Wetland Assessment for the Eloff Phase 3 Mining Project

Mpumalanga, South Africa

November 2018 (Updated January 2019)

CLIENT

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Report Name	**Wetland Assessment for the Eloff Phase 3 Mining Project**	
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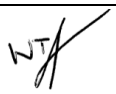
Report Reviewer	**Wayne Jackson**	

DOCUMENT GUIDE

The table below provides the NEMA (2014) Requirements for Biodiversity Assessments, and also the relevant sections in the reports where these requirements are addressed:

GNR 326 April 2017	Description	Section in the Report
Specialist Report		
Appendix 6 (a)	A specialist report prepared in terms of these Regulations must contain— details of— i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page i.
Appendix 6 (b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Page vi
Appendix 6 (c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 1
Appendix 6 (cA)	An indication of the quality and age of base data used for the specialist report;	Section 3.1
Appendix 6 (cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6
Appendix 6 (d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1
Appendix 6 (e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
Appendix 6 (f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a, site plan identifying site alternatives;	Section 5.7
Appendix 6 (g)	An identification of any areas to be avoided, including buffers;	Section 5.8
Appendix 6 (h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 6
Appendix 6 (i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
Appendix 6 (j)	A description of the findings and potential implications of such findings on the impact of the proposed activity **[including identified alternatives on the environment]** or activities;	Section 5 & 6
Appendix 6 (k)	Any mitigation measures for inclusion in the EMPr;	Section 6.3/4
Appendix 6 (l)	Any conditions for inclusion in the environmental authorisation;	Section 6.5
Appendix 6 (m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 6.6
Appendix 6 (n)	A reasoned opinion— i. **[as to]** whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 7 Section 6.3/4 Section 5
Appendix 6 (o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	GCS[1]
Appendix 6 (p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	GCS
Appendix 6 (q)	Any other information requested by the competent authority.	None

[1] GCS has undertaken the public and stakeholder consultation process

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Declaration

I, Andrew Husted 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.

Andrew Husted

Aquatic / Wetland Ecologist

The Biodiversity Company

25 November 2018

1 Introduction

The Biodiversity Company was commissioned by GCS Water and Environment (Pty) Ltd (GCS) to conduct a specialist wetland study to supplement the relevant applications and amendment applications to existing authorisations and/or licences pertaining to the Eloff Phase 3 Mining project.

A rapid ecological assessment of the project area was conducted during the first week of March 2018, which included the deployment of camera traps. An assessment of the wetland systems was conducted from the 9th / 13-16th March 2018, which constitutes a wet season survey.

This report presents the results of a wetland ecological study on the environments associated with the proposed mining project. This report should be interpreted after taking into consideration the findings and recommendations provided by the specialist herein. Further, this report should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

1.1 Aim and Objective

The aim of the assessment was to provide information to guide the proposed mining operation and associated aspects with respect to the current ecological state of the wetland ecosystems in the area of study. As part of this assessment, the following objectives were established:

- The delineation and assessment of wetlands within 500m regulation area;
- The evaluation of the extent of site-related impacts;
- A risk assessment for the proposed mining operation; and
- The prescription of mitigation measures and recommendations for identified risks.

2 Description of the Project Area

The project area is located approximately 6 km south of Delmas, in the Mpumalanga Province, South Africa. The focus for the project is the selected farm portions on the Farm Strydpan 243 IR. The catchment area of the project site consists of agricultural fields and various other coal mining operations. The project area is also located within the Olifants Water Management Area (WMA 2) (NWA, 2016), and the B20A quaternary catchment which falls within the Highveld lower Ecoregion. The B20A-1308 and B20A-1362 Sub Quaternary Reaches (SQR) of the Bronkhorstspruit are the primary drainage feature associated with the project area. A locality map of the project area is presented in Figure 1. The two SQR's are part of the Bronkhorstpruit River system and the desktop ecological classification of the B20A-1308 (Table 1) and the B20A-1362 (Table 2) SQR's is presented below.

The Olifants WMA is largely occupied by the South African portion of the Olifants River catchment. The Olifants River originates to the east of Johannesburg, initially flowing

northwards before gently curving eastwards towards the Kruger National Park, where it is met at the confluence with the Letaba River before flowing into Mozambique. The climate varies from the cool Highveld in the south to subtropical, east of the escarpment. The region has a mean annual precipitation rate of 500 to 800 mm. Diverse economic activity includes mining, metallurgic industries, irrigation, dryland and subsistence agriculture and ecotourism. The provision of water to meet ecological requirements in the Olifants River is one of the controlling factors in the management of water resources throughout the WMA. Several dams control the flow in these rivers. The Olifants WMA receives water from transfers to serve as cooling water for power generation, while smaller transfers are made to neighbouring WMAs (StatsSA, 2010).

Figure 1: Location of the project area in relation to the general setting

Table 1: The desktop information peratining to the B20A-1308 Sub Quaternary Reach

Component/Catchment	B20A-1308
Present Ecological Status	Largely Modified (Class D)
Ecological Importance Class	Moderate
Ecological Sensitivity	Moderate
Default Ecological Category	Moderately Modified (Class C)

Based on the above table (Table 1), the desktop PES of this reach of the Bronkhorstspruit system is a class D or largely modified. The ecological importance and sensitivity of the river

reach was rated as moderate. The defined Default Ecological Category for the river was class C or moderately modified.

Table 2: The desktop information peratining to the B20A-1362 Sub Quaternary Reach

Component/Catchment	B20A-1362
Present Ecological Status	Moderately Modified (Class C)
Ecological Importance Class	Moderate
Ecological Sensitivity	Moderate
Default Ecological Category	Moderately Modified (Class C)

Based on the above table (Table 2) the desktop PES of this reach of the Bronkhorstspruit system is a class C or moderately modified. The ecological importance and sensitivity of the river reach was rated as moderate. The defined Default Ecological Category for the river was class C or moderately modified.

3 Methodology

3.1 Desktop Assessment

The following information sources were considered for the desktop assessment;

- Information as presented by the South African National Biodiversity Institutes (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org);
- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel, et al. 2011);
- The Mpumalanga Highveld wetlands (2014);
- Mpumalanga Biodiversity Sector Plan Freshwater Assessment (2011); and
- Contour data (5m).

3.2 Wetland Assessment

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) was 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. In addition, the method also includes the assessment of structural features at the lower levels of classification (Ollis, et al. 2013).

3.2.1 Wetland Delineation

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 2. 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.

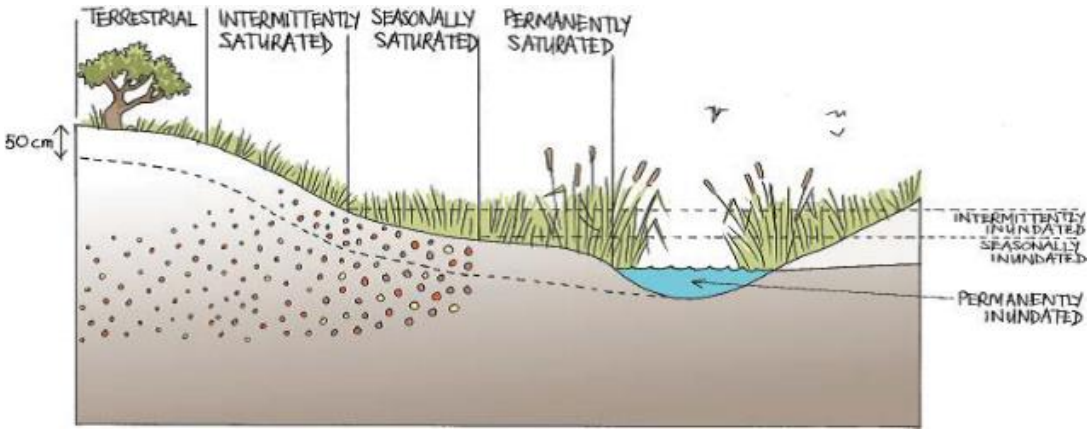

Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis, et al. 2013).

3.2.2 Wetland 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 State categories are provided in Table 4.

Table 3: The PES categories (Macfarlane, et al. 2009)

Impact Category	Description	Impact Score Range	Present State Category
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**

3.2.3 Wetland Ecosystem Services

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze, et al. 2009). 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).

Table 4: 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

3.2.4 Ecological Importance and Sensitivity

The method used for the EIS determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no

importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 5..

Table 5: Description of EIS categories.

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

3.3 Buffer Determination

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.

3.4 Risk Assessment

The matrix assesses impacts in terms of consequence and likelihood. The significance of the impact is calculated according to Table 6.

Table 6: Significance ratings matrix

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

4 Limitations and Assumptions

The following are applicable to this study:

- Access to areas adjacent to the project area (within the required 500m regulation area) was restricted. As much of the area was ground truthed as possible, but extrapolations have been made for these adjacent areas.
- The GPS used for wetland delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.

- The fieldwork component of the assessment comprised one seasonal assessment only, that was conducted during the March 2018 wet season. This study has not assessed any temporal trends for the respective seasons.
- No detailed activity list or mining methods for the proposed project were provided and therefore the risk assessment has been completed based on presumptions for standard development operations.

5 Results and Discussion

5.1 Desktop Soils

According to the land type database (Land Type Survey Staff, 1972-2006) the project area is located within the Bb3 land type (Figure 3). The land type is described in the table below (Table 7). The dominant soil forms on the upper and mid-slopes include the Hutton, Glencoe and Avalon forms, with pans also represented. The Rensburg and Katspruit soil forms are largely representative in the lower lying and valley bottom areas.

The geology of the land type is classified as:

- Shale, sandstone, clay, conglomerate, limestone and marl of the Ecca Group;
- Shale and tillite of the Dwyka Formation and Karoo Sequence;
- Occasional Ventersdorp lava, Witwatersrand quartzite and slate; and'
- Dolomite.

Table 7: The expected soil features for the land types present

Land Type	Expected Soil Features
Bb3	PLINTHIC CATENA: UPLAND DUPLEX AND MARGALITIC SOILS RARE; Dystrophic and/or mesotrophic; red soils not widespread

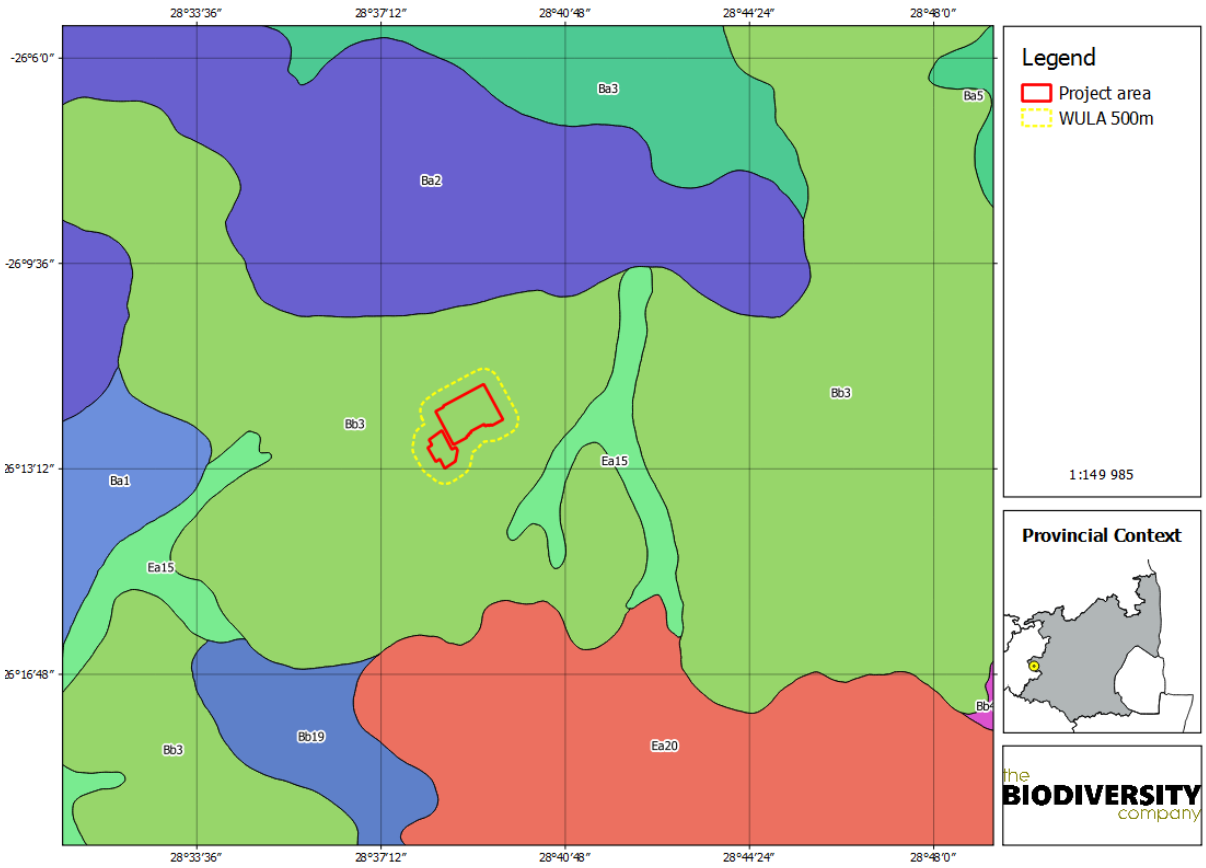

Figure 3: The land type in the project assessment area

5.2 Desktop Vegetation

The site is situated in the grassland biome. In South Africa the grassland biome occurs primarily on the Highveld, the inland areas of the eastern seaboard, the mountainous areas of KwaZulu-Natal and the central parts of the Eastern Cape (Mucina & Rutherford, 2010). The topography associated with these regions is mainly rolling to flat but also includes mountainous regions and the escarpment (Mucina & Rutherford, 2010). Grasslands are landscapes structurally and visually-dominated by grass (Ferrar & Lötter, 2007).

The project area is situated in the Eastern Highveld Grassland (Gm12) vegetation community (Figure 4). Eastern Highveld Grassland (Gm12) occurs on plains in the Mpumalanga and Gauteng Provinces (Mucina & Rutherford, 2010). This vegetation type extends from Johannesburg in the west to Belfast in the east and Bethal and Ermelo in the south. The topography consists of slightly to moderately undulating plains with some low hills and pan depressions (Mucina & Rutherford, 2010). This vegetation type is classified as Endangered (EN) with only a small fraction conserved on statutory and private reserves. In 2010 44% of this vegetation type was classified as transformed primarily by cultivation of crops, plantations, mining, urbanisation of building of dams (Mucina & Rutherford, 2010).

