WETLAND ASSESSMENT

December 2022

biosphere
Enviro Solutions

WETLAND ASSESSMENT FOR HARMONY TARGET, FREE STATE PROVINCE, WITH REGARDS TO THE PROPOSED SOLAR PV FACILITY.

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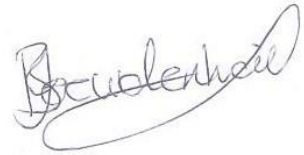
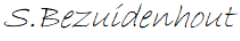
Internal Review	Justin Bezuidenhout - Registered EAP (2019/748.) Accredited Aquatic Ecologist, BA Environmental Management, ND in Disaster Risk Management	17/12/2022	
Quality Assurance	Suné Bezuidenhout – Accredited Aquatic Ecologist	18/12/2022	
Final Submission	Savannah Environmental	18/12/2022	V1.0

DECLARATION OF INDEPENDENCE

I, Mari van der Westhuizen, in my capacity as a specialist consultant, hereby declare that I - Act as an independent consultant;

- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement.

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- MSc. Environmental Sciences
- SACNASP Reg. No. 400166/15

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List of abbreviations	
CBA	Critical Biodiversity Areas
DFFE	Department of Forestry, Fisheries and the Environment
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EIS	Ecological Sensitivity and Importance
ESA	Ecological Support Areas
GA	General Authorisation
HGM type	Hydrogeomorphic type
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
NWM5	National Wetland Map version 5
PES	Present Ecological State
PV	Photovoltaic
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
WUL	Water Use License

1 INTRODUCTION

Avgold (Pty) Ltd (a subsidiary of Harmony Gold Mining Company Ltd) is looking to supplement its energy supply by implementing Photovoltaic (PV) generation, aiding their transition to a more sustainable and environmentally friendly energy mix.

The development of a solar photovoltaic (PV) facility with a generating capacity of up to 30MW is proposed 550m south of the Harmony Target operations, approximately ~14km south of the town of Allanridge within the Matjhabeng Local Municipality and within the Lejweleputswa District Municipality, Free State Province. The PV facility is located on Portion 0 of the Farm Kromdraai 386 and Portion 0 of the Farm Aandenk 227. The solar PV development will be known as Harmony Target Solar PV Facility.

The preferred site for the project is on properties which are privately owned by the Mine and are available for the proposed project and is therefore deemed technically feasible by the project developer for such development to take place.

A project site considered to be technically suitable for the development of the solar PV facility, with an extent of approximately 500ha, was identified. A development area of ~245ha was demarcated within this project site and allows an adequate footprint for the installation of a solar PV facility with a contracted capacity of up to 30MW, while allowing for the avoidance of environmental site sensitivities.

The infrastructure associated with the 30MW solar PV facility will include:

- PV modules and mounting structures.
- Inverters and transformers a SCADA room, and maintenance room.
- Cabling between the project components, to be laid underground where practical.
- Access roads, internal roads and fencing around the development area.
- Temporary and permanent laydown areas and O&M buildings.
- Overhead Power Line (OHPL)
- Grid connection solution which will tie-in to the Avgold Substation via a 2km easterly overhead power line with a capacity of up to 132kV.

The successful development of the renewable energy projects will enable Harmony Gold to make a valuable and meaningful contribution towards growing the green economy within the

province and South Africa. This will assist the Free State in creating green jobs and reducing Green House Gas emissions, whilst reducing the energy demand on the National Grid.

Biosphere Enviro Solutions (Pty) Ltd had been commissioned by Savannah Environmental to compile a wetland functionality assessment and risk matrix assessment for the wetlands in and around the proposed Solar PV Facility site.

1.1 Terms of Reference

The purpose of the study was to complete the following:

- A wetland classification,
- Wetland delineation and buffer zone calculations,
- Functionality assessment including:
- Present Ecological State (PES),
- Ecological Importance and Sensitivity (EIS),
- Recommended Ecological Category (REC).
- Department of Water and Sanitation Risk Matriks Assessment that will form part of the Water Use License (WUL) application.

1.2 Legal Framework

The National Environmental Management Act (NEMA, Act 107 of 1998) and the National Environmental Management Biodiversity Act (NEMBA, Act 10 0f 2004) ensure the protection of ecological processes, natural systems and the preservation of biotic diversity within the natural environment. They also ensure the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes, products or activities.

The National Water Act, 1998 (Act No. 36 of 1998) [NWA] provides for Constitutional water demands including pollution prevention, ecological and resource conservation and sustainable utilisation. In terms of this Act, all water resources are the property of the State and are regulated by the Department of Water and Sanitation (DWS). The NWA sets out a range of water use related principles that are to be applied by DWS when taking decisions that significantly affect a water resource.

Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (GN 1199). Such an activity requires a Water Use Licence (WUL) from the relevant authority.

1.3 Assumptions and Limitations

- The fieldwork component of the assessment comprised of one assessment only, during the wet season in December 2022. No temporal trends for the respective seasons have been assessed.
- Mainly physical structure, augering and presence of vegetation associated with wetlands were used to indicate wetland boundaries.
- The soil was ploughed in the past, but in spite of this, mottles were clearly visible between 40 and 50 cm in these wetlands.
- Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental studies deal with dynamic natural systems, additional information may come to light at a later stage.
- Due to the scale of the remote imagery used (Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineate wetland areas in the field, the delineated boundaries cannot be guaranteed beyond an accuracy of about 15m on the ground.
- Despite these limitations, a comprehensive desktop study was conducted, in conjunction with the detailed results from the current survey, and as such there is a high confidence in the information provided.

1.4 Definitions

Wetlands provide a wide range of ecosystem services, such as water purification, flood attenuation and streamflow regulation, carbon storage, biodiversity maintenance, recreation and many others (Kotze *et al.*, 2021). Wetlands are therefore important ecosystems and are protected by law.

The National Water Act (no. 36 of 1998) (NWA) defines **wetlands** 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."

Wetlands are also included in the definition of a **watercourse** within the NWA, which implies that whatever legislation refers to a watercourse, will also be applicable to wetlands. The National Water Act (36 of 1998), Section 1(1)(xxiv), defines a 'watercourse' as:

a) "a river or spring;
b) a natural channel in which water flows regularly or intermittently;
c) a wetland, lake or dam into which, or from which, water flows; and
d) 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 defines **riparian areas** as

- *"...the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas..."*

General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998) states the following:
In accordance with GN 509 of 2016, a regulated area of a watercourse for Section 21(c) and 21(i) of the NWA, 1998 is defined as:

- The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam.
- In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench: or
- A 500 m radius from the delineated boundary (extent) of any wetland or pan.

2 BACKGROUND TO THE STUDY AREA

2.1 LOCATION

The study area is the wetlands on and around Portion 0 of the Farm Kromdraai 386 and Portion 0 of the Farm Aandenk 227, Free State Province. It is located south-west of Allanridge (Figure 2).

2.2 CLIMATE

Warm-temperate, summer-rainfall climate, with overall MAP of 530 mm. High summer temperatures. Severe frost (37 days per year on average) occurs in winter (Mucina & Rutherford, 2006).

2.3 EIA SCREENING TOOL

According to the national web-based environmental screening tool in terms of National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), the site has a Low sensitivity for Aquatic Biodiversity.

A post-screening site visit was conducted to determine whether the assessment was accurate. After the site visit the following was concluded:

- The site has a Low sensitivity from an Aquatic biodiversity perspective. The wetlands in the project area has been ploughed and planted with agricultural crops. It was not planted this year and weeds and declared invader plant species has grown. Some of the wetlands outside of the development area has a higher sensitivity, but they will not be significantly impacted by the development.

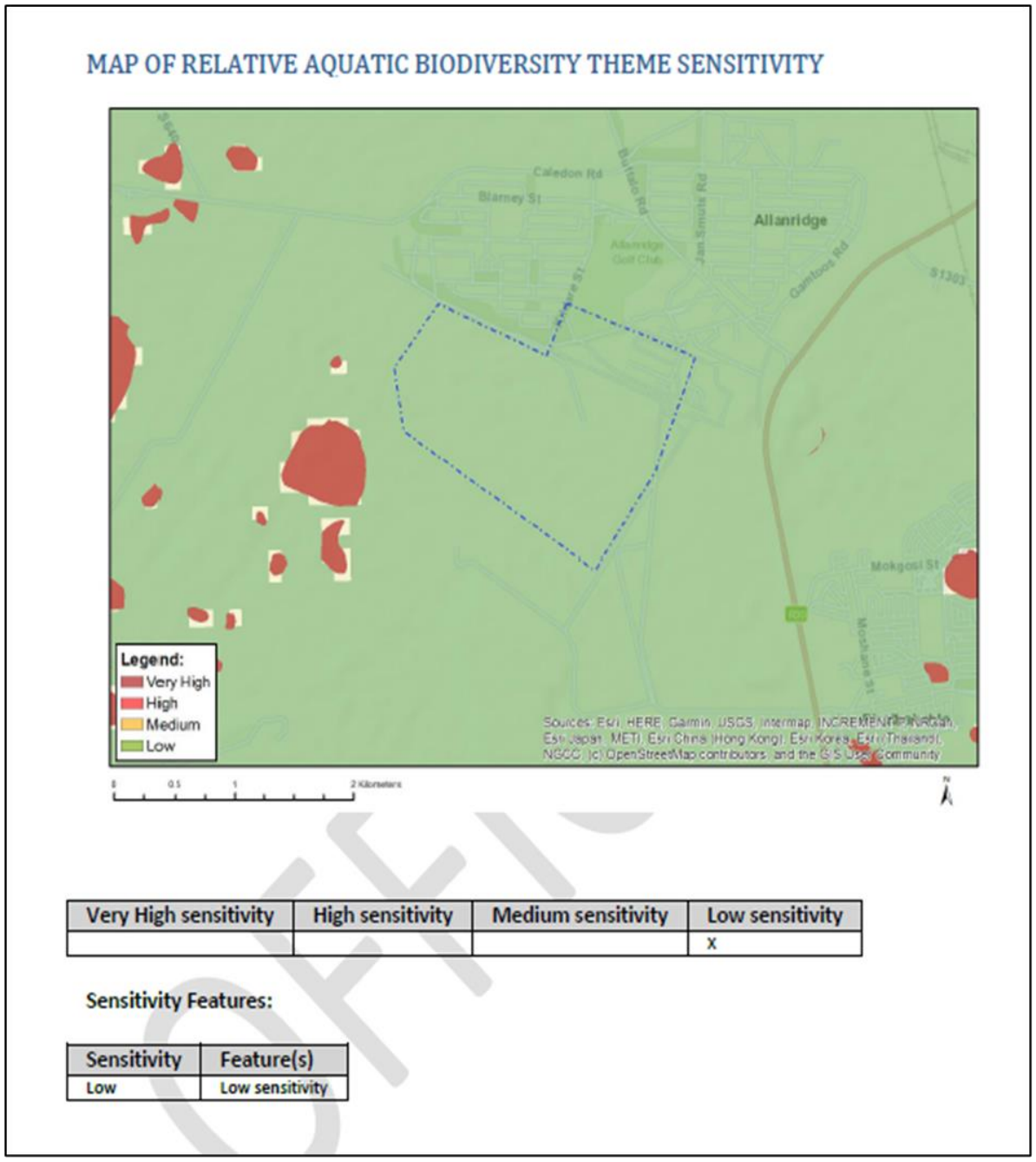

Figure 1: Aquatic biodiversity theme sensitivity according to the Screening Tool

2.4 Quaternary Catchments and Associated Watercourses

The study site falls within the C25B Quaternary Catchment and forms part of the Middle Vaal Water Management Area (WMA). The major rivers in the Middle Vaal WMA are the Mooi, Vet and Vaal Rivers.

