Wetland Baseline and Impact Assessment for the proposed Becrux Solar Photovoltaic Energy Facility

Secunda, Mpumalanga

November 2021

CLIENT

savannah environmental

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Table of Contents

Figures

Tables

Declaration

I, Ivan Baker declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Ivan Baker

Wetland Ecologist

The Biodiversity Company

November 2021

1 Introduction

Becrux Solar PV Project One (Pty) Ltd is proposing the development of a Solar Photovoltaic (PV) Energy Facility and associated infrastructure on Portion 6 of the Farm Goedehoop No. 290, located ~7km south-east of Secunda and 15 km east of Embalenhle. The project site falls within jurisdiction of the Govan Mbeki Local Municipality, which forms part of the Gert Sibande District Municipality in the Mpumalanga Province.

The Solar PV Facility will have a contracted capacity of up to 19.99MW_{ac} and will use bi-facial panels with single axis tracking or fix tilt mounting structures to harness the solar resource on the project site. The purpose of the facility will be to generate electricity for exclusive use by SASOL's Secunda (coal-to-liquids) CTL Plant. The construction of the PV Facility aims to reduce SASOL's dependence on direct supply from Eskom's national grid for operation purposes and demonstrate SASOL's move towards a greener future through procurement of renewable energy from Independent Power Producers (IPPs).

To evacuate the generated power to SASOL's Secunda CTL Plant, a 11kV overhead power line will be established to connect the 11kV E-house containerized substation (with a development footprint of 32 m^2) to the existing Goedehoop Substation. The overhead power line will run ~400 m from the Solar PV Facility to the Goedehoop Substation. One 170m wide and 400m long grid connection corridor has been identified for the assessment and placement of the overhead power line. The assessment of a wider grid connection corridor allows for the avoidance of sensitive environmental features that may be present within the project site, and to ensure the suitable placement of the power line within the identified corridor. A development area of ~26.64 ha and a development footprint of ~19.95 ha have been identified within the preferred project site (~433 ha) by Becrux Solar PV Project One (Pty) Ltd for the development of the Becrux Solar PV Energy Facility. Infrastructure associated with the facility will include the following:

- Solar PV array comprising PV modules and mounting structures;
- Inverters and transformers;
- Cabling between the panels;
- E-house containerized substation;
- 11kV overhead power line for the distribution of the generated power, which will be connected to the existing Goedehoop Substation;
- Access gravel road (existing) and internal gravel roads; and
- Security booth, O&M building, workshop, storage area and site office.

The Biodiversity Company was commissioned to conduct a wetland baseline and impact assessment, in support of the Environmental Authorisation application process for the proposed activities associated with the Becrux Solar Photovoltaic (PV) Facility. One wetland site visit was conducted on the 2nd of November 2021.

The approach of this study has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 20 March 2020: "Procedures for the Assessment and Minimum

Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation". The National Web based Environmental Screening Tool has characterised the aquatic theme sensitivity for the project area as "low sensitivity".

The purpose of these specialist studies is to provide relevant input into the Environmental Authorisation application process for the proposed activities associated with the solar PV facility. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the viability of the proposed project from a wetland perspective.

1.1 Specialist Details

Report Name	**Wetland Baseline and Impact Assessment for the proposed Becrux Solar Photovoltaic Energy Facility**	
Reference	**Becrux Solar PV Facility**	
Submitted to	savannah environmental	
Report Writer and Site Assessment	**Ivan Baker**	
	Ivan Baker is Cand. Sci Nat registered (119315) in environmental science and geological science. Ivan is a wetland and ecosystem service specialist, a hydropedologist and pedologist that has completed numerous specialist studies ranging from basic assessments to EIAs. Ivan has carried out various international studies following FC standards. Ivan completed training in Tools for Wetland Assessments with a certificate of competence and completed his MSc in environmental science and hydropedology at the North-West University of Potchefstroom.	
Reviewer	**Andrew Husted**	
	Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.	
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.	

2 Scope of Work

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- The delineation, classification and assessment of wetlands within the project area and surrounding 500 m regulated area;
- Conduct a functional assessment of wetland systems;
- Conduct a risk assessment relevant to the proposed activity;
- Recommendations relevant to associated impacts; and
- Report compilation detailing the baseline findings.

3 Key Legislative Requirements

3.1 National Water Act (NWA, 1998)

The Department of Water and Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998) (NWA) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource;
- The rehabilitation of the water resource;

A watercourse means;

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

3.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an Environmental Authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Scoping & Environmental Impact Assessment (S&EIA) process depending on the scale of the impact.

4 Methodology

4.1 Wetland Identification and Mapping

The wetland areas were delineated in accordance with the DWAF (2005) guidelines. A cross section of a typical wetland is presented in Figure 4-1. 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.

Vegetation is used as the primary wetland indicator. However, in practise, the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

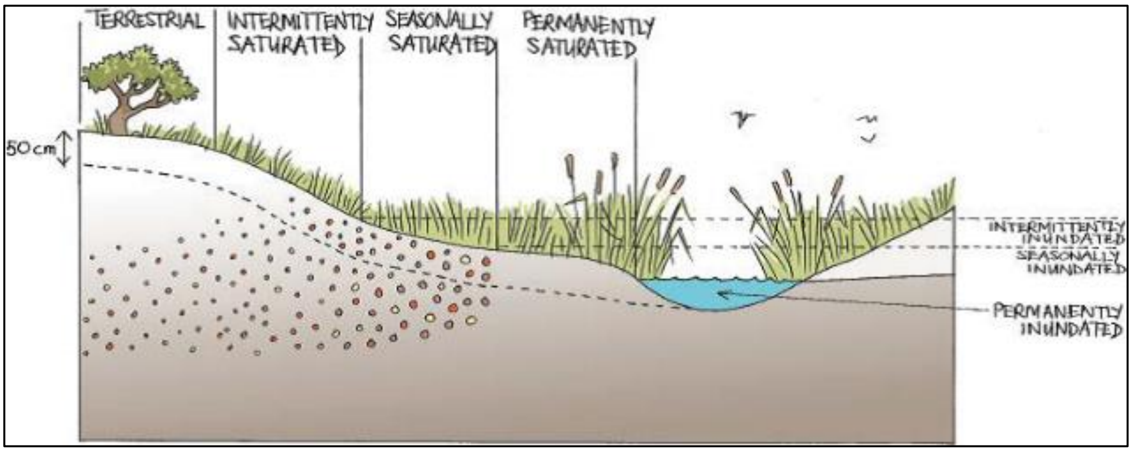

Figure 4-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al. 2013)

4.2 Delineation

The wetland indicators described above are used to determine the boundaries of the wetlands within the project site. These delineations are then illustrated by means of maps accompanied by descriptions.

4.3 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands as well as humans. Eco Services serve as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*. 2008). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 4-1).

Table 4-1 Classes for determining the likely extent to which a benefit is being supplied

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

4.4 Present Ecological Status

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present Ecological Status categories are provided in Table 4-2.

Table 4-2 The Present Ecological Status categories (Macfarlane, et al., 2008)

Impact Category	Description	Impact Score Range	PES
None	Unmodified, natural	0 to 0.9	A
Small	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	B
Moderate	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	C
Large	Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	D
Serious	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	E
Critical	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	F

4.5 Importance and Sensitivity

The importance and sensitivity of water resources is determined in order to establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants is used to assign the Importance and Sensitivity (IS) category as listed in Table 4-3.

Table 4-3 Description of Importance and Sensitivity categories

IS 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**

4.6 Ecological Classification and Description

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and then also includes structural features at the lower levels of classification (Ollis *et al.,* 2013).

4.7 Buffer Requirements

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane *et al.,* 2014) was used to determine the appropriate buffer zone for the proposed activity.

4.8 Impact Assessment Methodology

Direct, indirect and cumulative impacts will be assessed using the following criteria;

- The nature, which shall include a description of what causes the effect, what will be affected and how it will be affected;
- The extent, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The duration, wherein it will be indicated whether:
    - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
    - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
    - medium-term (5–15 years) – assigned a score of 3;
    - long term (> 15 years) - assigned a score of 4; or
    - permanent - assigned a score of 5;
- The magnitude, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes;

- The probability of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures);
- the significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;
- the status, which will be described as either positive, negative or neutral;
- the degree to which the impact can be reversed;
- the degree to which the impact may cause irreplaceable loss of resources; and
- the degree to which the impact can be mitigated.

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

S=(E+D+M)P

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

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

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

Assessment of Cumulative Impacts

As per DFFE's requirements, specialists are required to assess the cumulative impacts. In this regard, please refer to the methodology below that will need to be used for the assessment of Cumulative Impacts.

"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e., whether the addition of the proposed project in the area will increase the impact). This section should address whether the construction of the proposed development will result in:

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

The specialist is required to conclude if the proposed development will result in any unacceptable loss or impact considering all the projects proposed in the area.

5 Assumptions and Limitations

The following aspects were considered as limitations:

- No detailed layout has been provided. The main objective will therefore be to recommend no-go areas and relevant recommendations to ensure the successful operation of the proposed activities whilst conserving sensitive receptors;
- The entire project area is characterised by a large crop field. This area has transformed natural grassland into cultivation. Therefore, the use of vegetation could not be made to identify wetland areas;
- The direct project site was extensively ground truthed and covered together with the surrounding 500 m. The remainder of the 500 m regulated area has been delineated by means of desktop delineations; and
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.

6 Results and Discussion

6.1 Desktop Results

The project area is located approximately 6 km south-west of Secunda and 5 km east of SASOL Industrial Area, Mpumalanga (see Figure 6-1). The surrounding land-use predominantly includes agriculture, industrial areas and regional roads.

