Wetland Assessment for the Development of the proposed Pure Source Mine Project

Parys, Free State Province

February 2019

Client

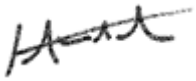
Shango Solutions

Prepared for:

Van Wyk Development Corporation (Pty) Ltd

Prepared by:

The Biodiversity Company
info@thebiodiversitycompany.com
www.thebiodiversitycompany.com

Report Name	**Wetland Assessment for the Proposed Pure Source Mine Project**
Submitted to	Shango Solutions
Report Reviewer	**Andrew Husted**  Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.
Report Writer and Fieldwork (Wetlands)	**Ivan Baker**  Mr. Ivan Baker obtained his BSc Hons degree in Environmental Science in 2016 at the North-West University of Potchefstroom. Ivan has been part of various wetland assessments, both in conducting the fieldwork as well as writing reports for various projects which include mining, housing developments, roads and infrastructure and rehabilitation. Ivan has experience in soil science which has been part of his BSc. and Honours degree. Ivan completed his MSc degree in soils and hydropedology in 2018 and is Cand. Sci. Nat registered (119315). Additionally, Ivan completed training in Tools for Wetland Assessments (2018) with a certificate of competence.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

Date: 2018/07/13 **Location: 26°44'35.93"S; 27°36'24.54"E**

Executive Summary

GN R982	Appendix 6 (n): Specialist Opinion
It is the specialist's opinion that a wetland offset be completed for the wetlands expected to be completely lost given the extent of the proposed open cast pits (HGM 1, 3 and 5). Additionally, rehabilitation has been recommended given the result from the impact assessment indicating some final significance ratings rated moderate. By applying all of the recommended mitigation measures and adhering to all recommendations (including wetland offsets), no fatal flaw is foreseen for the proposed activities in regard to wetland areas.	

The Biodiversity Company (TBC) was appointed to conduct a wetland Environmental Impact Assessment (EIA) for the Pure Source Mining project. This specialist study is completed to meet the requirements of a Mining Right Application (MRA) and the associated environmental authorisations for a proposed open pit mine.

The proposed project will involve the development of various open pit mines associated with the "roll-over mining" method, a processing plant and associated infrastructure. Commodities to be mined will include sand, gravel and diamond (alluvial) with the Life of Mine (LoM) being envisaged to last 30 years. Northern, central and southern portions of the project area are proposed for aggregate mining and one central and eastern portion are proposed for sand mining.

The applicant has a Prospecting Right (PR) over the proposed MRA area approximately 859 hectares in size and consists of Portion 1 and Portion 3 of Woodlands 407 (District Parys) of which a prospecting right has being issued in terms of Section 18 of the Minerals and Petroleum Reserve Development Act (N.P.R.D.A.), 2002 (Law 28 OF 2002). Approximately 401.67 ha of the property will be mined for aggregate and 283.1 ha for sand.

Two wetland types were identified within the project area, which has been divided into five Hydrogeomorphic (HGM) units. The overall present ecological state scores for all of the HGM units have been determined to be "Largely Modified" except for that of HGM 4, which has been scored "Moderately Modified". The average ecosystem services score has been determined to be "Intermediate" for HGM 1, 3, 4 and 5 with HGM 2 being rated "Moderately Low".

A "high" EIS has been scored for HGM 1, with the rest of the HGM units being scored "Moderate". The Hydrological/Functional Importance has been rated "High" for HGM 1 and HGM 5, with the remainder of the HGM units being scored "Moderate". The Direct Human Benefits have been scored "Low" for all of the identified HGM units given the lack of cultural benefits and the fact that no crop fields are reliant on irrigation from these wetlands. A buffer size of 79 m has been recommended for the delineated wetlands to limit impacts from the proposed activity.

Impact Assessment Summary

The only aspects identified to be located within the recommended 79 m buffer zones are the sand deposits, the aggregate deposits and the proposed water supply pipeline. These components where the only components not to meet the first requirement of the mitigation hierarchy, which is to avoid impacts. The second step is to minimise impacts to a final

significance rating of “Low Negative”, which could only be done for the construction, operation and decommissioning of the water supply pipeline.

The following step according to the mitigation hierarchy is to rehabilitate all degraded areas. This step is only relevant to the decommissioning of stockpiles given the fact that a direct loss of wetlands is expected for the mining activities scored a final significance rating of “High Negative”.

The latter mentioned aspects will result in a direct loss of wetlands, subsequently enforcing the last step in the mitigation hierarchy, which is wetland offsets. It therefore is the specialist’s opinion that the proposed activities proceed only if all of the recommendations made (Section 11- “Recommendations”) have been adhered to. This includes rehabilitation plans, wetland offsets (for HGM 1, 3 and 5), the application of all recommended mitigation measures as well as adhering to the 79 m buffer zone for all proposed activities in close proximity to HGM 2 and HGM 4.

Table of Contents

Figures

Tables

Declaration

I, **Ivan Baker** declare that:

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

Ivan Baker

Wetland Ecologist

The Biodiversity Company

25th February 2019

1 Introduction

The Biodiversity Company (TBC) was appointed to conduct a wetland Environmental Impact Assessment (EIA) for the Pure Source Mining project. This specialist study is completed to meet the requirements of a Mining Right Application (MRA) and the associated environmental authorisations for a proposed open pit mine.

The proposed project will involve the development of various open pit mines associated with the "roll-over mining" method, a processing plant and associated infrastructure. Commodities to be mined will include sand, gravel and diamond (alluvial) with the Life of Mine (LoM) being envisaged to last 30 years. Northern, central and southern portions of the project area are proposed for aggregate mining and one central and eastern portion are proposed for sand mining.

The applicant has a Prospecting Right (PR) over the proposed MRA area approximately 859 hectares in size and consists of Portion 1 and Portion 3 of Woodlands 407 (District Parys) of which a prospecting right has being issued in terms of Section 18 of the Minerals and Petroleum Reserve Development Act (N.P.R.D.A.), 2002 (Law 28 OF 2002). Approximately 401.67 ha of the property will be mined for aggregate and 283.1 ha for sand.

Mid-dry season surveys were conducted on the 6th July 2018 and the 9th – 12th July 2018. The surveys primarily focussed on the development footprint area, referred to as the project area herein. Furthermore, the identification and description of any sensitive receptors were recorded across the project area, and the manner in which these sensitive receptors may be affected by the activity was also investigated.

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP), enabling informed decision making as to the ecological viability of the proposed development and to provide an opinion on the whether any environmental authorisation process or licensing is required for the proposed project.

2 Project Area

The project area is situated about 20 km north-east of Parys, on the border of the Vaal River in the Free State Province, South Africa. The north-eastern and north-western portions of the project area border on the Gauteng and North West provinces respectively. The Applicant has a PR over the proposed MRA area covering approximately 859 hectares. The land uses surrounding the project area consist of agricultural land, natural areas, existing sand mining operations, the urban area of Vaal Oewer with associated houses, livestock and game farming. Infrastructure such as secondary tar roads, gravel roads and homesteads occur within the project area (Figure 1). The Vaal river forms the northern boundary of the proposed project area.