2.5 National Freshwater Ecosystem Priority Areas (NFEPAs) and National Wetland Map 5

South Africa's freshwater ecosystems are diverse, ranging from sub-tropical in the north-eastern part of the country, to semi-arid and arid in the interior, to the cool and temperate rivers of the fynbos. "Freshwater ecosystems" refer to all inland water bodies whether fresh or saline, including rivers, lakes, wetlands, sub-surface waters and estuaries. Consistent with global trends, high levels of threat have been reported for freshwater ecosystems. According to the National Biodiversity Assessment 2018 nearly 80% of inland wetland ecosystem types in South Africa are threatened and approximately 75% of inland wetland ecosystem types are both threatened and under-protected (SANBI, 2019). South Africa's freshwater fauna also displays high levels of threat: at least one third of freshwater fish indigenous to South Africa are reported as threatened, and a recent southern African study on the conservation status of major freshwater-dependent taxonomic groups (fishes, molluscs, dragonflies, crabs and vascular plants) reported far higher levels of threat in South Africa than in the rest of the region.

Urgent attention is needed to ensure that we conserve some representative natural examples of the different ecosystems that make up the natural heritage of this country for current and future generations. NFEPA responds to this need, providing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources (Driver *et al.*, 2011)

The National Wetland Map version 5 (NWM5) shows the distribution of inland wetland ecosystem types across South Africa and includes estuaries and the extent of some rivers (CSIR, 2018).

There are no NFEPA or NWM5 wetlands inside the project area, but there are several NFEPA and NWM5 wetlands within 500m of the project area (Figure 2). These are depression wetlands; some are natural and some artificial. There are four depression wetlands inside the project area which are not indicated in either of the aforementioned databases.

2.6 Critical Biodiversity Areas and Ecological Support Areas

Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan. Ecological Support

Areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic.

The primary purpose of a map of Critical Biodiversity Areas and Ecological Support Areas is to guide decision-making about where best to locate development. It should inform land-use planning, environmental assessment and authorisations, and natural resource management, by a range of sectors whose policies and decisions impact on biodiversity. It is the biodiversity sector's input into multi-sectoral planning and decision-making processes (SANBI Biodiversity Advisor, 2017).

The project area falls into an ESA2, ((Collins, 2015; Collins, 2016) (Figure 3).

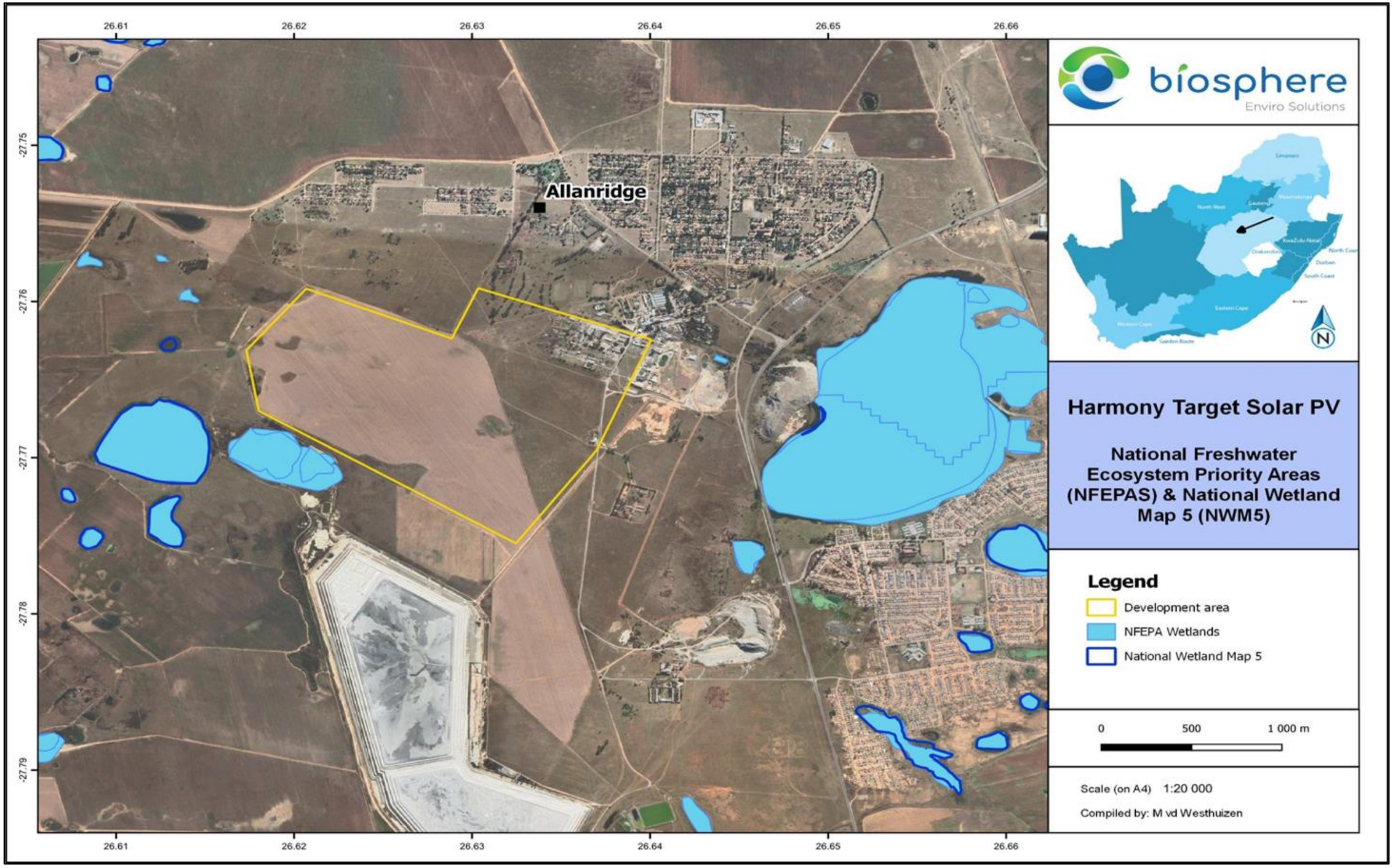

Figure 2: National Freshwater Ecosystem Priority Areas (NFEPAs) and National Wetland Map 5

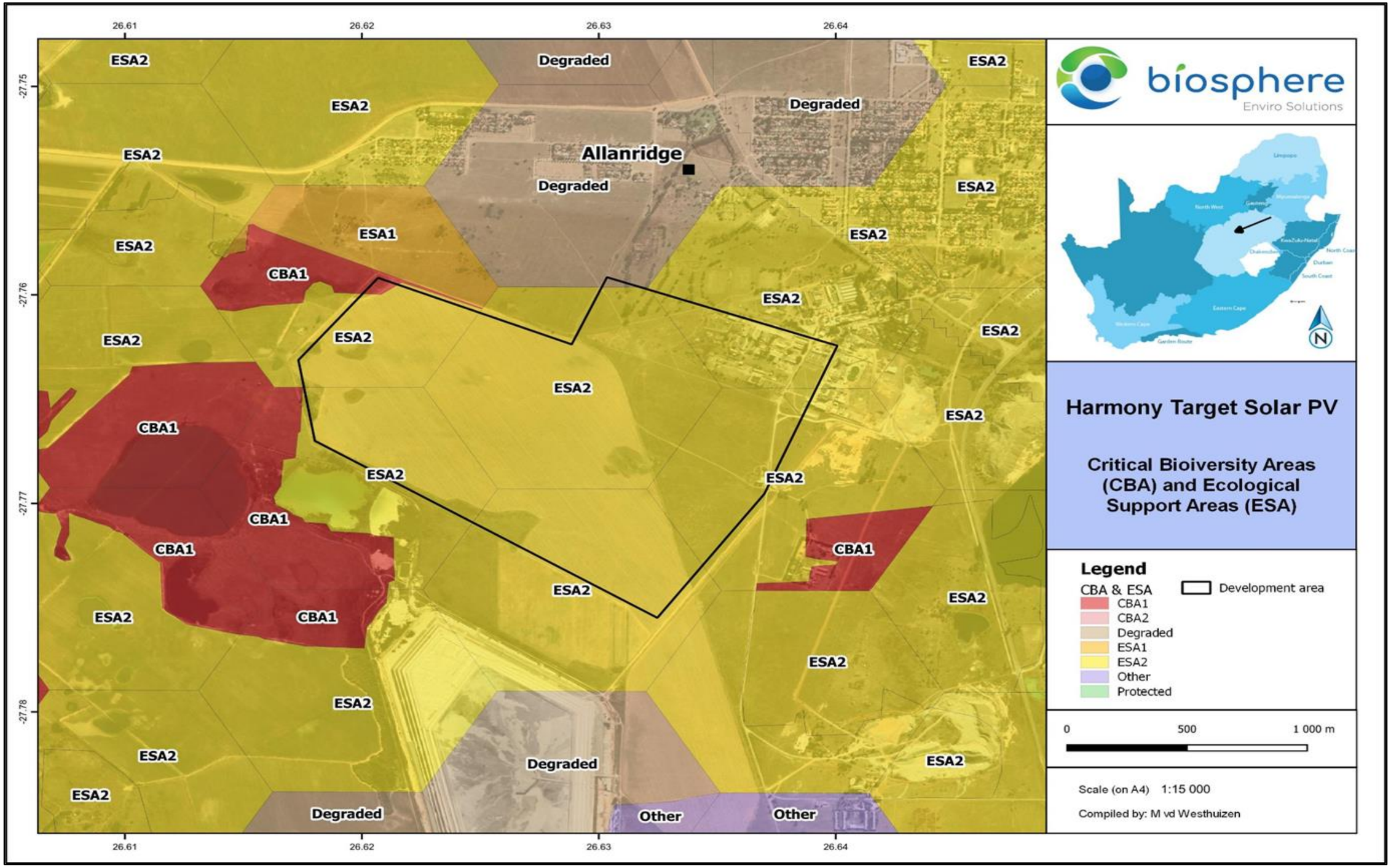

Figure 3: Free State Biodiversity Sector Plan map (Collins, 2015; Collins, 2016)

3 METHODS

3.1 WETLAND CLASSIFICATION

Wetlands can be classified into different hydrogeomorphic (HGM) types based on the geomorphic setting of the wetland in the landscape (e.g. valley bottom, floodplain, whether the wetland is open or closed), water source (surface water or groundwater), how water flows through the wetland (diffusely or channelled) and how water exits the wetland (Macfarlane *et al.*, 2009). The HGM type of a wetland gives an indication of the structure and processes of the wetland.