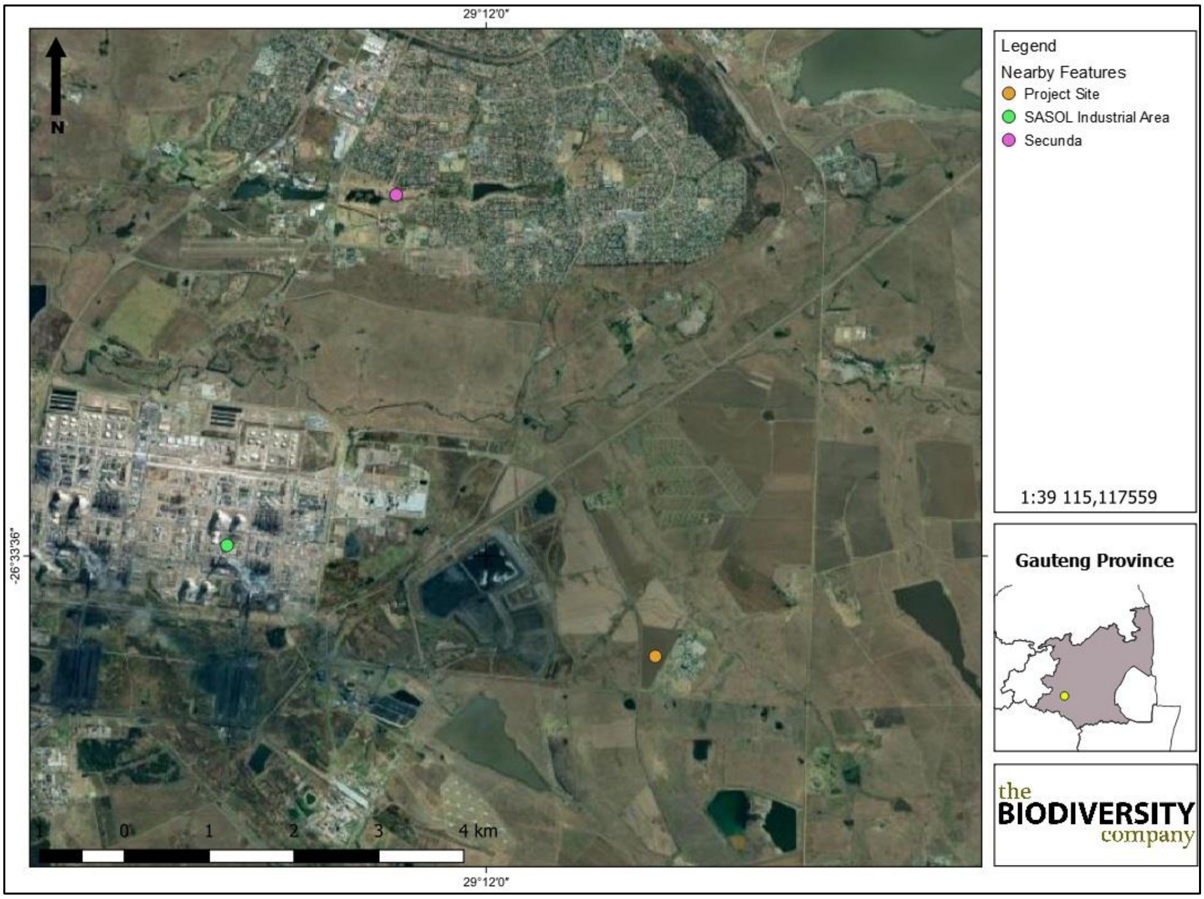

Figure 6-1 Locality of proposed development

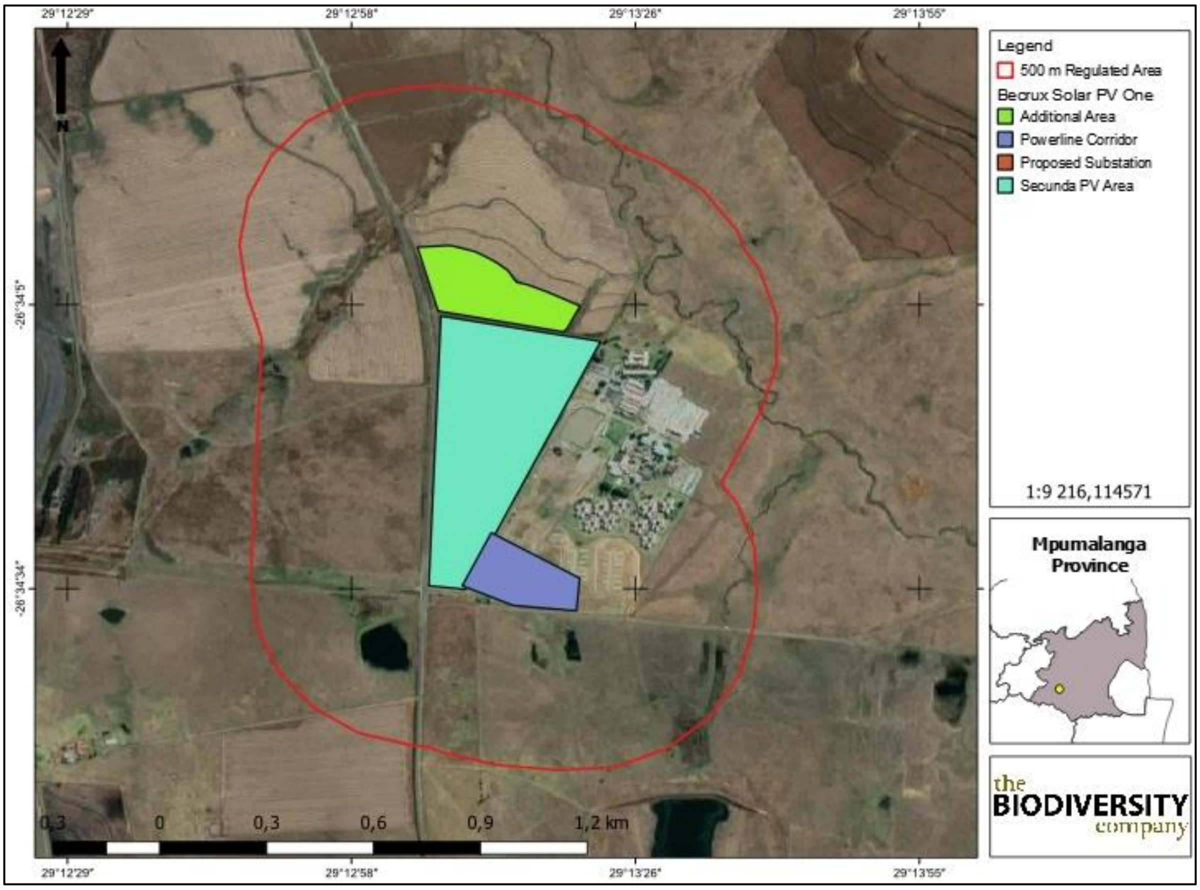

Figure 6-2 Proposed layout

6.1.1 Vegetation Types

The project site is located within the Soweto Highveld Grassland (GM 8) vegetation type. The distribution of the Soweto Highveld Grassland (GM 8) vegetation type is restricted to the Gauteng and Mpumalanga provinces with small portions of this vegetation type occurring in the North West and Free State provinces. This vegetation type is roughly delineated by the Vaal River, the town Perdekop in the south-east and the N17 between Johannesburg and Ermelo. In the Gauteng Province, the GM 8 vegetation type extends further westward as far as Randfontein and includes parts of Soweto. Furthermore, thisvegetation type surrounds parts to the south as well, including Vanderbijlpark, Vereeniging and Sasolburg, which are located in the northern most parts of the Free State Province (Mucina & Rutherford. 2006).

The vegetation within the GM 8 region is dominated by short to medium-high, dense, tufted grassland which mostly includes *Themeda triandra* within gently to moderately undulating landscapes on the Highveld plateau. Other grass species which occur to a lesser extent include *Eragrostis recemosa*, *Elionurus muticus*, *Tristachya leucothrix* and *Heteropogon contortus* (Mucina & Rutherford, 2006).

The conservation status of the GM 8 vegetation type is endangered with a target percentage of 24. Half of the area is already transformed into agriculture, mining, urban build-up etc. with a handful of conservation areas still up and running. These include Waldrift, Suikerbosrand and Rolfe's Pan Nature Reserve (just to name a few).

6.1.2 Soils and Geology

The geology of this area is characterised by the Madzaringwe Formation shale, mudstone and sandstone from the Karoo Supergroup or the Karoo Suite dolerites which feature prominently in this area. To the west, the rocks of Ventersdorp, old Transvaal and Witwatersrand Supergroups are significant with the south being characterised by the Volksrust Formation from the Karoo Supergroup. Deep soils occur in this area and are typically labelled by Ea, Ba and Bb land types (Mucina and Rutherford, 2006).

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Ea 17 land type. The Ea land type consists of one or more of the following soils: Vertic, Melanic, and red structured diagnostic horizons, of which these soils are all undifferentiated. The Ea 17 land type terrain units and expected soil forms are illustrated in Figure 6-3 and Table 6-1 respectively.

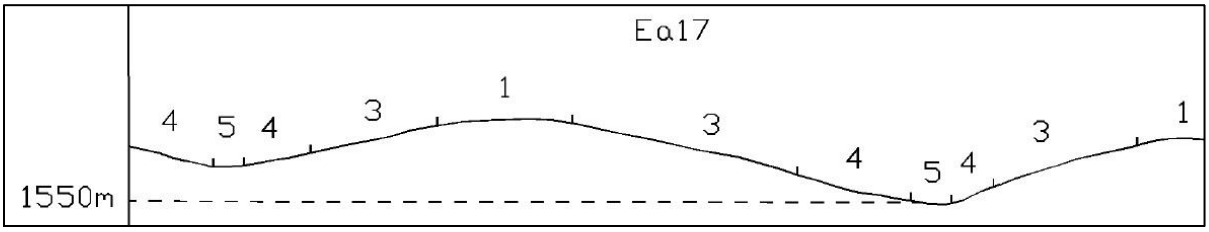

Figure 6-3 Illustration of land type Ea 17 terrain unit (Land Type Survey Staff, 1972 - 2006)

Table 6-1 Soils expected at the respective terrain units within the Ea 17 land type (Land Type Survey Staff, 1972 - 2006)

Terrain Units							
1 (30%)		3 (50%)		4 (15%)		5 (5%)	
Arcadia	40	Arcadia	70	Arcadia	50	Rensburg	70
Mayo	15	Rensburg	15	Rensburg	30	Stream Beds	20
Valsrivier	15	Valsrivier	5	Bonheim 5	10	Arcadia	10
Swartland	10	Swartland	5				
Avalon	5	Bonheim	5				
Westleigh	5						
Glenrosa	5						
Rock	2						

6.1.3 Climate

The mean annual precipitation for this region reaches approximately 662mm and is characterised by summer rainfall (Mucina & Rutherford, 2006). This area is characterised by high and low extreme temperatures during the summer and winter respectively with frost frequently occurring (see Figure 6-4).

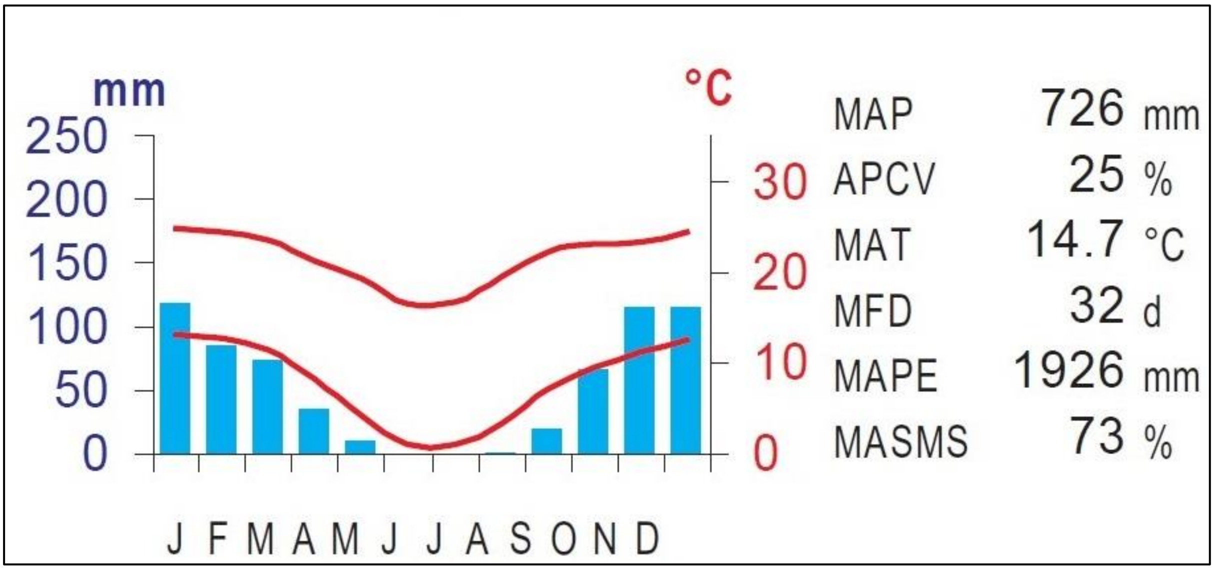

Figure 6-4 Climate diagram for the region (Mucina & Rutherford, 2006)

6.1.4 National Freshwater Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach for 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. This directly applies to the NWA, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*. 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (Act No.10 of 2004) (NEM:BA), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al.,* 2011).

According to Nel *et al.* (2011), all NFEPA wetland systems located within the 500 m regulated area are classified as being artificial (see Figure 6-5).

6.1.5 Topographical River Lines

According to the topographical river line data from the "2629" quarter degree square, various perennial and non-perennial river lines are located throughout the 500 m regulated area and are likely to represent wetland indicators. None of these systems are located within the project site with the closest system being located approximately 220 m from the proposed development.

6.1.6 Mpumalanga Highveld Grassland Wetlands

The Mpumalanga Highveld Grassland (MPHG) wetland layer was used to identify potential wetland areas within the 500 m regulated area. This shapefile indicates three potential wetland types, namely channelled valley bottom wetlands, seeps and artificial dams. None of these areas are located within the project site, although, a large wetland system is located immediately west of the project site.