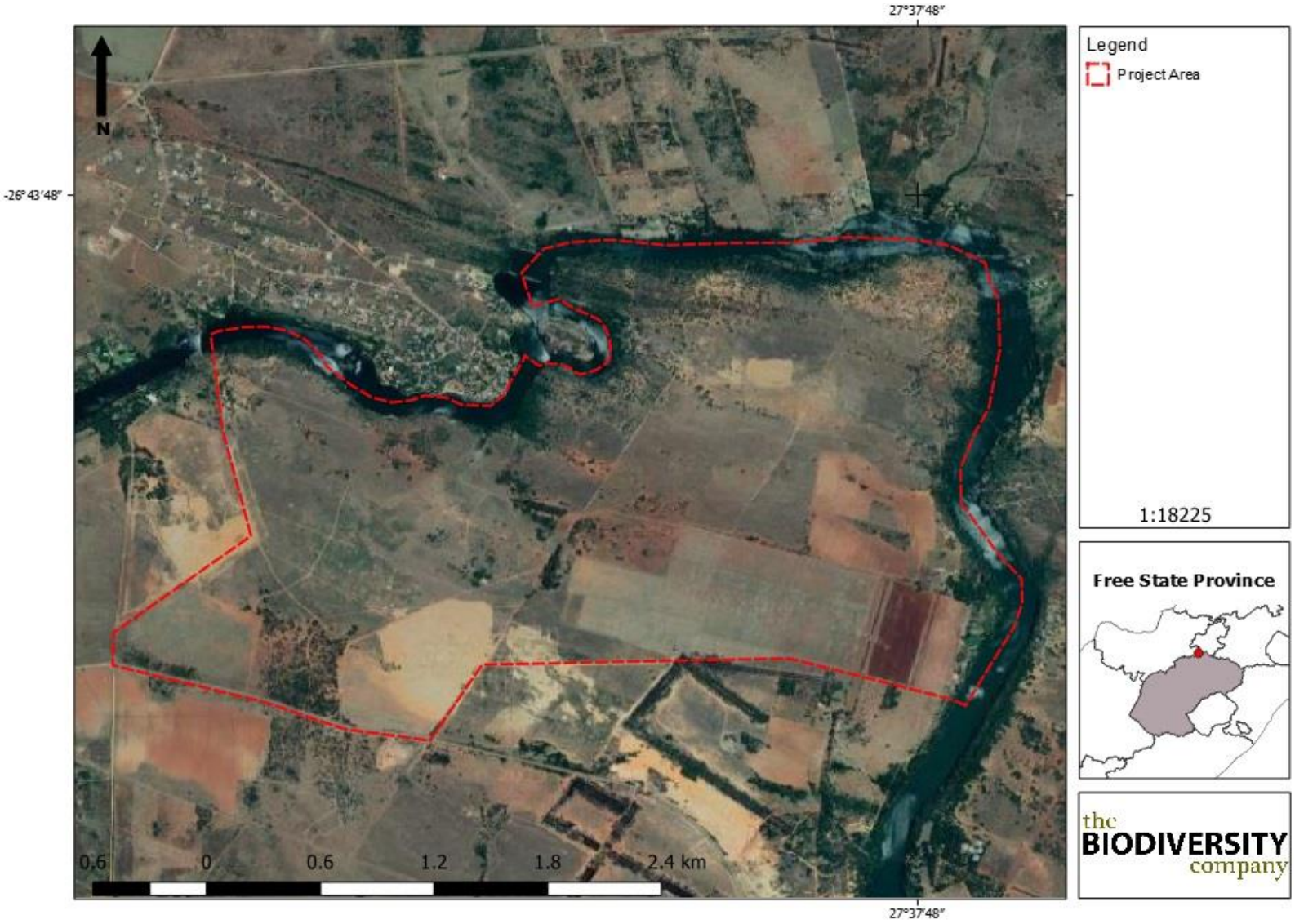


Figure 1: General location of the project area

3 Scope of Work

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

- The delineation, classification and assessment of wetlands within the project area;
- Implementation of WET-Health for determination of Present Ecological State (PES) of wetland areas;
- Implementation of WET-EcoServices for determination of ecosystem services for the wetland areas;
- Determine the Environmental Importance and Sensitivity (EIS) of wetland systems;
- Conduct risk assessments relevant to the proposed project and associated activities;
- Prescribe recommendations and mitigation measures relevant to associated impacts; and
- Report compliation.

4 Methodology

The following sections describe the methodology required by the Department of Water and Sanitation (DWS) (DWS, 2014) for a wetland assessment to meet EIA and Water Use License requirements;

4.1 Desktop assessment

- Aerial imagery (Google Earth Pro);
- Topographical river line data;
- Vegetation and climate information (Mucina & Rutherford, 2006);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel *et al.,* 2011); and
- Contour data (5 m).

4.2 Wetland Identification and Mapping

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.

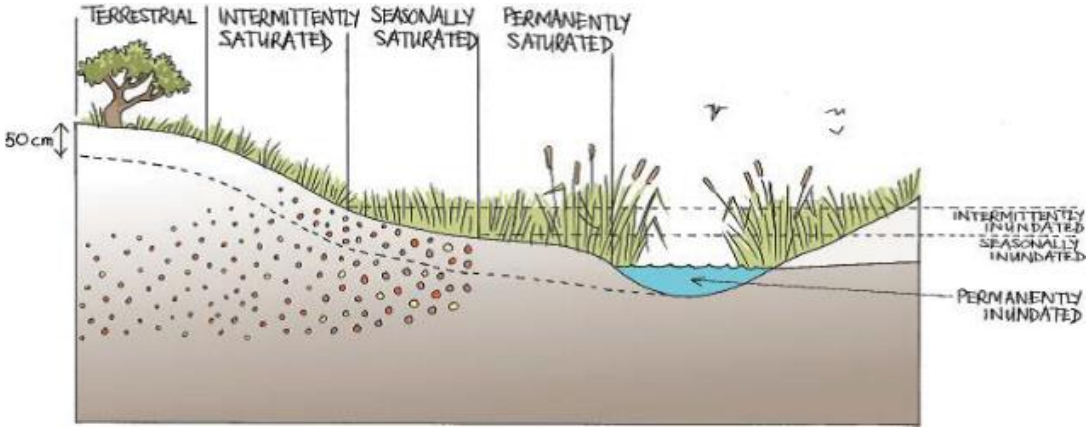


Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al. 2013)

4.3 Wetland Delineation

The wetland indicators described in "4.2" are used to determine the boundaries of the wetlands within the project area. These delineations are then illustrated by means of maps accompanied by descriptions.

4.4 Wetland Functional Assessment

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

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze et al. 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 1).

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

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low

0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

4.5 Determining the Present Ecological Status of wetlands

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 2.

Table 2: The Present Ecological Status categories (Macfarlane, et al., 2009)

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

4.6 Determining the Ecological Importance and Sensitivity of Wetlands

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 4 (Rountree *et al.,* 2012).

Table 3: Description of Ecological Importance and Sensitivity 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**

4.7 Ecological Classification and Description

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

4.8 Determining Buffer Requirements

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

4.9 Impact Assessment

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2014). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S).

Table 4: Description of Impact Categories

Value	Description
< -20	High Negative (i.e. where the impact must have an influence on the decision process to develop in the area)
-20 to -10	Medium Negative (i.e. where the impact could influence the decision to develop in the area)
0 to -10	Low Negative (i.e. where this impact would not have a direct influence on the decision to develop in the area)
0 to 10	Low Positive (I.e. where this impact would not have a direct influence on the decision to develop in the area)

10 to 20	Medium Positive (i.e. where the impact could influence the decision to develop in the area)
> 20	High Positive (i.e. where the impact must have an influence on the decision process to develop in the area)

5 Limitations

The following aspects were considered as limitations:

- The rehabilitation and closure plans for the proposed project is unknown;
- Crop fields and disturbed areas typically provide difficulties in detecting exterior signs of wetness, i.e. vegetation and soil patterns. This phenomenon could cause inaccuracies regarding the identification and delineation of wetland areas; and
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.

6 Spatial Context of the Project Area

6.1 Vegetation Types

The project area falls within the Soweto Highveld Grassland (GM 8) type according to Mucina and Rutherford (2006).

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

The vegetation within the GM 8 region is dominated by short to medium-high (<1m), dense, tufted grassland which includes *Themeda triandra* within gently to moderately undulating landscapes on the Highveld plateau. Other grass species which occur to a lesser extent include *Eragrostis recemosa*, *Elionurus muticus*, *Tristachya leucothrix* and *Heteropogon contortus*, Mucina and Rutherford (2006).

The conservation status of this vegetation type is endangered with a target percentage of 24. Half of the area which is covered in this vegetation type has been transformed into agriculture, mining and urban landuses.

6.2 Climate

The mean annual precipitation for this region reaches approximately 662 mm and is characterised by summer rainfall, Mucina and Rutherford (2006). This area is characterised by high and low extreme temperatures during the summer and winter periods respectively and has frequent frost during the winters, see Figure 3.

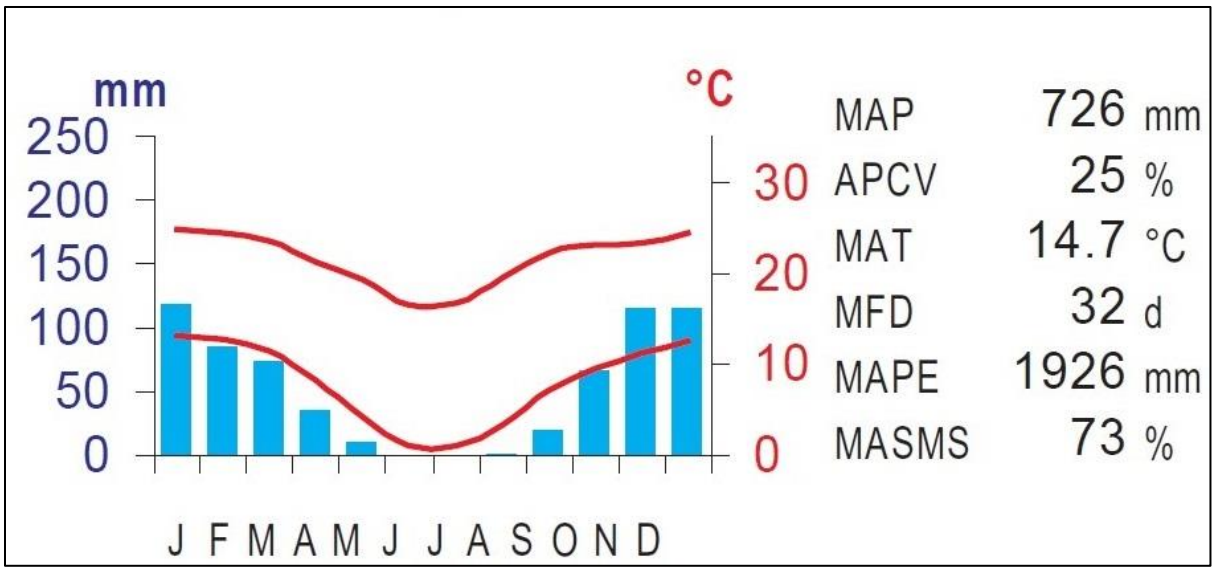


Figure 3: Climate diagram for the project area, Mucina & Rutherford (2006).