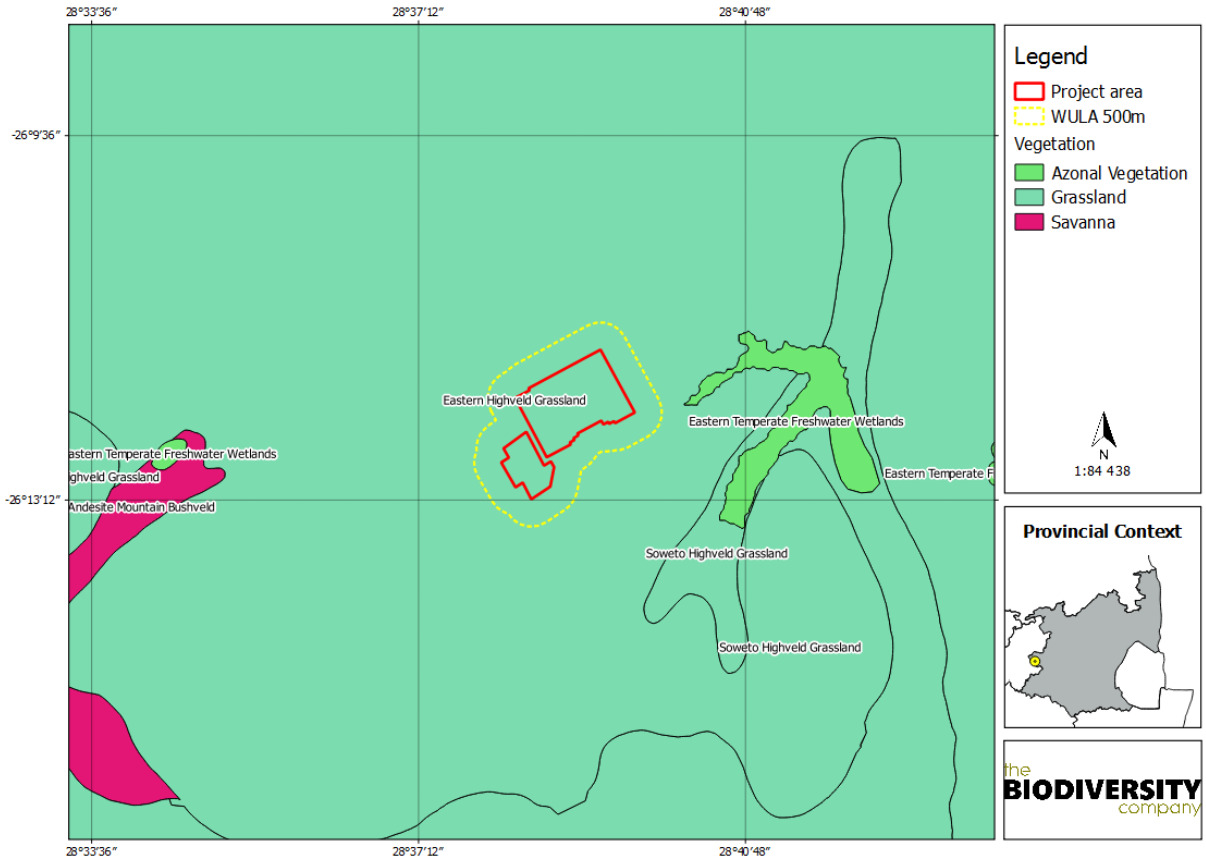

Figure 4: The project area showing the vegetation type based on the Vegetation Map of South Africa, Lesotho & Swaziland (BGIS, 2017)

5.3 Wetland National Freshwater Priority Areas

A total of five (5) Freshwater Ecological Priority Areas (FEPA) wetland types were identified within the assessment area of the project. The systems are either regarded as natural or artificial systems. There is a gap in the dataset, and no details pertaining to the wetland condition and rank for this area are available. Based on this, this desktop information is omitted from the study, and this study will place emphasis in the extent of the delineated wetland areas. The FEPA wetland systems are listed in Table 8. The location of the FEPA wetlands in reference to the project area are provided in Figure 5.

Table 8: NFEPA description for the FEPA systems

Classification Levels				Wetland Vegetation Class	Natural / Artificial	Wetland Condition	Rank
L1 (System)	**L2 (Ecoregion)**	**L3 Landscape Position**	**L4 HGM Classification**				
Inland System	Highveld	Slope	Seep	Mesic Highveld Grassland	-	-	-
Inland System	Highveld	Valley Floor	Channelled	Mesic Highveld Grassland	-	-	-

Inland System	Highveld	Valley Floor	Floodplain	Mesic Highveld Grassland	-	-	-
Inland System	Highveld	Bench	Flat	Mesic Highveld Grassland	-	-	-
Inland System	Highveld	Bench	Depression	Mesic Highveld Grassland	-	-	-

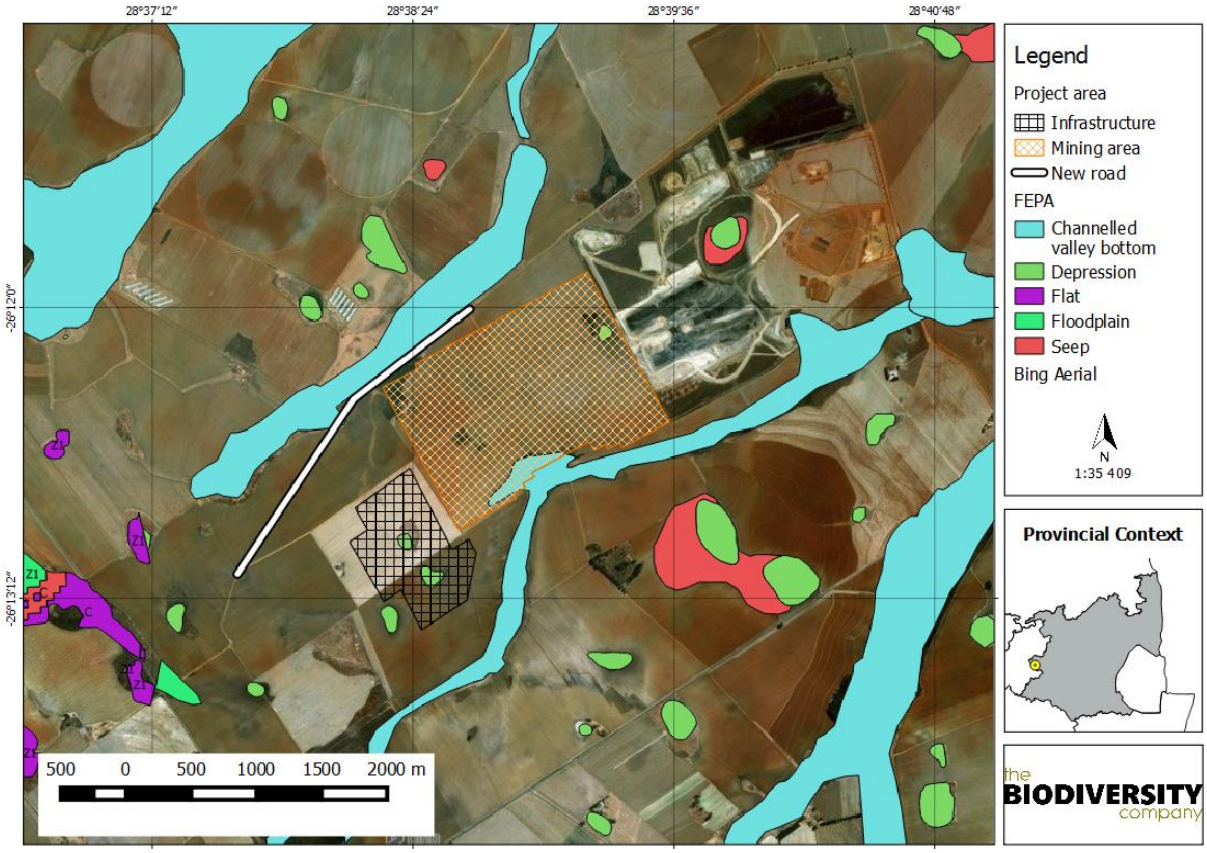

Figure 5: The FEPA wetlands in the project assessment area

5.4 The Mpumalanga Highveld Wetlands

The Mpumalanga Highveld (MPHG) wetlands dataset was considered for the proposed mining project, with numerous HGM types located within the assessment area. The dominant wetland type within the assessment area was channelled valley bottom systems, with depression and seepage areas comprising a lower extent of the assessment area (Figure 6). The status of the wetlands within the project assessment area varies from Moderately Modified (Class C) to Largely / Heavily Modified (Class Z). From this desktop dataset it is likely that some wetland areas may be lost as a result of the project. In the event that these wetland areas (and associated buffers) cannot be avoided, a wetland offset strategy my be required.

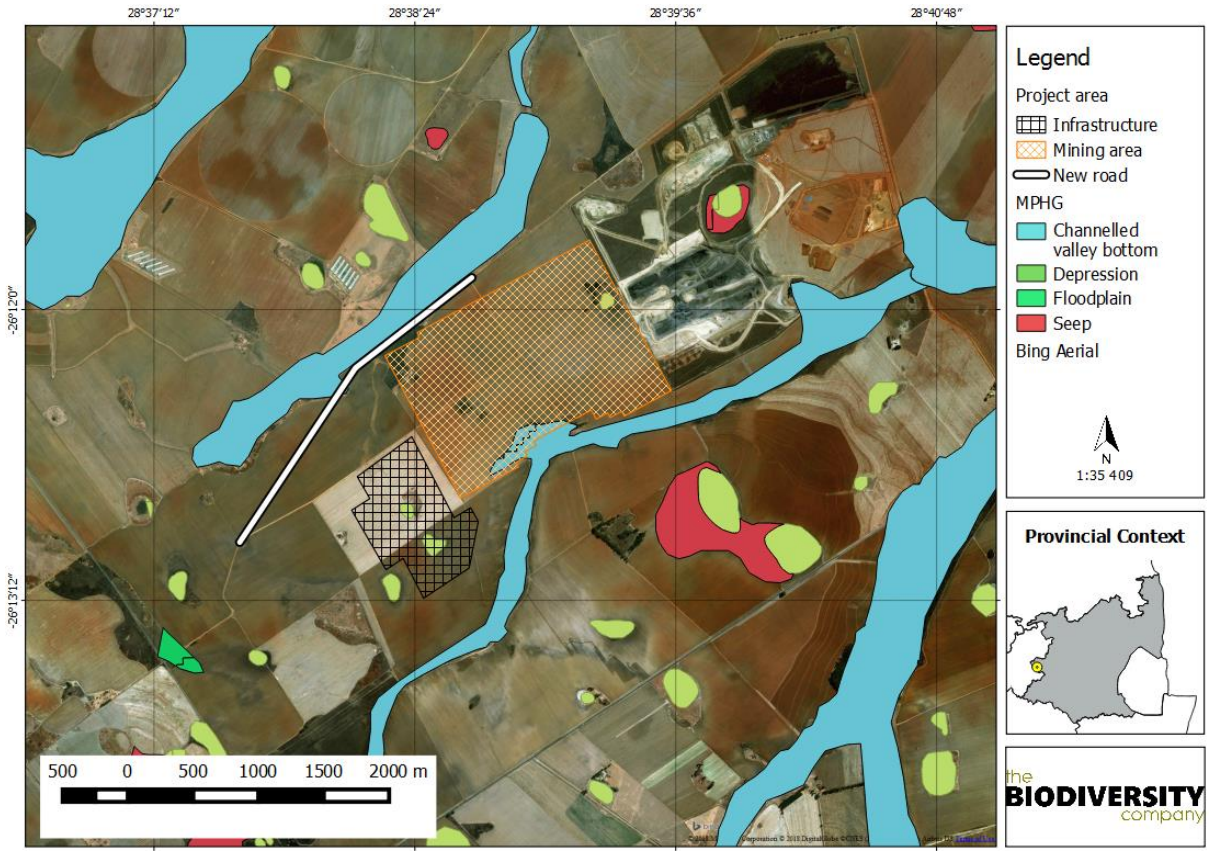

Figure 6: The MPHG wetlands in the project assessment area

5.5 The Mpumalanga Biodiversity Sector Plan (MTPA, 2014)

The Mpumalanga Biodiversity Sector Plan (MBSP) is a spatial tool that forms part of a broader set of national biodiversity planning tools and initiatives that are provided for in national legislation and policy (MTPA, 2014).

The aim of the Mpumalanga Biodiversity Sector Plan is to provide up-to-date spatial biodiversity information and land-use guidelines that ensure biodiversity is sufficiently considered – and safeguarded – in decisions, plans and activities (MTPA, 2014). This spatial product considers the following five broad map categories, some of which are further divided into sub-categories (MTPA, 2014):

- Critical Biodiversity Areas (CBAs). These include:
    - Aquatic species;
    - Rivers; and
    - Wetlands.
- Ecological Support Areas (ESAs). These include:
    - Important sub-catchments;
    - Wetland clusters; and

- Wetlands.

- Other Natural Areas (ONAs);
- Heavily Modified Areas; and
- Dams.

The project area is situated in a predominantly heavily modified area (Figure 7). ESAs and ONAs are located within and on the periphery of the project area, and larger assessment area (500m regulation area).

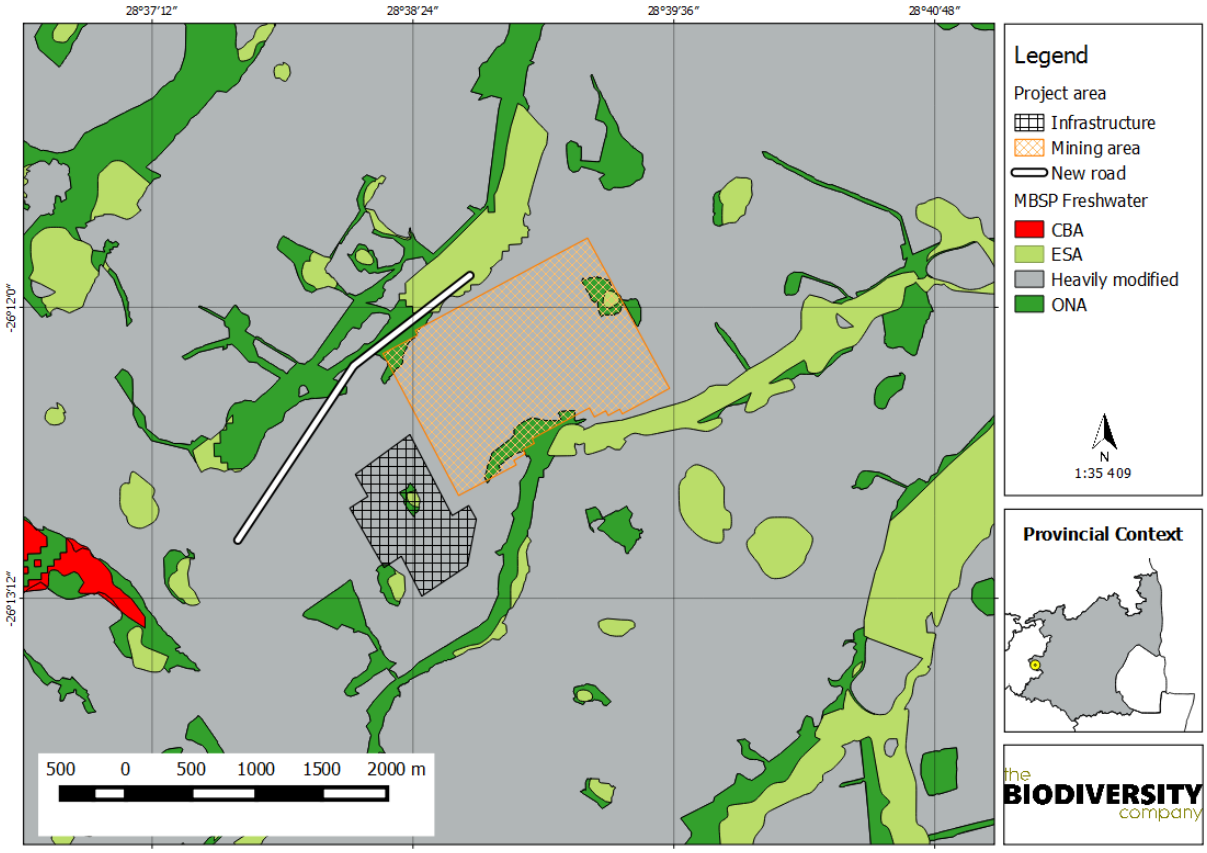

Figure 7: Project area superimposed on the MBSP freshwater map (MTPA, 2014).