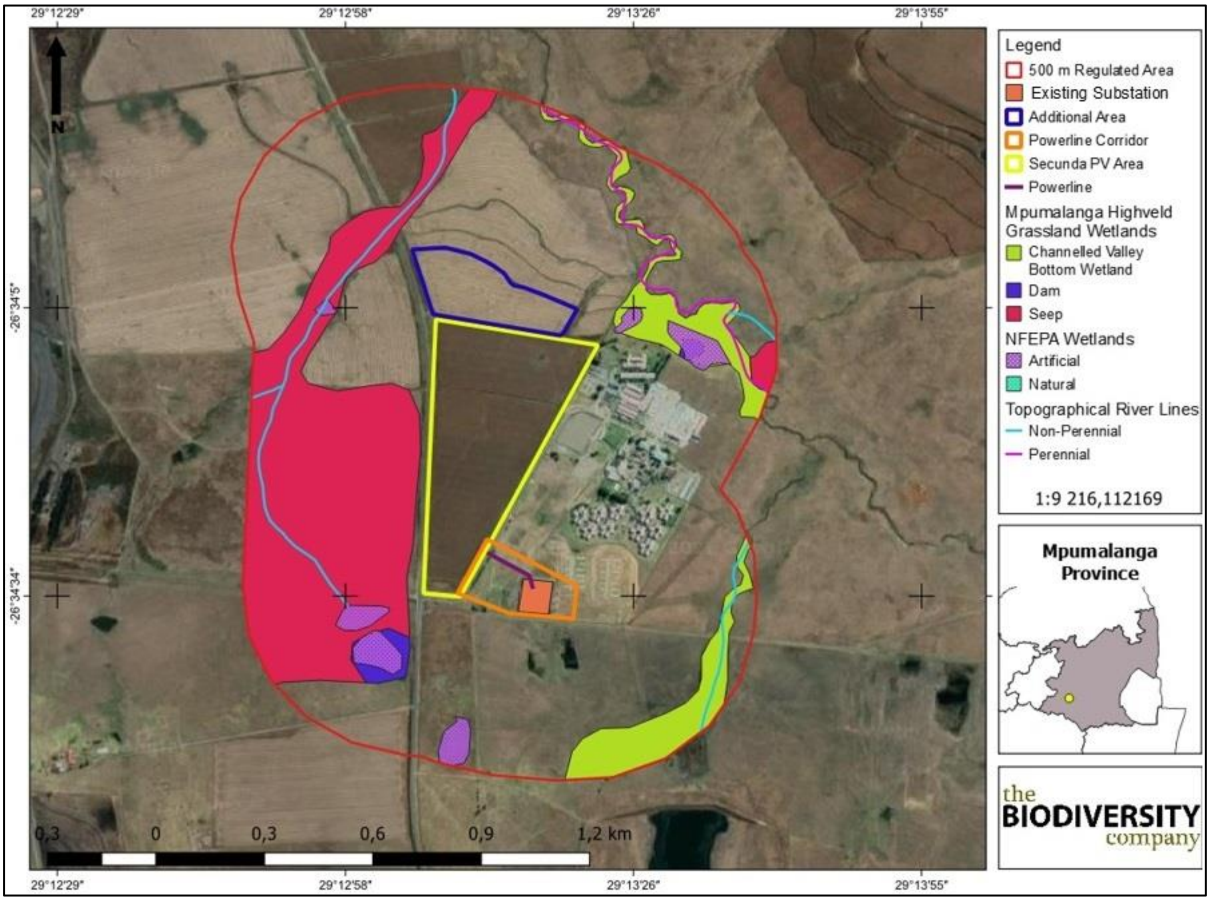

Figure 6-5 Topographical River Lines, MPHG and NFEPA wetlands located within the 500 m regulated area

6.1.7 South African Inventory of Inland Aquatic Ecosystems

This spatial dataset is part of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the National Biodiversity Assessment (NBA) 2018. National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE, 2018).

Two wetland types have been identified by means of this data set, namely channelled valley bottom wetlands and seeps (see Figure 6-5). These wetland systems are “Critically Endangered” due to the fact that less than 20% of these systems are in a natural or largely natural condition.

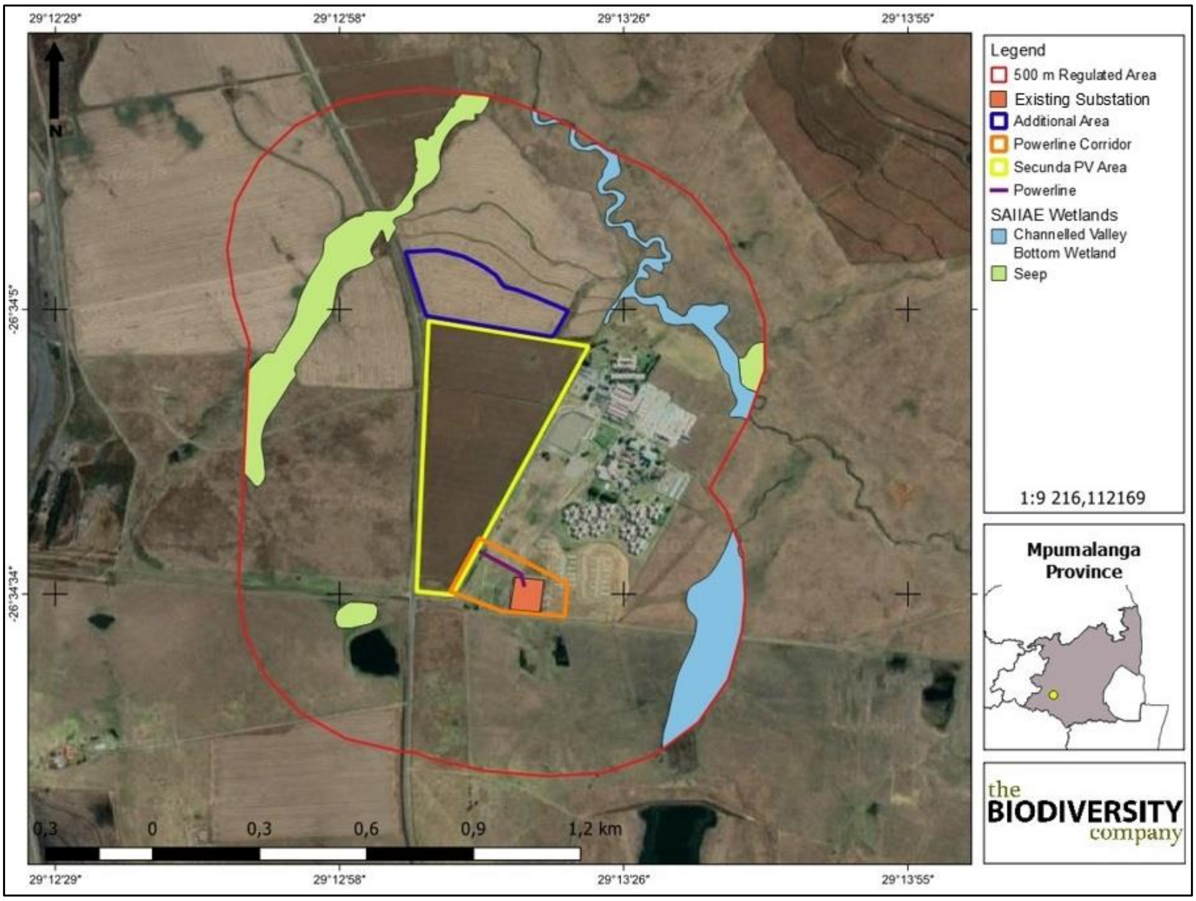

Figure 6-6 SAIIAE Wetlands located within the 500 m regulated area

6.2 Status of sub-quaternary reach C12D-01662

Desktop information for SQR's was obtained from DWS, 2021. The C12D-01662 SQR spans 8,37 km which is joined by various tributaries which are located in close proximity to the proposed road or crosses underneath the proposed road. The PES category of the reach is classed as moderately modified (class C) (Table 6-2). The slightly modified state of the reach can be described to to moderately significant impacts to various minor impacts towards the system, including the mining and instream dams. The mean ecological importance and sensitivity has been determined to be "Moderate" (DWS, 2020) with the default ecological category rated as "C".

Table 6-2 Summary of the status of sub-quaternary reach W12C-03225

Present Ecological Status	Moderately Modifiedl (class C)
Mean Ecological Importance	Moderate
Mean Ecological Sensitivity	Moderate
Default Ecological Category	C

6.3 National Freshwater Ecosystem Priority Area Status

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach for 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 National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*. 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (NEM:BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011). According to Nel et al. (2011), the proposed road falls within the W12C-03225 SQR (Figure 6-7) which is classified as a sub-quaternary catchment.

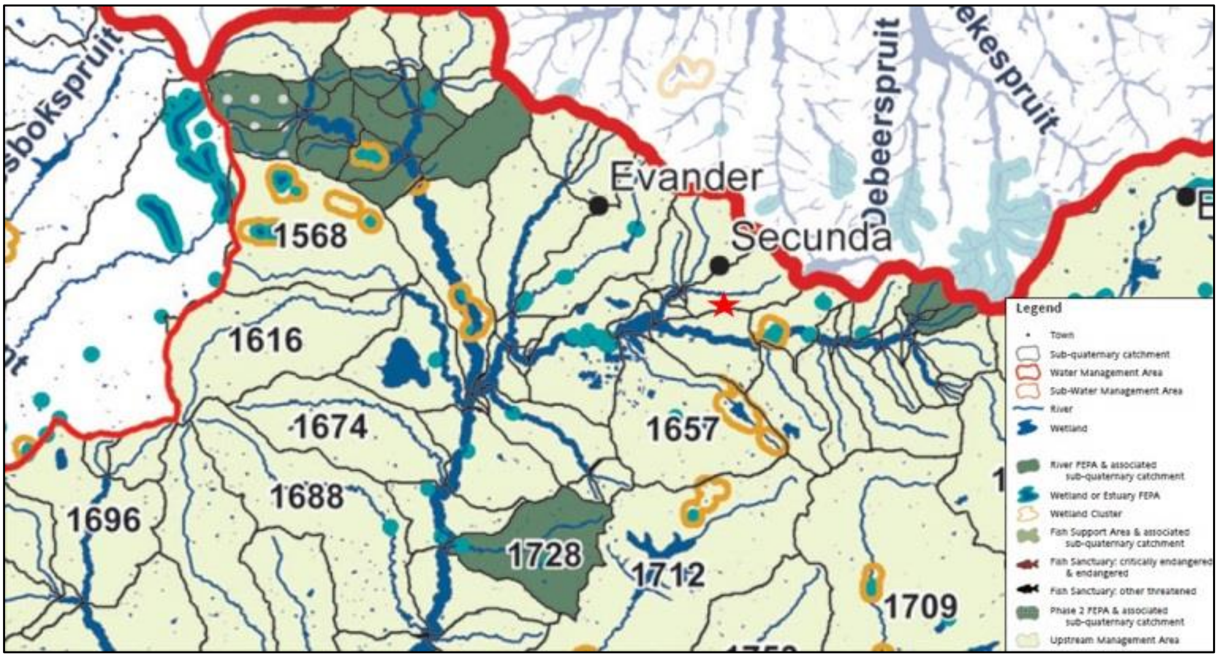

Figure 6-7 Map illustrating fish and river FEPAs for the project area, the project area is represented by the red star symbol (Nel et al., 2011)

6.3.1 Terrain

The terrain of the 500 m regulated area has been analysed to determine potential areas where wetlands are more likely to accumulate (due to convex topographical features, preferential pathways or more gentle slopes).

6.3.1.1 Digital Elevation Model

A Digital Elevation Model (DEM) has been created to identify lower laying regions as well as potential convex topographical features which could point towards preferential flow paths. The 500 m regulated area ranges from 1 597 to 1 640 Metres Above Sea Level (MASL). The lower laying areas (generally represented in dark blue) represent areas that will have the highest potential to be characterised as wetlands (see Figure 6-8).