6.3 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006) the project area falls within the Bc36 land type. This land type is characterised by plinthic catena. Upland duplex with margalitic soils are rare within this land type. Eutrophic red soils are known to be wide spread across this area.

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

7 Results and Discussion

7.1 Desktop Results

The following sections include findings from desktop data which indicates potential wetland areas, which ultimately improves the accuracy of wetland delineations.

7.1.1 NFEPA Wetlands

No NFEPA wetlands have been identified within the proposed project area.

7.1.2 Topographical River Lines (Quarter Degree Square "2627")

As illustrated in Figure 4, the topographical river line data for quarter degree square "2627" indicates six river lines flowing from inland towards the Vaal River. These river lines have been investigated and either labelled as wetland areas or drainage lines given the suitable topography and the presence/lack of hydromorphic properties.

The river lines labelled “A”, “B”, “E” and “F” have all been identified as wetland areas, whereas those labelled “C” and “D” have been identified to be dry drainage lines, see section “7.2.1” and Figure 4.

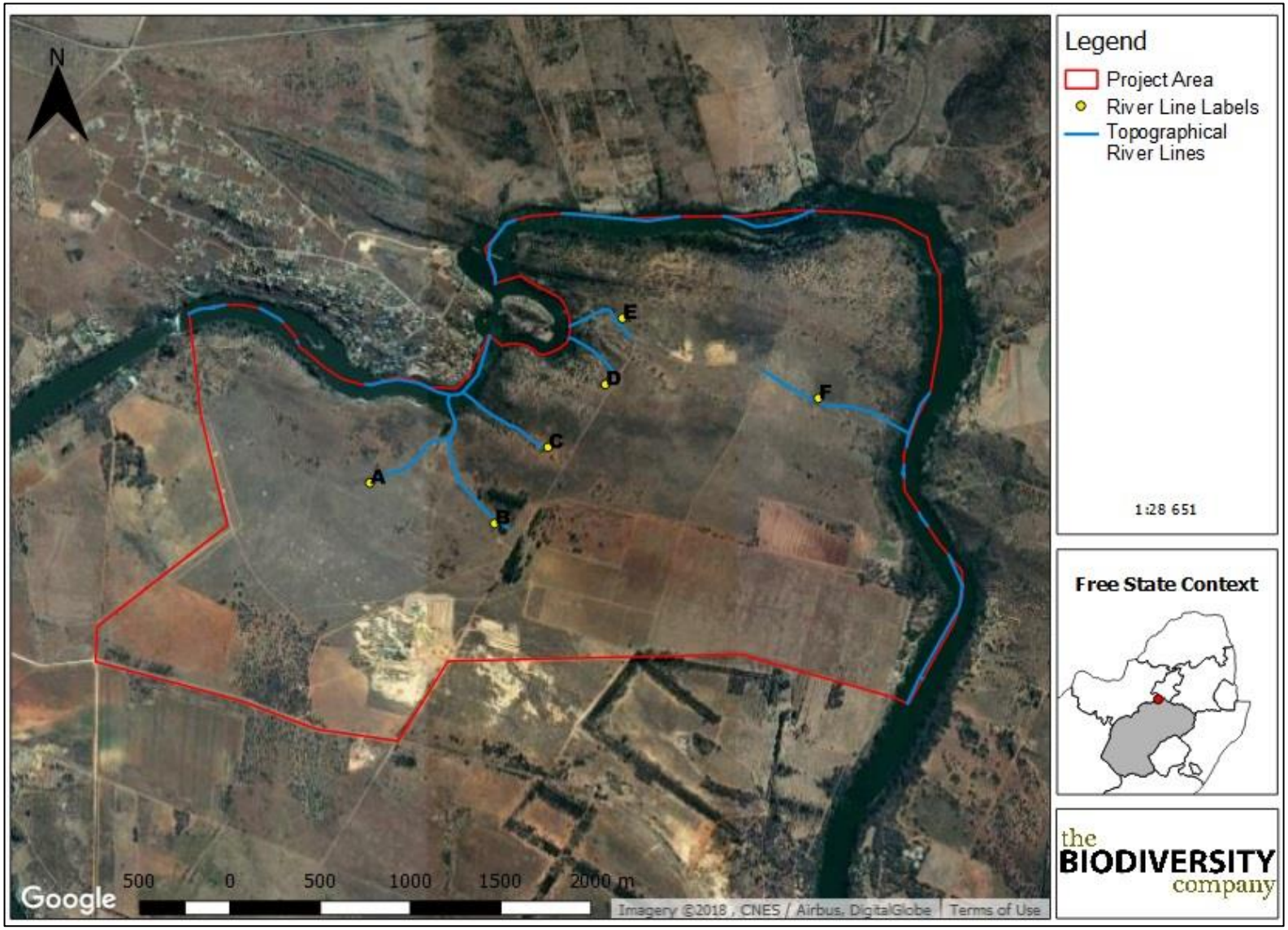


Figure 4: Topographical River Lines

7.2 Survey Results

7.2.1 Wetland Delineation

The extent of the delineated wetland areas is presented in Figure 6. Two unchannelled valley bottom wetlands (HGM 1 and HGM 2) and three hillslope seeps (HGM 3, HGM 4 and HGM 5) have been identified during the site assessment (see Figure 5).

HGM 1 is directly fed by a hillslope seep (HGM 3) and is modified by a dam directly within the delineated wetland. This dam wall allows the accumulated water to seep out which feeds directly into the Vaal River. This wetland, even though modified by the dam located within the middle of the HGM unit, provides a sustainable source of water to various species ranging from birds to large mammals (given the land use in the area).

HGM 2 has been formed by historic mining activities which has altered the topography of wetland's direct surroundings to such an extent that hydromorphic properties have formed within the delineated wetland.

HGM 3 flows directly into HGM 1, which in turn feeds the Vaal River with diffuse flows. This system has been identified as a hillslope seep connected to another watercourse which ensures indirect benefits in the form of water quality enhancement.

HGM 4 is located 10 m north of HGM 2 and has been identified as an isolated hillslope seep. This system is characterised by a stand of *Imperata cylindrica* and is approximately 3 m^2 in size. Very few signs of modification have been identified for this wetland.

HGM 5 has been identified as a hillslope seep connected to a watercourse. This system diffusely flows into the Vaal River which emphasises the importance of the indirect water quality benefits provided by HGM 5.