3.2 WETLAND INTEGRITY ASSESSMENTS

3.2.1 Present Ecological Status (PES) of wetlands

WET-Health (Macfarlane *et al.*, 2020) is designed to assess the PES of a wetland by scoring the perceived deviation from a theoretical reference condition, where the reference condition is defined as the un-impacted condition in which ecosystems show little or no influence of human actions. In thinking about wetland health or PES, it is thus appropriate to consider 'deviation' from the natural or reference condition, with the ecological state of a wetland taken as a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition (Macfarlane *et al.*, 2020).

Whilst wetland features vary considerably from one wetland to the next, wetlands are all broadly influenced by their climatic and geological setting and by three core inter-related drivers, namely hydrology, geomorphology and water quality. The biology of the wetland (in which vegetation generally plays a central role) responds to changes in these drivers, and to activities within and around the wetland. The interrelatedness of these four components is illustrated schematically in the figure below.

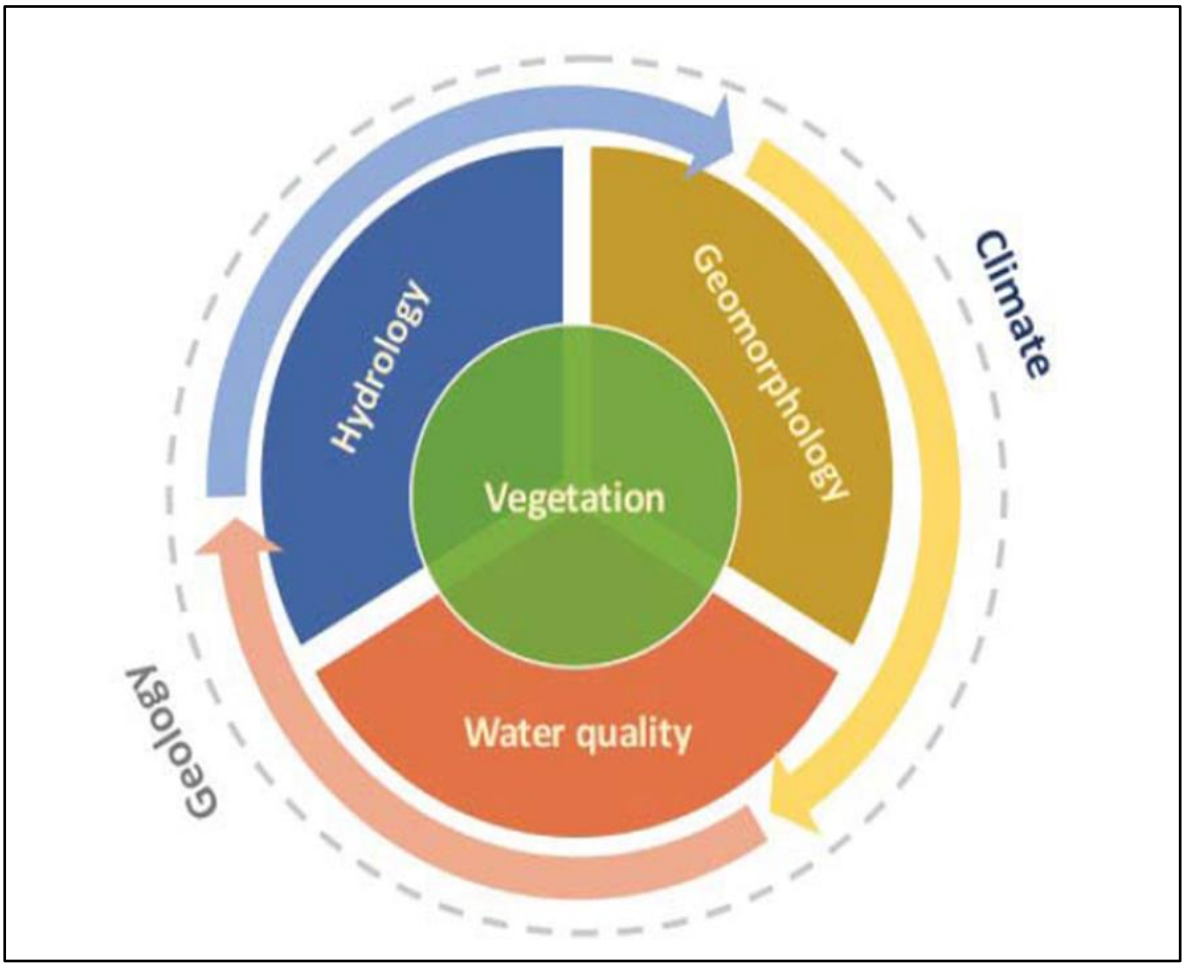

Figure 4: Diagram representing the four key components of Wetland PES considered in WET-Health Version 2 (Macfarlane *et al.*, 2020).

The impact categories, scores, and associated present state categories are summarised in Table 1 below.

Table 1: Impact scores and categories of Present Ecological State used by WET-Health for describing the integrity of the wetland (Macfarlane et al., 2020).

Impact Category	Description	Impact Score Range	Present Ecological State Category
None	Unmodified, or approximates natural condition	0 – 0.9	A
Small	Largely natural with few modifications, but with some loss of natural habitats	1 – 1.9	B
Moderate	Moderately modified, but with some loss of natural habitats	2 – 3.9	C
Large	Largely modified. A large loss of natural habitat and basic ecosystem function has occurred	4 – 5.9	D
Serious	Seriously modified. The losses of natural habitat and ecosystem functions are extensive	6 – 7.9	E
Critical	Critically modified. Modification has reached a critical level and the system has been modified completely with almost complete loss of natural habitat	8 – 10.0	F

3.2.2 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) assessment was conducted per the guidelines as discussed by DWAF (1999). Here DWAF defines "ecological importance" of a water resource as an expression of its importance to the maintenance of ecological diversity and function on local and wider scales. "Ecological sensitivity", according to DWAF (1999), is the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred.

Table 2: Description of the 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

3.2.3 Recommended Ecological Category (REC)

his is the Ecological Category in which it is recommended that a water resource be managed. The modus operandi is that, if the Ecological Importance and is high or very high, the aim should be to improve the condition of the resource. However, the causes related to a particular PES should also be considered to determine if improvement is realistic and attainable. This relates to whether the problems in the catchment which are causing an impacted PES can be addressed and mitigated for.

If the Ecological Importance and Sensitivity is evaluated as moderate or low, the aim should be to maintain the wetland in its PES. Within the Ecological Reserve context, ecological categories A-D can be recommended as future states (the Recommended Ecological Category) depending on the EIS and PES. Ecological Categories E and F are regarded as ecologically unacceptable, and remediation is needed (Malan & Day, 2012).

Table 3: Recommended Ecological Category

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

3.2.4 Buffer zone calculation

The buffer zones were calculated using "Buffer Zone Guidelines for Wetlands, Rivers and Estuaries. Part 2: Practical Guide. WRC Report No. TT 715/2/17." by Macfarlane & Bredin (2017).

3.3 Department of Water Affairs and Sanitation Risk assessment matrix

A Risk Assessment, as required in terms of the General Authorisation Notice 509 of 2016 (Gazette No.40229), for any development within 500m of a wetland. The risk assessment should be based on the following ratings (Table 4).

Table 4. Risk rating tables and methodology for the risk assessment

SEVERITY	
How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, and habitat)?	
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	
SPATIAL SCALE	
How big is the area that the aspect is impacting on?	
Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5
DURATION	
How long does the aspect impact on the resource quality?	
One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2

One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	
FREQUENCY OF THE ACTIVITY	
How often do you do the specific activity?	
Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5
FREQUENCY OF THE INCIDENT/IMPACT	
How often does the activity impact on the resource quality?	
Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5
LEGAL ISSUES	
How is the activity governed by legislation?	
No legislation	1

Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	
DETECTION	
How quickly/easily can the impacts/risks of the activity be observed on the resource quality, people and property?	
Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Risk scores, classes, and the appropriate authorization process (Extract from DWS, 2016)

Rating	Class	Management Description	Authorisation	Delegation
1 - 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands are excluded.	GA	Regional Head
56 - 169	(M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.	WUL	Regional Head

170 - 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.	WUL	Director General

Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance₩Risk = Consequence X Likelihood
RISK ASSESSMENT MUST BE CONDUCTED BY A SACNASP REGISTERED PROFESSIONAL MEMBER AND THE ASSESSOR MUST:
1)CONSIDER BOTH CONSTRUCTION AND OPERATIONAL PHASES OF PROPOSED ACTIVITIES;
2) CONSIDER RISKS TO RESOURCE QUALITY POST MITIGATION CONSIDERING MITIGATION MEASURES LISTED IN TABLES PROVIDED;
3) CONSIDER THE SENSITIVITY (ECOLOGICAL IMPORTANCE AND SENSITIVITY – EIS) AND STATUS (PRESENT ECOLOGICAL STATUS - PES) OF THE WATERCOURSE AS RECEPTOR OF RISKS POSED;

4) CONSIDER POSITIVE IMPACTS/RISKS REDUCTION AS A VERY LOW RISK IN THIS ASSESSMENT;
5) INDICATE CONFIDENCE LEVEL OF SCORES PROVIDED IN THE LAST COLUMN AS A PERCENTAGE FROM 0 - 100%.