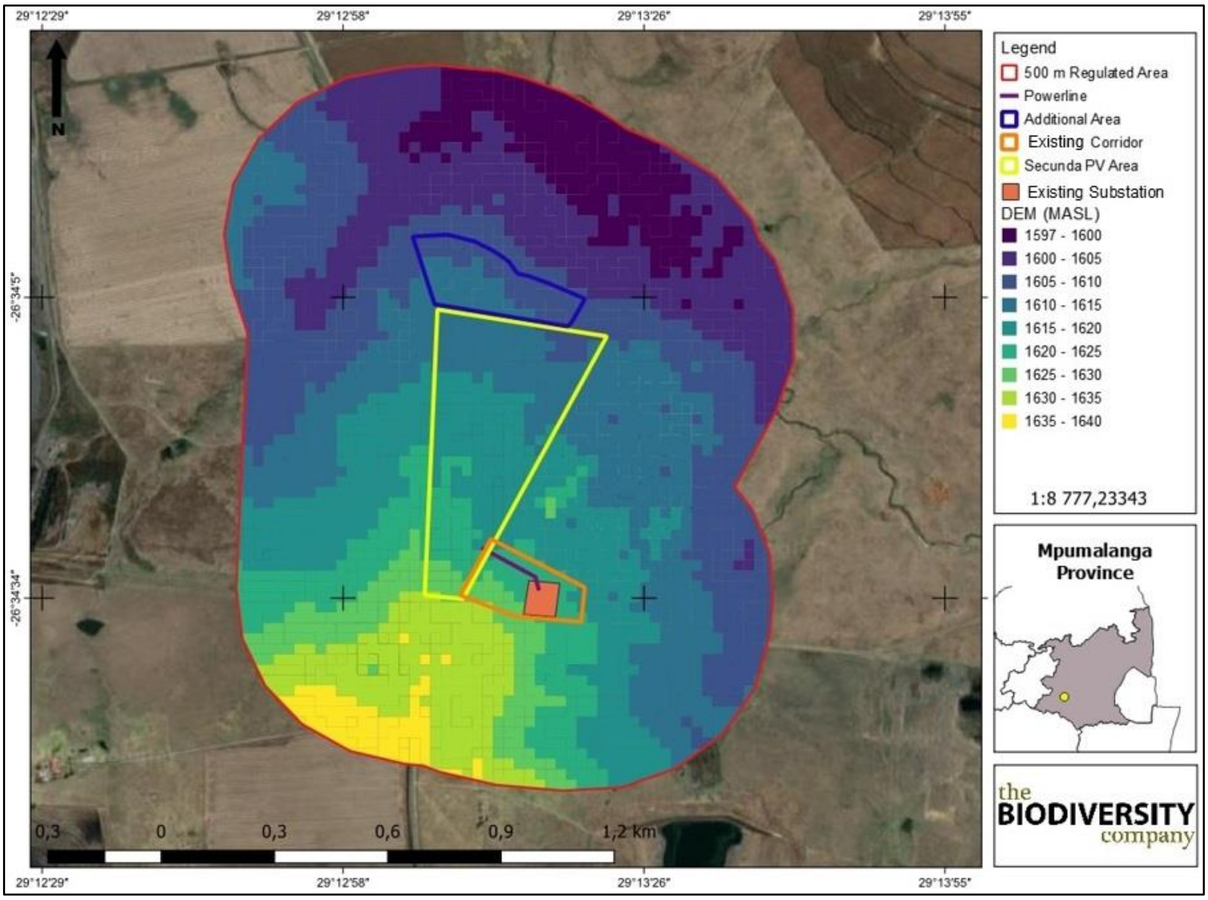

Figure 6-8 Digital Elevation Model of the 500 m regulated area

6.3.1.2 Slope Percentage

The slope percentage of the 500 m regulated area is illustrated in Figure 6-9. The slope percentage ranges from 0 to 19%, with the majority of the 500 m regulated area being characterised by a gentler slope (between 0 and 5%). Besides the fact that hillslope seeps are likely to occur on any slope percentage, wetlands in general tend to accumulate in flatter areas.

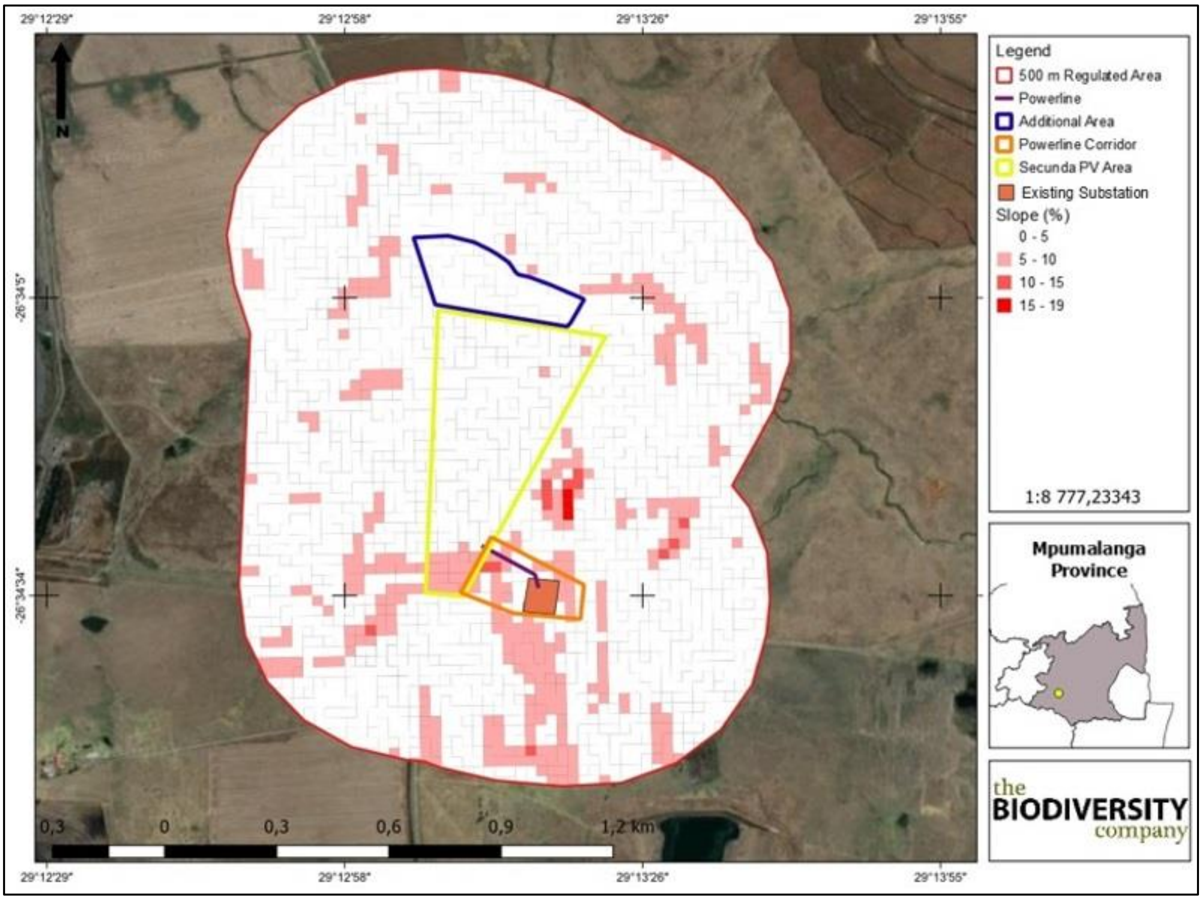

Figure 6-9 Slope percentage of the 500 m regulated area

6.4 Baseline Findings

6.4.1 Delineation and Description

The wetland areas were delineated in accordance with the DWAF (2005) guidelines (see Figure 6-10 and Figure 6-11). Seven HGM units were identified within the 500 m regulated area, which have been classified as unchanneled valley bottom (UVB) wetlands (HGM 1, 3 and 7), a seep (HGM 6), a depression (HGM 2) and a floodplain (HGM 5). Of these wetland systems, only HGM 1, 2 and 3 are expected to be at an appreciable level of risk due to the locality of these systems being within the proposed PV area. Therefore, only these systems will be assessed as part of the functional component.

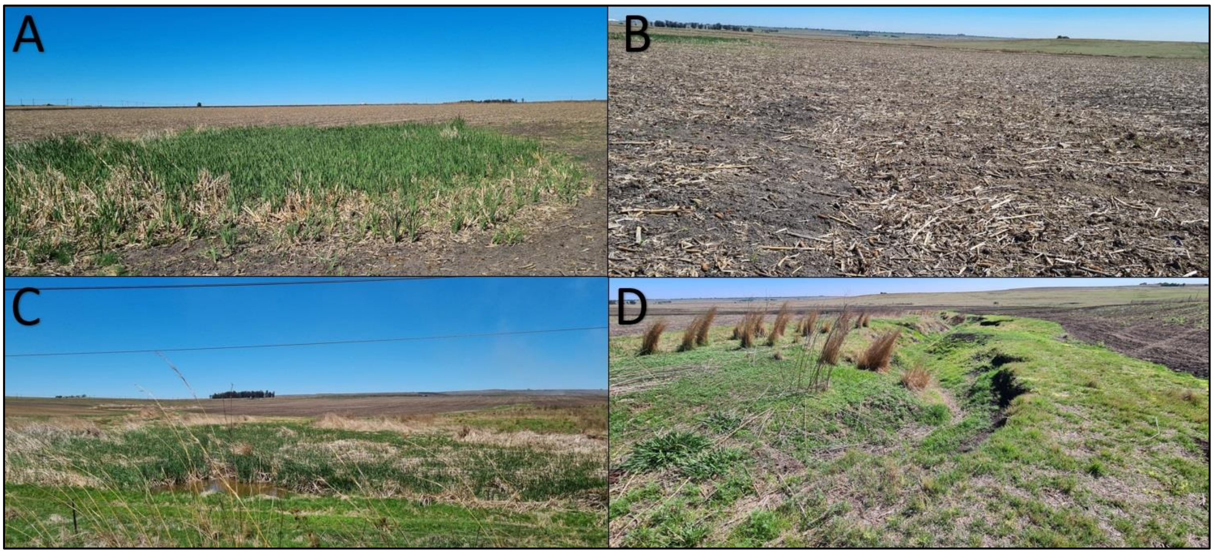

Figure 6-10 Examples of wetlands identified. A) Depression. B) Drainage lines. C) HGM 3. D) HGM 1.

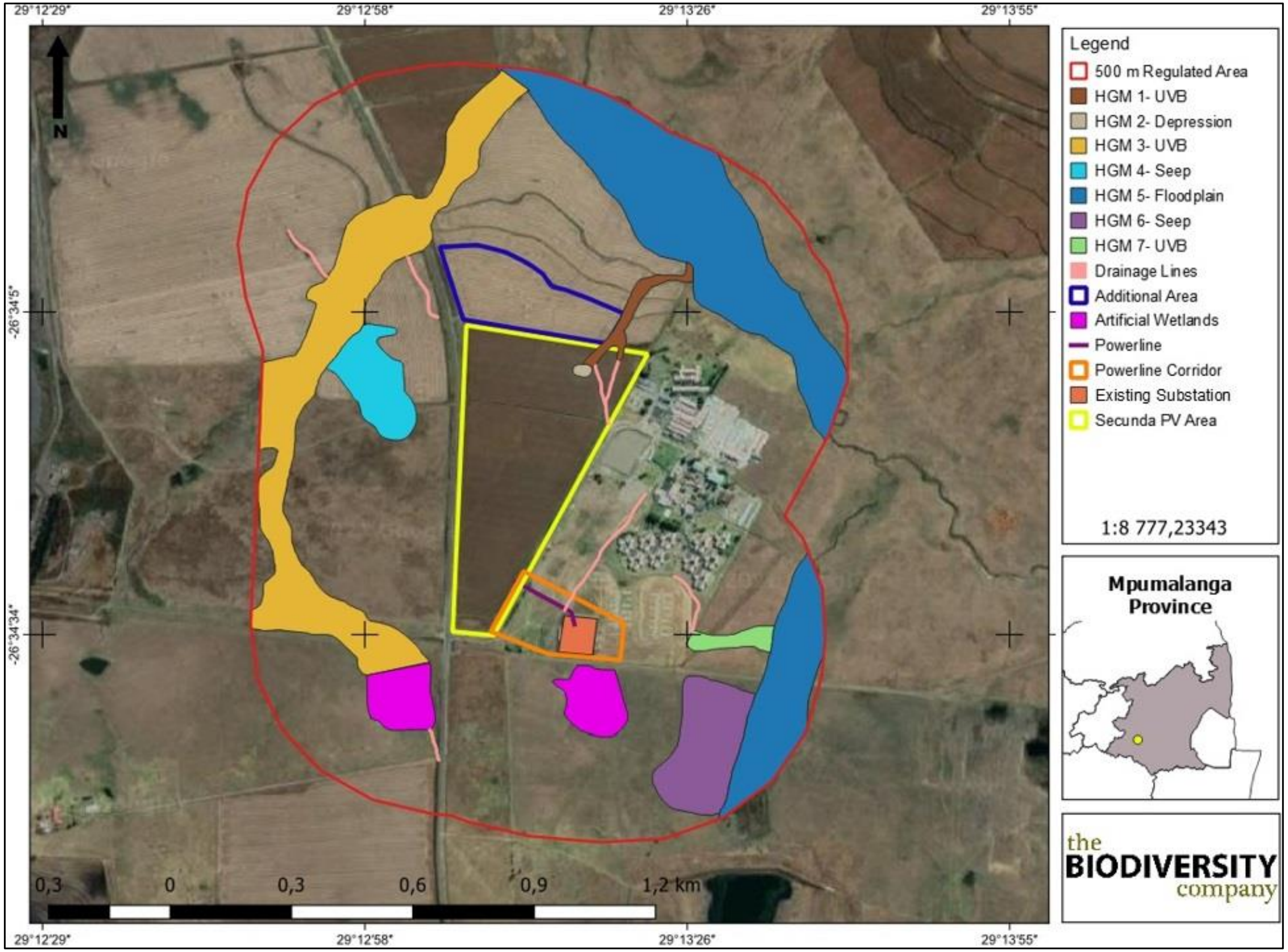

Figure 6-11 Delineation of wetlands within the 500 m regulated area

6.4.2 Unit Identification

The wetland classification as per SANBI guidelines (Ollis *et al.,* 2013) is presented in Table 6-3. All three systems share the same level 1 classification, DWS ecoregion and NFEPA wet veg groups.