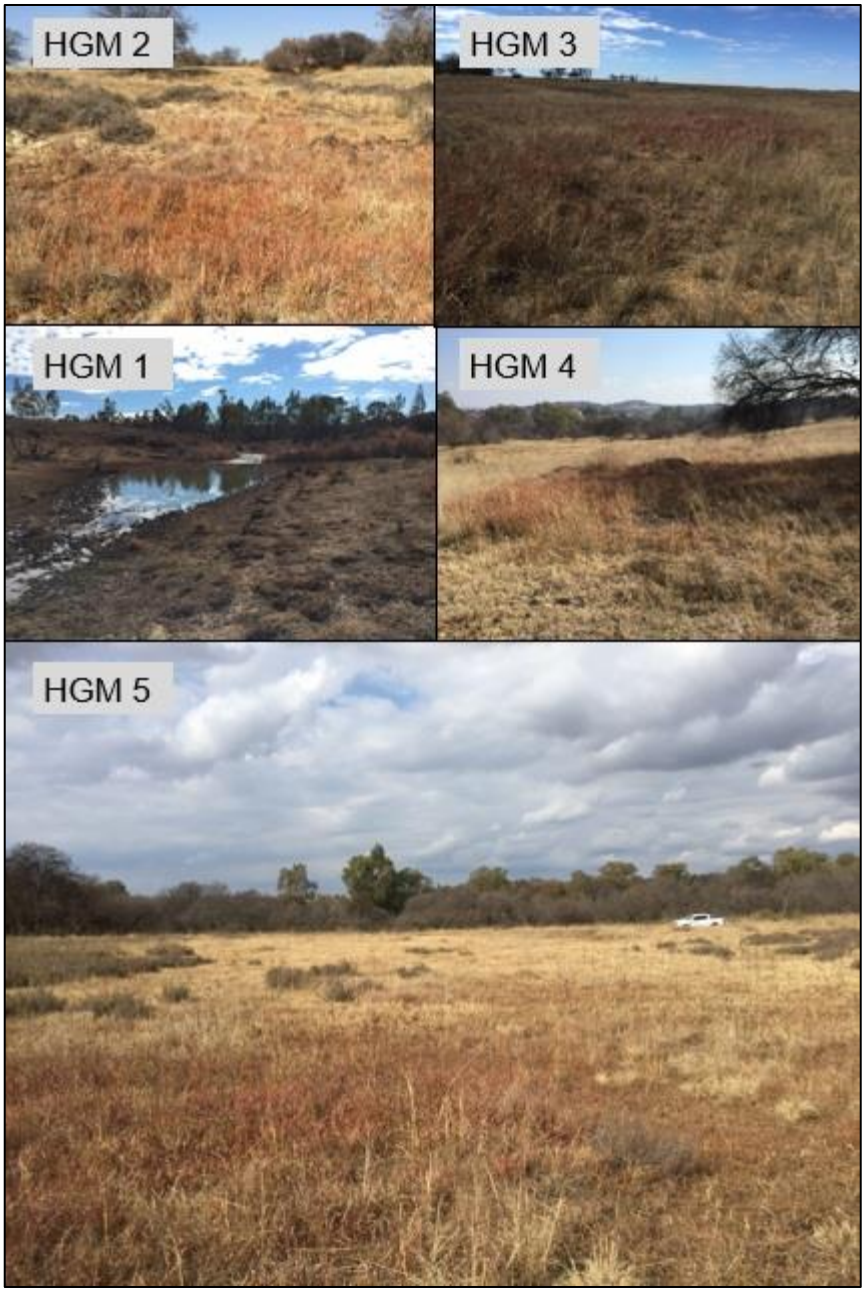


Figure 5: Wetlands identified within the project area

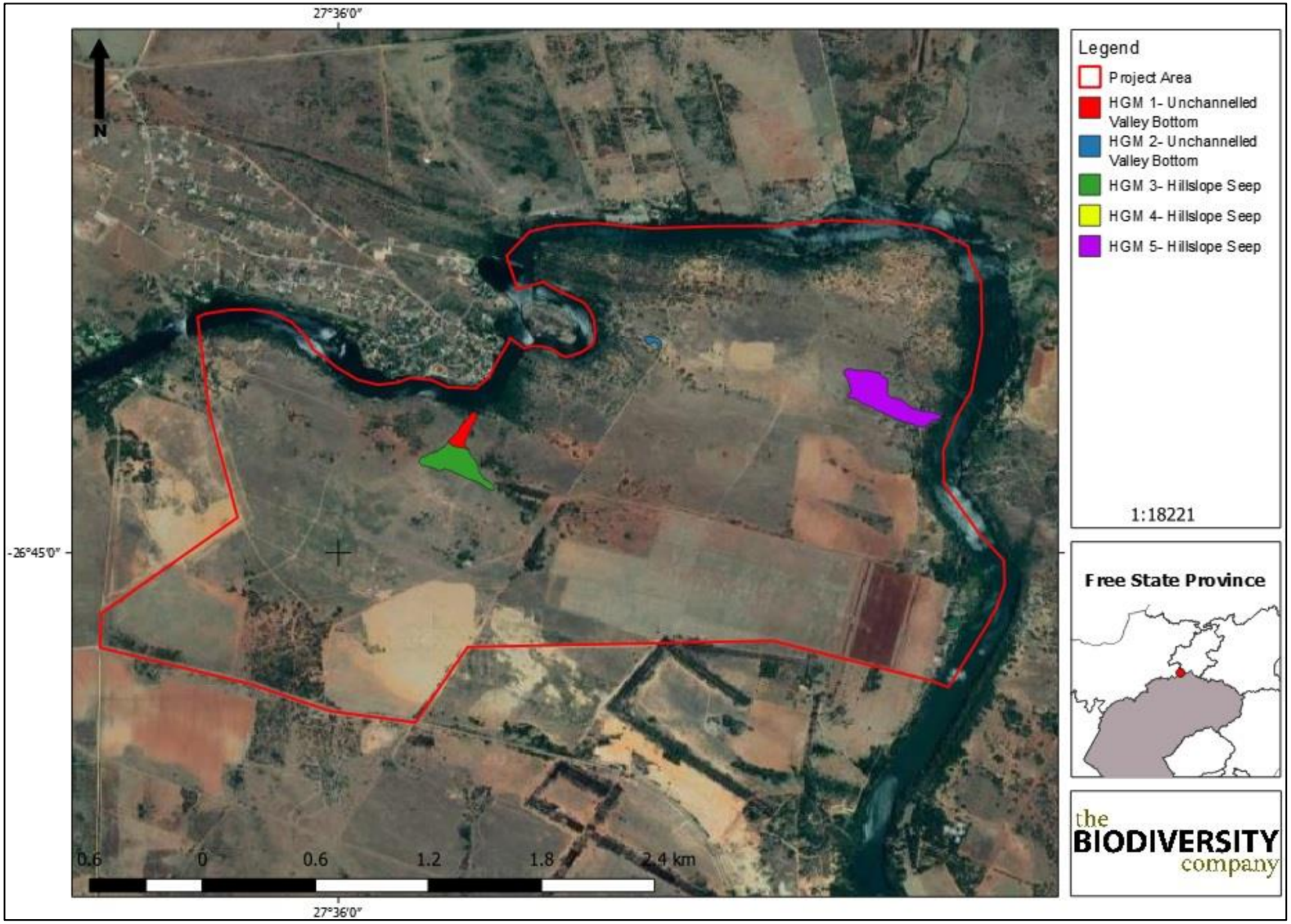


Figure 6: Delineated HGM units within project area

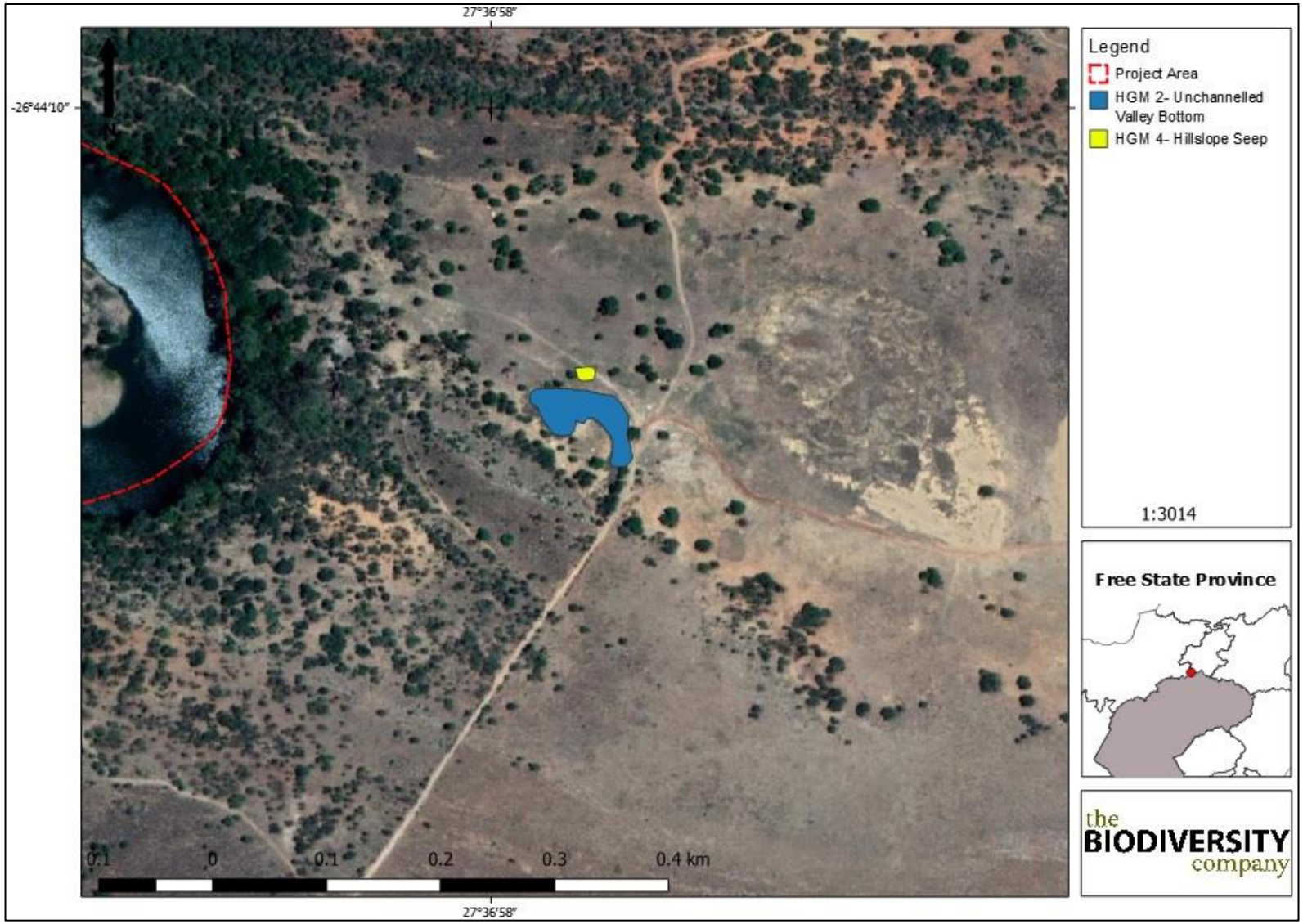


Figure 7: Locality of HGM 4

7.2.2 Wetland Unit Identification

The wetland classification as per SANBI guidelines (Ollis *et al.,* 2013) is presented in Table 5. Two wetland types were identified within the project assessment boundary, namely unchannelled valley bottom wetlands (HGM 1 and HGM 2) and seeps (HGM 3, 4 and 5).