5.6 Wetland Specialist Study

GCS conducted a "Detailed Ecological Assessment of the Proposed Eloff Project Phase 1 Area" (2017), which included a wetland component. It is apparent from the study, that the wetland component was completed in 2016, but the study will be referenced as a 2017 study. Information from GCS study has been considered to supplement the findings of this study. The extent of wetland areas identified and delineated by GCS are presented in Figure 8.

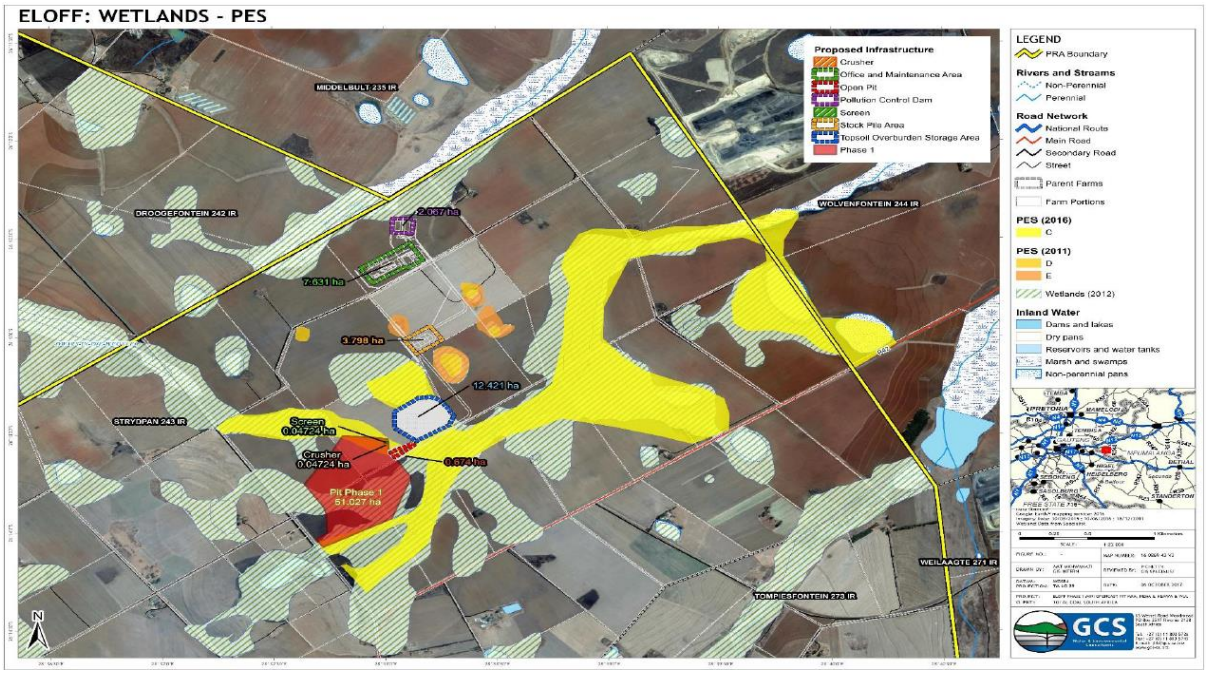

Figure 8: The wetland areas delineated by GCS (2017) for the assessment area

5.7 Wetland Assessment

The National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) (V3.0, 1 arcsec resolution) Digital Elevation Model (DEM) was obtained from the United States Geological Survey (USGS) Earth Explorer website. Basic terrain analysis was performed on this DEM using the SAGA GIS software that encompassed a slope and channel network analyses in order to detect catchment areas and potential drainage lines respectively. A DEM, 3-dimensional (3-D) representation, delineated watersheds and flow accumulation plans for the project area are presented in Figure 9. Figure 10 presents a 3D representation of the area with the surface flow directions, in relation to the project disturbance footprint areas.

The normalized difference vegetation index (NDVI) was created to provide a graphical indicator to determine the extent of live green vegetation or not, to assist with the delineation of wetland areas. Landsat data was processed for numerous time periods, and an example of the NDVI data generated for data acquired for 22/02/2018 is presented in Figure 11.

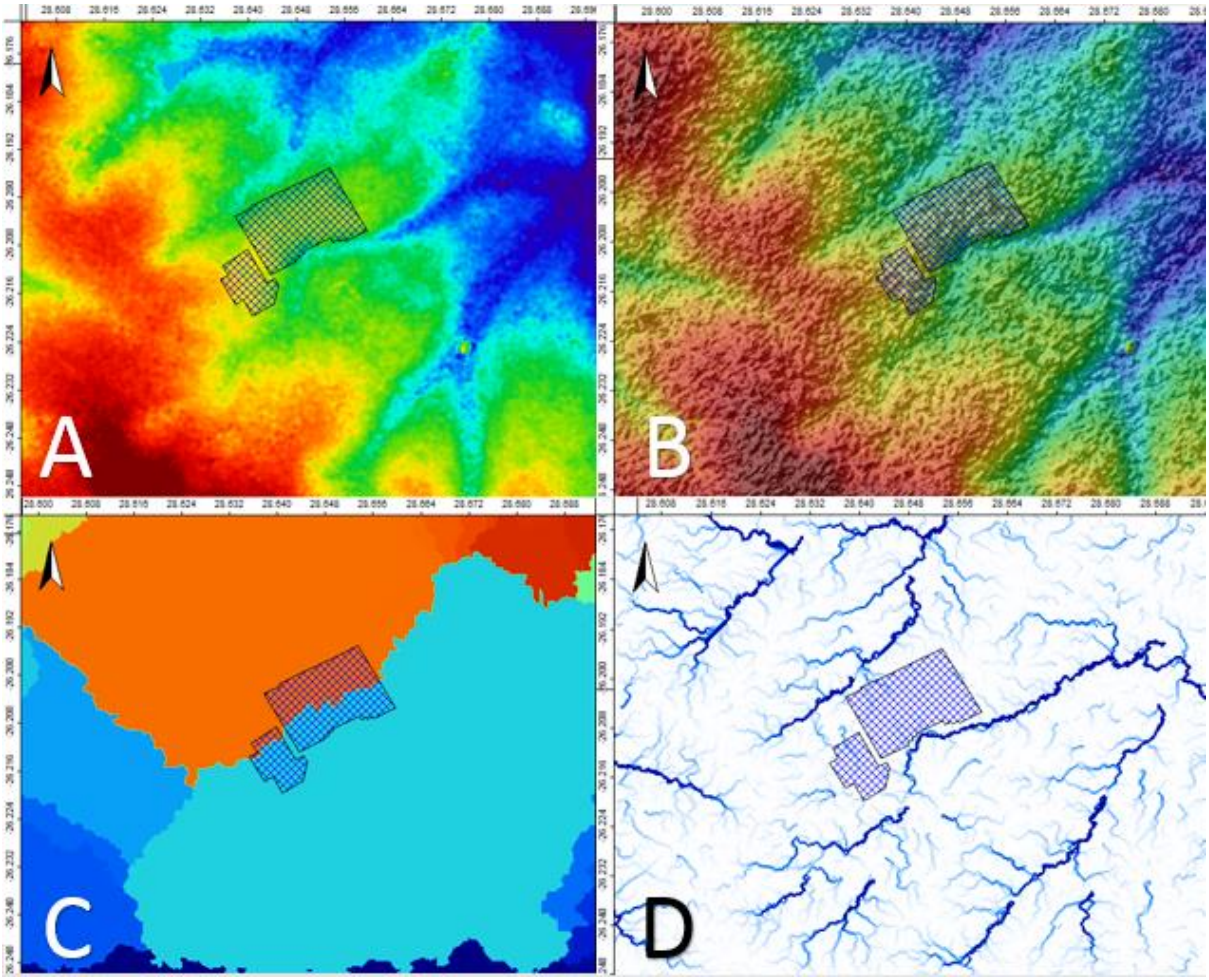

Figure 9: A collage of processed maps. A: DEM. B: 3D with infrastructure footprint area. C: Watersheds with infrastructure footprint area. D: Flow accumulation

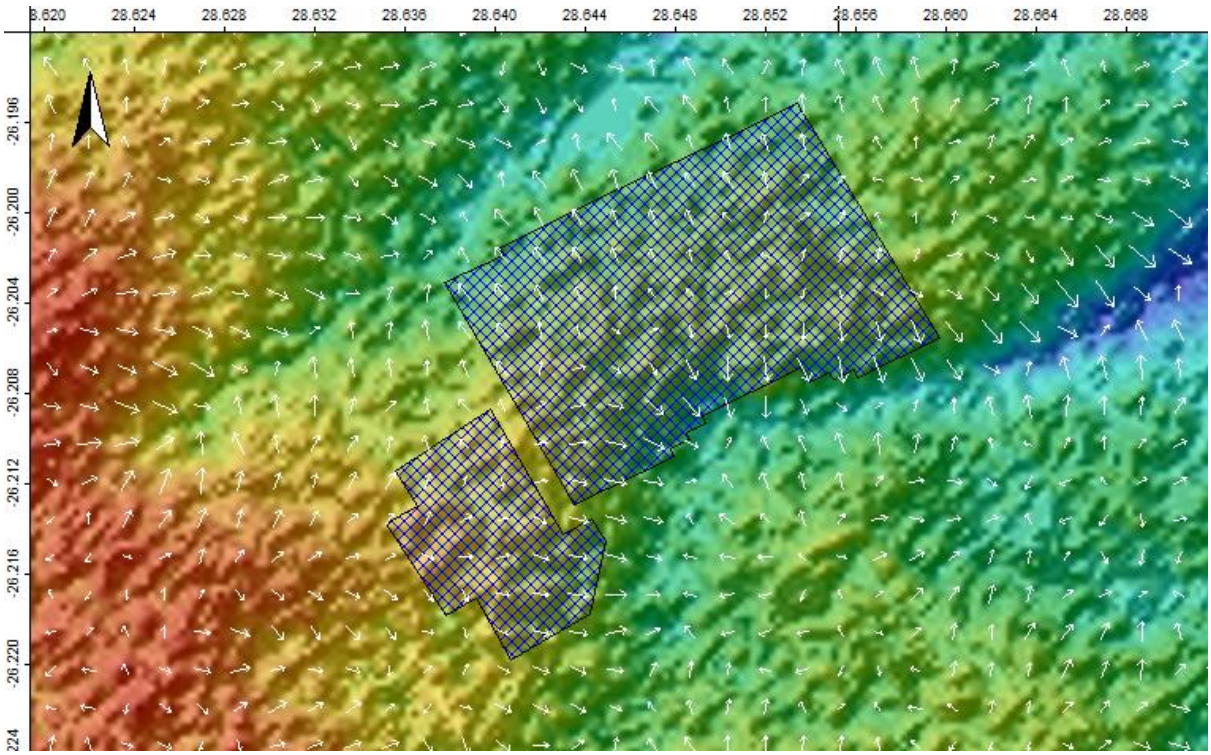

Figure 10: The 3D representation with surface flow direction for the project area (infrastructure footprint area shaded blue)

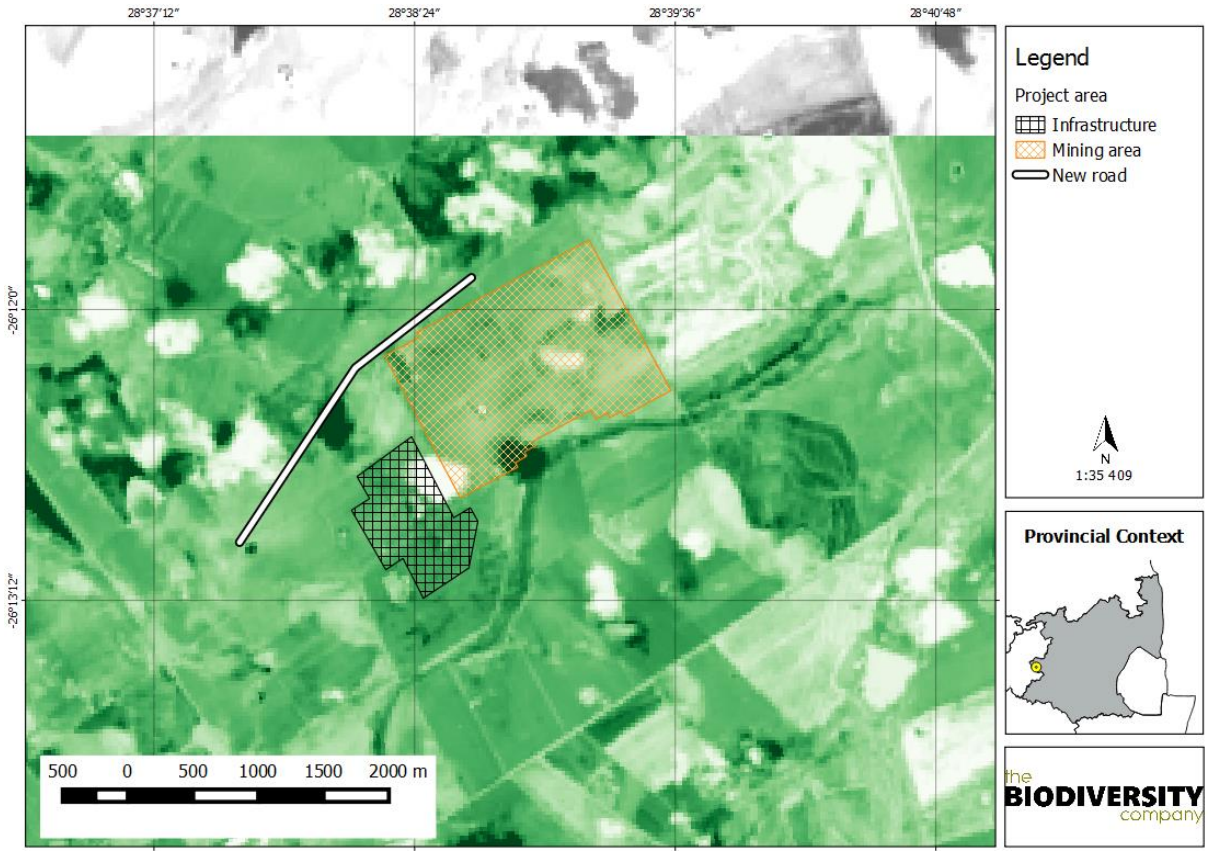

Figure 11: The Normalized Difference Vegetation Index data (22/02/2018) created for the project area

The wetland delineation is shown in Figure 12. The wetland classification as per SANBI guidelines (Ollis *et al.*, 2013) is presented in Table 9. A total of three (3) HGM types were identified and delineated for the project.