3.4 IMPACT ASSESSMENT

Direct, indirect and cumulative impacts were assessed in terms of 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 a score is assigned:
    - 0 is small and will have no effect on the environment
    - 2 is minor and will not result in an impact on processes
    - 4 is low and will cause a slight impact on processes
    - 6 is moderate and will result in processes continuing but in a modified way
    - 8 is high (processes are altered to the extent that they temporarily cease)
    - 10 is very high and results in complete destruction of patterns and permanent cessation of processes

- The **probability** of occurrence, which 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; and
- 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.
- 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) x 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),

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

4 RESULTS

4.1 WETLAND DELINEATION AND CLASSIFICATION

See Figure 6 for the wetland delineation.

There are four wetlands inside the project area, but there are nine more within 500m of the project area. All of the wetlands are depression wetlands, some natural and others artificial.

A depression is a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates (Ollis *et al.*, 2013). An 'endorheic' depression is inward-draining, meaning it has no outflow (Ollis *et al.*, 2013). An exorheic depression has an outflow.

The wetlands inside the development area are in a poor condition as they were ploughed in the past for agricultural crops. Some were not ploughed recently and have had some time to recover, but all are still dominated by weeds.

Figure 5: Group 1 Depression wetland in project area dominated by weeds

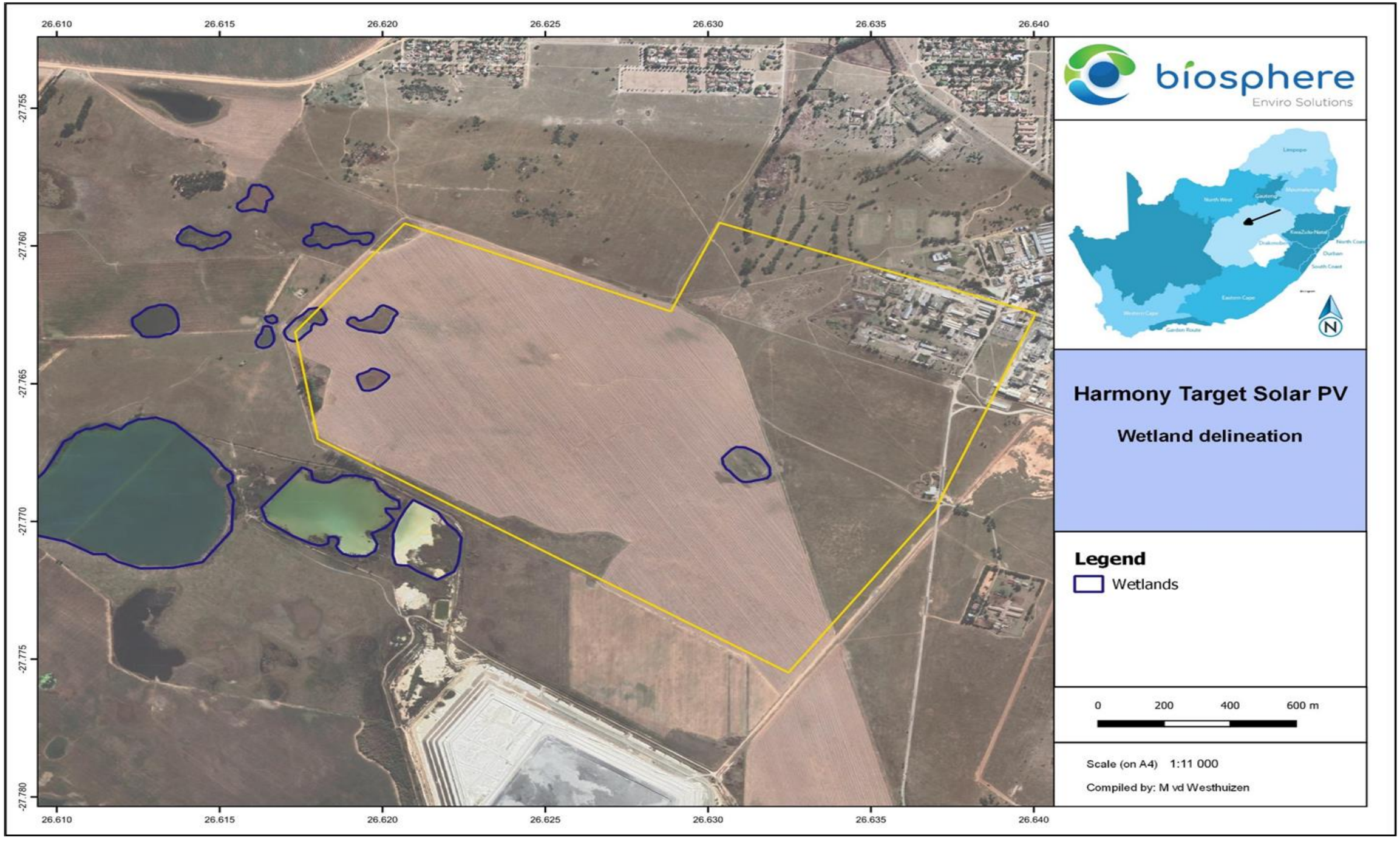

Figure 6: Wetland delineation

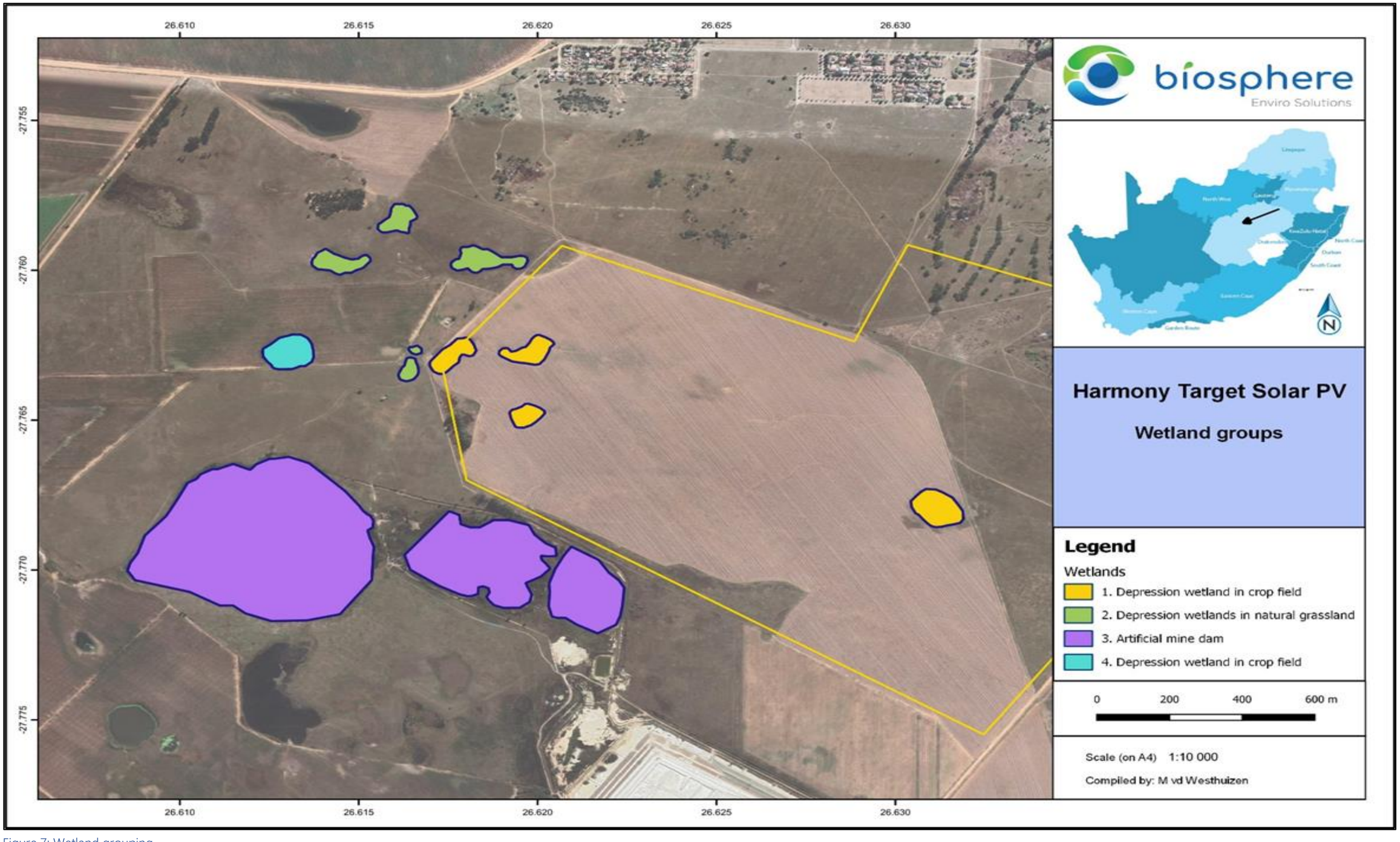

Figure 7: Wetland grouping

Figure 8: Wetland soil in project area showing mottling

Figure 9: Sedges in wetland

Table 5: Description of the assessed wetland areas on site.

Feature	1. Endorheic Depression Wetlands in agricultural crop fields (in project area)	2. Endorheic depression wetlands in natural grassland (outside project area)
Catchment Features and Current Impacts	The catchment area of this assessed wetlands consists mostly of cultivated crops (that has not been planted this season and now consists of weeds), natural veld used for cattle grazing and gold mining activities.	The catchment area of this assessed wetlands consists mostly of natural veld used for cattle grazing and cultivated crops.
Wetland Type	Endorheic Depression Wetland	Endorheic Depression Wetland
Downstream Features	None – there is no outflow from the wetland	None – there is no outflow from the wetland
Vegetation Characteristics	Vegetation consists of weeds (*Conyza bonariesis*, *Pseudognaphalium luteo-album*, *Lobelia erinus*) and sedges (*Schoenoplectus* spp., *Cyperus* spp.)	Hydrophilic vegetation such as sedges (*Cyperus* & *Schoenoplectus* spp.), *Potamogeton schweinfurthii* and grasses
Algae Presence	No, no standing water during site visit	Yes
Aquatic Faunal Impacts	No	Disturbance by cattle
Depth Characteristics	No water	Up to 50cm
Flow Conditions	No flow	No flow
Water Clarity	N/A	Moderate turbidity
Water Odour	None detected	None detected
Erosion Impacts	Low erosion potential as the wetland vegetation is moderately dense.	Low erosion potential as the wetland vegetation is moderately dense.