Table 6-3 Wetland classification as per SANBI guideline (Ollis et al. 2013)

Wetland System	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	Highveld	Mesic Highveld Grassland Group 3	Valley Bottom	UVB	N/A	N/A
HGM 2				Bench	Depression	With channelled outflow	N/A
HGM 3				Valley Bottom	UVB	N/A	N/A

6.4.3 Unit Setting

Unchanneled valley bottom wetlands are typically found on valley floors where the landscape does not allow high energy flows. Figure 6-12 presents a diagram of the relevant HGM units, showing the dominant movement of water into, through and out of the system.

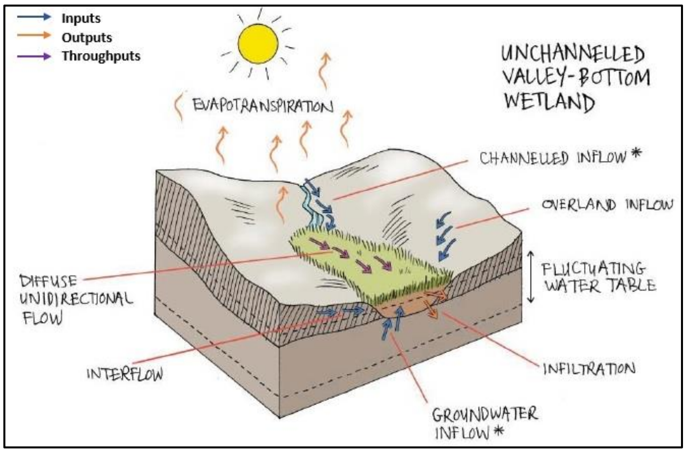

Figure 6-12 Amalgamated diagram of a typical unchanneled valley bottom, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

The relevant depression, as mentioned in Figure 6-13, is located on the "bench" landscape unit. Depressions are inward draining basins with an enclosing topography which allows for water to accumulate within the system. Depressions, in some cases, are also fed by lateral sub-surface flows in cases where the dominant geology allows for these types of flows. Figure 6-13 presents a diagram of the relevant HGM unit, showing the dominant movement of water into, through and out of the system.

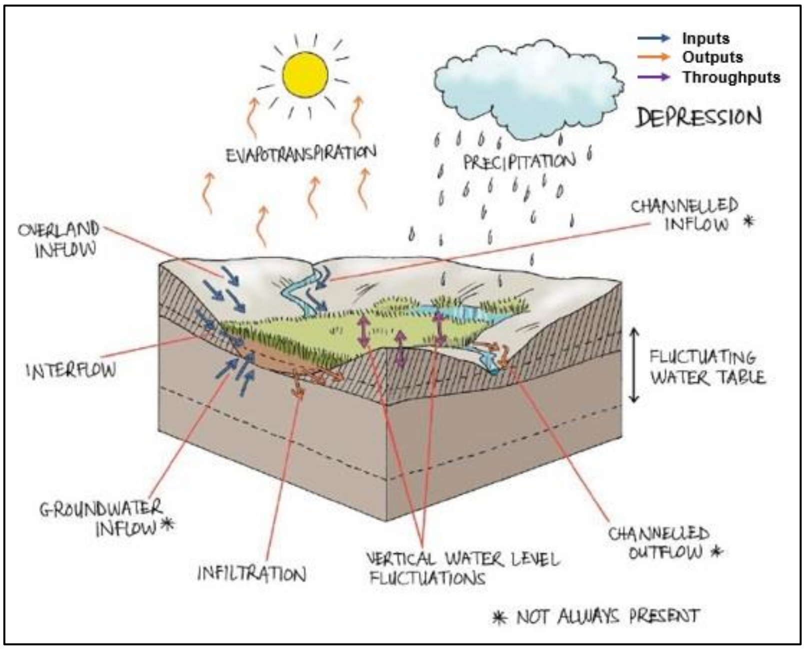

Figure 6-13 Amalgamated diagram of the HGM unit, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

6.4.4 Wetland Indicators

6.4.4.1 Hydromorphic Soils

According to (DWAF, 2005), soils are the most important characteristic of wetlands in order to accurately identify and delineate wetland areas. One dominant soil form was identified for all three relevant wetland units, namely the Rensburg soil form.

The Rensburg soil form consists of a vertic topsoil on top of a gley horizon. The soil family group identified for the Rensburg soil form on-site has been classified as the “2000” soil family due to the calcareous nature of the soil.

Vertic topsoils have high clay content with smectic clay particles being dominant (Soil Classification Working Group, 2018). The smectic clays have swell and shrink properties during wet and dry periods respectively. Peds will be shiny, well-developed with a highly plastic consistency during wet periods as a result of the dominance of smectic clays. During shrinking periods, cracks form on the surface and rarely occurs in shallow vertic clays.

Gley horizons that are well developed and have homogenous dark to light grey colours with smooth transitions. Stagnant and reduced water over long periods is the main factor responsible for the formation of a Gley horizon and could be characterised by green or blue tinges due to the presence of a mineral called Fougerite which includes sulphate and carbonate complexes. Even though grey colours are dominant, yellow and/or red striations can be noticed throughout a Gley horizon. The structure of a Gley horizon mostly is characterised as strong pedal, with low hydraulic conductivities and a clay texture, although sandy Gley horizons are known to occur. The Gley soil form commonly occurs at the toe of hillslopes (or benches) where lateral water inputs (sub-surface) are dominant and the underlaying geology is characterised by a low hydraulic conductivity. The Gley horizon usually is second in diagnostic sequence in shallow profiles yet is known to be lower down in sequence and at greater depths (Soil Classification Working Group, 2018).

Figure 6-14 Vertic topsoils with signs of wetness (gleying and mottling)

6.4.4.2 Hydrophytes

Vegetation plays a considerable role in identifying, classifying and accurately delineating wetlands (DWAF, 2005). During the site visit, one main hydrophytic species was identified within the project area, namely *Typha capensis*.

Figure 6-15 Example of Typha capensis

6.4.5 General Functional Description

Unchanneled valley bottoms are characterised by sediment deposition, a gentle gradient with streamflow generally being spread diffusely across the wetland, ultimately ensuring prolonged saturation levels and high levels of organic matter. The assimilation of toxicants, nitrates and phosphates are usually high for unchanneled valley-bottom wetlands, especially in cases where the valley is fed by sub-surface interflow from slopes. The shallow depths of surface water within this system adds to the degradation of toxic contaminants by means of sunlight penetration.

The generally impermeable nature of depressions and their inward draining features are the main reasons why the streamflow regulation ability of these systems is mediocre. Regardless of the nature of depressions in regard to trapping all sediments entering the system, sediment trapping is another Eco Service that is not deemed as one of the essential services provided by depressions, even though some systems might contribute to a lesser extent. The reason for this phenomenon is due to winds picking up sediments within pans during dry seasons which ultimately leads to the removal of these sediments and the deposition thereof elsewhere. The assimilation of nitrates, toxicants and sulphates are some of the higher rated Eco Services for depressions. This latter statement can explain the precipitation as well as continues precipitation and dissolving of minerals and other contaminants during dry and wet seasons, respectively (Kotze *et al.,* 2009).

It is however important to note that the descriptions of the above-mentioned functions are merely typical expectations. All wetland systems are unique and therefore, the ecosystem services rated high for these systems on site might differ slightly to those expectations.

6.4.6 Ecological Functional Assessment

The ecosystem services provided by the wetland units identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). The summarised results for HGM 1, 2 and 3 are shown in Table 6-4. The average ecosystem score for all three relevant wetlands have been determined to be “Intermediate”.

Even though HGM 2 has scored considerably higher indirect benefits than HGM 1 and 3, all three systems have been classified as having “Intermediate” average ecosystem service scores. The direct benefits for all three systems decreases the overall average ecosystem service scores significantly. No signs were identified on-site concerning using water from HGM 3 to irrigate crop fields. Similarly, no harvesting is expected to take place, predominantly due to the fact that no signs of poverty can be noted within the area.

Key differences in ecosystem services between these three wetland systems include the education and research score. HGM 3 is associated with significant data considering the SAIIAE wetland dataset which fully covers this system to ultimately provide more information about this system. Biodiversity maintenance is another functionality that has been scored significantly higher for HGM 3 than HGM 1 and 2 due to denser vegetation as well as various habitat types that promote biodiversity maintenance.

Erosion control for HGM 2 has been scored “Very High” considering the fact that no physical disturbances have been identified within this system. The fact that HGM 2 is completely surrounded by crop fields increases the toxicant, nitrate and phosphate assimilation scores. The reason for this increase can be explained by the potential for the wetland system to assimilate these contaminants from pesticide and fertiliser input increases (see Figure 6-16).

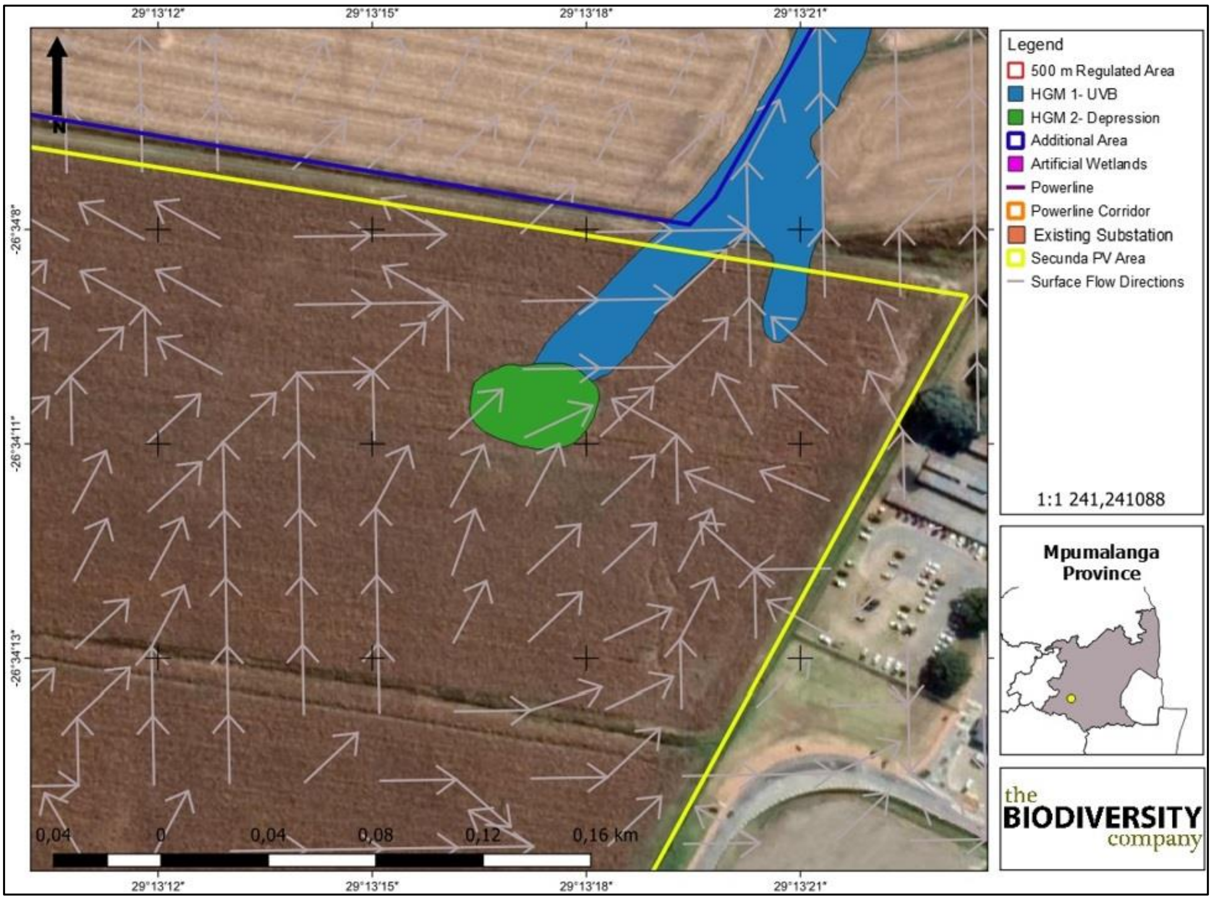

Figure 6-16 Surface flow directions potentially channelling contaminants/fertiliser into wetlands

