated as part of the assessment, impacts are ultimately assessed based on an understanding of the degree to which within-wetland geomorphic processes and the associated structure of the wetland have been altered by anthropogenic activities. The component also accounts for differences in geomorphic processes in wetlands characterised by clastic (minerogenic) sedimentation and those characterised by organic sediment accumulation (peat).

Water quality is defined as the physico-chemical attributes of the water in a wetland. It is assessed based on considering both potential diffuse runoff from land uses within the wetland and from the areas surrounding the wetland, together with point-source discharges of pollution entering directly into the wetland and/or into streams that flow into that wetland.

Vegetation is defined in this context as the structural and compositional state of the vegetation within a wetland. This component evaluates changes in vegetation composition and structure as a consequence of current and historic on-site transformation and/or disturbance. Whilst the assessor needs to have some knowledge of vegetation in a particular region, the method does not require the assessor to be able to identify all wetland plant species. The emphasis is rather on identifying alien and ruderal (weedy) species that indicate disturbance and assessing their occurrence relative to common naturally occurring indigenous species, including those that are naturally dominant in the wetland.

The aim of WET-Health Version 2.0 is to facilitate the derivation of an Ecological Category for each of the four components of wetland PES and an overall Ecological Category for each wetland that is being assessed. A common suite of Ecological Categories (or Present State Categories), ranging from A to F, are typically used in PES assessments of inland aquatic ecosystems in South Africa (see Table 6-1).

Table 6-1: The Present Ecological State categories (Macfarlane, et al., 2020).

Impact Category	Ecological Category	Description	Impact Score	PES Score (%)
None	**A**	**Unmodified, natural.**	**0 to 0.9**	**90 - 100**
Small	**B**	**Largely Natural** with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	**1.0 to 1.9**	**80 - 89**
Moderate	**C**	**Moderately Modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	**2.0 to 3.9**	**60 - 79**
Large	**D**	**Largely Modified.** A large change in ecosystem processes and loss of natural habitat and biota has occurred.	**4.0 to 5.9**	**40 - 59**
Serious	**E**	**Seriously Modified.** The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	**6.0 to 7.9**	**20 - 39**
Critical	**F**	**Critical Modification.** The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**8.0 to 10**	**0 - 19**

6.1.3 Ecosystem Services

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Version 2) (Kotze, et al., 2020).

WET-EcoServices provides a set of indicators (e.g., slope of the wetland) rated on a five-point scale that reflect the supply/capability of a wetland for each of the 16 different ecosystem services. Indicator scores are then combined automatically in an algorithm that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators (Table 6-2). In addition, the extent of the wetland providing the service is recorded, and the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g., toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale.

Table 6-2: Classes for determining the likely extent to which a benefit is being supplied (Kotze, et al., 2020).

Importance Category	Description

Very Low	**0 - 0.79**	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	**0.8 – 1.29**	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately Low	**1.3 – 1.69**	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	**1.7 – 2.29**	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately High	**2.3 – 2.69**	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	**2.7 – 3.19**	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	**3.2 - 4.0**	The importance of services supplied is very high relative to that supplied by

6.1.4 Importance and Sensitivity

The method used for the Importance and Sensitivity (IS) determination was adapted from the method as provided by the then Department of Water and Sanitation (DWS) (1999) for floodplains by (Rountree & Kotze, 2013).

Ecological Importance (EI) is the expression of the importance of wetlands and rivers in terms of the maintenance of biological diversity and ecological functioning at a local and landscape level. Ecological Sensitivity (ES) refers to ecosystem fragility or the ability to resist or recover from disturbance (Rountree & Kotze, 2013). The purpose of assessing ecological importance and sensitivity of water resources like wetlands, and rivers is to be able to identify those systems that provide valuable biodiversity support functions, regulating ecosystem services, or are especially sensitive to impacts. Knowing what ecosystems are valuable enables the appropriate setting of management objectives (i.e., recommended ecological category - REC) and the prioritization of management actions and interventions to promote effective water resource management.

A series of variables for IS are assessed on a scale of 0 to 4, where 0 indicates Low importance and 4 indicates Very High importance. The mean of the variables is used to assign the Ecological Importance and Sensitivity (EIS) category as listed in Table 6-3.

Table 6-3: Description of EIS categories.