Table 5: Wetland classification as per SANBI guideline (Ollis et al. 2013)

Wetland System	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	Highveld	Mesic Highveld Grassland Group 3	Valley Floor	Unchannelled Valley Bottom	N/A	N/A
HGM 2	Inland	Highveld	Mesic Highveld Grassland Group 3	Valley Floor	Unchannelled Valley Bottom	N/A	N/A
HGM 3	Inland	Highveld	Mesic Highveld Grassland Group 3	Hillslope	Hillslope Seep	Without Channelled Outflow	N/A
HGM 4	Inland	Highveld	Mesic Highveld Grassland Group 3	Hillslope	Hillslope Seep	Without Channelled Outflow	N/A
HGM 5	Inland	Highveld	Mesic Highveld Grassland Group 3	Hillslope	Hillslope Seep	Without Channelled Outflow	N/A

7.2.3 Wetland Unit Setting

HGM 1 and HGM 2, as mentioned in Table 5, is located on the “valley floor” landscape unit. Unchanneled valley bottom wetlands are typically found on valley floors where the landscape does not allow high energy flows. Figure 8 presents a diagram of HGM 1 and HGM 2, showing the dominant movement of water into, through and out of the system.

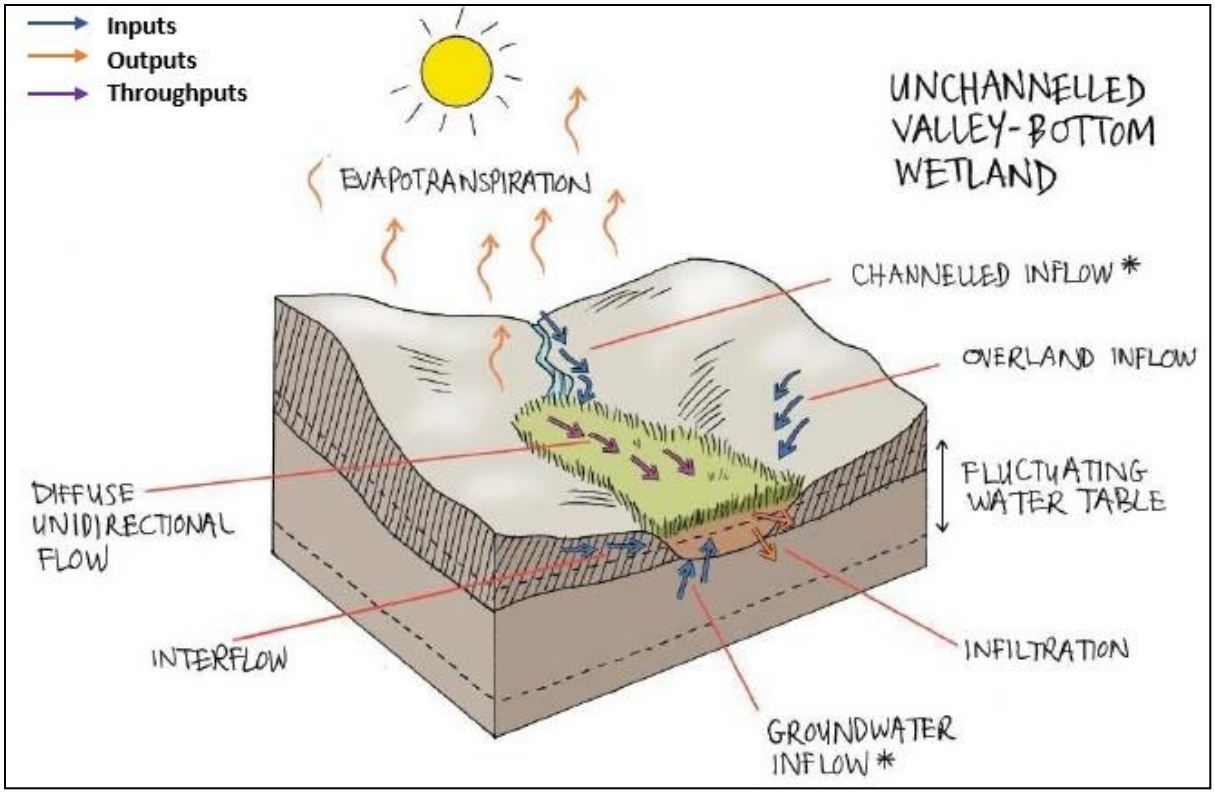


Figure 8: Amalgamated diagram of the HGM type, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

HGM 3, 4 and 5 is located within hillslopes, as mentioned in Table 5. Hillslope seeps are characterised by colluvial movement of material. These systems are fed by very diffuse sub-surface flows which seep out at very slow rates, ultimately ensuring that no direct surface water connects this wetland with other water courses within the valleys. Figure 9 presents a diagram of HGM 3, 4 and 5, showing the dominant movement of water into, through and out of the system.

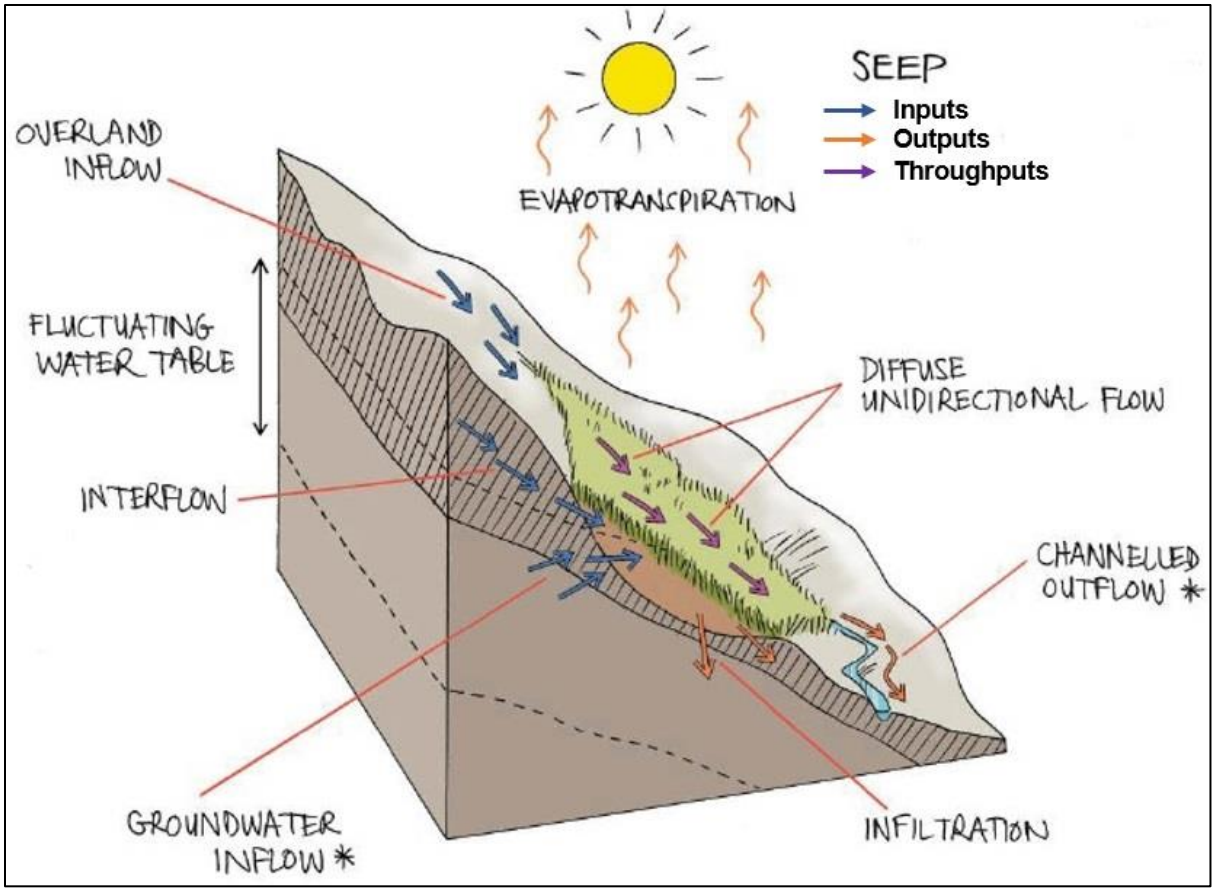


Figure 9: Amalgamated diagram of the HGM type, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

7.2.4 Wetland Indicators

7.2.4.1 Hydromorphic Soils

According to (DWAF, 2005), soils are the most important characteristic of wetlands in order to accurately identify and delineate wetland areas. One main wetland soil form was identified (present within all the delineated wetlands) during the survey and has been classified as a Fernwood soil form.

This soil form consists of an Orthic A-horizon on top of an E-horizon, which in turn is underlain by an unspecified material. The E-horizon indicates the leaching of soil as a result of the lateral movement of sub-surface flows, which in turn is the driving force of the formation of the wetland conditions found within the delineated wetland areas. Mottles have been identified within this horizon which provides further evidence of wetland conditions. Mottles form due to fluctuating levels of saturation, which activates oxidation and reduction forces, ultimately leaving behind bright orange coloured nodules within the soil. This feature, according to (DWAF, 2005) is one of the main features present within hydromorphic soils, see Figure 10 and Figure 11.

The Fernwood soil form consists of an Orthic A-horizon on top of an E-horizon, which in turn is underlain by an unspecified material. The soil family group identified for the Fernwood soil

form on-site has been classified as the Penicuik (1110) soil family due to the light colour of the top soil and the grey colour of the E-horizon.