Table 6-4 The ecosystem services being provided by the HGM units

Wetland Unit	HGM 1	HGM 2	HGM 3

Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		2.0	2.5	2.0
			Streamflow regulation		2.8	3.2	3.0
			Water Quality enhancement benefits	Sediment trapping	2.8	3.4	2.4
				Phosphate assimilation	2.9	3.2	2.9
				Nitrate assimilation	2.9	3.5	3.2
				Toxicant assimilation	2.9	3.3	3.0
				Erosion control	1.2	3.2	2.6
			Carbon storage		0.7	2.3	2.7
	Direct Benefits		**Biodiversity maintenance**		1.1	1.2	1.8
		Provisioning benefits	Provisioning of water for human use		0.8	1.0	1.2
			Provisioning of harvestable resources		0.0	0.0	0.0
			Provisioning of cultivated foods		0.0	0.0	0.0
		Cultural benefits	Cultural heritage		0.0	0.0	0.0
			Tourism and recreation		0.1	0.9	1.3
			Education and research		0.8	1.3	2.3
Average Eco Services Score					1.4	2.0	1.9

6.4.7 Ecological Health Assessment

The PES for the assessed HGM units is presented in Table 6-5. The overall PES score for HGM 1 and 3 has been calculated to be “Seriously Modified” with HGM 2 being scored “Largely Modified”. HGM 1 has been modified by severe erosion over the entire extent of the wetland (see Figure 6-17) with some alien invasive species like *Tagetes minuta* spreading throughout the system.

Figure 6-17 Example of erosion within HGM 1

The main impacts associated with HGM 2 include the fact that a large portion of the wetland’s fringes (and catchment) have been transformed to such an extent that indigenous hydrophytic vegetation has been removed to make way for crop fields (see Figure 6-18).

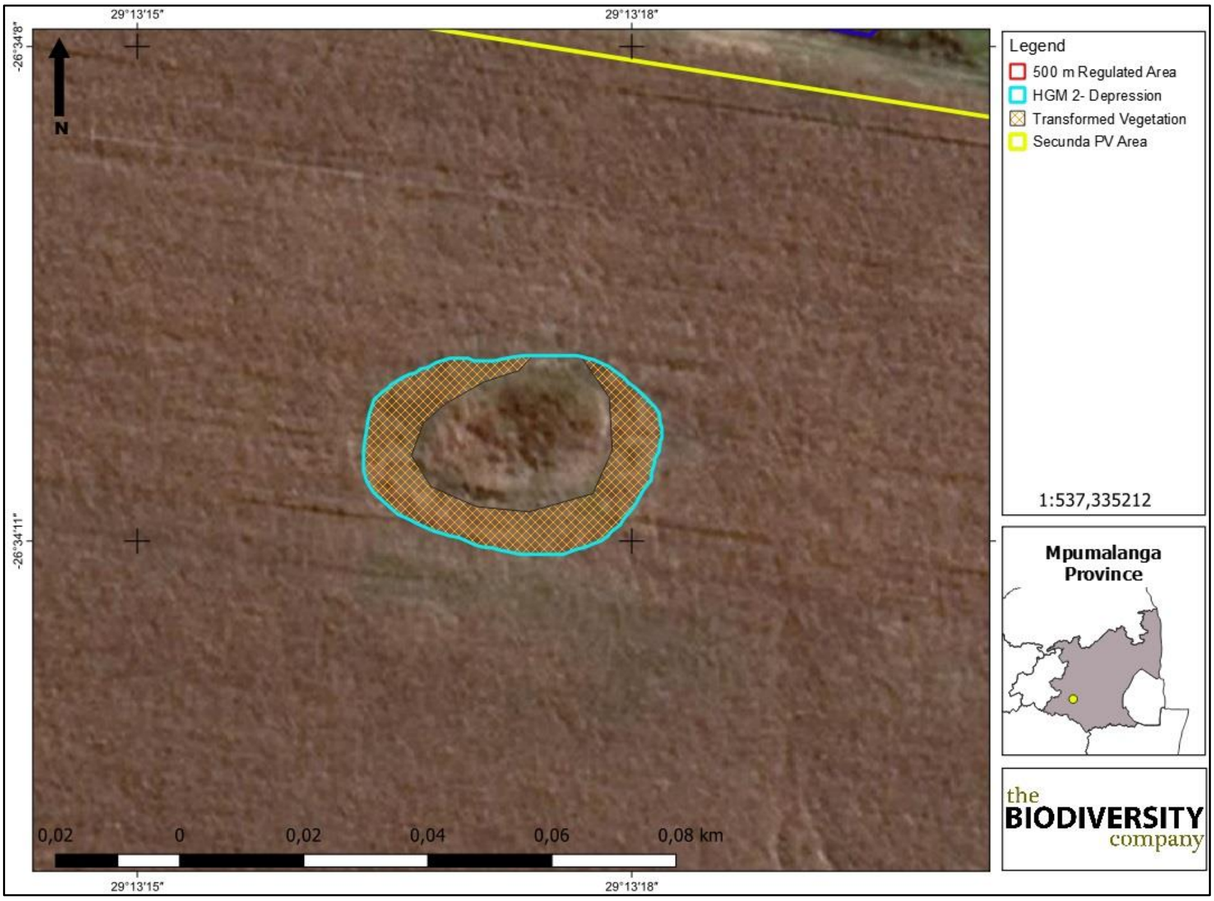

Figure 6-18 Transformed portion of HGM 2

Lastly, HGM 3 has been modified by the presence of dams as well as road crossings (see Figure 6-19) that have altered the hydrological flow dynamics significantly. Such alterations potentially could result in a reduction of stream length, an increase in cross sectional width as well as poor flood attenuation and erosion.

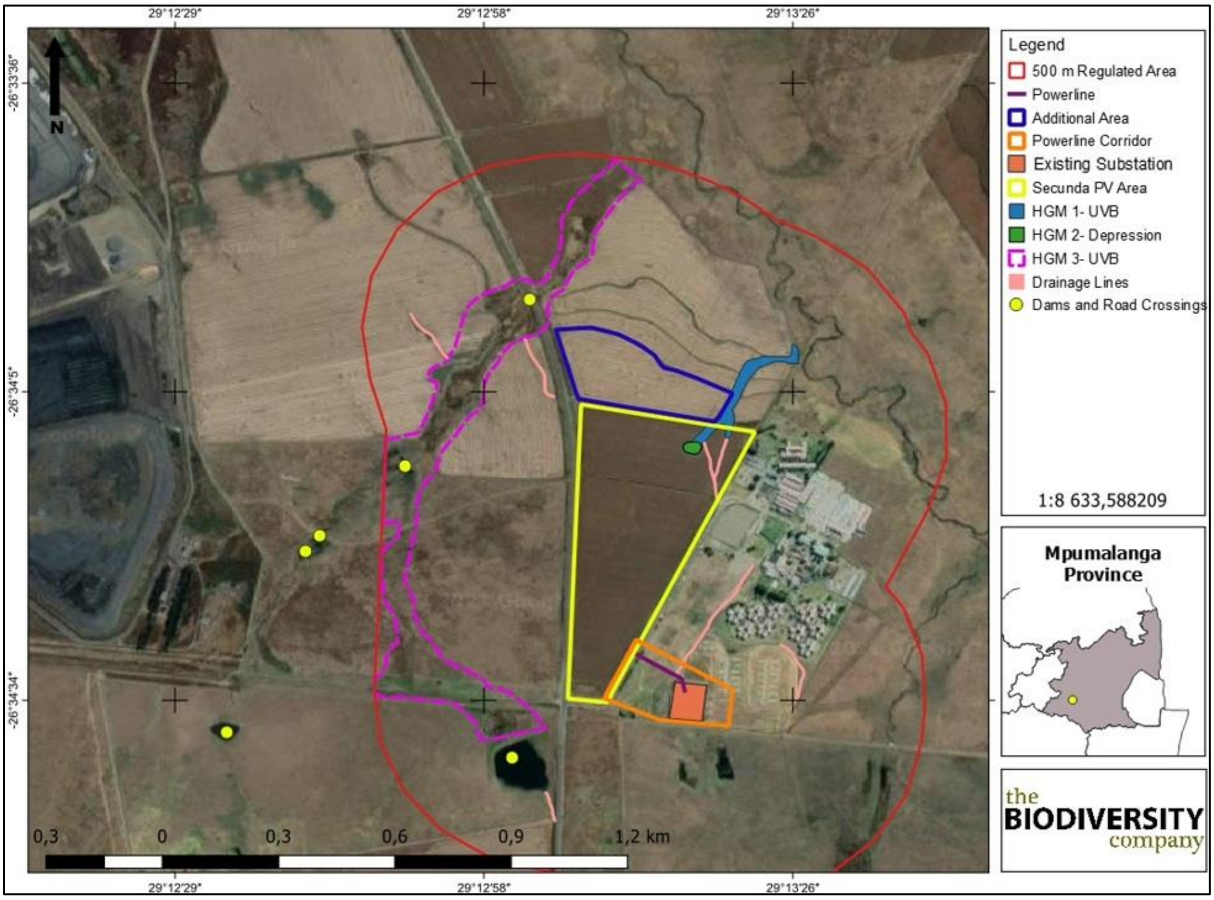

Figure 6-19 Location of dams and road crossings within HGM 3's extent

Table 6-5 Summary of the scores for the wetland PES

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 1	Critically Modified (F)	9.5	Largely Modified (D)	5.1	Critically Modified (F)	8.4
Overall PES Score	7.9		Overall PES Class		Seriously Modified (E)	
HGM 2	Moderately Modified (C)	3.5	Moderately Modified (C)	3.8	Seriously Modified (E)	6.0
Overall PES Score	4.3		Overall PES Class		Largely Modified (D)	
HGM 3	Critically Modified (F)	9.5	Moderately Modified (C)	2.9	Seriously Modified (E)	7.0
Overall PES Score	6.9		Overall PES Class		Seriously Modified (E)	

6.4.8 Ecological Importance & Sensitivity Assessment

The results of the ecological IS assessment are shown in Table 6-6. Various components pertaining to the protection status of a wetland are considered for the IS, including Strategic Water Source Areas (SWSA), the NFEPA wet vegetation protection status and the protection status of the wetland itself considering the NBA wetland dataset. The IS for HGM 1 and 2 has been calculated to be "Moderate" with HGM 3 being scored "High", which combines all parameters listed in Table 6-6.

It is worth noting that the DFFE screening tool report (2021) was used to further refine the sensitivity of wetland features by means of the aquatic biodiversity theme. HGM 3 is associated with "Inland Waters, Wetland and Estuaries", which has been allocated a "Very High" sensitivity (see Figure 6-20). It is worth noting that additional wetlands were identified during the site visit.