A total of 15 separate HGM units were identified and delineated for the project. The study has ground truthed and prioritised the wetlands within the 500m regulation area, and making reference to similar wetland units in the vicinity of the study area. Where it is deemed acceptable (and appropriate), HGM units have been collectively assessed (or grouped) per the respective HGM type. Based on this, a total of five (5) HGM types (some comprising numerous HGM units) have been assessed in further detail, these include the following (Figure 13):

- HGM 1: Unchannelled valley bottom wetland;
- HGM 2: Unchannelled valley bottom wetland;
- HGM 3: Depression (with accompanying seepage areas);
- HGM 4: Seep (isolated); and
- HGM 5: Seep.

An illustration of the HGM types in the relevant landscape, and the hydro-dynamics of the systems are presented in Figure 14.

The two wetland systems located to the north and south of the project area have been identified as unchannelled valley bottom systems. The remaining HGM units comprised endorheic pans and seepage areas[2].

The wetland areas had the greatest plant species composition in comparison to all the remaining areas. Patches of *Phragmites australis, Imperata cylindrica*, *Agrostis lachnantha var. lachnantha* as well as *Typha capensis* occurred throughout the wetland systems. *Crinum bulbispermum, Eucomis autumnalis* as well as *Nerine angustifolia* are flora species associated with marshy or moist areas which occurred throughout the wetland area. Photographs of flora species encountered in the project area are presented in Figure 15.

The range of Soil Forms identified for the study included the Willowbrook, Oakleaf, Tukulu, Bonheim, Inhoek, Mispah and Katspruit forms. The Kastspruit form was characteristic of the valley bottom wetlands. Photographs of soil characteristics encountered in the project area are presented in Figure 16.

[2] For this study, system delineated as depression include adjoining seepage areas

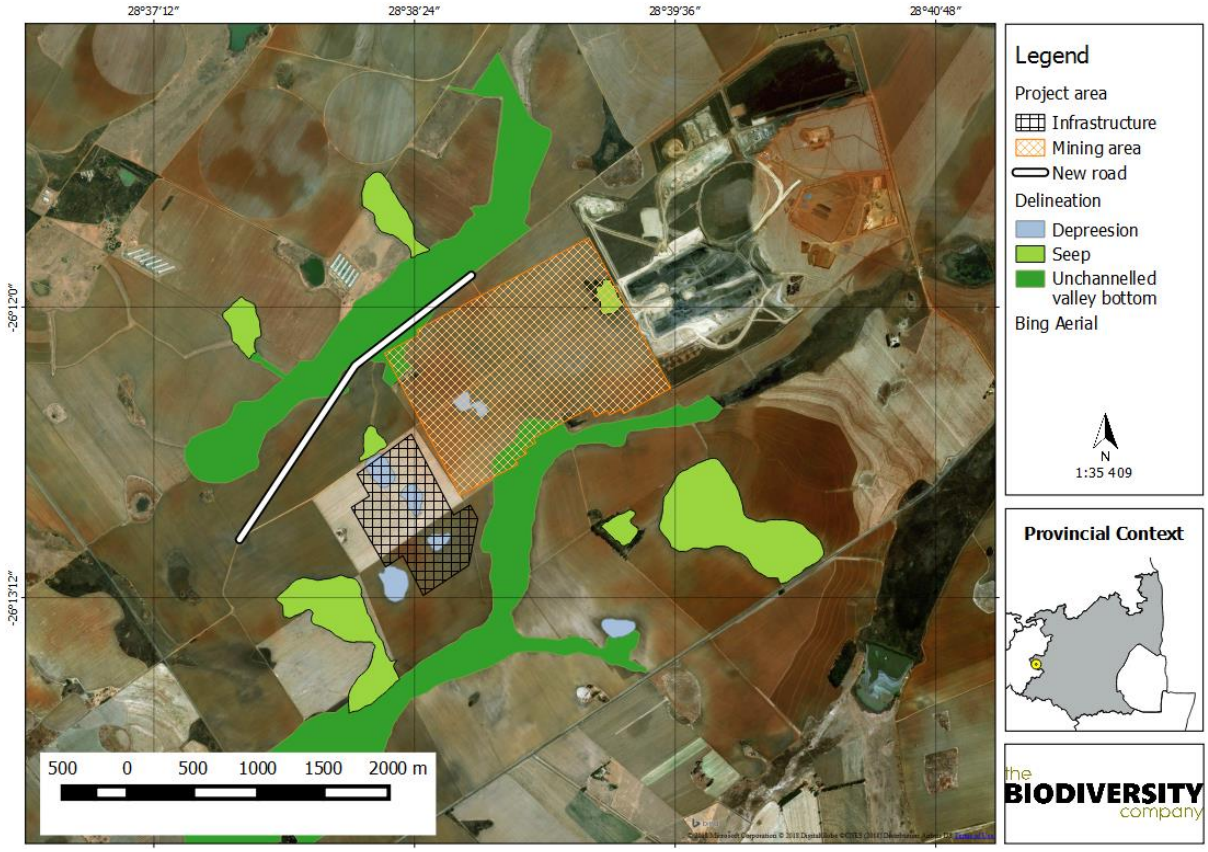

Figure 12: The delineated wetland systems within 500m of the project area

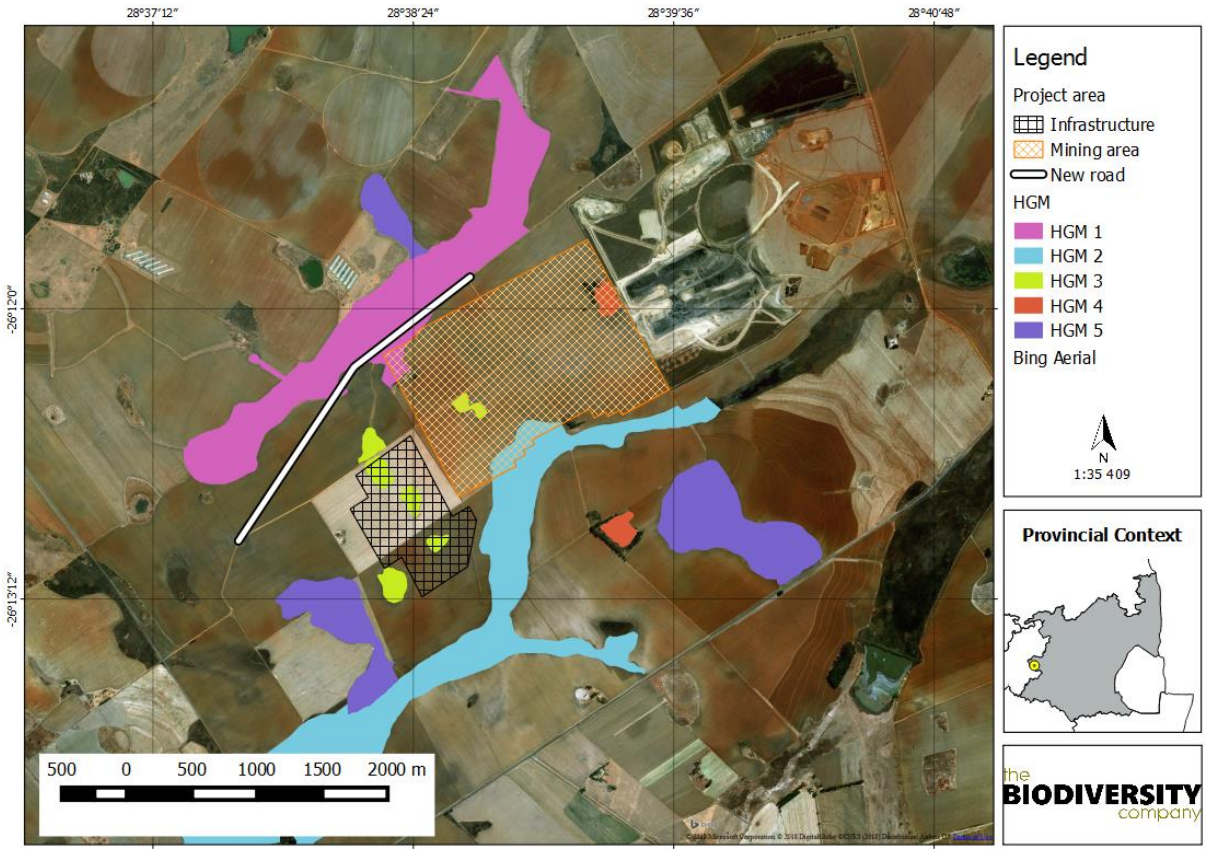

Figure 13: The assessed HGM units within 500m of the project area

Table 9: Wetland classification as per SANBI guideline (Ollis et al., 2013)

HGM	Level 2		Level 3	Level 4		
	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
1 & 2	Highveld	Mesic Highveld Grassland	Valley Floor	Unchannelled Valley Bottom	N/A	N/A
3	Highveld	Mesic Highveld Grassland	Bench	Depression	Endorheic	Without channel inflow
4	Highveld	Mesic Highveld Grassland	Slope	Seepage	Without channel outflow	N/A
5	Highveld	Mesic Highveld Grassland	Slope	Seepage	With channel outflow	N/A

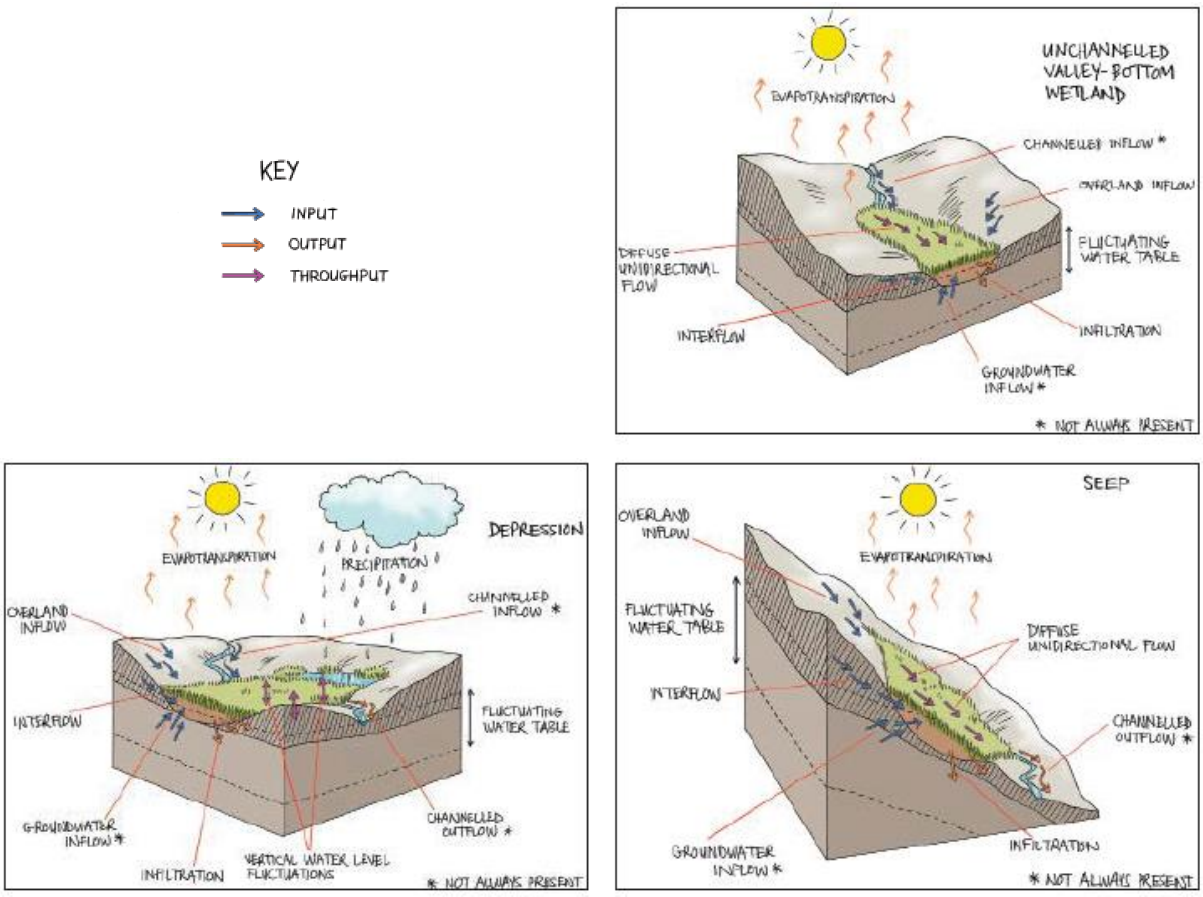

Figure 14: Conceptual illustration of wetlands, showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013)

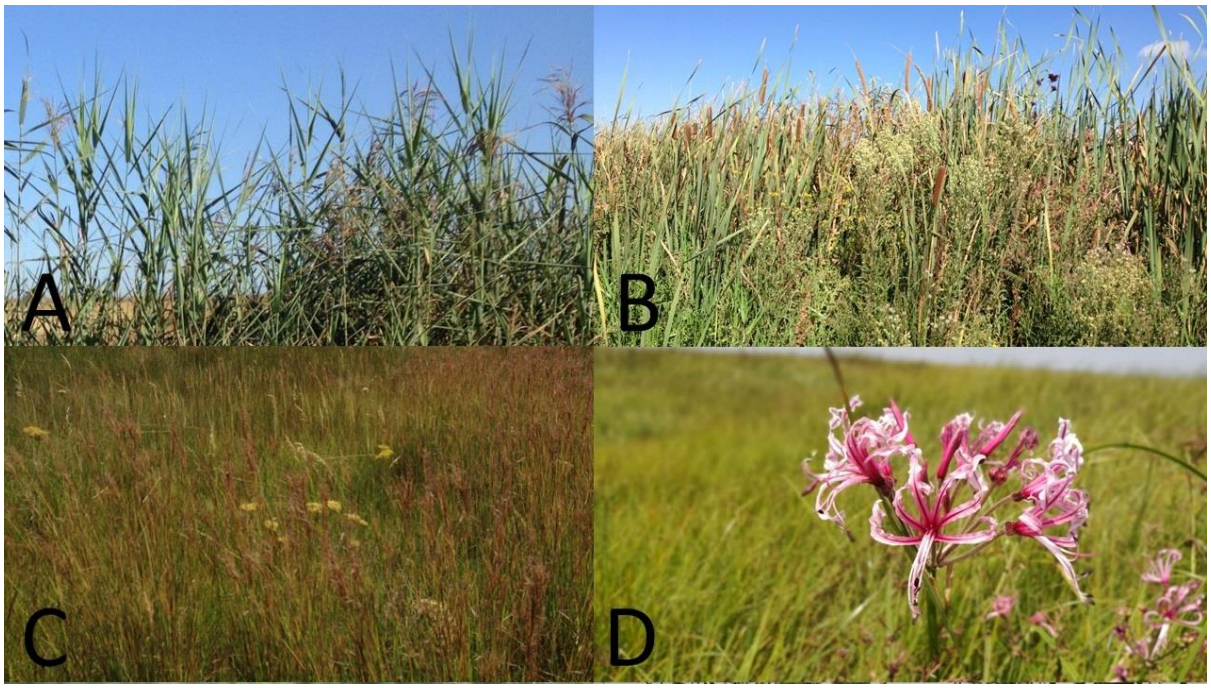

Figure 15: A photo collage of some wetland plants identified for the project (March 2018). A: Phragmites australis. B: Typha capensis. C: Imperata cylindrica. D: Nerine angustifolia