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

6.1.5 Recommended Ecological Category

The Recommended Ecological Category (REC) is determined by the PES of the water resource and the importance and/or sensitivity of the water resource.

Water resources which have Present Ecological State categories in an E or F ecological category are deemed unsustainable by the DWA. In such cases the REC must automatically be increased to a D (Rountree, et al., 2013).

The REC and associated management objective for the water resource is informed by an understanding of PES, EIS and social importance (where available). Trajectory of change should be considered here by selecting a PES that is attainable rather than using the current PES, which may be subject to rapid change in a high threat environment or to improvement through planned rehabilitation interventions (Macfarlane & Bredin, 2017). The default table used to inform this process is Table 6-4.

Table 6-4: Summary of selection criteria (Macfarlane & Bredin, 2017).

Attainable PES	Importance			
	Very High	High	Moderate	Low
A	A Maintain	A Maintain	A Maintain	A Maintain
B	A Improve	A/B Improve	B Maintain	B Maintain
C	B Improve	B/C Improve	C Maintain	C Maintain
D	C Improve	C/D Improve	D Maintain	D Maintain
< D	D Improve	D Improve	D Improve	D Improve

6.1.6 Buffer Determination

The "Buffer Zone Guidelines for Rivers, Wetlands, and Estuaries" (Macfarlane & Bredin, 2017) was used to determine the appropriate buffer zone for the proposed activity.

Buffer zones have been defined as a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another. Buffer zones are typically designed to act as barriers between human activities and sensitive water resources to protect them from adverse negative impacts.

7 FINDINGS

7.1 Wetland Findings

7.1.1 NFEPA Wetlands

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA (Nel, et al., 2011).

No wetlands or watercourses could be identified directly on the study site. Additionally, no wetlands were found to be within 500m of the study site.

However, the Leeudoringspruit was found to be within approximately 150m south from the southern corner of the study site boundary. The Leeudoringspruit is classified as having a PES: B (Largely natural), EI: Moderate and ES: Moderate (DWA, 2014). At a general level however, the North West Province Biodiversity Conservation Plan (2008) database shows that the study site falls within a Critical Biodiversity Area – Category 1, making the local region ecologically significant from a conservation point of view (SiVEST, 2020).

7.1.2 South African Inventory of Inland Aquatic Ecosystems (SAIIAE)

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer, et al., 2018) has updated the previous NFEPA maps to give a more comprehensive desktop data set of the wetlands at a national level. The data has been called the National Wetland Map 5 layers (NWM5).

No wetlands or watercourses could be identified directly on the study site. Additionally, no wetlands were found to be within 500m of the study site.

7.1.3 Wetland Survey Results

The wetland survey was conducted on the 23rd of July 2022 which is within the dry season. A hand-held auger and a GPS phone were used to log all information in the field. The wetlands within the 500m regulated area were identified in some areas and delineated in accordance with the DWAF (2005) guidelines. A surface water (wetland assessment) has been conducted in the area and the findings were used to inform parts of this assessment. The assessment is listed below:

- Proposed Construction of Leeuwbosch Solar Photovoltaic (PV) Plants (Leeuwbosch 1 Solar PV Plant & Leeuwbosch 2 Solar PV Plant) on Portion 37 of the Farm Leeuwbosch No. 44 near Leeudoringstad, North West Province: Surface Water Delineation and Assessment Report (SiVEST, 2020)

The wetland delineation for the 500m regulated area is shown in Figure 7-3. The wetlands identified are listed in Table 7-1. The wetland delineation identified three (3) depression wetland units and were categorised into 3 HGM units based on the similarities and impacts within these wetlands.

Only the wetlands at risk were analysed during the functional assessment. This is determined on whether the wetlands will incur direct or indirect impacts. Therefore, wetlands that are a significant distance upstream, and/or away from the proposed activity, and/or are in a separate catchment will not be at risk. Also, only natural systems can be assessed (see Table 7-1).

Table 7-1: Wetlands with their associated HGM classifications for the proposed project area.

Wetland Type	HGM Unit	Risk
Depression	HGM 1	No
Depression	HGM 2	No
Depression	HGM 2	No

Only HGM 3 was located within the 500m regulated area, however this wetland is approximately 185m away from the proposed project infrastructure and is buffered by the main road. Even with a strict buffer zone the proposed infrastructure will not have any impacts on this wetland.