Soil characteristics	Mottling is present between 40 and 50cm	Gleying and mottling present

Feature	3. Exorheic Depression Wetlands south of project area (Mine dams)	4. Endorheic depression wetlands in agricultural crop fields (outside project area)
Catchment Features and Current Impacts	The catchment area of the assessed wetlands consists mostly of disturbed grassland, gold mining activities and cultivated crops.	The catchment area of this assessed wetlands consists mostly of cultivated crops and natural veld used for cattle grazing.
Wetland Type	Exorheic Depression Wetland	Endorheic Depression Wetland
Downstream Features	Agricultural crops, disturbed grassland, dams, mining activities	None – there is no outflow from the wetland
Vegetation Characteristics	Vegetation consists of the tree *Eucalyptus camaldulensis*, grasses, weeds (*Tagetes minuta*, *Opuntia* sp.) and sedges	Hydrophylic vegetation such as sedges (*Cyperus* & *Schoenoplectus* spp.), and grasses
Algae Presence	Yes	Yes
Aquatic Faunal Impacts	Water pollution by mining activities	Disturbance by cattle
Depth Characteristics	Deep, not measured	Up to 50cm
Flow Conditions	Slow flow	No flow
Water Clarity	High turbidity	Moderate turbidity
Water Odour	None detected	None detected
Erosion Impacts	Low erosion potential as the wetland vegetation is quite dense.	High erosion potential as the catchment of this wetland is cultivated and vegetation is sparse
Soil characteristics	Gleying	Gleying and mottling present

Figure 10: Group 2 depression wetland in natural grassland

Figure 11: Group 3 exorheic wetlands (mine dams)

Figure 12: Group 4 endorheic depression wetland in crop field outside project area

4.2 Wetland Integrity Assessments

In determining the integrity of the wetland, the condition of the site and the indirect and direct disturbances are considered. The roads, alien invasive vegetation species, pollution, sedimentation and density roughness elements was taken into account in determining the PES and EIS of the wetland units on site.

4.2.1 WET-Health Assessment

Three modules, namely hydrology, geomorphology and vegetation, were assessed as a single unit for the HGM Units and subsequently an area weighted score was obtained for the HGM Units. The potential impacts of activities such as agriculture, drought and altered hydrological functions within the greater catchment were taken into consideration during the assessment. The results are summarised in Table 6 – 9 below.

Table 6: WET-Health assessment: Present Ecological State (PES) – Group 1

Final PES Scores Group 1				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5,6	4,7	5,7	7,8
PES Score (%)	44%	53%	43%	22%
Ecological Category	D	D	D	E
Trajectory of change	→	→	→	→
Confidence (revised results)	Medium	Medium	Medium	Medium
Combined Impact Score	5,9			
Combined PES Score (%)	41%			
Combined Ecological Category	D			
Hectare Equivalents	1,5 Ha			

The combined **PES Category for Group 1 depression wetlands is a D**, meaning that the wetland is Largely modified. A large loss of natural habitat and basic ecosystem function has occurred. Based on the Trajectory of change, the wetlands PES is likely to remain stable over the next 5 years.

Table 7: WET-Health assessment: Present Ecological State (PES) – Group 2

Final PES Scores Group 2				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1,8	2,0	5,7	3,6
PES Score (%)	82%	80%	43%	64%
Ecological Category	B	B	D	C
Trajectory of change	→	→	→	→
Confidence (revised results)	Medium	Medium	Medium	Medium
Combined Impact Score	3,1			
Combined PES Score (%)	69%			
Combined Ecological Category	C			
Hectare Equivalents	2,3 Ha			

The combined **PES Category for Group 2 depression wetlands is a C**, meaning that the wetland is Moderately modified, but with some loss of natural habitats. Based on the Trajectory of change, the wetlands PES is likely to remain stable over the next 5 years.

Table 8: WET-Health assessment: Present Ecological State (PES) – Group 3

Final PES Scores Group 3				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	7,2	4,8	4,9	9,8
PES Score (%)	28%	52%	51%	2%
Ecological Category	E	D	D	F
Trajectory of change	→	→	→	→
Confidence (revised results)	Medium	Medium	Medium	Medium
Combined Impact Score	6,8			
Combined PES Score (%)	32%			
Combined Ecological Category	E			
Hectare Equivalents	13,5 Ha			

The combined **PES Category for Group 3 depression wetlands is an E**, meaning that the wetland is Seriously modified. The losses of natural habitat and ecosystem functions are extensive. Based on the Trajectory of change, the wetlands PES is likely to remain stable over the next 5 years.

Table 9: WET-Health assessment: Present Ecological State (PES) – Group 4

Final PES Scores Group 4				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1,7	2,4	5,9	0,9
PES Score (%)	83%	76%	41%	91%
Ecological Category	B	C	D	A
Trajectory of change	→	→	→	→
Confidence (revised results)	Medium	Medium	Medium	Medium
Combined Impact Score	2,6			
Combined PES Score (%)	74%			

Combined Ecological Category	C
Hectare Equivalents	1,1 Ha

The combined **PES Category for Group 4 depression wetlands is a C**, meaning that the wetland is Moderately modified, but with some loss of natural habitats. Based on the Trajectory of change, the wetlands PES is likely to remain stable over the next 5 years.

4.2.2 Ecological Importance and Sensitivity

The EIS assessment was applied to all wetland features within the study area in order to ascertain the levels of sensitivity and ecological importance of the features. The results of these assessments are summarised in Table 10 below.

Table 10: EIS scores obtained for the Wetlands (DWAF, 1999).

Ecological Importance and Sensitivity								
	1. Endorheic Depression Wetlands in agricultural crop fields (in project area)		2. Endorheic depression wetlands in natural grassland (outside project area)		3. Exorheic Depression Wetlands south of project area (Mine dams)		4. Endorheic depression wetlands in agricultural crop field (outside project area)	
Determinant	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence
Biotic determinants								
Rare and endangered biota	0	3	1	2	0	2	1	2
Unique biota	0	3	1	2	0	2	1	2
Intolerant biota	0	3	1	2	0	2	1	2
Species/taxon richness	1	3	2	2	1	3	2	2
Habitat (instream and riparian) determinants								
Diversity of aquatic habitat types or features	1	4	2	3	2	3	1	3
Refuge value of habitat types	1	4	2	3	1	3	1	3
Sensitivity of habitat to flow changes	1	3	2	3	1	3	1	3
Sensitivity to flow related water quality changes	1	3	1	3	1	3	1	3
Migration route/corridor for instream and riparian biota	0	4	0	4	0	4	0	4
National parks, Wilderness areas, Nature reserves Natural Heritage sites Natural areas	0	4	1	3	0	3	0	3
Total	5		13		6		9	
Average score	0,5		1,3		0,6		0,9	

Category	Low / marginal	Moderate	Low / marginal	Low / marginal

The **Ecological Importance and Sensitivity of the depression wetlands, except those in the natural grassland is low / marginal**. This means that the wetlands are not unique at any scale. These wetlands (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use (DWAF, 1999). The Ecological Importance and Sensitivity of the depression wetlands in the natural grassland is Moderate, which means that it is unique on local scale. They are usually not very sensitive to flow modifications and often have a substantial capacity for use.

4.2.3 Recommended Ecological Category (REC)

The **Recommended Ecological Category is:**

- Group1 D: Maintain.
- Group2 C: Maintain
- Group3 D: Improve
- Group 4 C: Maintain

Table 11: Summary of results

Classification	Endorheic Depression Wetland (Group 1)	Endorheic Depression Wetland (Group 2)	Exorheic Depression Wetland (Group 3)	Endorheic Depression Wetland (Group 4)
PES	D: Largely modified	C: Moderately modified	E: Seriously modified	C: Moderately modified
EIS	0,5: Low / marginal	1,3: Moderate	0,6: Low / marginal	0,9: Low / marginal
REC	D: Maintain	C: Maintain	D: Improve	C: Maintain
Buffer	10m	10m	10m	10m