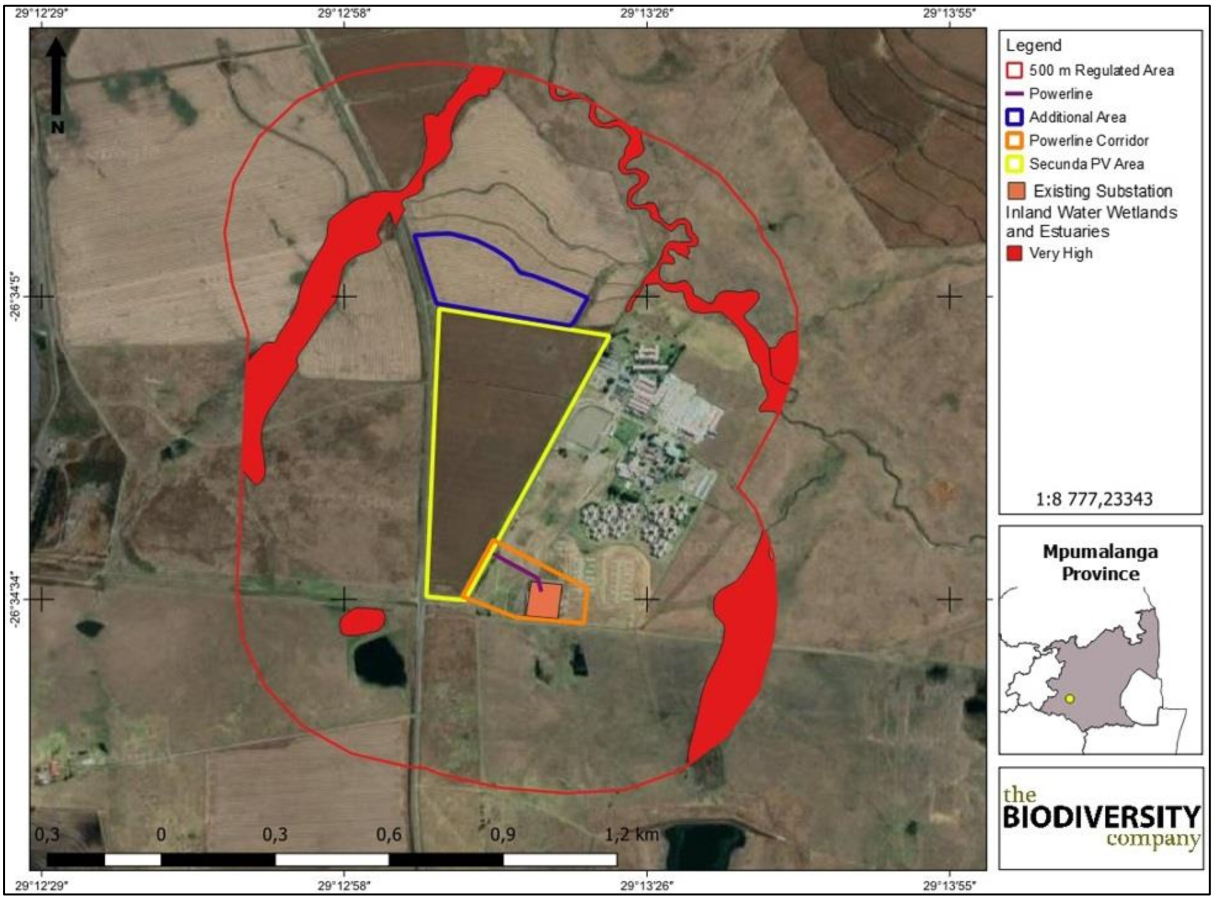

Figure 6-20 Results from the DEA screening tool (2021)

Table 6-6 The IS results for the delineated HGM unit

HGM Type	Wet Veg			NBA Wetlands		SWSA (Y/N)	Calculated IS
	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018		
HGM 3	Mesic Highveld Grassland Group 3	Critically Endangered	Not Protected	D/E/F Seriously Modified	Critically Endangered	N/A	High
HGM 1 and 2		Critically Endangered	Not Protected	N/A	N/A	N/A	Moderate

6.5 Buffer Requirements

The "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane *et al.*, 2014) was used to determine the appropriate buffer zone for the proposed activity. A pre-mitigation buffer zone of 30 m is recommended for the identified wetland, which can likely be decreased to 22 m if suitable avoidance and mitigation measures are implemented (see Table 6-5 and Figure 6-21). Even though the artificial wetlands and drainage lines have not been assigned any buffer zones, it is worth noting that the major drainage lines delineated need to be conserved throughout the construction and operational phases. Various mitigation measures of relevance will be prescribed.

Table 6-7 Pre-and post-mitigation buffer sizes

	Buffer Widths
Pre-mitigation buffer	30 m
Post-mitigation buffer	22 m

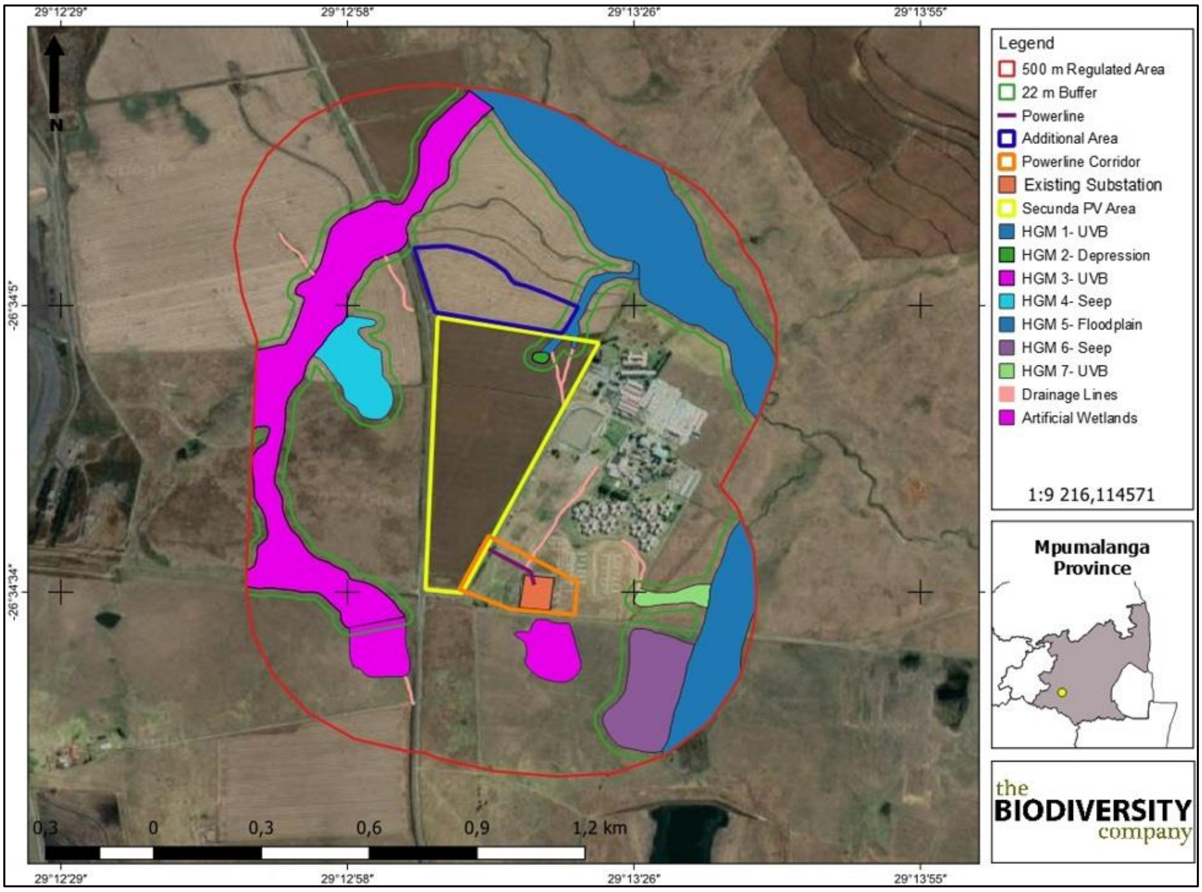

Figure 6-21 Illustration of recommended buffer requirement

7 Risk Assessment

The impact assessment considered both direct and indirect impacts, to the wetland system. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 7-1). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts. Section 6.5- “Buffer Requirements” illustrates the extent of the recommended buffer zones for the identified wetlands. It is evident from these illustrations that wetland areas are located within the proposed development footprint area. Therefore, avoidance can only be achieved in the event that the wetland buffer zones be stayed clear of. Other alternatives will be considered in the event that adherence to this buffer zone cannot be achieved.

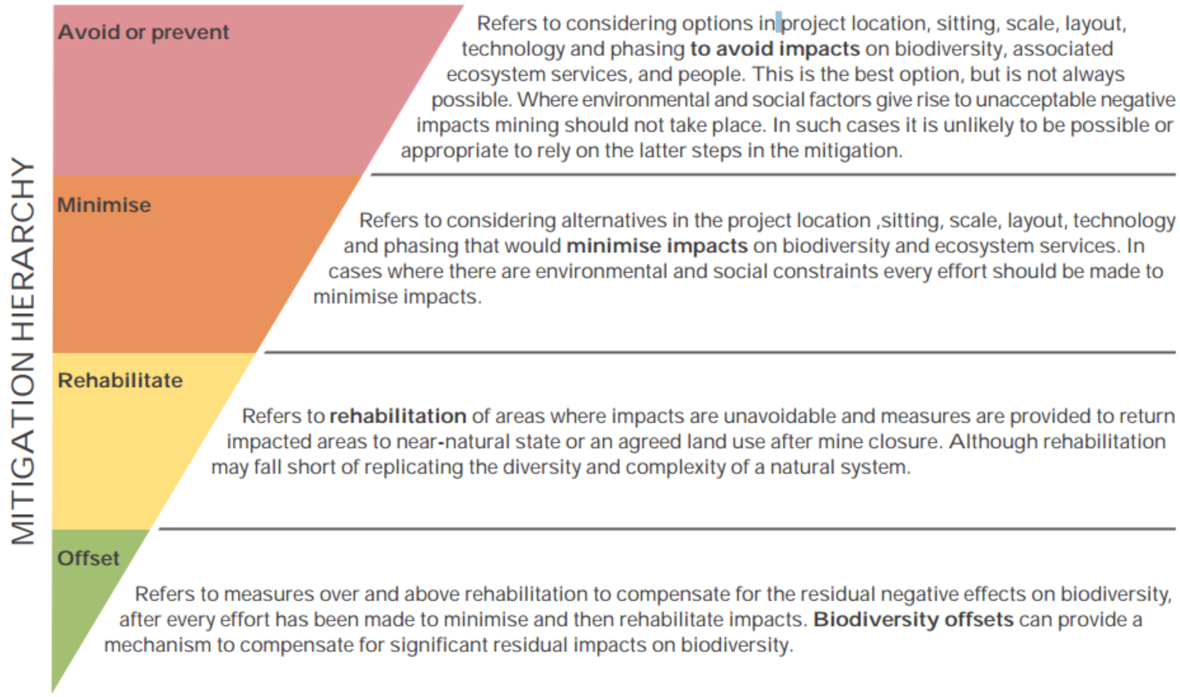

Figure 7-1 The mitigation hierarchy as described by the DEA (2013)

7.1 Potential Impacts Anticipated

Table 7-1 illustrates the potential aspects expected to threaten the integrity of sensitive receptors during the proposed activities. The pre- and post- mitigation significance ratings have been calculated considering various parameters, these results are illustrated in Table 7-2 and Table 7-3.

Table 7-1 Aspects and impacts relevant to the proposed activity

Phase	Aspect	Impact
Construction	Removal of topsoil	• Indirect loss of wetlands; • Erosion of wetland; • Loss of vegetation; • Decrease in functionality; • Water quality impairment; • Compaction;
	Minor Excavations	
	Use of machinery/vehicles close to wetlands	
	Ablution facilities	

	Domestic and industrial waste	• Altering hydromorphic soils; • Drainage patterns change; • Altering overland flow characteristics; and • Deposition of dust.
	Storage of chemicals, mixes and fuel	
Operation	Traffic during Maintenance	
	Altered Overlflow Dynamics	

Two post-mitigation scenarios have been considered for this risk assessment, namely avoidance of the wetland buffers and impedance into the wetland buffers. The findings from Table 7-2 and Table 7-3 indicate various aspects scored “Moderate” pre-mitigation significance ratings. Considering the scenario where the applicant adheres to the buffer zones, all of the post-mitigation significance ratings are expected to be decreased to “Low”. In the event that the buffers be impeded on, some of the aspects are expected to still be associated with “Moderate” post-mitigation significance ratings.