The survey was conducted during the dry season in July 2022. The project area was dominated by yellow-brown apedal soils of the Clovelly soil form (see Figure 7-1). No wetland soil indicators were identified on the site.

Figure 7-1: The soils within the project area with uniform pedological features (July 2022).

The project area was uniformly covered with short grassland (see Figure 7-2). No wetland vegetation was identified. This is in concurrence with the previous assessments completed in the areas.

Figure 7-2: Uniform short grass vegetation covering the entire site (July 2022).

Based on the above no Wetland Health or Functional assessment is necessary however the wetland assessment ratings for the previous assessment will be summarised below for reference.

Terrain and Soil Characteristics

Depression HGM 3 (approximately 5.7ha) is found approximately 125m to the south west of PV project study site. As such, the landscape characteristics are identical in that the landscape is flat. Once more, the shallowed-out basin in the landscape provides the template where the wetland has formed.

However, excavation activities have taken place within the wetland, presumably in an attempt to provide additional surface water for cattle to drink.

In terms of soil characteristics, an Orthic A horizon overlaying a Soft Plinthic B horizon was observed. Excavations within the wetland make the wetland artificially deeper than would otherwise naturally be the case. A limited amount of surface water was therefore evident in the deeper excavated areas within the wetland. Nonetheless, the sub-soils were found to comprise a mixture of sandy/loamy/clay particles within the soil matrix. The soils were a dark brown colour with mottling signatures present in the form of orange, red and black mottles. Grey soil particles indicating reduction processes taking place in the wetland subsoils were also evident. Accordingly, with the combination of the two soil horizon types, the Westleigh Soil Form could be attributed to the soils in Depression Wetland 3. With the degree of clay particles in Depression Wetland 3, it is also expected that soil saturation is seasonal.

Vegetation

Vegetation observed in Depression HGM 3 varied from hydrophytic species within the open surface water pools in the excavated areas to graminoid species which dominated the majority of the wetland. Of the hydrophytic species observed, these included *Juncus sp.* (ow), *Marsilea sp.* (ow) and *Persicaria sp*. (ow - weed). Graminoid species in the wetter core areas of the wetland consisted of mainly *E. plana* (fw), whilst *T. triandra* and *H. hirta* were also observed.

Present Ecological State (PES)

The overall PES for the depression wetland was determined to have an overall PES – D Largely Modified (SiVEST, 2020).

With respect to the hydrological integrity of the wetland, the most significant factors to have scored a negative impact on the system included the change in surface roughness and impeding features (dirt and tar roads in / nearby the wetlands). The change in surface roughness and the presence of dirt roads which act to change the distribution and retention of water within the wetland by increasing flood peaks after rainfall events. Limited cover therefore can also act as an erosive force contributing to additional sediment inputs into the wetlands. A further factor affecting the state of Depression HGM 3 specifically were the excavation impacts to the wetlands. Here the excavation areas leave the wetland exposed when not inundated. Fortunately, due to the shallow nature of the wetlands and the presence of bedrock, this hardened layer seems to assist in preventing erosion as no erosion was evident. The excavations therefore did not impact to a significant degree on the overall health category.

The vegetation component for the wetland was assessed to have mainly been affected by the presence of dirt roads and grazing by cattle. The lack of surface roughness was observed to influence the degree of vegetation disturbance noted in the wetlands. However, vegetation disturbance was assessed to be moderate in terms of these impacts. Again however, the excavation impacts were an additional impact affecting Depression HGM 3 specifically which resulting in an increased impact to the wetland. The magnitude of existing impacts was assessed to have a large overall impact on the vegetation PES of the Depression HGM 3, as a result of additional impacts due to excavation, a health category of D – Largely modified was attributed.

Ecosystem Services

The potential ecosystem service provided by depression HGM 3 which scored highest was sediment trapping, which can be said to be the primary function of an endorheic wetland. Other potential wetland ecosystem services provided at a slightly lower degree include phosphate trapping and erosion control followed closely by toxicant control and nitrate removal. Other potential wetland ecosystem services which could potentially be provided, which scored to a lesser degree, included flood attenuation, education and research, tourism and recreation, natural resources and maintenance of biodiversity. The ecosystem services are not very high due to the relatively limited extent (5.7 hectares) of the wetland, the degree of disturbance as well as the general limitations to basic functions that can be performed by endorheic wetlands. However, the main functions and services provided are arguably most significant in terms of sedimentological functions such sediment trapping (SiVEST, 2020).