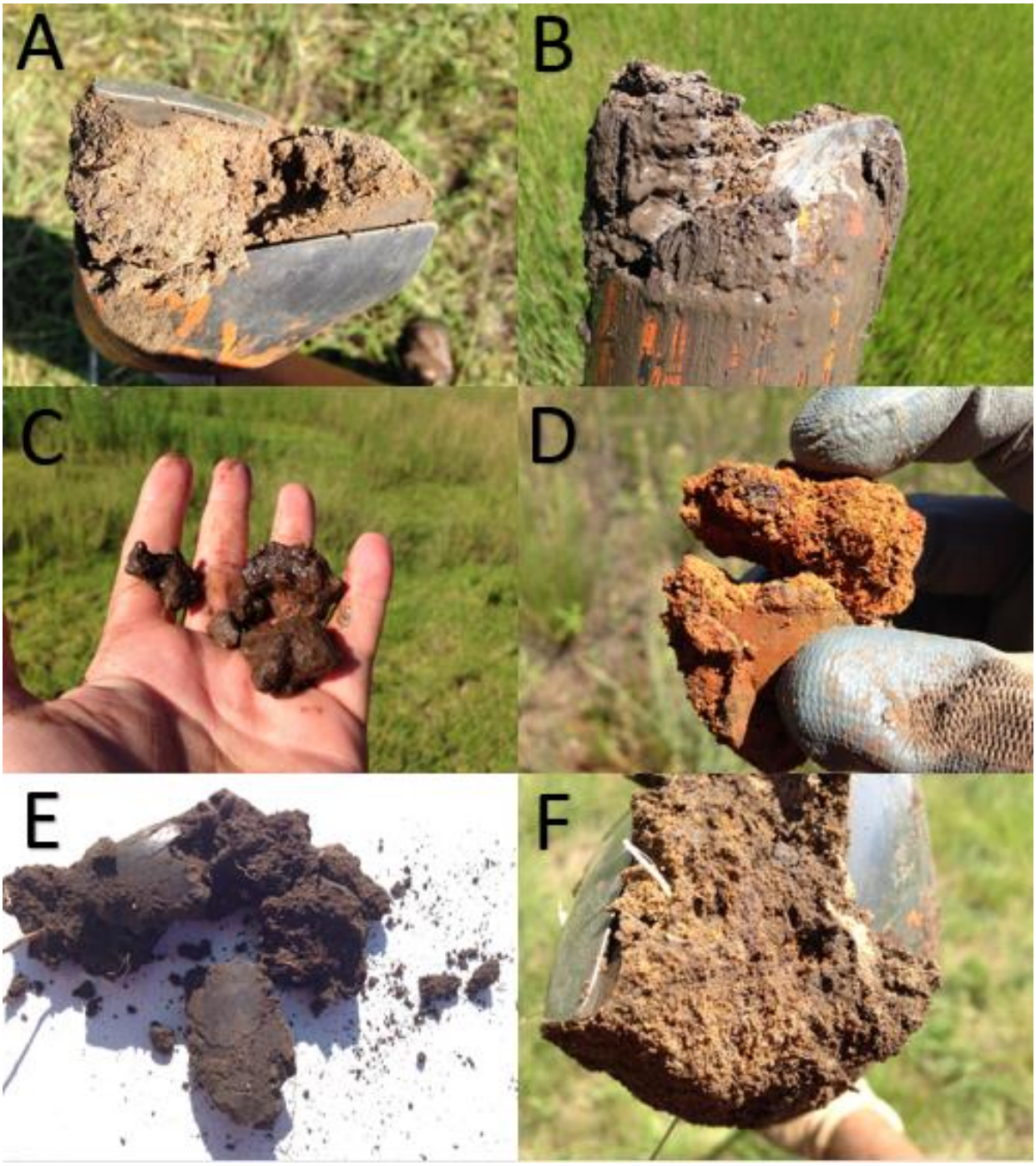

Figure 16: Photographs of characteristics considered for the study. A: E-Horizon with mottling, B: G Horizon. C: Hard plinthite. D: Soft plinthite. E: Melanic topsoil. F: Orthic with mottling

5.7.1 Present Ecological State

The PES for the assessed HGM units is presented in Table 10. Photographs of aspects that has contributed to the modifications of the systems are presented in Figure 17. The overall wetland health for the wetlands varied from Moderately Modified (Class C) to Largely Modified (Class D) systems, with the majority of the wetlands rated a Class C. Figure 18 depicts the PES of the wetland systems.

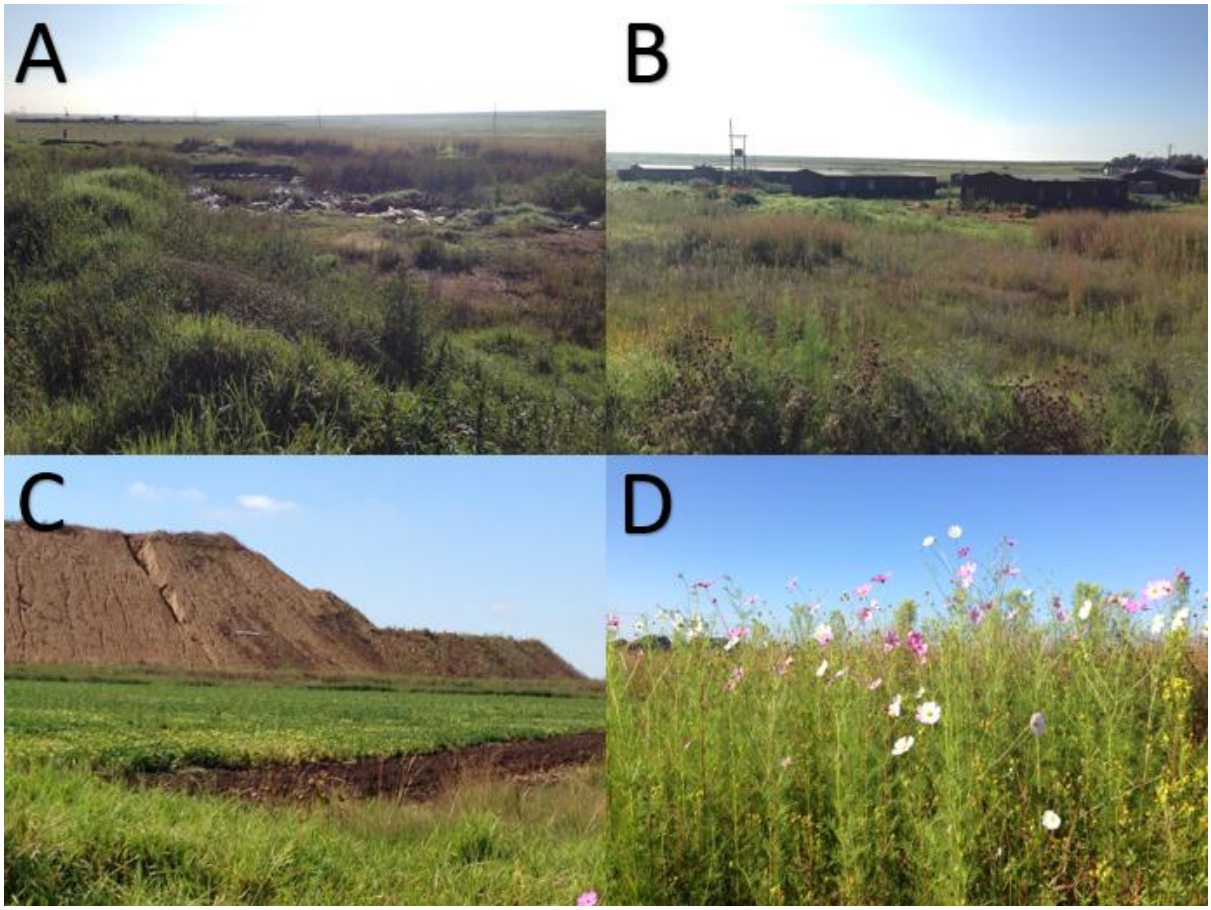

Figure 17: Photographs of aspects impacting on the wetlands. A: Excavations. B: Commercial farming and residences. C: Mining. D: Alien vegetation, Cosmos bippinatus

The hydrology within the catchment of the two valley bottom systems has been impacted on (or impeded) due to the placement of dams and access route crossings (further downstream). The extent of commercial agriculture has caused the loss of groundcover which has resulted in increased run-off volumes and velocities across the catchment area. These increases have resulted in changes to the floodpeaks and hydrological regimes of the valley bottom wetlands. The extent of commercial farming (predominantly) has encroached into the depression and seepage wetlands, altering the vegetation composition and soil profile (somewhat), causing the narrowing of these systems. This has impacted on the hydrological inputs of these systems. A number of pump houses and irrigation systems were also encountered during the assessment. These will draw water from the created impoundments, removing water from the valley bottom systems, with a considerable proportion of water lost to evaporation.

The geomorphology of the valley bottom wetlands, notably HGM 1, has also been impacted on due to the placement of dams within these systems. Additionally, both valley bottom systems are traversed by formal and informal access routes. These have resulted in reaches of the system being inundated, and resulted in the onset or erosion, particularly downstream of the larger impoundments and crossing areas. The depressions are predominantly restricted to the higher lying areas of the topography. These areas are flat, with poorly drained soils. The seepage areas are located on the slopes of the catchment, with some seeps being isolated and others connected to other wetland systems. The local commercial

farming and mining activities have largely avoided direct impacts to the basins of the depressions, and also the seepage areas, but the periphery of these systems has been encroached upon. This has resulted in the narrowing of these systems.

The vegetation of the wetland systems has been predominantly impacted on by the commercial agricultural, and infrastructure development and mining but to a lessor extent. The agricultural areas are the areas which has been degraded significantly. The agricultural areas were cultivated with crops whereas the areas adjacent to the mining and other infrastructure projects are associated with stands of weeds and bare soil due to the disturbance to the topsoil layer. The disturbed area didn't contain a large amount of diverse indigenous vegetation mainly due to the anthropogenic influence. Weeds such as *Bidens pilosa, Conyza bonariensis, Cortaderia selloana, Verbena bonariensis* and *Tagetes minuta* occurred throughout the project area and the overall state of the area was degraded.

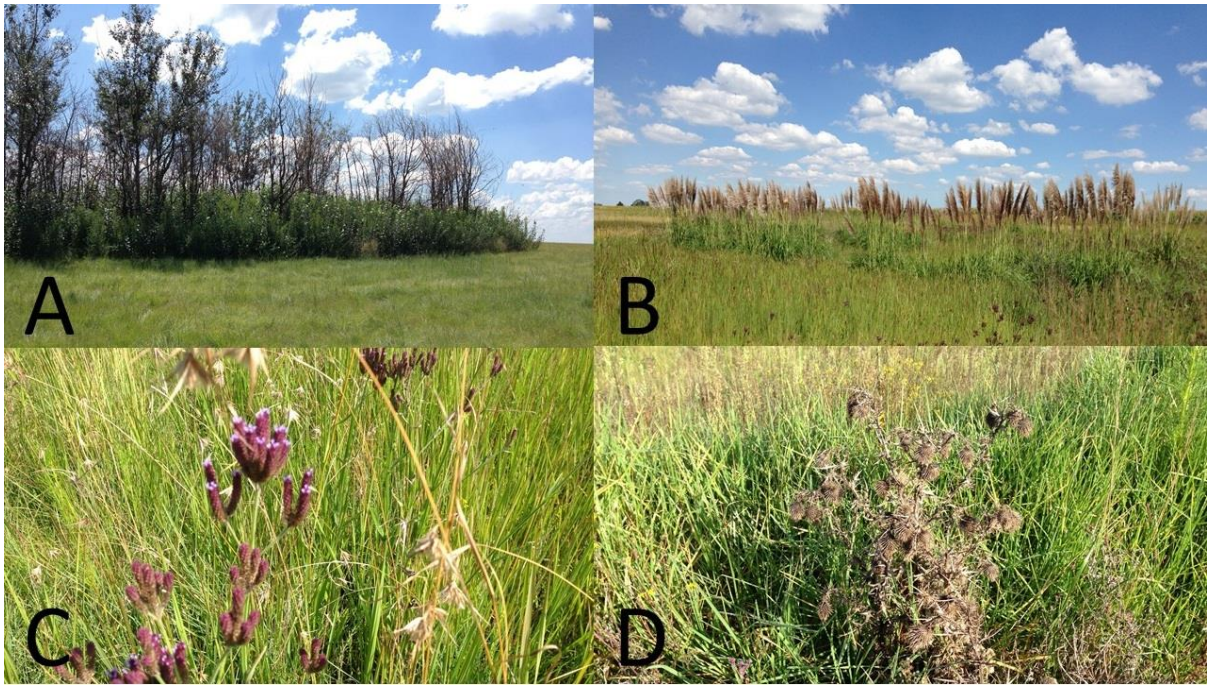

Figure 17: Photographs of alien vegetation identified for the study (March 2018). A: Populus alba (NEMBA Cat 2). B: Cortaderia selloana. C: Verbena bonariensis (NEMBA Cat 1b). D: Cirsium vulgare (NEMBA Cat 1b)

Table 10: Summary of the scores for the wetland PES

HGM Type	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 1 - Unchannelled valley bottom	C: Moderately Modified	3.5	C: Moderately Modified	2.4	D: Largely Modified	5.3
Overall PES Score	3.7		Overall PES Class		C: Moderately Modified	
HGM 2 - Unchannelled valley bottom	C: Moderately Modified	3.1	C: Moderately Modified	2.3	D: Largely Modified	5.2
Overall PES Score	3.5		Overall PES Class		C: Moderately Modified	
Pans (and connected seeps)	C: Moderately Modified	3.0	A: Unmodified	0.4	E: Seriously Modified	6.7
Overall PES Score	4.4		Overall PES Class		D: Largely Modified	
Seeps (isolated)	D: Largely Modified	4.0	A: Unmodified	0.6	E: Seriously Modified	7.8
Overall PES Score	4.1		Overall PES Class		D: Largely Modified	
Seeps	C: Moderately Modified	3.3	B: Largely Natural	1.6	C: Moderately Modified	3.1
Overall PES Score	2.8		Overall PES Class		C: Moderately Modified	

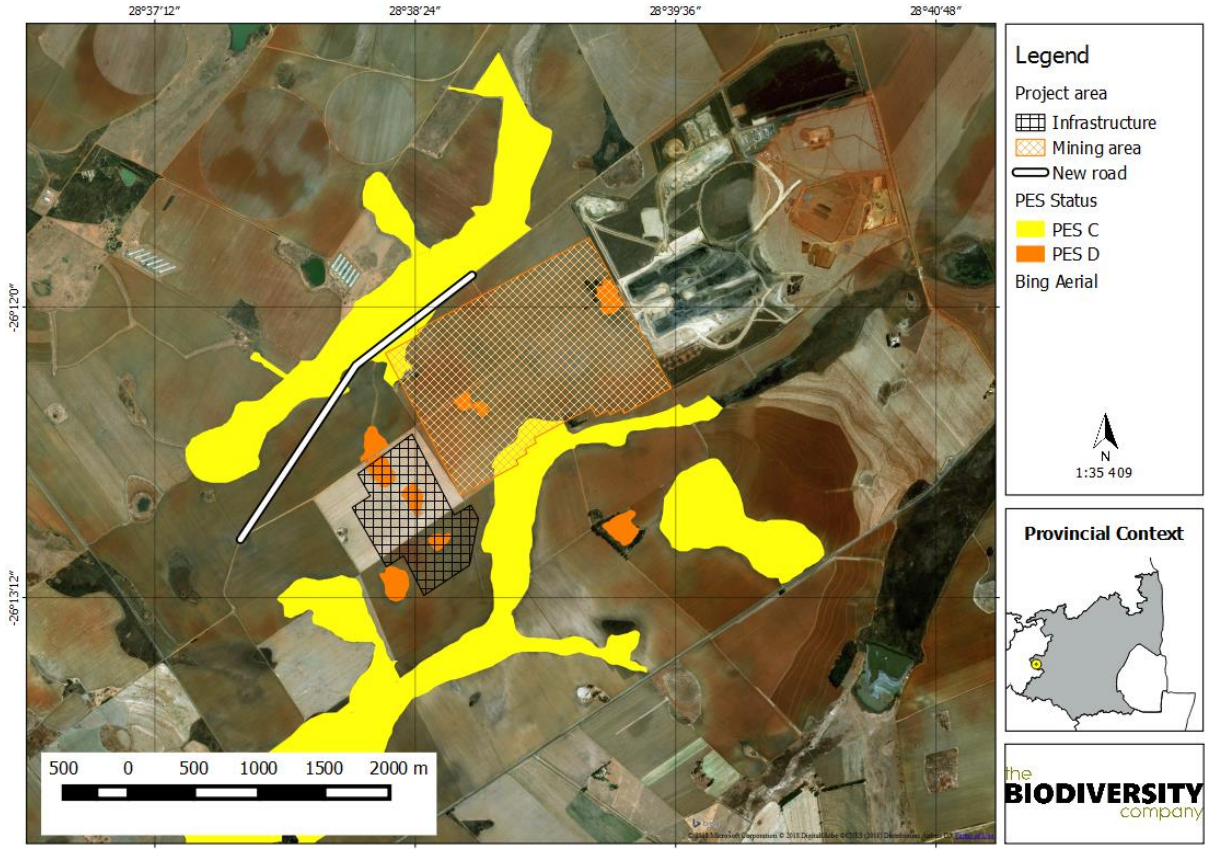

Figure 18: The depicted PES of the wetlands

5.7.2 Ecosystem Services Assessment

The Ecosystem services provided by the HGM units present at the site were assessed and rated using the WET-EcoServices method (Kotze *et al*. 2009). The summarised results for the HGM types are shown in Table 11 and presented in Figure 19.