Orthic-A horizons are called “normal” soils given the fact that this soil horizon does not have any diagnostic properties pertaining to other diagnostic soil horizons. The Orthic A-horizon does not have specific characteristics regarding colour, texture, base status etc. due to this diagnostic soil horizon’s wide range throughout South African Landscapes.

The E-horizon is characterised by a leached colour and lacks the colour from the top soil and/or the soil horizon underneath the E-horizon. The E-horizon’s iron oxides and organic material has been leached out by lateral sub-surface flows, hence the grey colou. Rusty marks (mottles) are common in E-horizons and indicate a temporary to seasonally saturated soil.

An unspecified material refers to a material that has diagnostic characteristics similar to an E-horizon, a G-horizon, a Litocutanic horizon etc., but is not expected to occur in a certain position within a given soil profile.

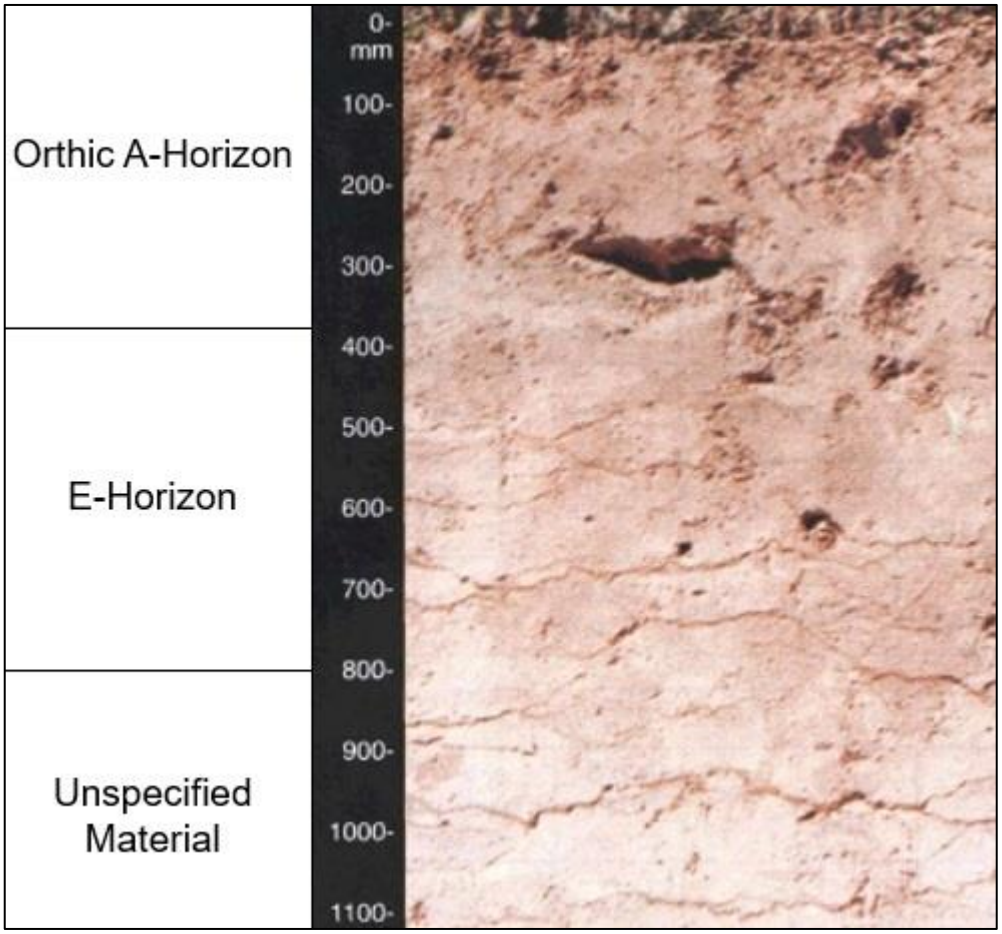


Figure 10: Example of a Fernwood soil form, (SASA, 1999).

Figure 11: Hydromorphic soils within delineated wetlands (July 2018)

7.2.4.2 Hydrophytes

Vegetation plays a considerable role in identifying, classifying and accurately delineating wetlands, (DWAF, 2005). Hydrophytes identified within the project area include *Imperata cylindrica* (which was abundant within the seeps) and *Typha capensis* (which cover parts of the dam within the unchannelled valley-bottom to the west), see Figure 12.

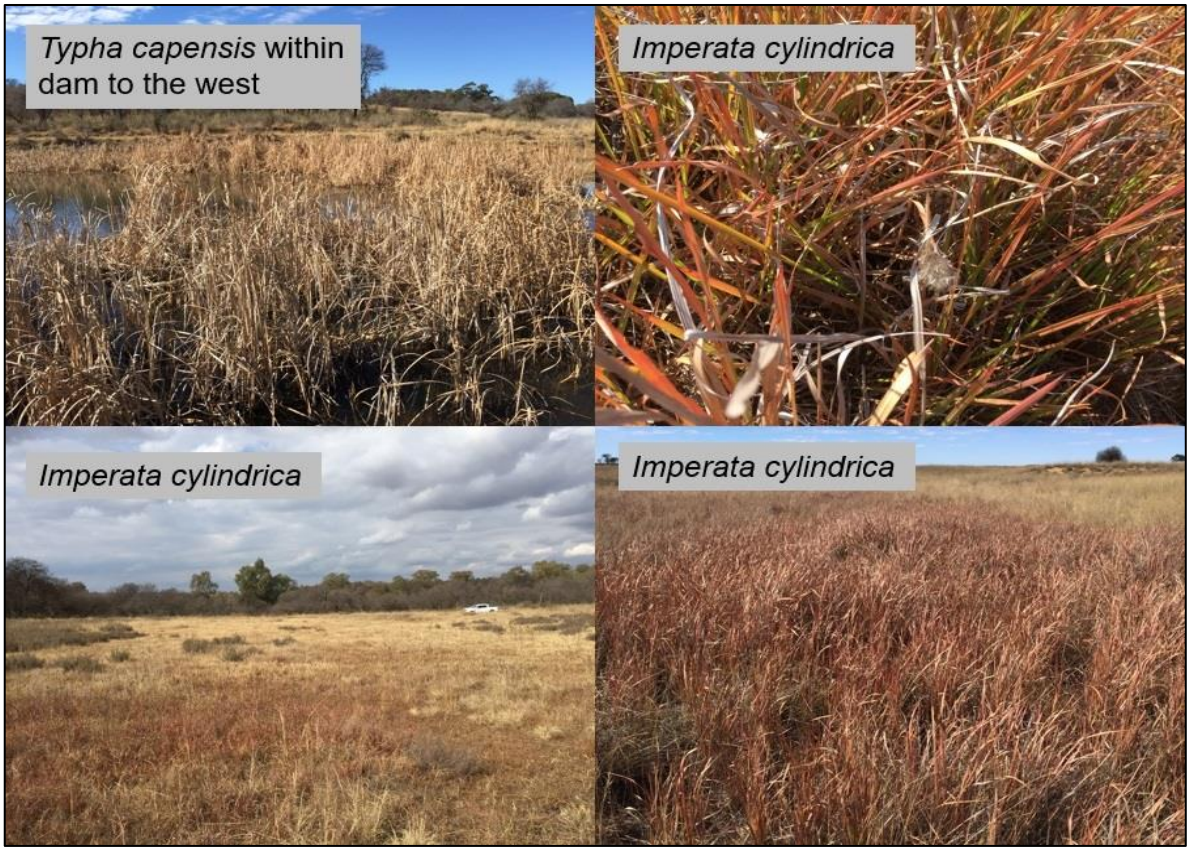


Figure 12: Hydrophytes identified within delineated wetlands (July 2018)

7.2.5 General Functional Description of Wetland Types

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

Hillslope seeps are well documented by (Kotze *et al.,* 2009) to be associated with sub-surface ground water flows. These systems tend to contribute to flood attenuation given their diffuse nature. This attenuation only occurs while the soil within the wetland is not yet fully saturated. The accumulation of organic material and sediment contributes to prolonged levels of saturation due to this deposition slowing down the sub-surface movement of water. Water typically accumulates in the upper slope (above the seep). The accumulation of organic matter additionally is essential in the denitrification process involved with nitrate assimilation. Seeps generally also improve the quality of water by removing excess nutrient and inorganic pollutants originating from agriculture, industrial or mine activities. The diffuse nature of flows ensures the assimilation of nitrates, toxicants and phosphates with erosion control being one of the Eco Services provided very little by the wetland given the nature of a typical seep's position on slopes.

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

7.2.6 Wetland Ecological Functional Assessment

The ecosystem services provided by the wetlands identified on site was assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). The summarised results for HGM 1 to HGM 5 are shown in Table 6. The average ecosystem services score has been determined to be "Intermediate" for HGM 1, 3, 4 and 5 with HGM 2 being rated "Moderately Low".