Ecological Importance and Sensitivity (EIS)

During the site visit (SiVEST, 2020), the only faunal activity observed included ground squirrels and mongoose in the nearby surrounding area outside the wetlands. However, whilst limited activity was observed at the time the fieldwork was undertaken, avifaunal and amphibian species may well frequent the wetland at various stages of the day and seasonally in the year when surface water is present. This is especially so for the man-made impoundment where water supply will be of a more regular occurrence than the surrounding features in the landscape which rely directly on rainfall. Therefore, the limitations of this short term once off study must not detract from the possibility of faunal activity in the area throughout the year. Overall, taking the above into account as well as the PES / wetland ecosystem services results the overall PES for the depression wetland was determined to have an overall EIS – Class C (Moderate).

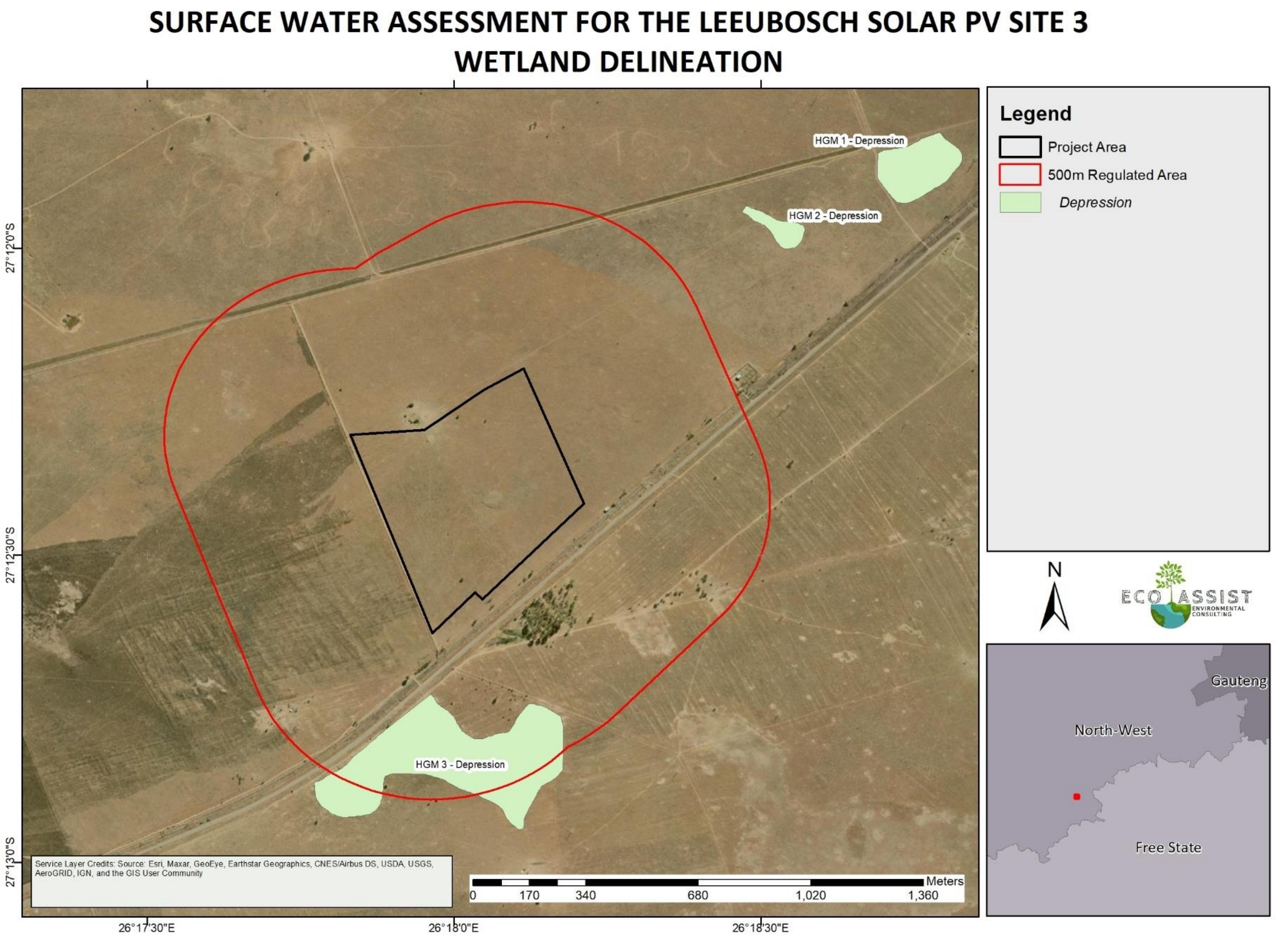

Figure 7-3: Wetland delineations for the proposed project area.

8 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

8.1 Methodology

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

8.1.1 Determination of Significance of Impacts

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 8-1.

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.

8.1.2 Impact Rating System

The impact assessment must take account of the nature, scale, and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- 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 has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

8.1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 8-1: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g., Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / 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 (e.g., oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
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 (P)		
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).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter 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 (L)		
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.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects 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 and its effects 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 – 50 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 transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e., whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
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 (system collapse). Rehabilitation and remediation often impossible. If possible, rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
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. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) 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**

5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	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".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

8.2 Impacts Identified

The potential impacts on agricultural resources identified for the proposed construction of the development within the various sites and the associated mitigation measures are provided in Table 8-2.

Table 8-2: Impacts description and mitigation measures to be taken.

Impact	Description