Therefore, the relevant buffer zone may be impeded on, which means that the first and second steps in the mitigation hierarchy (avoidance and minimising impacts) cannot be met. Therefore, the third step in the mitigation hierarchy (rehabilitation) will need to be implemented. This rehabilitation plan must not only focus on areas degraded during the construction phase, but must also ensure that all rehabilitation efforts are focussed to rehabiltiate HGM 1 and 2 to a “Largely Modified” overal PES condition from whatever the overall PES of these systems are after the construction phase. In addition, the 22 m buffer can only be impeded on up to the 10 m mark (therefore 12 m from the edge of the buffer) to avoid direct impacts to the wetland.

Proceeding with the proposed acitivities and avoiding the wetland buffer zone will constitute “Low” post-mitigation significance ratings, ultiamtely only requiring general authorisation. By impeding into the buffer zones, a water use license will be required with the condition of rehabilitation as stipulated earlier (rehabiltiating HGM 1 and 2 to “Largely Modified” after construction).

Table 7-2 DWS Risk Impact Matrix for the proposed project (Andrew Husted Pr Sci Nat 400213/11)

	Severity							
Aspect	**Flow Regime**	**Physico and Chemical (Water Quality)**	**Habitat (Geomorph and Vegetation)**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**
				Construction Phase				
Removal of topsoil	5	5	5	5	5	2	1	8
Minor Excavations	5	5	5	5	5	2	2	9
Use of machinery/vehicles close to wetlands	5	5	5	5	5	2	1	8
Ablution facilities	5	5	5	5	5	2	2	9
Domestic and industrial waste	5	5	5	5	5	2	2	9
Storage of chemicals, mixes and fuel	5	5	5	5	5	2	2	9
				Operational Phase				
Traffic during Maintenance	5	5	5	5	1,25	2	5	8,25
Altered Overlflow Dynamics	5	5	5	5	2	1	5	8

Table 7-3 DWS Risk Assessment Continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation (Avoidance of Buffers)	With Mitigation (Non-Adherence of Buffers)
Construction Phase									
Removal of topsoil	1	2	5	1	9	72	Moderate	Low	Moderate
Minor Excavations	2	2	5	2	11	99	Moderate	Low	Moderate
Use of machinery close to or within wetlands	1	2	5	2	10	80	Moderate	Low	Moderate
Ablution facilities	2	2	5	1	10	90	Moderate	Low	Low
Domestic and industrial waste	3	2	1	3	9	81	Moderate	Low	Low
Storage of chemicals, mixes and fuel	2	2	5	1	10	90	Moderate	Low	Low
Operation Phase									
Traffic during Maintenance	5	2	1	1	9	108	Moderate	Low	Low
Altered Overflow Dynamics	2	2	1	2	7	77	Moderate	Low	Moderate

(*) denotes - In accordance with General Notice 509 “Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below.”

8 Impact Assessment

The impact assessment focusses on the activities that are expected to pose threats towards HGM 1, 2 and 3 specifically. All proposed activities are expected to be long term (> 15 years) and have been considered “permanent” on this basis, which renders the decommissioning phase irrelevant. From the proposed activities, only the proposed PV area is expected to pose measurable impacts towards HGM 1 and 2 (direct and indirect) as well as HGM 3 (potential indirect impacts).

It is assumed that the PV area will not be covered in concrete with PV structures rather being installed into the surface directly and underlying vegetation cover only being maintained throughout the operational phase. It is further recommended that the 22 m buffer area be adhered to and that the proposed layout be designed in such a manner that this conservation strategy be made possible.

Construction Phase

During the construction phase heavy vehicles (trucks) will be used to transport PV structures throughout the footprint area with reliance on manual labour for finer refinement. No vegetation is located within this area due to the dominance of crop fields. Potential sedimentation is possible during the construction phase, although limited due to the clay nature of the soil in the footprint area.

It is evident from the impact calculations in Table 8-1 that in a pre-mitigation state, significant impacts are expected. The main mitigation objective would be to realign the proposed layout in such a manner that the 22 m buffer zone be adhered to. In the event that this recommendation be adhered to, considerably lower impacts are foreseen which ultimately results in a post-mitigation significance rating of "Low". In the event that adherence to this buffer zone is not feasible, the post-mitigation significance ratings will match that of the pre-mitigation ratings.

Table 8-1 Impact assessment related to the loss of wetland functionality during the construction phase of the proposed PV facility

Nature: Loss of wetland functionality		
	Without mitigation	**With mitigation**
Extent	Low (2)	Low (2)
Duration	Short Term (2)	Short Term (2)
Magnitude	Very High (10)	Low (4)
Probability	Definite (5)	Improbable (2)
Significance	**High (70)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
***Mitigation:* See Section 9**		
Residual Impacts:		
Limited residual impacts will be associated with these activities, assuming that all prescribed mitigation measures be strictly adhered to.		

Operational Phase

During the operational phase, very little impacts are foreseen. Vegetation cover will naturally re-establish in the area after cultivation practices cease. Maintenance of vegetation as well as the occasional maintenance of PV structures will have to be carried out throughout the life of the project. It is expected that these maintenance practices can be undertaken by means of manual labour. Overland flow dynamics are expected to improve due to the change in land use from baron crop fields to a PV area predominantly being covered in basal cover.

Considering the low magnitude of impacts as well as the fact that the 22 m buffer zone will be conserved, very little impacts are expected pre- and post-mitigation for the proposed operational phase.

Table 8-2 Impact assessment related to the loss of wetland functionality during the operational phase of the proposed PV facility

Nature: Loss of wetland functionality

	Without mitigation	With mitigation
Extent	Low (2)	Low (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (18)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: **See Section 9**		
Residual Impacts:		
Limited residual impacts will be associated with these activities, assuming that all prescribed mitigation measures be strictly adhered to.		

8.1 Cumulative Impacts

Cumulative impacts within the proposed PV area and its surroundings have been determined to be low. Even though the health of the relevant wetland systems has been impaired over the last few decades in regard to cultivation, infrastructure and grazing, it is worth noting that the proposed land use is expected to have fewer impacts than the current land use (cultivation).

Table 8-3 Impact assessment related cumulative impacts

Nature: Loss of wetland functionality		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Low (2)	Low (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (18)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: **See Section 9**		
Residual Impacts:		
Limited residual impacts will be associated with these activities, assuming that all prescribed mitigation measures be strictly adhered to.		

9 Specialist Management Plan

The aim of the management outcomes is to present the mitigations in such a way that they can be incorporated into the Environmental Management Programme (EMPr), allowing for more successful implementation and auditing of the mitigations and monitoring guidelines. Table 9-1 presents the recommended mitigation measures and the respective timeframes, targets and performance indicators for the wetland study.

The focus of mitigation measures is to reduce the significance of potential impacts associated with the development and thereby to ensure the conservation of wetland functionality.

Table 9-1 Mitigation measures, including requirements for timeframes, roles and responsibilities for the wetland study

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Responsible Party	Frequency
Management outcome: Conservation of Wetland Functionality				
Existing roads must be used as much as possible	Planning, Construction and Operational	Contractor/Operator	Developer's Environmental Officer (dEO)/Environmental Control Officer (ECO)	Daily
Proper stripping and stockpiling techniques must be followed	Construction	Contractor	ECO	Daily, for the duration of stripping and stockpiling
Avoid preferential surface flow paths	Construction	Contractor	ECO	Daily
Storage of potential contaminants must be undertaken in bunded areas	Construction	Contractor	ECO	Weekly
All contractors must have spill kits available and be trained in the correct use thereof	Construction	Contractor	ECO	Monthly
All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping"	Construction and Operational	Environmental Officer & Contractor/Operator	dEO/ECO	Monthly
No cleaning or servicing of vehicles, machines and equipment in water resources	Construction and Operational	Contractor/Operator	dEO/ECO	Weekly
Adequate sanitary facilities and ablutions must be provided for all personnel throughout the project area	Construction	Contractor	ECO	Monthly
Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems	Construction	Environmental Officer & Contractor	ECO	Monthly
All waste generated on-site must be adequately managed and separated and recycling of different waste materials should be supported	Construction	Environmental Officer & Contractor	ECO	Monthly
Demarcate footprint areas to be stripped of topsoil to avoid unnecessary stripping of topsoil	Construction	Project manager, Environmental Officer & Contractor	Construction	Monthly
Exposed areas must be ripped and vegetated to increase surface roughness	Construction	Contractor	ECO	As and when required

All machinery and equipment should be inspected regularly for faults and possible leaks. These should be serviced off-site or designated areas	Construction	Environmental Officer & Contractor	ECO	Weekly
Crossings are to be constructed during the low flow period	Construction	Contractor	ECO	As and when required
Well-engineered, and wide enough culvert systems should be installed at all drainage systems, including those minor systems not identified during the site assessment	Construction	Contractor	ECO	Monthly
It is critical to spread flows across the system, avoiding incisions in the landscape caused by concentrated flows. Temporary stormwater channels should be filled with aggregate and/or logs (branches included) to dissipate flows	Construction	Contractor	ECO	Monthly
It is recommended that the material surrounding and holding the culverts in place include a coarse rock layer that has been specifically incorporated to increase the porosity and permeability to accommodate flooding and very low flows	Construction	Contractor	ECO	Monthly
The culverts used in the design should be as large as possible, partially sunken and energy dissipating material must be placed at the discharge area of each culvert to prevent erosion of these areas	Construction	Contractor	ECO	Monthly
The use of larger culverts will prevent the build-up of debris by allowing the free movement of debris through the large culverts	Construction	Project manager, Environmental Officer & Contractor	Construction	Ongoing
Culverts should avoid inundation (damming) of upstream areas by facilitating streamflow and catering properly for both low flows and high flows	Construction	Contractor	ECO	Monthly
Surface run-off from the roads flowing down the embankments often scours the watercourse on the sides of the culvert causing sedimentation of the channel. This should be catered for with adequate concreted stormwater drainage depressions and channels with energy dissipaters that channel these flows into the river in a controlled manner	Construction	Contractor	ECO	Monthly
The culvert installations should further take into account the scouring action of high flows and gabion structures or similar should be placed on both sides of the culvert on the embankments both upstream and downstream. This will serve as retention of the soils from scouring around and underneath the culvert structures aiding in the protection of the structure	Construction	Contractor	ECO	Monthly
Large aggregate outsourced or from the project area (if available) can be used for energy dissipation in the channel downstream of the culverts to reduce the likelihood of scouring the riverbed and sedimentation of the catchment. It is preferable that larger aggregate be used	Construction	Contractor	ECO	Monthly

to avoid flows removing material from the site				
Signs of erosion must be addressed immediately to prevent further erosion	Construction	Contractor	ECO	Monthly
Silt traps and fences must be placed in the preferential flow paths along the road to prevent sedimentation of the watercourse	Construction	Contractor	ECO	Monthly

10 Recommendations

Two ways forward is recommended;

1. Impeding into the wetland buffer zone up to the 10 m mark, applying for a water use license and carrying out a rehabilitation strategy focussed on rheabiltiating HGM 1 and 2 to “Largely Modified” PES; or

2. Avoiding the wetland buffer zones and applying for general authorisation.

Further to this, the following recommednations have been made;

- The drainage features, even though not regarded as wetlands, must be conserved by ensuring that erosion control measures be implemented within these systems and that proper stormwater management plans incorporate the conservation of these systems by means of best-practice culvert designs.

11 Conclusion and Impact Statement

11.1 Baseline Ecology

Seven HGM units were identified of which only three systems have been included in the functional assessment due to the system being at an appreciable level of risk posed by the proposed development. These wetland systems have been determined to all have “Intermediate” average ecosystem service scores with the overall present ecological state of the systems ranging from “Largely Modified” to “Seriously Modified”. The importance and sensitivity score of HGM 3 is calculated to be “High” with the remainder of the wetlands scored “Moderate”. A 22 m buffer zone has been recommended for the conservation of the delineated wetlands.

As part of the impact assessment results, it has been determined that all risks posed by the proposed activities are characterised by “Low” post-mitigation significance ratings. Considering these findings, it is the specialist’s opinion that the proposed activities can be favourably considered on condition that all mitigations measures be implemented, including the adherence to the 22 m buffer zone.

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