Table 6: The ecosystem services being provided by the HGM types

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		1.7	1.4	1.5	1.4	1.5
			Streamflow regulation		2.7	2.2	2.8	2.4	2.6
			Water Quality enhancement benefits	Sediment trapping	2.2	2.0	1.7	1.3	1.6
				Phosphate assimilation	2.3	2.0	2.2	2.1	2.2
				Nitrate assimilation	2.6	2.1	2.5	2.4	2.5
				Toxicant assimilation	2.2	1.9	2.2	2.1	2.3
				Erosion control	2.2	1.6	2.0	1.9	2.1
			Carbon storage		1.7	1.2	1.3	1.3	1.3
	Direct Benefits	**Biodiversity maintenance**			1.5	1.1	1.3	1.3	1.3
		Provisioning benefits	Provisioning of water for human use		1.1	0.0	0.6	0.6	0.6
			Provisioning of harvestable resources		0.0	0.0	0.0	0.0	0.0
			Provisioning of cultivated foods		0.0	0.0	0.0	0.0	0.0
		Cultural benefits	Cultural heritage		0.0	0.0	0.0	0.0	0.0
			Tourism and recreation		2.4	1.5	0.5	0.5	0.5
			Education and research		1.3	1.1	2.3	1.9	2.2
Average Eco Services Score					1.6	1.2	1.4	1.3	1.4

Table 7 illustrates the ecosystem services rated "High" or "Very High" for the delineated wetlands with summarised descriptions of these ecosystem services. For HGM 1, seven ecosystem services have been rated "High", namely that of streamflow regulation, sediment trapping, erosion control, tourism and recreation and the assimilation of phosphates, toxicants and nitrates. As for HGM 2, two ecosystem services have been rated "High", namely streamflow regulation and nitrate assimilation. For HGM 3, five ecosystem services have been scored "High", namely streamflow regulation, education and research as well as the assimilation of phosphates, toxicants and nitrates. Four ecosystem services have been scored "High" for HGM 4, namely streamflow regulation and the assimilation of phosphates, toxicants and nitrates. HGM 5 has been rated "High" for six ecosystem services, namely streamflow

regulation, erosion control, education and research as well as the assimilation of phosphates, toxicants and nitrates.

Table 7: Ecosystem services scored "High" or "Very High" for the delineated wetland

EcoService	HGM 1	HGM 2	HGM 3	HGM 4	HGM 5	Justification of High Score
Streamflow Regulation	✓	✓	✓	✓	✓	The linkage the delineated wetlands to important water systems downstream (the Vaal River) and the reduction in evapotranspiration due to the occurance of frost in the area.
Sediment Trapping	✓					The high score determined for "Sediment Trapping" for HGM 1 is described to the location of the dam which allows for the trapping of sediment.
Phosphate Assimilation	✓		✓	✓	✓	The high score presented for the assimilationof phosphates, nitrates and toxicants is described to the opportunity to decrease the concentration of contaminants entering important watercourses down-stream. Additionally, the extent of vegetation cover within the delineated wetlands contribute to the high scores rated for the assimilating of various contaminants.
Nitrate Assimilation	✓	✓	✓	✓	✓	
Toxicant Assimilation	✓		✓	✓	✓	
Erosion Control	✓				✓	The slope of the wetland is the main component contributing to this high score for the relevant wetlands. Additionally, the high surface cover and the lack of erosion within the wetlands contributes to the high ecosystem service score for "Erosion Control".
Tourism and Recreation	✓					The high score rated for "Tourism and Recreation" as well as "Education and Research" is attributed to the ease of access to this area, the level of significance species (see Section 7.2.8- "The EIS Assessment of the Remaining Wetland Areas"), excellent birding opportunities and the site reference suitability of the relevant wetlands.
Education and Research			✓		✓	

7.2.7 The Ecological Health Assessment

The PES for the assessed HGM types is presented in Table 8. The hydrology component for HGM 2 has been scored "Moderately Modified" with HGM 4 being scored "Largely Modified". HGM 1, 3 and 5 has been determined to have "Seriously Modified" hydrology scores. The geomorphological score of HGM 3 has been scored "Natural/Unmodified" with HGM 4 and HGM 5 being rated "Largely Natural". HGM 1 and HGM 2 have been determined to have "Largely Modified" geomorphology scores. The vegetation component for HGM 4 has been rated "Moderately Modified" with the remainder of the HGM units being scored "Largely Modified".

The overall PES scores for all of the HGM units have been determined to be "Largely Modified" except for that of HGM 4, which has been scored "Moderately Modified".

Table 8: Summary of the scores for the wetland PES

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 1	E: Seriously Modified	7.0	D: Largely Modified	4.0	D: Largely Modified	5.5
Overall PES Score	5.7		Overall PES Class		D: Largely Modified	
HGM 2	C: Moderately Modified	3.4	D: Largely Modified	4.2	D: Largely Modified	5.8
Overall PES Score	4.3		Overall PES Class		D: Largely Modified	
HGM 3	E: Seriously Modified	7.0	A: Natural/Unmodified	0.5	D: Largely Modified	5.5
Overall PES Score	4.7		Overall PES Class		D: Largely Modified	
HGM 4	D: Largely Modified	4.3	B: Largely Natural	1.1	C: Moderately Modified	3.2
Overall PES Score	3.1		Overall PES Class		C: Moderately Modified	
HGM 5	E: Seriously Modified	7.8	B: Largely Natural	1.2	D: Largely Modified	5.9
Overall PES Score	5.4		Overall PES Class		D: Largely Modified	

For HGM 1, the hydrology has been altered by the presence of a specific invasive plant species (*Seriphium plumosum*) which has resulted in a reduction of sub-surface water reserves and a decrease of indigenous plant species (surface roughness). Additionally, the major component contributing to the high hydrology modification score is described to the presence of the dam within the wetland. The dam wall has resulted in flooding/inundation of the area upstream of the dam and has affected the horizontal movement of water through the modified area (see Figure 13 to Figure 14).

For HGM 2, hardened surfaces, areas characterised by bare soil and some invasive plant species (see Figure 13 to Figure 14). HGM 3 and HGM 5 has been affected severely by the presence of *Seriphium plumosum* which covers the majority of the wetlands. HGM 4, given the size of the wetland and the lack of invasive plant species have been modified less than HGM 3 and 5.

The geomorphology component for HGM 1 has been altered by the presence of dams within the wetland's catchment. As for HGM 2, some disturbances have been recorded 10 to 20 m south-west of the delineated wetland in the form of historic mining activities. These activities have resulted in erosional gullies forming around HGM 2. HGM 3, 4 and 5 has been modified very little in regard to a geomorphological point of view and has therefore been rated "Natural" or "Largely Natural".

The vegetation component has been modified by the presence of dirt roads (vegetation removal), invasive species encroachment and graining. The extent of these aspects differs throughout the project area, hence the difference in vegetation modification score for the five HGM units.

Figure 13: Identified impacts

Figure 14: Impacts towards HGM 2. Blue: Historic mining activities. Red: Erosional gully formed by historic mining activities. Green: Section of HGM 2

7.2.8 The EIS Assessment of the Remaining Wetland Areas

The wetland 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 9.

A “high” EIS has been scored for HGM 1, with the rest of the HGM units being scored “Moderate”. The high EIS score for HGM 1 is described to the presence of unique species identified within close proximity to the wetland (see Figure 15 to Figure 18) and the suitable habitat of the wetland. This wetland is characterised by approximately 5 m^2 of open water, which offers a sustainable source of drinking water for animals within the wetland’s vicinity.

Figure 15: Some of the avifauna recorded in the project area (July 2018): A) African Red-eyed Bulbul (Pycnonotus nigricans), B) Pied Starling (Spreo bicolor), C) Southern Pochard (Netta erythrophthalma), D) Spur-winged Goose (Plectropterus gambensis), E) Hamerkop (Scopus umbretta) and F) Red-chested Cuckoo (Cuculus solitarius)