The two valley bottom wetland types, HGM 1 and HGM 2, had overall moderately high level of service, with the remaining wetland units displaying an intermediate level of service. A number of moderately high benefit services were identified for the various wetland systems, these include:

- Flood attenuation;
- Streamflow regulation;
- Water quality enhancement;
- Biodiversity maintenance; and
- Provision benefits.

Table 12 presents a summary of the service classifications for the respective wetland units. It is important from this summary that all the wetland units contribute considerably (moderately high) to regulating and supporting services, the bulk of which includes the enhancement of water quality. In addition to this, the two valley bottom systems and the adjoining seepage areas also provide supporting biodiversity maintenance services considered to be of a moderately high benefit. The direct services provided by the wetland units, referring to provisioning and cultural benefits, are less significant with the majority of the system providing an overall moderately low level of benefit.

Table 11: The Eco-Services being provided by the wetland units

Wetland Unit					HGM 1	HGM 2	HGM 3	HGM 4	HGM 5
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		2.1	2.3	1.7	1.8	2.2
			Streamflow regulation		2.8	2.7	2.0	2.0	2.3
			Water Quality enhancement benefits	Sediment trapping	2.5	2.5	1.9	1.8	2.4
				Phosphate assimilation	2.9	2.8	2.4	2.4	2.4
				Nitrate assimilation	3.1	3.1	2.9	2.5	2.6
				Toxicant assimilation	2.7	2.7	2.3	2.3	2.4
				Erosion control	2.0	2.3	2.6	2.2	2.3
			Carbon storage		2.3	2.3	2.3	2.3	2.4
	Direct Benefits	Biodiversity maintenance			2.1	2.2	1.5	1.6	2.2
		Provisioning benefits	Provisioning of water for human use		1.6	1.7	0.9	0.8	0.9
			Provisioning of harvestable resources		1.6	1.6	1.0	0.9	1.0
			Provisioning of cultivated foods		2.2	2.3	1.0	0.8	1.0
		Cultural benefits	Cultural heritage		1.0	1.1	1.0	1.0	0.7
			Tourism and recreation		2.1	2.1	0.7	0.6	1.1
			Education and research		2.0	2.0	1.8	1.3	1.8
Overall					33.2	33.9	25.9	24.2	27.7
Average					2.2	2.2	1.7	1.6	1.8

Table 12: Summary of Eco-Service classes being provided by the wetland units

Service	HGM 1	HGM 2	HGM 3	HGM 4	HGM 5
Indirect benefits	2.6	2.6	2.3	2.2	2.4
Direct benefits	1.8	0.8	1.1	0.9	1.0
Biodiversity maintenance	2.1	2.2	1.5	1.6	2.2

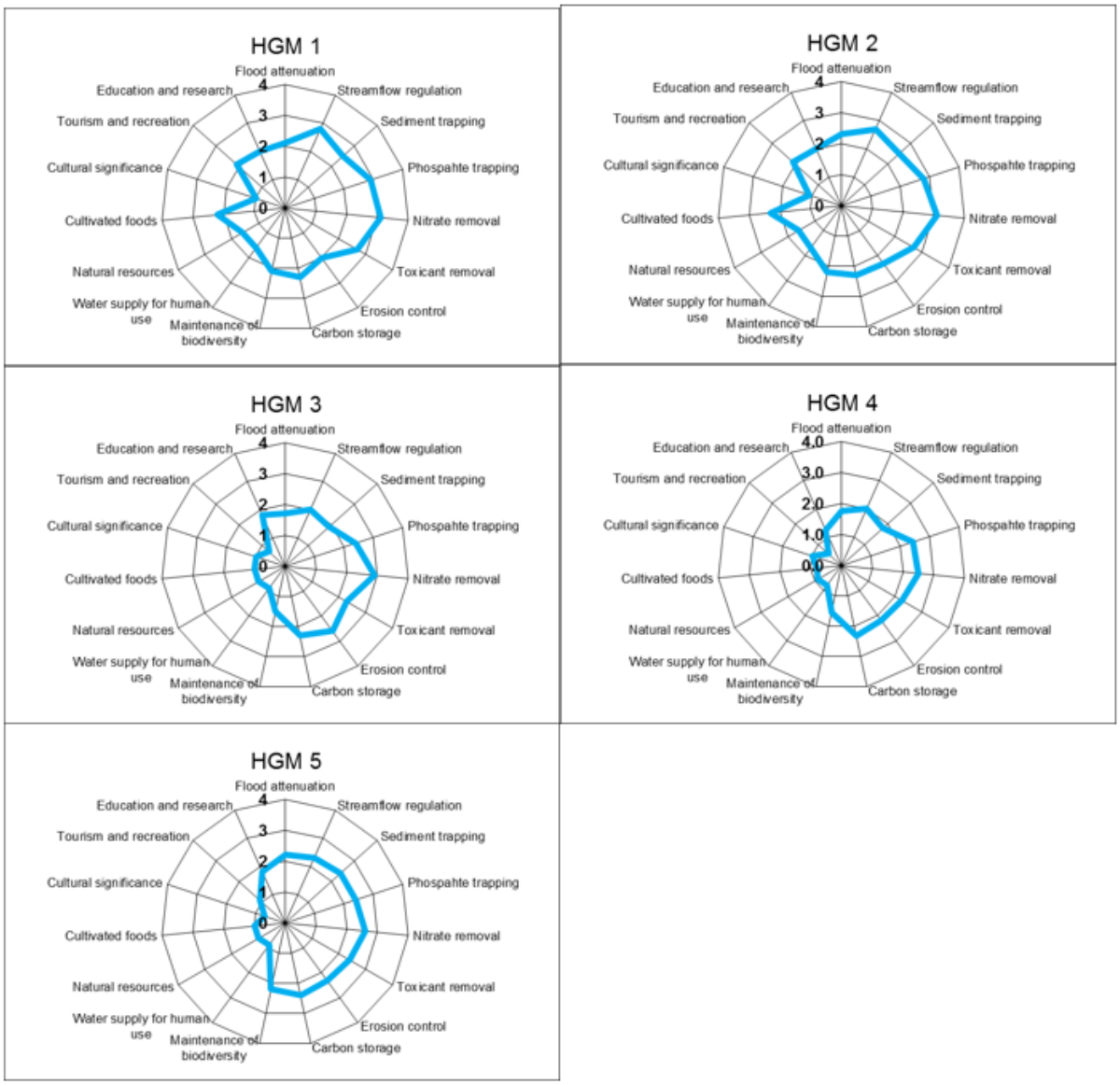

Figure 19: Radar plots depicting the ecological services for the wetland types

5.7.3 Ecological Importance and Sensitivity

The EIS assessment was applied to the HGM units described in the previous section in order to assess the levels of sensitivity and ecological importance of the wetland. The results of the assessment are shown in Table 13. Figure 20 depicts the EIS of the wetland systems. The following findings from the ecological assessment were considered for the EIS classification:

- The project area is not associated within any formally protected areas.
- The wetland findings for this study present a considerable expanse (or extent) of wetland area, comprising varying HGM types. These wetlands are considered to be predominantly in a moderately modified state and provide moderately high levels of indirect benefits.

- The results of the PES assessment conducted by The Biodiversity Company (2017) derived a largely modified ecological category (Class D) for the Bronkhorstspruit system. This PES is below the attainable ecological management class (Class C).
- No plants Species of Conservation Concern (SCC) were recorded for the project area. The likelihood of occurrence of any of the Red and Orange List plant species is low to medium.
- Seventy-six (76) bird species were recorded in the general project area (since January 2018). No bird SCC were recorded during the survey, although based on the various wetland habitats encountered in the project area, the likelihood that bird SCC occur there is rated as high.
- Overall, mammal diversity in the project area was considered high, with eighteen (18) mammal species being recorded in the general project area based on either direct observation, camera trap photographs or the presence of visual tracks & signs (Figure 21).
- Three (3) mammal SCC were recorded in the general project area. Serval (*Leptailurus serval*) have been recorded on a number of occasions in the area, and it appears that a healthy population of these threatened mammals occur within the general area. Similarly, there seems to be healthy populations of Cape Clawless Otters (*Aonyx capensis*) along the wetland areas and in the dams within the general area.
- Six (6) reptile species were recorded in the project area during the January 2018. One near-endemic snake and one endemic snake species were recorded in the project.
- Four (4) amphibian species was recorded in the project area during the January 2018 survey based on visual observations as well as from calls made by various frog species.

The EIS of the two valley bottom wetland types, and the adjoining seepage systems was rated as high (Class B), with the remaining wetland types being rated as moderate (Class C).

The hydrological / functional importance was rated as Moderate (Class C) for all the wetland systems. The direct human benefits were rated, varying from moderate (Class C) to low (Class D) for all the wetland systems. These findings are based on the Eco-Services classifications.

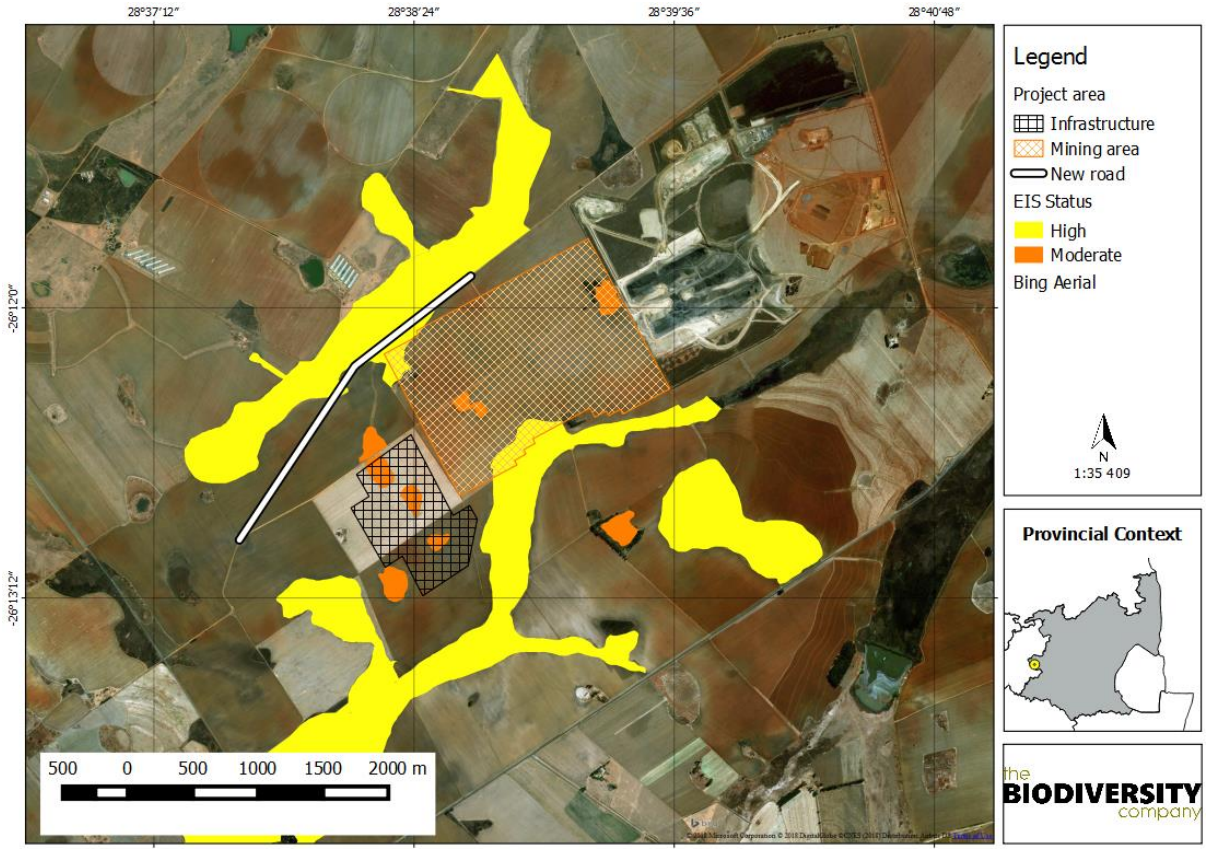

Figure 20: The depicted EIS of the wetlands

Table 13: The EIS results for the delineated wetlands

WETLAND IMPORTANCE AND SENSITIVITY	HGM 1	HGM 2	HGM 3	HGM 4	HGM 5
Ecological Importance & Sensitivity	2.6	2.6	1.6	1.5	2.3
Hydrological / Functional Importance	2.6	2.6	2.3	2.2	2.4
Direct Human Benefits	1.8	0.8	1.1	0.9	1.0

Figure 21: Photographs of some fauna recorded by means of camera traps. 1) Rinkhals. 2) Black-backed Jackal (Mange). 3) Slender Mongoose. 4) Common Duiker. 5) Large Grey Mongoose. 6) Honey Badger. 7) Guineafowl. 8) Water Mongoose

5.8 Buffer Zones

The project is for the proposed opencast mining operation and supporting infrastructure. The proposed mining area will result in the loss of some of the delineated wetlands. The DWS buffer tool recommends at a desktop level that the required buffer for opencast mining be 180 m. The Mpumalanga Tourism and Parks Agency (MPTA) will request a minimum buffer width of 100m from the edge of the delineated wetlands.