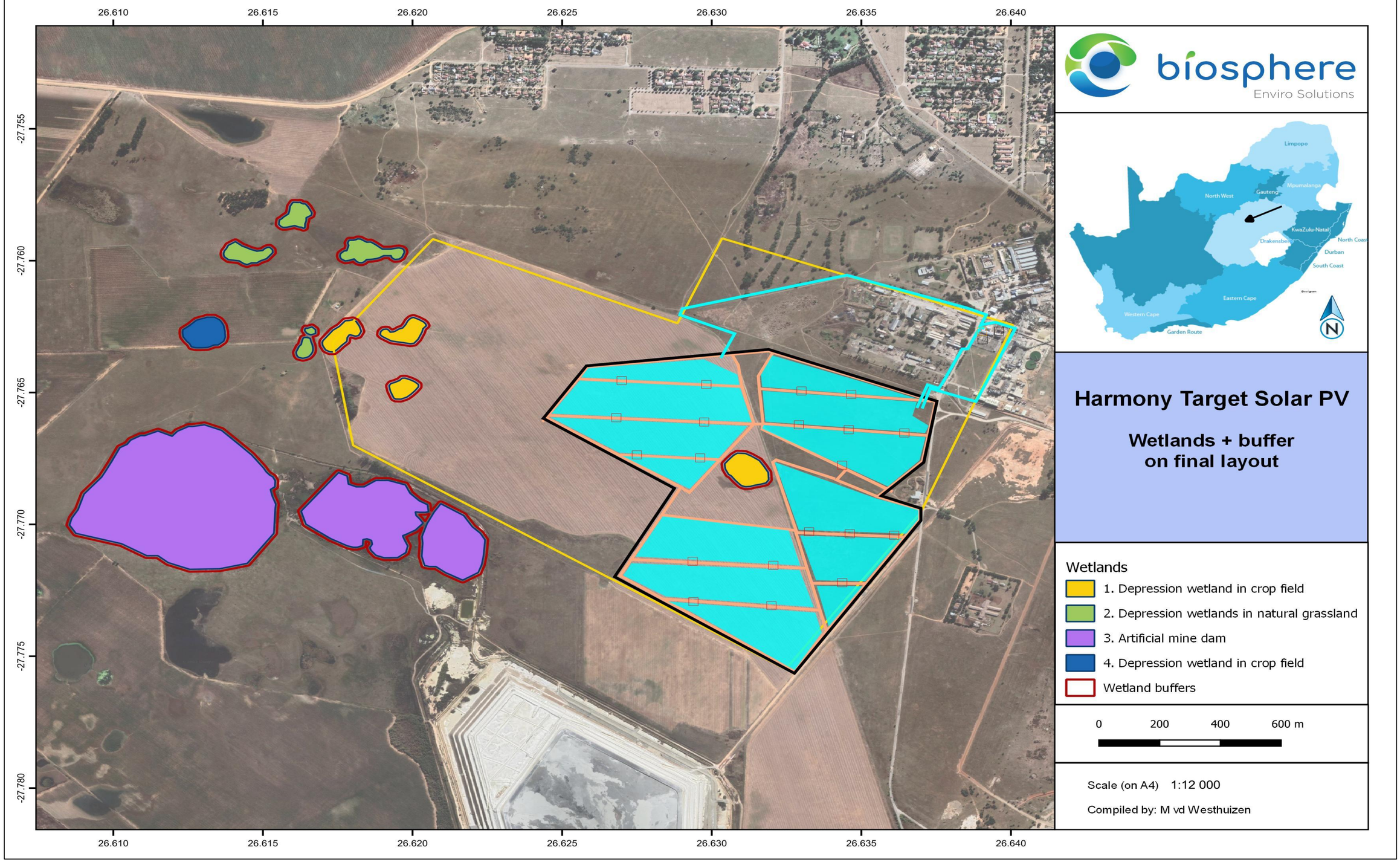

Figure 13: Wetlands and wetland buffers on final layout

4.3 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE WETLANDS

There are four depression wetlands inside the development area. They were already disturbed by ploughing in the past. They have recovered to some extent but are still in a very disturbed condition. Impacts will be assessed only for these four wetlands. The other wetlands (Group 2 -4) will not be impacted as they are too far away or topographically higher than the development area. See Table 12 for the DWS Risk Matrix Assessment and Table 13 to Table 18 for the NEMA Impact Assessment.

4.3.1 Compaction, Soil Erosion and Sedimentation

Description of impact:

The use of heavy machinery during the construction process of the development will result in the compaction of soil, resulting in decreased infiltration of rainwater and increased surface run-off volumes and velocities leading to a greater erosion risk. The hardened surfaces of the road and compacted soils of the proposed development area will also lead to an increase in surface run-off during storms. This can lead to erosion in the cleared areas and sedimentation in the wetlands.

Mitigation measures

- Compaction of soils should be limited and / or avoided as far as possible. Compaction will reduce water infiltration and will result in increased runoff and erosion. Where any disturbance of the soil takes place (have taken place in the past), these areas must be stabilised and any alien plants which establish should be cleared and follow-up undertaken for at least 2 years thereafter and preferably longer. Where compaction becomes apparent, remedial measures must be taken (e.g., "ripping" the affected area).
- Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion.
- Erosion control mechanisms must be established as soon as possible.
- A stormwater plan must be developed with the aid of an engineer to ensure that water runoff is diverted off the site without pooling and stagnation or erosion. Financial provision for closure will include the estimated costs for erosion control post-construction and post-decommissioning.
- The indiscriminate use of machinery within the wetland area will lead to compaction of soils and destruction of vegetation and must therefore be strictly controlled.
- A buffer zone of 10 m should be implemented around the wetland as a no-go area, to prevent sediment changes.

4.3.2 Soil and water pollution

Description of impact:

Construction work will also carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface- or groundwater, leading to potential medium/long-term impacts on fauna and flora.

Mitigation measures

- Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.
- No dumping of waste should take place within the wetlands or their buffer zones. If any spills occur, they should be cleaned up immediately.
- Contain all dirty water in the dirty water system and contain all dirty stormwater up to a 1:50 year flood line as a minimum. Ensure that all activities impacting on groundwater resources of the subject property are managed according to the relevant DWS Licensing regulations and groundwater monitoring and management requirements.
- Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility.
- Excess waste or chemicals should be removed from site and discarded in an environmentally friendly way. The Environmental Control Officer (ECO) should enforce this rule rigorously.
- Hazardous chemicals to be stored on an impervious surface protected from rainfall and stormwater run-off.
- Spill kits should be on-hand to deal with spills immediately.
- All vehicles should be inspected for oil and fuel leaks on a regular basis. Vehicle maintenance yards on site should make provision for drip trays to capture spills. Drip trays should be emptied into a holding tank and returned to the supplier.
- Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) and chemical dust suppressants of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.
- A speed limit (preferably 40 km/hour) should be enforced on dirt roads.

- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with the label and application permit directions and stipulations for terrestrial and aquatic applications.

4.3.3 Spread and establishment of alien invasive species

Description of impact:

The construction almost certainly carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project.

Declared invader plant species such as Argemone ochroleuca (Mexican Poppy, Category 1b) are already present at the site. The spread of the alien invasive species through the area will be accelerated when seeds are carried by stormwater into the drainage features on the site that will cause environmental degradation and indigenous species to be displaced.

Mitigation measures

- Alien and invader vegetation must not be allowed to colonise the area. Control involves killing alien invasive plants present, seedlings and establishing an alternative plant cover to limit re-growth. The use of indigenous plants must be encouraged in the rehabilitated areas (stormwater canals). Control should begin prior to construction phase considering small populations of invader plant species occur around the project area.
- Institute strict control over materials brought onto site, which should be inspected for seeds and steps taken to eradicate these before transport to the site. The contractor is responsible for the control of weeds and invader plants.
- Rehabilitate disturbed areas as quickly as possible.
- Institute a monitoring programme to detect alien invasive species early.
- Institute an eradication/control programme for early intervention if invasive species are detected. The use of indigenous plants must be encouraged in the rehabilitated areas. Active management and eradication of exotic / alien plant species should also occur when seedlings are found.

Table 12: Risk Matrix Assessment: Depression wetland

RISK MATRIX (BasedA1:W28 on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)
NAME and REGISTRATION No of SACNASP Professional member: Mari van der Westhuizen..... Reg no. 400166/15
Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity																
No.	Phases	Activity	Aspect	Impact	Flow Regime	Water quality	Habitat (Geomorph +	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures Mitigation Measures	PES AND EIS OF WATERCOURSE
1	Construction Phase	Compaction of soil. Exposure of soils to rainfall and wind	Earth works will lead to the compaction and exposure of bare soil	Sedimentation	1	1	2	1	1,25	1	2	4,25	1	1	5	1	8	34	Low Risk	80%	Please refer to wetland assessment report	PES - Class D: Largely modified; EIS - Low / Marginal
	Operational Phase		If not rehabilitated properly, erosion and sedimentation will continue	Sedimentation	1	1	2	1	1,25	1	2	4,25	1	1	5	1	8	34	Low Risk	80%	Please refer to wetland assessment report	PES - Class D: Largely modified; EIS - Low / Marginal
2	Construction Phase	Movement of vehicles on site	Spillage of harmful substances Leakages by vehicles	Soil and Water pollution	1	2	1	2	1,5	2	2	5,5	1	2	5	1	9	49,5	Low Risk	80%	Please refer to wetland assessment report	PES - Class D: Largely modified; EIS - Low / Marginal
	Operational Phase		Leakages by maintenance vehicles		1	2	1	2	1,5	1	2	4,5	1	2	5	1	9	40,5	Low Risk	80%	Please refer to wetland assessment report	PES - Class D: Largely modified; EIS - Low / Marginal
3	Construction Phase	Movement of people and vehicles to and from the development site	Delivery of construction material and other vehicles to the development site	Import and spread of alien invasive vegetation	1	1	2	3	1,75	1	2	4,75	1	2	5	1	9	42,75	Low Risk	80%	Please refer to wetland assessment report	PES - Class D: Largely modified; EIS - Low / Marginal
	Operational Phase		Movement of maintenance vehicles and peopole on site		1	1	1	2	1,25	1	2	4,25	2	2	5	1	10	42,5	Low Risk	80%	Please refer to wetland assessment report	PES - Class D: Largely modified; EIS - Low / Marginal

All impacts are rated as low. This is because development will be kept outside of the wetlands and their buffers and because the wetlands closest to the development has already been disturbed.

Table 13: Impact Assessment: Compaction, Soil Erosion and Sedimentation

Nature: Compaction of soil caused by heavy machinery. Soil erosion because of cleared areas and increased runoff. Potential sedimentation of wetlands			
Impact description: The use of heavy machinery during the construction process of the development will result in the compaction of soil, resulting in decreased infiltration of rainwater and increased surface run-off volumes and velocities leading to a greater erosion risk. The hardened surfaces of the road and compacted soils of the proposed development area will also lead to an increase in surface run-off during storms. This can lead to erosion in the cleared areas and sedimentation in the wetlands			
	Rating	Motivation	Significance
Prior to Mitigation			
Duration	Short-term (2)	Without mitigation, vegetation and soil will stabilise naturally, because of the gentle slope	Low Negative (15)
Extent	Low (1)	The development area and the area directly next to it will be affected	
Magnitude	Minor (2)	The only potential impact on the wetland is sedimentation, as no development will occur inside the wetland or its buffer. This will be minor as the development is some distance from the impact and the slope is gentle	

Probability	Probable (3)	If soil is compacted and cleared of vegetation soil erosion and sedimentation is likely	
Mitigation/Enhancement Measures			
Mitigation: Compaction of soils should be limited and / or avoided as far as possible. Compaction will reduce water infiltration and will result in increased runoff and erosion. Where any disturbance of the soil takes place (have taken place in the past), these areas must be stabilised and any alien plants which establish should be cleared and follow-up undertaken for at least 2 years thereafter and preferably longer. Where compaction becomes apparent, remedial measures must be taken (e.g., "ripping" the affected area). Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion. Erosion control mechanisms must be established as soon as possible. A stormwater plan must be developed with the aid of an engineer to ensure that water runoff is diverted off the site without pooling and stagnation or erosion. Financial provision for closure will include the estimated costs for erosion control post-construction and post-decommissioning. The indiscriminate use of machinery within the wetland area will lead to compaction of soils and destruction of vegetation and must therefore be strictly controlled. A buffer zone of 10 m should be implemented around the wetland as a no-go area, to prevent sediment changes.			
Post Mitigation/Enhancement Measures			
Duration	Very short-term (1)	Re-vegetation and erosion control will decrease the duration of the impact.	Low Negative (6)

Extent	Low (1)	The development area and the area directly next to it will be affected.	
Magnitude	Small (1)	If development occurs outside the wetlands and their buffers and impacts are mitigated, the magnitude will be small.	
Probability	Improbable (2)	Revegetation and erosion control should effectively prevent erosion and sedimentation	
Cumulative impacts	Low		
Residual risks	Low		

Table 14: Cumulative impacts: Compaction, Soil Erosion and Sedimentation

Nature: Compaction, Soil Erosion and Sedimentation		
	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Duration	Very short-term (1)	Short term (2)
Extent	Low (1)	Medium-low (2)
Magnitude	Small (1)	Minor (2)
Probability	Improbable (2)	Probable (3)
Significance	**Low (6)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	High	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

Confidence in findings: High.
Mitigation: "Mitigation", means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.