Loss of agricultural land and / or loss of agricultural potential as a result of the proposed activity	Potential disturbances include compaction, physical removal, and potential pollution; The exposed soil surfaces have the potential to erode easily if left uncovered which could lead to the loss of the soil resource. • Soil that are excavated for the installation of foundations will have their physical and chemical states altered negatively; • Potential loss of stockpiled topsoil and other materials through erosion if not protected properly; • Insufficient stormwater control measures may result in localised high levels of soil erosion, possibly creating dongas or gullies, which may lead to decreased water quality in surrounding watercourses; • Increased erosion could result in increased sedimentation which could impact on ecological processes; • The additional hardened surfaces created during construction could increase the amount of stormwater runoff, which has the potential to cause erosion; • Physical disturbance of the soil and plant removal may result in soil erosion/loss; and • Erosion and potential soil loss from cut and fill activities and areas where naturally dispersive soils occur.

8.3 Impact Assessment Findings

The Table 8-3 presents the impact assessment findings in relation to the proposed construction activities.

Construction Phase:

During the construction phase the Solar PV as well as the access road footprints will be cleared and then excavated for the construction of foundations and the levelling of the road. The clearing of the footprint will increase the bare surface area increasing the runoff potential which will increase the risk of potential erosion and sedimentation into the wetland areas. The risk associated with the clearing is rated as being Low as the wetland HGM 3 is 185m away from the proposed infrastructure, and no impacts are anticipated to impact the wetlands.

Operational Phase:

During the operational phase the major concerns are that of the change in surface and sub-surface flows. With the increase in hardened surfaces within the wetland catchment, the volume and velocity of stormwater runoff will increase significantly and with it the risk of erosion. The risk was rated as Low as the wetland HGM 3 is 185m away from the proposed infrastructure, and no impacts are anticipated to impact the wetlands.

The impact assessment has determined that the activities are rated as a Low as the wetland HGM 3 is 185m away from the proposed infrastructure, and no impacts are anticipated to impact the wetlands.

Table 8-3: Impact assessment ratings for the Ukuwela development sites

LEUMAX PV 1 SOLAR PV FACILITY																				
ENVIRONMENTAL PARAMETER	**ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**RECOMMENDED MITIGATION MEASURES**	**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**		**E**	**P**	**R**	**L**	**D**	**I / M**	**TOTAL**	**STATUS (+ OR -)**	**S**
Construction Phase																				
Clearing of infrastructure footprints for construction	Loss of wetland areas through direct impact or indirect impacts of erosion or sedimentation).	1	1	2	1	2	1	7	-	Negative Low impact	• See mitigation section	1	1	2	1	2	1	7	-	Negative Low impact
Operation of equipment and machinery	Hydrocarbon spills and compaction within wetland zones.	1	1	1	1	1	2	10	-	Negative Low impact	• See mitigation section	1	1	1	1	1	2	10	-	Negative Low impact