A minimum buffer zone of 175 m is recommended for the wetlands with regards to a mining operation (Macfarlane et al. 2009). These minimum buffer widths (to protect core wetland habitat and aquatic functioning) are calculated based on a simple classification of wetland types and land use categories, broadly grouped as riverine and palustrine systems. Ecological and landscape characteristics are then assessed to establish the need to increase the buffer width, if at all.

The model shows that the largest risks (Very High) posed by the project during the construction phase is that of “increased sediment inputs and turbidity”. During the operational phase Very High risks were flagged for “alterations to flow volumes as well as patterns” and “inputs of heavy metal contaminants”. A number of High risks are also expected for the operational phase of the project” (Table 16). These risks are calculated with no prescribed mitigation and presented in Table 14.

Table 14: Pre-mitigation buffer requirement

Required buffer before mitigation measures have been applied	
Construction Phase	**56 m**
Operational Phase	**96 m**

According to the buffer guideline (Macfarlane et al. 2015) a high-risk activity would require a buffer that is 95% effective to reduce the risk of the impact to a low-level threat. The tool is regarded as a guideline, adjustments have been made to provide a better suited buffer width. The prescribed mitigation measures will reduce the risks for some aspects and the required buffer is then 45m and 65m (Table 15) for the construction and operational phases respectively. It is recommended that the larger buffer width of 65m be implemented from the onset of the construction phase of the project.

Table 15: Post-mitigation buffer requirement

Required buffer after mitigation measures have been applied	
Construction Phase	**45 m**
Operational Phase	**65 m**

Table 16: The risk results from the wetland buffer model for the proposed project

Threat Posed by the proposed land use / activity		Specialist Threat Rating	Refined Threat Class	Specialist justification for refined threat ratings.
Construction Phase	1. Alteration to surface runoff flow volumes	Low		
	2. Alteration of patterns of flows (increased flood peaks)	Medium		
	3. Increase in sediment inputs & turbidity	Very High	High	Avoidance of valley bottom, and adjoining seepage areas and buffer. Dry season construction, limit (and demarcate) the disturbance footprint area, silt traps, stripping in a phased approach, begin vegetation clearing upslope and work downslope, managed stockpiles, storm water management
	4. Increased nutrient inputs	Low		
	5. Inputs of toxic organic contaminants	Medium		
	6. Inputs of toxic heavy metal contaminants	Medium	Low	Off-site equipment and vehicle fuelling and maintenance, storage of chemicals and fuel in bunded area, no on-site fabrication, oil spill kits, equipment & vehicle inspections.
	7. Alteration of acidity (pH)	Low		
	8. Increased inputs of salts (salinization)	Low		
	9. Change (elevation) of water temperature	Low		
	10. Pathogen inputs (i.e. disease-causing organisms)	Very Low		
Operational Phase	1. Alteration to flow volumes	Very High	High	Avoidance of valley bottom, and adjoining seepage areas and buffer. Minimise opencast pit footprint area. Pumping of clean water back into the wetland systems. Divert clean water around working areas, with controlled release into valley bottom areas. Stockpiling (and shaping) of soils and materials within the existing working area, and not within preferential flow paths.
	2. Alteration of patterns of flows (increased flood peaks)	Very High	High	
	3. Increase in sediment inputs & turbidity	High	Medium	Stockpiling of soils and materials within the existing working area, and not within preferential flow paths. Compile a stormwater management plan for the area. Separate clean and dirty water, intercept surface run-off and direct this around the working area.
	4. Increased nutrient inputs	High	Medium	Provide sanitation, and waste storage area. Service waste depots and facilities regularly and dispose of waste in demarcated areas.
	5. Inputs of toxic organic contaminants	High		
	6. Inputs of toxic heavy metal contaminants	Very High	High	Off-site equipment and vehicle fuelling and maintenance, storage of chemicals and fuel in bunded areas, no on-site fabrication, oil spill kits, equipment & vehicle inspections.
	7. Alteration of acidity (pH)	High		
	8. Increased inputs of salts (salinization)	High		
	9. Change (elevation) of water temperature	Medium		
	10. Pathogen inputs (i.e. disease-causing organisms)	Low		.

6 Impact Assessment

6.1 Existing impacts

The following existing impacts were observed in or adjacent to the proposed project area:

- A depression wetland within the Kangala Colliery has been avoided by the mining project, but is now isolated from the catchment. The development of the area and also taking into account the commercial agricultural activities, other wetland systems are being isolated and hydrological processes interrupted.
- The removal of vegetation to accommodate local agricultural activities, infrastructure development and access routes. This has resulted in the establishment and encroachment of alien vegetation in the general area, including the water resources.
- The modified status of the Bronkhorstspruit system may be attributed to a combination of flow modification, habitat and water quality elated drivers and riparian areas (The Biodiversity Company, 2017).
- Predominantly the agricultural activities have also contributed to wetland modifications, which include altered flows caused by compaction and drainage, and also the establishment of alien vegetation within the systems.

6.2 Potential Impacts

The proposed project could result in the loss and modifications of water resources, notably the delineated wetland areas. The following list provides a framework for the anticipated major impacts associated with the project.

1. Loss / degradation of wetlands
    a. Project activities that can cause loss of habitat
        i. Physical removal of vegetation
        ii. Access roads and servitudes
        iii. Construction camps & laydown areas
        iv. Infrastructure development
        v. Linear trench excavation and berm creation
        vi. Soil dust precipitation
        vii. Coal dust precipitation
        viii. Stochastic events such as fire (cooking fires or cigarettes from staff)
    b. Secondary impacts anticipated
        i. Loss of shallow recharge zones
        ii. Increased potential for soil erosion (in conjunction with alterations in hydrological regimes)
        iii. Increased potential for establishment of alien & invasive vegetation
        iv. Loss of ecosystem services
2. Spread and/or establishment of alien and/or invasive species
    a. Project activities that can cause the spread and/or establishment of alien and/or invasive species
        i. Vegetation removal
        ii. Soil excavations and soil transportation

iii. Transportation vehicles potentially spreading seed while moving on, to and from mining areas
iv. Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive rodents
v. Creation of infrastructure suitable for breeding activities of alien and/or invasive birds

3. Environmental pollution due to increased sedimentation and erosion of watercourses
    a. Project activities that can cause pollution in water courses
        i. Erosion
        ii. Clearing of vegetation
        iii. Earth moving (removal and storage of soil]
        iv. Blasting of pit areas and excavation
        v. Soil dust precipitation
    b. Secondary impacts associated with pollution in water courses
        i. Groundwater pollution
        ii. Loss of ecosystem services
4. Impaired water quality (surface and groundwater)
    a. Project activities that can cause pollution in water courses
        i. Chemical (organic/inorganic) spills
        ii. Acid mine drainage (decanting)
        iii. Untreated runoff or effluent
        iv. Coal dust precipitation
5. Alterations in hydrological regime (flow of surface and sub-surface water)
    a. Project activities that can cause alterations in hydrological regime
        i. Excavations and infrastructure development
        ii. Road network creation
        iii. Excavations of opencast pit
        iv. Alterations to surface topography (due to voids and surface structures)
        v. Dewatering of aquifers
    b. Secondary impacts associated with alterations in hydrological regime
        i. Loss of ecosystem services
        ii. Worsening of the ecological status of wetlands
        iii. Increased or reduced runoff dependent on system manipulation
        iv. Loss of soil fertility and topsoil recharge through interruption of seasonal recharge and natural flow, including natural sedimentation
        v. Scouring and erosion of wetlands
        vi. Loss of soil fertility and topsoil recharge through interruption of seasonal recharge and natural flow, including natural sedimentation

6.3 Assessment of Significance

The project is for the proposed opencast mining operation, new road and supporting infrastructure. Figure 22 presents the proposed project aspects which have been considered for the study, with close consideration being afforded to the opencast, new road and infrastructure footprint areas in relation to the delineated wetland areas.

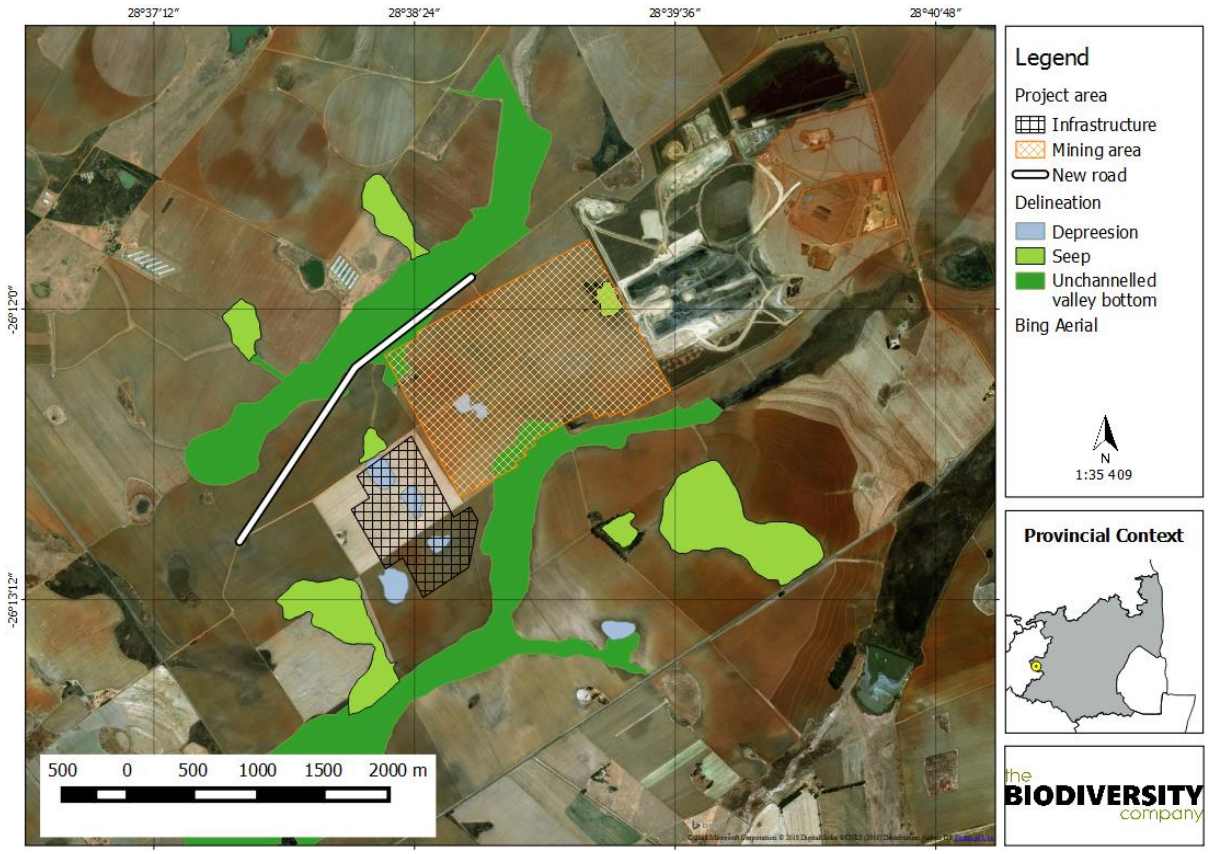

Figure 22: The proposed project aspects in relation to the wetlands

The most notable impact is the expectant loss of some water resources, the delineated wetlands in particular. The loss of wetlands is expected for the mining of the opencast area, the road route and the placement of the adjacent waste stockpiles.

Findings from the DWS aspect and impact register / risk assessment are provided in Table 17, Table 18 and Table 19.

Table 17: Impacts assessed for the proposed project

Activity	Aspect	Impact
Pr Sci Nat	**Andrew Husted (400213/11)**	
Construction Phase		
Clearing of vegetation	Creation of access routes & new road	• Loss of surface roughness • Loss of seepage (infiltration) areas • Alteration to surface runoff flow volumes • Alteration of patterns of flows (increased flood peaks) • Impaired water quality • Increase in sediment inputs & turbidity • Increased nutrient inputs • Inputs of toxic organic contaminants • Inputs of toxic heavy metal
	Creation of laydown areas and offices / ablutions / camps	
Soil excavations	Removal of top and sub-soil layers	
	Stockpiling of soils	
	Change in topography and slope	
Heavy duty vehicle use	Spills, leaks and dust precipitation	
	Spread of alien vegetation	
Light vehicles, machine and	Spills, leaks and dust precipitation	

equipment use		contaminants • Pathogen inputs (i.e. disease-causing organisms) • Alien vegetation infestation • Loss of, or impaired ecosystem services • Erosion
Staff, personnel & contractors	Ablutions	
	Waste management	
Construction materials	Storage of materials and solutions	
	Spills and leaks	
	Untreated run-off	
Operation Phase		
Blasting of pit areas	Coal precipitation	• Loss of wetlands • Loss of, or impaired ecosystem services • Loss of seepage (infiltration) areas • Loss of aquifers (and recharge) • Alteration to surface runoff flow volumes • Alteration of patterns of flows (increased flood peaks) • Impaired water quality • Increase in sediment inputs & turbidity • Increased nutrient inputs • Inputs of toxic organic contaminants • Inputs of toxic heavy metal contaminants • Pathogen inputs (i.e. disease-causing organisms) • Alien vegetation infestation • Erosion
	Dust precipitation	
Soil excavations	Opencast mining	
	Change in topography and slope	
Heavy duty vehicle use	Haulage	
	Spread of alien vegetation	
Light vehicles, machine and equipment use	Spills, leaks and dust precipitation	
Staff, personnel & contractors	Ablutions	
	Waste management	
Operation materials	Storage of materials and solutions	
	Spills and leaks	
	Untreated run-off	

Table 18: DWS Risk Impact Matrix for the proposed project

Severity								
Aspect	**Flow Regime**	**Water Quality**	**Habitat**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**
Construction Phase								
Creation of access routes & new road	2	2	2	2	2	2	4	8
Creation of laydown areas and offices / ablutions / camps	1	1	1	1	1	1	1	3
Removal of top and sub-soil layers	3	2	2	2	2.25	2	2	6.25
Stockpiling of soils	2	2	1	1	1.5	1	2	4.5
Change in topography and slope	3	1	2	2	2	2	2	6
Spills, leaks and dust precipitation (heavy vehicle)	0	3	2	2	1.75	3	2	6.75
Spread of alien vegetation	0	0	3	2	1.25	3	2	6.25
Spills, leaks and dust precipitation (light vehicle)	0	3	2	2	1.75	3	2	6.75
Ablutions	0	3	1	2	1.5	2	1	4.5
Waste management	0	3	1	3	1.75	3	2	6.75
Storage of materials and solutions	0	2	1	0	0.75	1	2	3.75
Spills and leaks	0	3	2	3	2	3	2	7
Untreated run-off	0	4	3	3	2.5	3	2	7.5
Operational Phase								
Coal precipitation	0	3	3	3	2.25	3	4	9.25
Dust precipitation	0	3	3	3	2.25	3	4	9.25
Opencast mining	5	2	4	4	3.75	3	4	10.75
Change in topography and slope	5	1	4	3	3.25	3	4	10.25
Haulage & light vehicles	0	2	0	3	1.25	2	4	7.25
Spread of alien vegetation	0	0	3	2	1.25	3	4	8.25
Spills, leaks and dust precipitation	0	3	2	3	2	3	4	9
Ablutions	0	3	1	3	1.75	2	4	7.75
Waste management	0	3	1	3	1.75	3	4	8.75