Table 15: Impact Assessment: Soil and water pollution

Nature: Soil and water pollution caused by spillages from construction vehicles			
Impact description: Construction work will also carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface- or groundwater, leading to potential medium/long-term impacts on fauna and flora.			
	Rating	Motivation	Significance
Prior to Mitigation			
Duration	Medium-term (3)	Pollutants may take several years to break down.	Low Negative (27)
Extent	Medium-low (2)	Soil pollution will be limited to the area of the spill, but water pollution may spread further as polluted water may run off into lower lying areas and groundwater pollution may spread further.	
Magnitude	Low (4)	Pollution will impact on fauna and flora.	
Probability	Probable (3)	If care is not taken pollution is probable	
Mitigation/Enhancement Measures			
Mitigation:			

Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.

No dumping of waste should take place within the wetlands or their buffer zones. If any spills occur, they should be cleaned up immediately.

Contain all dirty water in the dirty water system and contain all dirty stormwater up to a 1:50 year flood line as a minimum. Ensure that all activities impacting on groundwater resources of the subject property are managed according to the relevant DWS Licensing regulations and groundwater monitoring and management requirements.

Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility.

Excess waste or chemicals should be removed from site and discarded in an environmentally friendly way. The Environmental Control Officer (ECO) should enforce this rule rigorously.

Hazardous chemicals to be stored on an impervious surface protected from rainfall and stormwater run-off.
Spill kits should be on-hand to deal with spills immediately.

All vehicles should be inspected for oil and fuel leaks on a regular basis. Vehicle maintenance yards on site should make provision for drip trays to capture spills. Drip trays should be emptied into a holding tank and returned to the supplier.

Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) and chemical dust suppressants of construction areas and

access roads, and ensure that these are continuously monitored to ensure effective implementation. A speed limit (preferably 40 km/hour) should be enforced on dirt roads. Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with the label and application permit directions and stipulations for terrestrial and aquatic applications.			
Post Mitigation/Enhancement Measures			
Duration	Short-term (2)	Pollution will be greatly limited and cleaned up	Low Negative (10)
Extent	Low (1)	Should pollution occur, the spread thereof will be limited	
Magnitude	Minor (2)	Pollution will be cleaned up	
Probability	Improbable (2)	Mitigation measures should prevent pollution	
Cumulative impacts	Low		
Residual risks	Low		

Table 16: Cumulative impacts: Soil and water pollution

Nature: Soil and water pollution		
	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Duration	Short-term (2)	Short term (2)
Extent	Low (1)	Medium (3)
Magnitude	Minor (2)	Low (4)
Probability	Improbable (2)	Improbable (2)

Significance	Low (10)	Low (18)
Status (positive or negative)	Negative	Negative
Reversibility	High	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Confidence in findings: High.		
Mitigation: "Mitigation", means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.		

Table 17: Impact Assessment: Spread and establishment of alien invasive species

Nature: Spread and establishment of alien invasive species			
Impact description: The construction almost certainly carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites. Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. Declared invader plant species such as *Argemone ochroleuca* (Mexican Poppy, Category 1b) are already present at the site. The spread of the alien invasive species through the area will be accelerated when seeds are carried by stormwater into the drainage features on the site that will cause environmental degradation and indigenous species to be displaced.			
	Rating	Motivation	Significance
Prior to Mitigation			

Duration	Permanent (3)	Declared invaders will stay there with no mitigation.	Low Negative (24)
Extent	Low (1)	New declared invader species may be spread to the site and ones that are present may be spread further in the project area. It should not spread further though, as storm water drains into depression wetlands and not a bigger drainage system.	
Magnitude	Low (4)	The project area is already infested with declared invader plant species. New declared invader species may however worsen the situation	
Probability	Probable (3)	Some existing declared invader plant species will be removed when vegetation is cleared for the solar farm, which is positive. It is however likely that disturbance will promote declared invader plant species outside of the development area.	
Mitigation/Enhancement Measures			
Alien and invader vegetation must not be allowed to colonise the area. Control involves killing alien invasive plants present, seedlings and establishing an alternative plant cover to limit re-growth. The use of indigenous plants must be encouraged in the rehabilitated areas (stormwater canals). Control should begin prior to construction phase considering small populations of invader plant species occur around the project area.			

Institute strict control over materials brought onto site, which should be inspected for seeds and steps taken to eradicate these before transport to the site. The contractor is responsible for the control of weeds and invader plants. Rehabilitate disturbed areas as quickly as possible. Institute a monitoring programme to detect alien invasive species early. Institute an eradication/control programme for early intervention if invasive species are detected. The use of indigenous plants must be encouraged in the rehabilitated areas. Active management and eradication of exotic / alien plant species should also occur when seedlings are found.			
Post Mitigation/Enhancement Measures			
Duration	Very short-term (1)	If declared invaders are managed throughout the development and operational phases, the duration of the impact will be very short	Low Negative (3)
Extent	Low (1)	Declared invaders will not be able to spread with mitigation	
Magnitude	Small (1)	Declared invader species will decrease with mitigation	
Probability	Very improbable (1)	Mitigation measures will prevent the spread of declare invader species	
Cumulative impacts	Low		
Residual risks	Low		

Table 18: Cumulative impacts: Spread and establishment of alien invasive species

Nature: Soil and water pollution

	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Duration	Very short-term (1)	Short term (2)
Extent	Low (1)	Medium (3)
Magnitude	Small (1)	Low (4)
Probability	Very improbable (1)	Improbable (2)
Significance	**Low (3)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	High	Moderate
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Confidence in findings: High.		
Mitigation: "Mitigation", means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.		

4.4 Environmental Management Plan

Table 19: Environmental Management Plan table

Objective	Prevent sedimentation in wetlands	Prevent soil and water pollution	Prevent spread and establishment of alien invasive species
Project component/s	Vegetation clearance Soil compaction by large construction vehicles	Oil and fuel spillages by large construction vehicles Ineffective waste management	Movement of people and construction vehicles on and off site Disturbance of soil and vegetation promote the spread and establishment of alien invasive species
Potential Impact	Compaction and erosion of soil, sedimentation of wetlands	Soil, water and groundwater pollution	Spread and establishment of alien invasive species
Activity/risk source	Vegetation clearance during construction phase Soil compaction during construction phase Lack of storm water management plan Lack of erosion control	Poor vehicle maintenance No clean-up of spills Ineffective waste management practices No dust control	Import of alien species from other sites with people, vehicles and building equipment Spread of alien invaders due to disturbance of vegetation and soil
Mitigation: Target/Objective	• Compaction of soils should be limited and / or avoided as far as possible. Compaction will reduce water infiltration and will result in	• Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage.	• Alien and invader vegetation must not be allowed to colonise the area. Control involves killing alien invasive plants present, seedlings

Objective	Prevent sedimentation in wetlands	Prevent soil and water pollution	Prevent spread and establishment of alien invasive species
	increased runoff and erosion. Where any disturbance of the soil takes place (have taken place in the past), these areas must be stabilised and any alien plants which establish should be cleared and follow-up undertaken for at least 2 years thereafter and preferably longer. Where compaction becomes apparent, remedial measures must be taken (e.g., "ripping" the affected area). • Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion. • Erosion control mechanisms must be established as soon as possible. • A stormwater plan must be developed with the aid of an engineer to ensure that water	• Regularly inspect all vehicles for leaks. • Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil. • No dumping of waste should take place within the wetlands or their buffer zones. • If any spills occur, they should be cleaned up immediately. • Contain all dirty water in the dirty water system and contain all dirty stormwater up to a 1:50 year flood line as a minimum. Ensure that all activities impacting on groundwater resources of the subject property are managed according to the relevant DWS Licensing regulations and	and establishing an alternative plant cover to limit re-growth. The use of indigenous plants must be encouraged in the rehabilitated areas (stormwater canals). Control should begin prior to construction phase considering populations of invader plant species occur in and around the project area. • Institute strict control over materials brought onto site, which should be inspected for seeds and steps taken to eradicate these before transport to the site. The contractor is responsible for the control of weeds and invader plants. • Rehabilitate disturbed areas as quickly as possible.

Objective	Prevent sedimentation in wetlands	Prevent soil and water pollution	Prevent spread and establishment of alien invasive species
	runoff is diverted off the site without pooling and stagnation or erosion. Financial provision for closure will include the estimated costs for erosion control post-construction and post-decommissioning. • The indiscriminate use of machinery within the wetland area will lead to compaction of soils and destruction of vegetation and must therefore be strictly controlled. • A buffer zone of 10 m should be implemented around the wetland as a no-go area, to prevent sediment changes.	groundwater monitoring and management requirements. • Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility. • Excess waste or chemicals should be removed from site and discarded in an environmentally friendly way. The Environmental Control Officer (ECO) should enforce this rule rigorously. • Hazardous chemicals to be stored on an impervious surface protected from rainfall and stormwater run-off. • Spill kits should be on-hand to deal with spills immediately.	• Institute a monitoring programme to detect alien invasive species early. This monitoring must continue 5 years after the decommissioning phase has been completed. • Institute an eradication/control programme for early intervention if invasive species are detected.

Objective	Prevent sedimentation in wetlands	Prevent soil and water pollution	Prevent spread and establishment of alien invasive species
		• All vehicles should be inspected for oil and fuel leaks on a regular basis. Vehicle maintenance yards on site should make provision for drip trays to capture spills. Drip trays should be emptied into a holding tank and returned to the supplier. • Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) and chemical dust suppressants of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.	