Waste and ablutions	Sewerage spills within wetlands or drainage lines feeding wetlands	1	1	1	1	1	2	10	-	Negative Low impact	• See mitigation section	1	1	1	1	1	2	10	-	Negative Low impact
Storage of construction material	Spills of stored hazardous material into wetlands or drainage lines feeding wetlands	1	2	1	1	1	1	6	-	Negative Low impact	• See mitigation section	1	1	1	1	1	1	5	-	Negative Low impact
Proliferation of alien vegetation	The introduction of alien vegetation into disturbed areas disrupting natural wetland vegetation composition or alteration of water transpiration from soils.	2	3	2	1	2	2	20	-	Negative Low impact	• See mitigation section	2	2	2	1	1	2	16	-	Negative Low impact
Alteration of surface & sub-surface drainage	The change in flow dynamics to and through wetlands potentially altering wetland types or potentially causing erosion from increased surface runoff.	1	1	1	1	1	1	5	-	Negative Low impact	• See mitigation section	1	1	1	1	1	1	5	-	Negative Low impact
Operational Phase																				

Drainage patterns change due to altered flow paths	The change in flow dynamics to and through wetlands potentially altering wetland types or potentially causing erosion from increased surface runoff.	1	1	1	1	1	1	5		Negative Low impact	• See mitigation section	1	1	1	1	1	1	5	-	Negative Low impact
Operational traffic causing hydrocarbon spills	Hydrocarbon spills and compaction within wetland zones.	1	1	1	1	1	1	5		Negative Low impact	• See mitigation section	1	1	1	1	1	1	5	-	Negative Low impact
Sedimentation from road surfaces & Infrastructure	Loss of wetland areas through direct impact or indirect impacts of erosion or sedimentation.	1	1	1	1	1	1	5		Negative Low impact	• See mitigation section	1	1	1	1	1	1	5	-	Negative Low impact

9 MITIGATION MEASURES

The mitigation hierarchy is regarded internationally as the best practice framework for environmental planning and managing environmental impacts. It is a set of prioritized, sequential steps that are applied to anticipate, avoid, and reduce the potential negative impacts of project activities on the natural environment. It involves a sequence of four key components: avoidance, minimization, remediation, and offset as illustrated in (Edwards, et al., 2018).

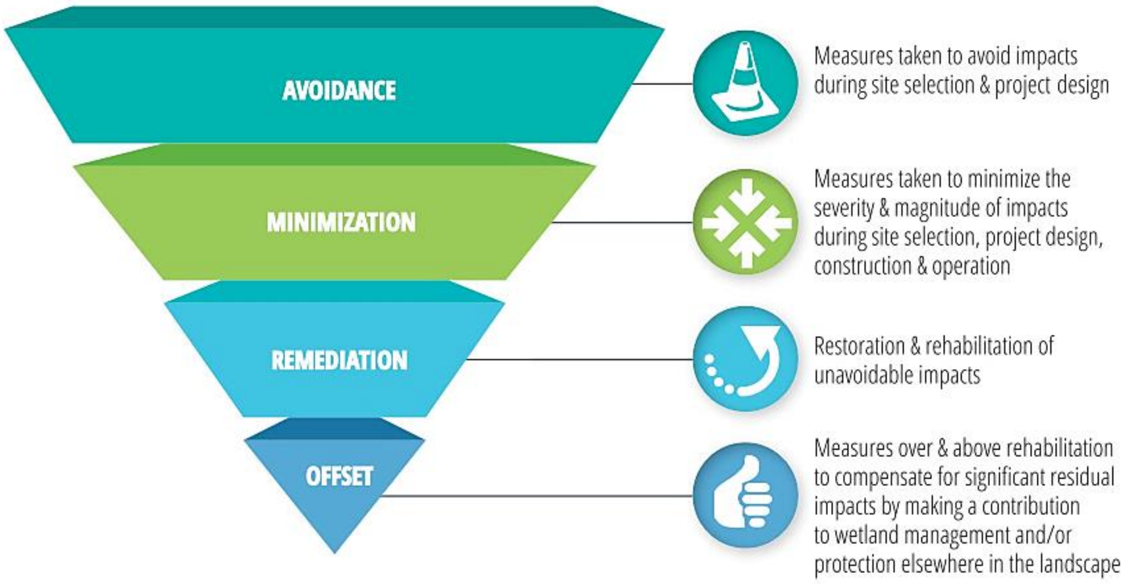

Figure 9-1: The mitigation hierarchy (Edwards, et al., 2018)