Storage of materials and solutions	0	2	0	0	0.5	1	4	5.5
Spills and leaks	0	3	2	3	2	3	4	9
Untreated run-off	0	4	3	3	2.5	3	4	9.5

Table 19: DWS Risk Impact Matrix for the proposed project (continued)

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Creation of access routes & new road	2	2	**5**	3	12	96	**Moderate**	**Moderate**
Creation of laydown areas and offices / ablutions / camps	2	1	1	1	5	15	**Low**	**Low**
Removal of top and sub-soil layers	2	3	1	1	7	43.75	**Low**	**Low**
Stockpiling of soils	3	2	1	2	8	36	**Low**	**Low**
Change in topography and slope	3	2	1	3	9	54	**Low**	**Low**
Spills, leaks and dust precipitation (heavy vehicle)	2	3	1	2	8	54	**Low**	**Low**
Spread of alien vegetation	3	2	1	2	8	50	**Low**	**Low**
Spills, leaks and dust precipitation (light vehicle)	2	3	1	2	8	54	**Low**	**Low**
Ablutions	2	1	1	2	6	27	**Low**	**Low**
Waste management	3	3	1	2	9	60.75	**Moderate***	**Low**
Storage of materials and solutions	3	1	1	1	6	22.5	**Low**	**Low**
Spills and leaks	2	2	1	2	7	49	**Low**	**Low**
Untreated run-off	2	3	1	2	8	60	**Moderate***	**Low**
Operational Phase								
Coal precipitation	4	3	1	3	11	77	**Moderate***	**Moderate**
Dust precipitation	5	3	1	3	12	111	**Moderate**	**Low**
Opencast mining	5	5	5	4	19	175.75	**High**	**High**
Change in topography and slope	5	5	1	5	16	172	**High**	**High**
Haulage & light vehicles	4	1	1	1	7	71.75	**Moderate***	**Low**

Spread of alien vegetation	3	3	1	2	9	42.75	**Low**	**Low**
Spills, leaks and dust precipitation	3	3	1	2	9	74.25	**Moderate***	**Low**
Ablutions	2	2	1	2	7	63	**Moderate***	**Low**
Waste management	3	3	1	2	9	69.75	**Moderate***	**Low**
Storage of materials and solutions	2	1	1	1	5	43.75	**Low**	**Low**
Spills and leaks	2	3	1	2	8	74	**Moderate***	**Low**
Untreated run-off	2	3	1	2	8	72	**Moderate***	**Low**

A number of aspects were considered for the construction phase of the project. The majority of these aspects are not expected to have a direct impact (or risk) on the delineated wetland areas. The moderate risks are expected for the clearing of vegetation and construction personnel and materials. Due to the placement of the new road within sections of the delineated wetland area, the severity of this direct impact is expected to be moderate for the duration of the project. If recommended mitigation measures are implemented, these risks will be reduced to a low risk, notable mitigation includes:

- Create crossings which allow for wetland connectivity;
- Culverts must be prefabricated and transported to the site. Culverts must not be fabricated on site;
- Where possible, as many culverts as possible must be incorporated into the design. An increase in the number of culverts will help to spread flows across the watercourse, avoiding incisions in the landscape caused by concentrated flows;
- Schedule the crossing for the dry season period, between May to August;
- Minimising the disturbance footprint area, and the duration of the build;
- Make use of existing access routes (where feasible); and
- Limit the number of vehicles, machines and personnel for the project. Make use of existing access routes, and demarcate the wetland areas as No Go areas.

Moderate risks were also identified for the construction of the new road, management of waste and the release of untreated run-off into the catchment during the construction phase of the project. The longevity of these risks is considered to be short (for the construction phase), but these risks will continue into the operational phase of the project. The significance of the risks associated with the management of waste and the release of untreated run-off during the construction phase will be reduced to a low risk if the prescribed mitigation measures are implemented, these include:

- Separate clean and dirty water. Clean water must be diverted and directed around working areas, and measures or structures created to manage the discharge to avoid scouring and erosion;
- Dirty water must be contained in control dams. This water may be recycled through the operation, but may not be released into the environment. In the event that water is required to be released, it is advisable that the water quality be within the target requirements for aquatic ecosystems;
- The Contractor should inform all site staff to the use of supplied ablution facilities and under no circumstances shall indiscriminate excretion and urinating be allowed other than in supplied facilities. A minimum of one toilet must be provided per 10 persons;
- The Contractor should supply sealable and properly marked waste collection bins and all solid waste collected shall be disposed of at a licensed waste disposal facility;

- Where a registered waste site is not available close to the project area, the Contractor shall provide a method statement with regard to waste management. Under no circumstances may solid waste be burned on site;
- Refuse bins will be emptied and secured;
- Temporary storage of waste shall be in covered waste skips; and
- Maximum waste storage period will be 10 days.

A number of moderate risks are expected for the operational phase of the project, with the significance of the majority of these risks being reduced to a low risk should the prescribed mitigation measures be implemented. A number of these risks are carried through from the construction phase of the project, and this emphasises the need and importance to have these risks managed and mitigated from the onset of the project. Coal (dust) precipitate is considered to pose a moderate risk with-mitigation, these is largely attributed to the nature of mining proposed, and the proximity and extent of wetland area in relation to the opencast area. The most notable risks posed during the operational phase of the project area the actual opencast mining methods which will result in the loss of wetlands area, and the altered topography which will have an effect on the hydrology of the catchment. These two aspects are considered to pose a high risk, and there is no mitigation available for the mining of wetlands. Similarly, owing to the fact that the opencast mining footprint area is located on a watershed, there are also limited possibilities to mitigate the altered topography.

The loss of wetland is unavoidable, and the only mitigation would be to avoid the wetland area. However, changes to the topography will likely also result in the loss of the wetland due to hydrological changes.

6.4 Mitigation measures

A number of supporting mitigation measures are prescribed, these include:

- The project layout area pertains to the mining pit and discard stockpiles for hards, softs and topsoil. These areas must be demarcated to ensure the correct footprint area of the areas of disturbance.
- Any possible contamination of topsoil by hydrocarbons, concrete or concrete water must be avoided. Spill kits must be available and on hand to clean these spills;
- Where applicable, materials must be stored in leak-proof, sealable containers or packaging. Materials must also be stored in bunded areas which can accommodate the required volumes;
- Drip trays or any form of oil absorbent material must be placed underneath mining vehicles/machinery and equipment (in operation and not storage) when not in use;
- No servicing of equipment on site unless absolutely necessary;
- Leaking equipment shall be repaired immediately or be removed from site to facilitate repair;

- All vehicles and equipment must be well maintained to ensure that there are no oil or fuel leakages;
- All contaminated soil / yard stone shall be removed and be placed in containers;
- A specialist Contractor shall be used for the bio-remediation of contaminated soil where the required remediation material and expertise is not available on site. Alternatively, the mine may undertake or contract the disposal of contaminated soil at a licenced and registered facility if necessary.;
- All personnel and contractors to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the project area, with particular reference to the wetland systems;
- Prior to construction, fences or other effective barriers should be erected in such a manner to prevent access and damage to the wetland and associated buffer areas. Where fences cannot be erected, these sensitive areas must be clearly demarcated, and sign posted;
- An alien invasive plant management plan needs to be compiled and implemented prior to construction and continued through the life of the mine, to control and prevent the spread of invasive aliens. Clean mining vehicles on-site, and prioritise the cleaning of mining vehicles gaining access from surrounding areas;
- Compile a suitable stormwater management plan, which must be implemented from the onset of the project, and continued for the life of the project;
- Construct cut-off berms downslope of working areas;
- Demarcate footprint areas to be cleared to avoid unnecessary clearing. Exposed areas which are not going to be utilised in the future must be ripped and vegetated to increase surface roughness;
- Create energy dissipation at discharge areas to prevent scouring. Temporary and permanent erosion control methods may include silt fences, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed areas, erosion mats, and mulching.
- Limited the extent (or size) of the void, rehabilitation must be concurrent. All voids must be backfilled, and surface infrastructure must be removed from the site when no longer required;
- Compacted areas which are not going to be utilised in the future must be ripped (perpendicularly) to a depth of 300mm. A seed mix must be applied to rehabilitated and bare areas. Any gullies or dongas must also be backfilled. The area must be shaped to a natural topography. No grazing must be permitted to allow for the recovery of the area;
- Determine the likelihood of AMD, and proactively implement measures to prevent or reduce this. Priority would be to ensure the treatment of this water to suitable standards for aquatic ecology;

- Rehabilitation of the area and shaping of the topography must minimise the ingress of water into the mining area. Additionally, measures must also be considered to implement constructed wetlands at likely decant areas, and the planting of trees to reduce groundwater recharge; an
- Decommission cut-off berms and drains last. Debris must be placed in preferential flow paths.

6.5 Recommendations

These recommendations may supplement the prescribed mitigation measures, but these recommendations must be investigated prior to the issuing of environmental authorisation. These recommendations must be investigated for the feasibility to realistically achieve what is intended for this project. The following recommendations are applicable for this project:

1. The recommended buffer width is 45 m and 65 m for the construction and operational phases respectively. It is recommended that the larger buffer width of 65 m be implemented from the onset of the construction phase of the project.
2. The new road must make allowances for surface flows across the wetland areas, these flows must be spread across the system and not confined.
3. Mitigation measures prescribed by the hydrology, groundwater and air quality specialists for this project must be adhere to.
4. In the event that wetland areas will be impacted on, or lost, a wetland offset (mitigation) strategy[3] is required. A key component of this strategy would be to ensure the securing of the proposed offsite areas by means of proclamation. The proposed offsite area/s may not be subjected by mining or any other land use / activity within the foreseeable future.
5. A hydropedology[4] study is recommended to establish the hydrological characteristics for the project area (and wetlands), and to also provide a more comprehensive assessment for the buffer area requirements.
6. It is recommended that a condition of the operating licence must be to review and report on the implementation of the rehabilitation annually. If it is determined during this review period that the rehabilitation plan has not been implemented, or poorly at that, all mining must cease until rehabilitation of the area is adequate.

6.6 Monitoring programme

Aquatic biomonitoring is currently being undertaken for the Kangala Colliery as per conditions of the Water Use Licence (WUL). It is recommended that this biomonitoring programme be expanded to include this proposed mining area. In addition to this, it is recommended that wetland monitoring be conducted simultaneously with the biomonitoring programme.

[3] A wetland offset strategy has been commissioned and are currently being undertaken by The Biodiversity Company

[4] A hydropedology study have been commissioned and are currently being undertaken by The Biodiversity Company

A monitoring programme is an essential management tool. The monitoring programme should be designed to enable the detection of potential negative impacts brought about by the proposed project. Table 20 highlights some important aspects to monitor for the duration of the programme.

Table 20: Aquatic and Wetland Ecology Monitoring Plan

Location	Monitoring objectives	Frequency of monitoring	Parameters to be monitored
Expanded current biomonitoring site allocation. Identify wetland monitoring sites.	Overall Aquatic PES Wetland PES, functioning & EIS	Bi-annual	Standard aquatic ecology (Ecostatus) methods Wetland WET-Series
Current sites used in this study.	Determine if water quality deterioration is occurring.	Bi-annual	SASS5 and ASPT scores should not decrease as and be related to mining activities.
Current sites used in this study.	Determine if water/habitat quality deterioration is occurring.	Bi-annual	Monitor for presence of fish.

7 Conclusion

A number of datasets indicated the presence of wetlands in and around the project area, these included the FEPA, MBSP for freshwater systems and MPHG wetlands. The processing of spatial data further supported the expectation for the presence of wetlands within the project and adjacent areas.

The presence of wetlands was confirmed during the fieldwork which was completed during the wet season. A total of three (3) HGM types were identified and delineated for the project. These comprised of 15 separate HGM units which were identified and delineated for the project. For this study, where it was deemed acceptable (and appropriate), HGM units were collectively assessed per the respective HGM type. Based on this, a total of five (5) HGM types were assessed.

The two wetland systems located to the north and south of the project area were identified as unchannelled valley bottom systems. The remaining HGM units comprised endorheic pans and seepage areas.

The overall wetland health for the wetlands varied from Moderately Modified (Class C) to Largely Modified (Class D) systems, with the majority of the wetlands rated a Class C. The two valley bottom wetland types had overall moderately high level of service, with the remaining wetland units displaying an intermediate level of service. All the wetland units contribute considerably (moderately high) to regulating and supporting services, the bulk of which includes the enhancement of water quality.

The EIS of the two valley bottom wetland types, and the adjoining seepage systems was rated as high (Class B), with the remaining wetland types being rated as moderate (Class C).

The buffer tool recommends at a desktop level that the required buffer for opencast mining be 180 m. The MPTA will request a minimum buffer width of 100m from the edge of the delineated wetlands.

The recommended buffer width is 45 m and 65 m for the construction and operational phases respectively. It is recommended that the larger buffer width of 65 m be implemented from the onset of the construction phase of the project.

The project is for the proposed opencast mining operation, a new road and supporting infrastructure. The most notable impact is the expectant loss of some water resources, the delineated wetlands in particular. The loss of wetlands is expected for the mining of the opencast area, sections of the new road and the placement of the adjacent waste stockpiles.

A variety of aspects were considered for the construction phase of the project. The majority of these aspects are not expected to have a direct impact (or risk) on the delineated wetland areas. The moderate risks are expected for the clearing of vegetation and construction personnel and materials. Due to the placement of the new road within sections of the delineated wetland area, the severity of this direct impact is expected to be moderate for the duration of the project. Moderate risks were also identified for the construction of the new road, management of waste and the release of untreated run-off into the catchment during the construction phase of the project. The longevity of these risks is considered to be short (for the construction phase), but these risks will continue into the operational phase of the project. The significance of the risks associated with the management of waste and the release of untreated run-off during the construction phase will be reduced to a low risk if the prescribed mitigation measures are implemented.

A number of moderate risks are expected for the operational phase of the project, with the significance of the majority of these risks being reduced to a low risk should the prescribed mitigation measures be implemented. A number of these risks are carried through from the construction phase of the project, and this emphasises the need and importance to have these risks managed and mitigated from the onset of the project. Coal (dust) precipitate is considered to pose a moderate risk with-mitigation, these is largely attributed to the nature of mining proposed, and the proximity and extent of wetland area in relation to the opencast area. The most notable risks posed during the operational phase of the project area the actual opencast mining methods which will result in the loss of wetlands area, and the altered topography which will have an effect on the hydrology of the catchment. These two aspects are considered to pose a high risk, and there is no mitigation available for the mining of wetlands. Similarly, owing to the fact that the opencast mining footprint area is located on a watershed, there are also limited possibilities to mitigate the altered topography.

7.1 Impact Statement

An impact statement is required as per the NEMA regulations with regards to the proposed development.

It is the opinion of the specialist that the feasibility of the project in avoiding the wetland areas and accommodating the recommended buffer widths must first be established, before the project is considered for authorisation. Infrastructure layout should also be amended to avoid the wetland areas. In the event that it is deemed unfeasible to make an allowance to avoid the wetlands and buffers, recommendations pertaining to the wetland offset strategy must be implemented. The offset strategy must also ensure that there is no net loss, but rather a gain in functional hectare equivalents before authorisation is granted.

Further to this, in the event that the project is approved, all recommendations and mitigation measures prescribed in this report must be implemented and included into the Environmental Management Plan (EMP) report.

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