Objective	Prevent sedimentation in wetlands	Prevent soil and water pollution	Prevent spread and establishment of alien invasive species
		• A speed limit (preferably 40 km/hour) should be enforced on dirt roads. • Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with the label and application permit directions and stipulations for terrestrial and aquatic applications.	

4.5 SENSITIVITY MAP

See Figure 14 below for the wetland sensitivity map. Note that only wetland characteristics were considered for this map and no other ecological factors, such as biodiversity, were taken into consideration. The wetlands and their buffers are considered to have a medium sensitivity. They are greatly disturbed and not completely functional but will recover to some extent without further disturbance and functionality will be increased. The areas outside of the wetlands and their buffers are considered to have a low sensitivity.

The ecologist who studied the biodiversity and ecology mentioned that there are wetland seeps in the project area and that they have a high sensitivity. It can be seen on the satellite image that there are more wet patches in the project area, but they are likely rather areas where water accumulates during the wet season and not wetland seeps. They are wetter than the surrounding areas, but not to such an extent as to be classified as wetlands. Soil was augured, but mottles were not found in the upper 50 cm of the soil. They were therefor not indicated as wetlands on the wetland map and further they are considered to have a low sensitivity.

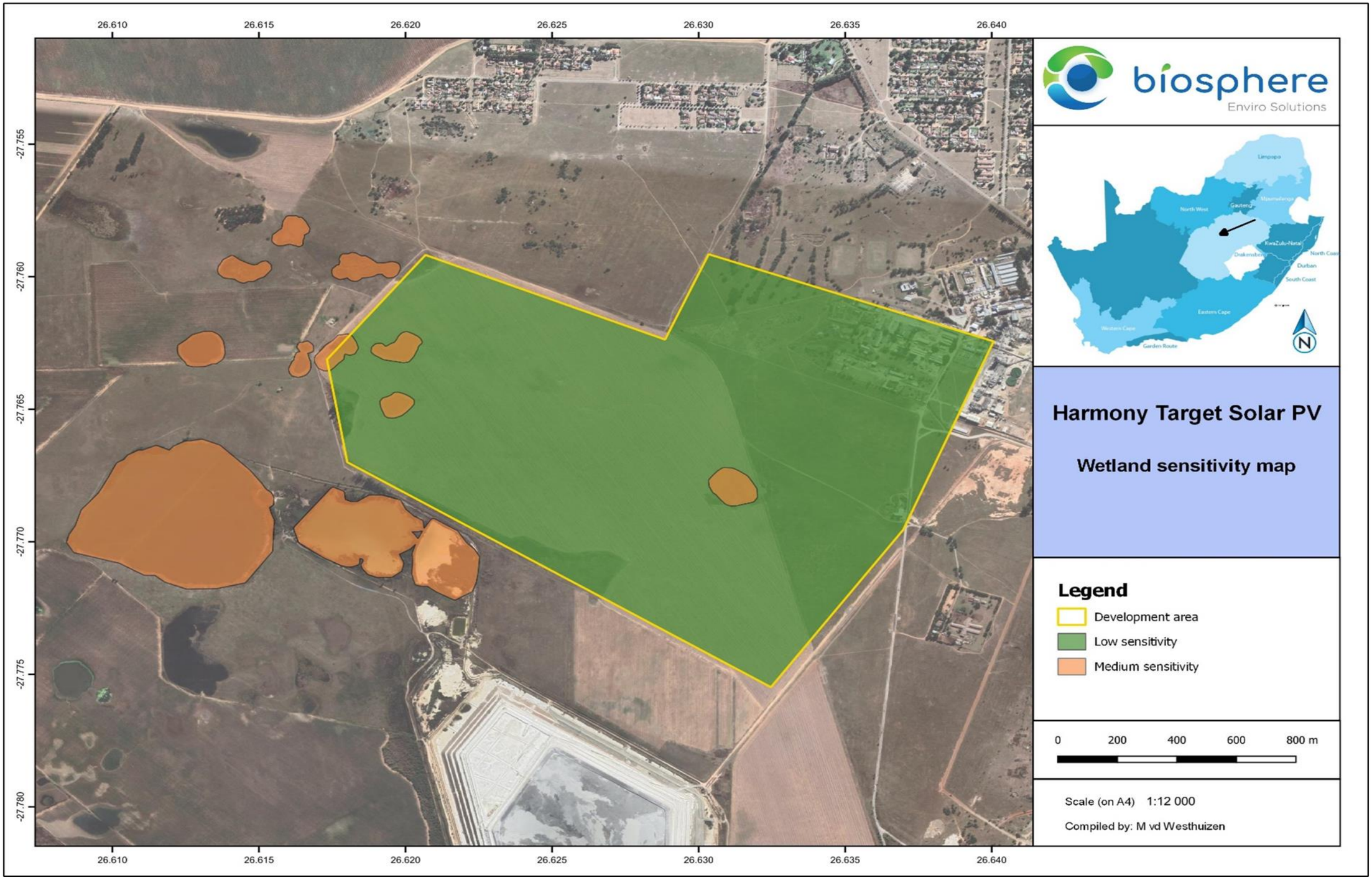

Figure 14: Wetland sensitivity Map

5 DISCUSSION & CONCLUSION

Biosphere Enviro Solutions (Pty) Ltd had been commissioned by Savannah Environmental to compile a wetland functionality assessment and risk matrix assessment for the wetlands in and around the proposed Solar PV Facility site.

According to the national web-based environmental screening tool in terms of National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), the site has a Low sensitivity for Aquatic Biodiversity. During the site visit, it was confirmed that the site has a Low sensitivity from an Aquatic biodiversity perspective. The wetlands in the project area has been ploughed and planted with agricultural crops. It was not planted this year and weeds and declared invader plant species has grown. Some of the wetlands outside of the development area has a higher sensitivity, but they will not be significantly impacted by the development.

The desktop survey indicated that there are some National Freshwater Ecosystem Priority Area (NFEPA) and National Wetland Map 5 wetlands in the 500m buffer area surrounding the project area.

The wetlands inside the development area are classified as endorheic depression wetlands. Wetlands in the development area and 500m buffer around the development area were divided into four groups and assessed accordingly (Figure 7).

A wetland functionality assessment was completed, including Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and Recommended Ecological Category (REC). Results are summarised in the table below:

Classification	Endorheic Depression Wetland (Group 1)	Endorheic Depression Wetland (Group 2)	Exorheic Depression Wetland (Group 3)	Endorheic Depression Wetland (Group 4)
PES	D: Largely modified	C: Moderately modified	E: Seriously modified	C: Moderately modified
EIS	0,5: Low / marginal	1,3: Moderate	0,6: Low / marginal	0,9: Low / marginal
REC	D: Maintain	C: Maintain	D: Improve	C: Maintain
Buffer	10m	10m	10m	10m

Three impacts were rated using the DWS Risk Matrix Assessment and also the NEMA Impact Assessment approach. These impacts are

1) Compaction, soil erosion and sedimentation,
2) Soil and water pollution,
3) Import and spread of alien invasive vegetation.

Both systems rated all risks / impact as low, due to the fact that the proposed development will be kept outside of the wetlands and their buffer zones.

From a wetland perspective this development can be supported, as long as mitigation measures and general good practice are adhered to.

6 REFERENCES

- Collins, N.B. 2015. Free State Province Biodiversity Plan: CBA map. Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs. Internal Report.
- Collins, N.B. 2016. Free State Province Biodiversity Plan: Technical Report v1.0. Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs. Internal Report.
- Council for Scientific and Industrial Research. 2011. NFEPA rivers [vector geospatial dataset] 2011. Available from the Biodiversity GIS website, downloaded on 19 April 2021
- Department of Water Affairs and Forestry. 1999. Ecological Importance & Sensitivity assessment method for river ecosystems [taken from Appendix R.7 of DWAF 1999].
- Department of Water and Sanitation. 2016. General Authorisation in terms of Section 39 of the National Water Act, 1998 (act no. 36 of 1998) for water uses as defined in Section 21(c) or Section 21(I). Notice 509 of 2016.
- Driver, A., Nel, J.L., Snaddon, K., Murray, K., Roux, D.J., Hill, L., Swartz, E.R., Manuel, J. & Funke, N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. South African National Biodiversity Institute, CSIR, The Freshwater Consulting Group, Water Research Commission, South African National Parks & South African Institute for Aquatic Biodiversity.
- Kotze, D., Macfarlane, D.M. and Edwards, R. 2021. WET-EcoServices (Version 2): A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas. Water Research Commission, Pretoria.
- Macfarlane, D.M & Bredin, I. 2017. Buffer Zone Guidelines for Wetlands, Rivers and Estuaries. Part 2: Practical Guide. WRC Report No. TT 715/2/17.
- Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P. & Goge, M. 2009. WET-Health: A technique for rapidly assessing wetland health. WRC Report No. TT 340/08. Water Research Commission: Pretoria.
- Macfarlane D.M., Ollis D.J & Kotze D.C. 2020. WET-Health (Version 2.0): A refined suite of tools for assessing the present ecological state of wetland ecosystems. Technical guide Water Research Commission, Pretoria. WRC Report TT820/20 May 2020.
- Malan, H.L. & Day, J.A. 2012. Water Quality and Wetlands: Defining Ecological Categories and Links with Land-Use. Freshwater Research Unit, University of Cape Town. WRC Report No. 1921/1/12

- Mucina, L. & Rutherford, M.C. (eds). 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. Pretoria: South African National Biodiversity Institute.
- Nel, J.L., Driver, A., Strydom, W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J., Nienaber, S., Van Deventer, H., Swartz, E. & Smith-Adao, L.B. 2011. Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. Water Research Commission Report No. TT 500/11.
- Ollis, D., Snaddon, K., Job, N. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. USER MANUAL: Inland Systems. Pretoria: SANBI Biodiversity Series 22.
- South African National Biodiversity Institute (SANBI). 2019. National Biodiversity Assessment 2018: The status of South Africa's ecosystems and biodiversity. Synthesis Report. South African National Biodiversity Institute, an entity of the Department of Environment, Forestry and Fisheries, Pretoria
- South Africa. 1998. National Environmental Management Act 107 of 1998.
- South Africa. 1998. National Water Act 36 of 1998.
- South Africa. 2009. National Environmental Management: Biodiversity Act no 10 of 2004.