The focus of mitigation measures is to follow the mitigation hierarchy where possible. The activities that are not required within the water resource and its associated buffer zone will follow the avoidance principles and as a result impacts/risk are expected to be low for these activities. The aspects that occur within the water resource will follow the minimization and remediating principles to reduce the significance of potential impacts associated with the proposed activity. The prescribed mitigation measures for the proposed activity are provided in the respective sections below.

9.1 Site Planning

Every effort must be made to avoid potential impacts from the outset of a project (e.g., through careful spatial or temporal placement of elements of infrastructure) to prevent or limit impacts to water resources.

Various aspects will contribute to the risks described above, and as a result the mitigation measures for these aspects are listed below.

9.2 Site Clearing

During site clearing the vegetation and topsoil is removed, increasing the runoff and erosion potential of flowing water. to mitigate these impacts the following measures must be followed:

- Minimise the area of soil disturbance to reduce the impact of sedimentation into waterbodies.

- Clearing and grading must occur only where necessary to build and provide access to structures and infrastructure. Clearing must be done immediately before construction, rather than leaving soils exposed for months or years.
- Where possible, plants should be cut down to ground level instead of being removed completely to stabilise the soil during land-clearing operations.
- The proposed limits of land disturbance must be physically marked off to ensure that only the land area required for the development is cleared.
- When excavated areas are backfilled the surface must be level with the surrounding land surface, to minimise soil erosion from the areas when the excavation is complete.
- The most efficient approach to control erosion is to minimise the area of land disturbed as well as the duration for which it is exposed.
- Once surfaces have been exposed, they must immediately be protected from erosion, so limiting the source of the sediment.
- During the excavation of pits, roads, construction sites etc. the removed topsoil must be stored and appropriately protected so that it does not wash into waterbodies, causing sedimentation and nutrient loading. This is then used to backfill the area so that it can be effectively rehabilitated.
- Topsoil that is removed during excavation must NEVER be buried or rendered unusable in any way (such as mixing it with spoils or being compacted by machinery).
- During excavation soil must be excavated one layer at a time and stored in separate stockpiles so they can be returned in their natural order when the area is backfilled. This improves soil functions and improves the template for plant growth.

9.3 Access Control

- Water resources must be well fenced and sign-posted, to keep machinery, people, and livestock away from the water body as well as vegetated areas to reduce the soil disturbance, soil compaction and vegetation destruction, which thus reduces the amount of erosion and habitat loss.

9.4 Erosion & Sedimentation Control

- Sediment traps are small impoundments that allow sediment to settle out of runoff. They are usually installed in a drainageway or other point of discharge from a disturbed area. Temporary diversions can be used to direct runoff to the sediment trap. Sediment traps detain sediments in stormwater runoff to protect receiving water bodies, and the surrounding area. The traps are formed by excavating an area or by placing an earthen embankment across a low area or drainage swale. An outlet or spillway is often constructed using large stones or aggregate to slow the release of runoff.

9.5 Soil Stabilisation

- Stabilization practices (e.g., revegetation) must occur as soon as possible after grading. In colder climates, a mulch cover is needed to stabilize the soil during the winter months when grass does not grow or grows poorly.

- The following measures can be used to stabilize soils for site preparation and construction: hydro mulch, straw (placed evenly on slope), crimping (rolling the placed straw with a sheep-foot roller), seeding, fertiliser, transplanting and net (jute netting pinned onto the slope).

9.6 Stockpile management

- Unprotected stockpiles are very prone to erosion and therefore must be protected. Small stockpiles can be covered with a tarp to prevent erosion. Large stockpiles must be stabilized by erosion blankets, seeding, and/or mulching.

9.7 Pollution Control

- If soil contamination occurs (such as due to a spill) the soil must be removed from the site and disposed of appropriately.
- Prevention of spills eliminates or minimizes the discharge of pollutants to water bodies.
- Handle hazardous and non-hazardous materials, such as concrete, solvents, asphalt, sealants, and fuels, as infrequently as possible and observe all national and local regulations when using, handling, or disposing of these materials.
- An effective response plan must be in place and personnel must be ready to mobilise in the event of a spillage to reduce the environmental effects of an oil or chemical spill.
- Spill control devices such as absorbent snakes and mats must be placed around chemical storage areas, and they can be used in an emergency to contain a spill.
- Implement preventative maintenance system to ensure that work vehicles are maintained in an acceptable condition. This would involve routinely checking vehicles for leaks before construction begins; and not allowing vehicles with significant leaks to operate or be repaired within the construction site. Ideally, vehicle maintenance and washing occurs in garages and wash facilities, not on active construction sites.
- Before an operation occurs near a waterbody, vehicles must be checked for leaks, to reduce soil and water contamination from vehicle fluids.
- Old engine oil must NOT be thrown on the ground or down a stormwater drains but rather collected in containers and recycled.
- Ensure that appropriate solid waste disposal facilities are provided, and adequate signage is provided for all solid, liquid, and hazardous waste types. These must contain waste products in a weatherproof manner and to prevent any airborne litter, access to scavengers or loss of food residues that may be washed into surface or ground waters. Collected waste needs to be disposed of at a registered landfill site/hazardous waste facility.
- Re-fuelling areas for vehicles must be bunded and located away from water resources and sensitive environments to prevent any accidental spillage contaminating soil or seeping into groundwater aquifers. All servicing area run-off must be directed towards a fully contained collection sump for recovery and appropriate disposal.
- There must be no standing water at a stockpile site, to reduce erosion as well as the contamination of the water by nutrients/ toxics.

9.8 Runoff Control

- Runoff from disturbed areas (such as landing/depot areas, extraction routes, gravel pits, temporary and unpaved roads) must be directed to silt traps (silt fences, sandbags, etc) to remove sediment and reduce the sedimentation of the water bodies.
- **Check dams** are small, temporary dams constructed across a swale or channel. They can be constructed using gravel, rock, gabions, or straw bales. They are used to reduce the velocity of concentrated flow and, therefore, to reduce erosion in a swale or channel.

9.9 Sediment Controls

- Sediment basins and rock dams can be used to capture sediment from stormwater runoff before it leaves a site. Both structures allow a pool to form in an excavated or natural depression, where sediment can settle. The pool is dewatered through a single riser and drainage hole leading to a suitable outlet on the downstream side of the embankment or through the gravel of the rock dam. The water is released more slowly than it would be without the control structure.

9.10 Sanitation

- Portable toilets must be provided where work is being done and must be located a considerable distance away from water resources and riparian areas.

9.11 Site Management

- Alien and invasive vegetation have several detrimental effects on water quality, from nutrient enrichment to increased erosion and excessive water use, which is especially relevant in dry areas or in important catchments. Invasive species are highly likely to colonise disturbed areas, even after rehabilitation and follow-up clearing must be done until healthy vegetation returns to the site.
- Areas (away from surface water bodies and outside of the riparian zone) must be designated for the storage of materials and mixing of materials (such as concrete or chemicals). This reduces contamination of water resources from these materials/ activities.
- To ensure that it reaches most people signs must be written in the languages of the area (NOT just English). This ensures that non-English speakers can understand and will hopefully cooperate in reducing water pollution by the measures indicated on the sign.
- Within a construction site, vehicle access must be strictly controlled (i.e., there must be set parking, turning areas, set routes and no access to undisturbed areas.) This minimises soil disturbance and compaction and pollution from fluids leaking onto the ground as well as the disturbance of aquatic organisms.

10 RECOMMENDATIONS

The following recommendations have been made to minimise threats to sensitive receptors (sub-surface flow paths) and wetland functioning;

- It is recommended that an alien invasive management programme is implemented.

11 CONCLUSIONS

The Leeuwbosch Solar PV site 3 project does not show wetlands within the boundary of the proposed footprint; however, one (1) wetland (HGM 3) was found within the 500m regulated area. The wetland was located south of the project area approximately 185m away. The wetland is also buffered by the main road. The impact assessment concluded that the wetland will not be impacted by the proposed project and that the impact was rated as Low or no perceived impact.

It is the opinion of the Specialist that the proposed development may proceed and that a GA will be sufficient, this is based on the above findings and recommendations.

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