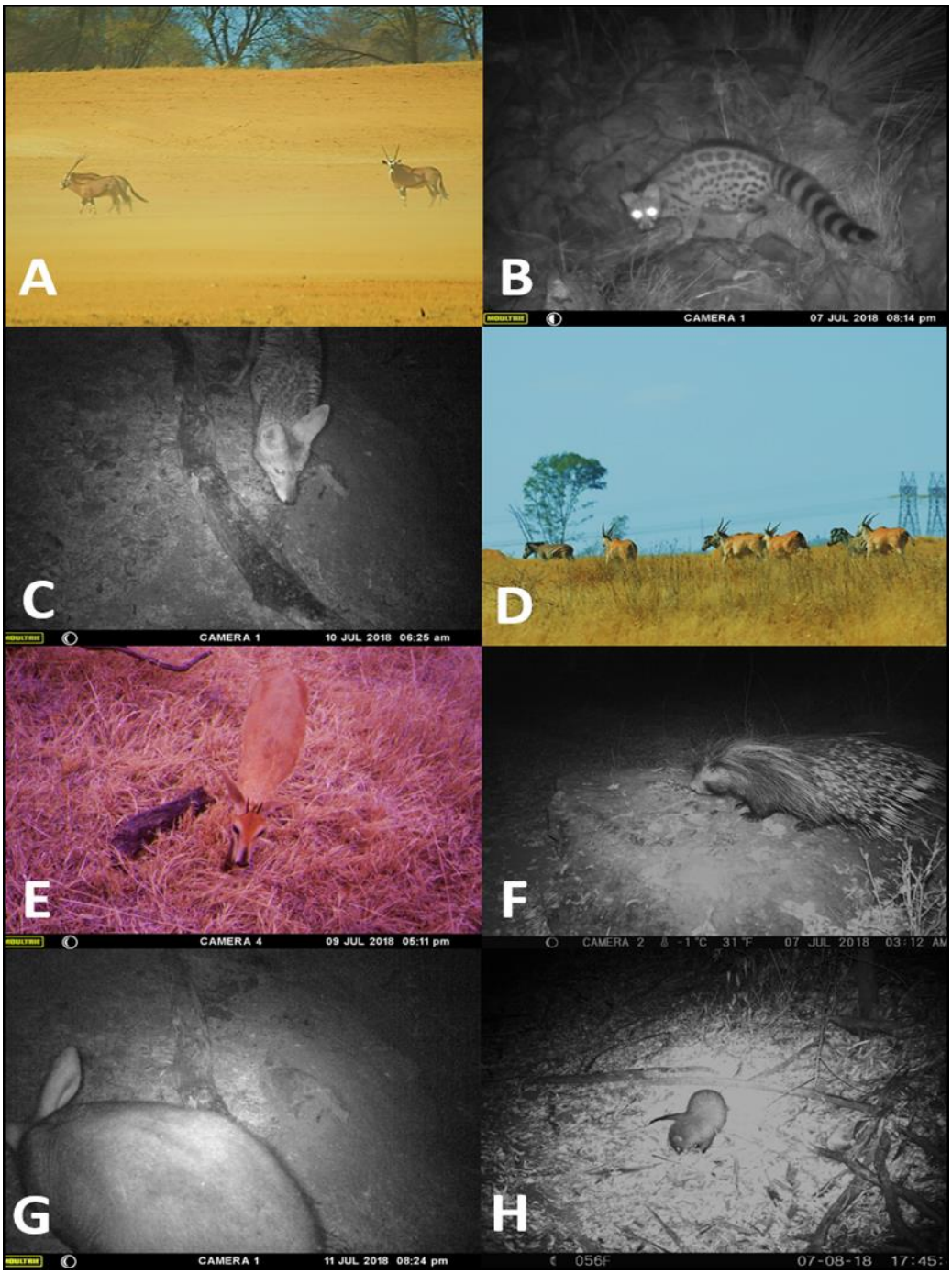


Figure 16: Some of the mammal species recorded in the project area (July 2018): A) Gemsbok (Oryx gazella); B) Small-spotted Genet (Genetta genetta); C) Black-backed Jackal (Canis mesomelas); D) Eland (Tragelaphus oryx); E) Common Duiker (Sylvicapra grimmia); F) Cape Porcupine (Hystrix africaeaustralis); G) Aardvark (Orycteropus afer); and H) Water Mongoose (Atilax paludinosus)

Figure 17: Some of the reptile recorded within the project area (July 2018): A) Red-lipped Snake (Crotaphopeltis hotamboeia); B) Delalande's Beaked Blind Snake (Rhinotyphlops lalandei); and C) Black Headed Centipede Eater (Aparallactus capensis)

Figure 18: The amphibian species recorded in the project area (July 2018): A) Guttural Toad (Sclerophrys gutturalis) and B) Flat-backed Toad (Sclerophrys pusilla)

The Hydrological/Functional Importance has been rated "High" for HGM 1 and HGM 5, with the remainder of the HGM units being scored "Moderate". The high scores are related to the indirect benefits described in section "7.2.6". The following ecosystem services all contribute to the high hydrological/functional importance determined for the delineated wetland;

- Streamflow regulation;
- Sediment trapping;
- Erosion control;
- Tourism and recreation;
- Education and research; and
- The assimilation of toxicants, nitrates and phosphates.

The Direct Human Benefits have been scored "Low" for all of the identified HGM units given the lack of cultural benefits and the fact that no crop fields are reliant on irrigation from these wetlands.

Table 9: The EIS results for the delineated HGM units

Category	HGM 1	HGM 2	HGM 3	HGM 4	HGM 5
Ecological importance and sensitivity	2.7	1.6	1.4	1.2	1.4
Hydrological/functional importance	2.2	1.7	2.0	1.8	2.1
Direct human benefits	0.8	0.4	0.6	0.5	0.6

7.3 Buffer Requirements

The "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane *et al.,* 2014) was used to determine the appropriate buffer zone for the proposed activity. The buffer tool recommends at a desktop level that the required buffer for mining be 180 m (worst case scenario).

Various aspects relevant to the wetlands identified have however been taken into account when calculating the buffer size required to ensure that all wetlands be conserved during the relevant phases of the proposed activity. After taking into considerations the specifics of the proposed mining activities and the resources proposed to be mined as well as the state of the delineated wetlands, a buffer size of 79 m has been calculated for the delineated wetland areas.

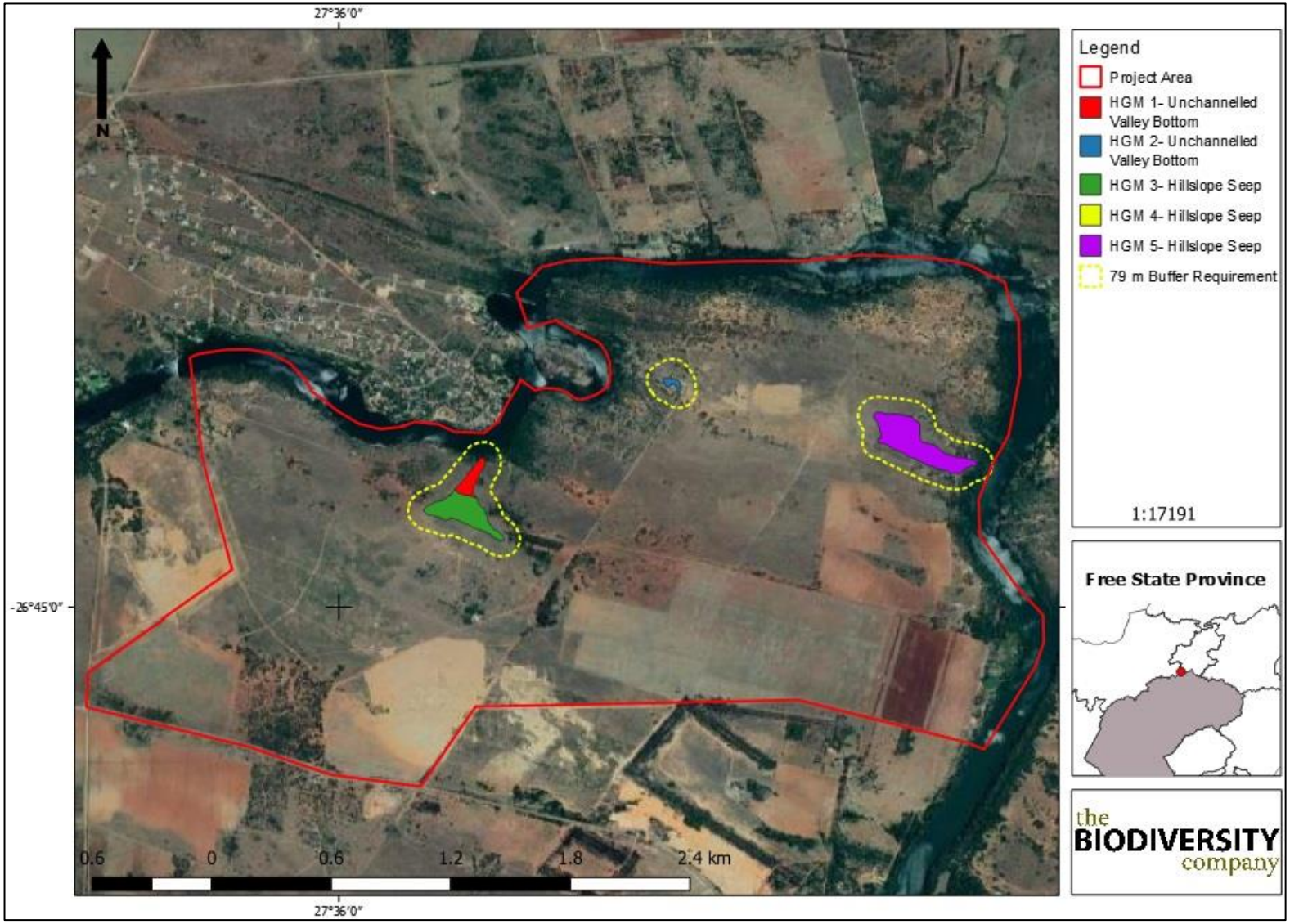


Figure 19: Extent of the recommended buffer requirement

8 Sensitivity Mapping

As per the terms of reference for the project, a GIS sensitivity map is required in order to identify sensitive features in terms of the specialist discipline/s. The sensitivity scores identified during the field survey for the delineated wetlands is illustrated in Figure 20. All five HGM units have been deemed to have “High” sensitivty ratings.

The reason for the high sensitivity ratings can be described to the variety of functions these wetlands provide to the environment and indirectly to humans (i.e. water quality, flood control etc.) The importance of these functions is emphasised given the fact that important watercourse/s are located downstream of the wetlands (the Vaal River).

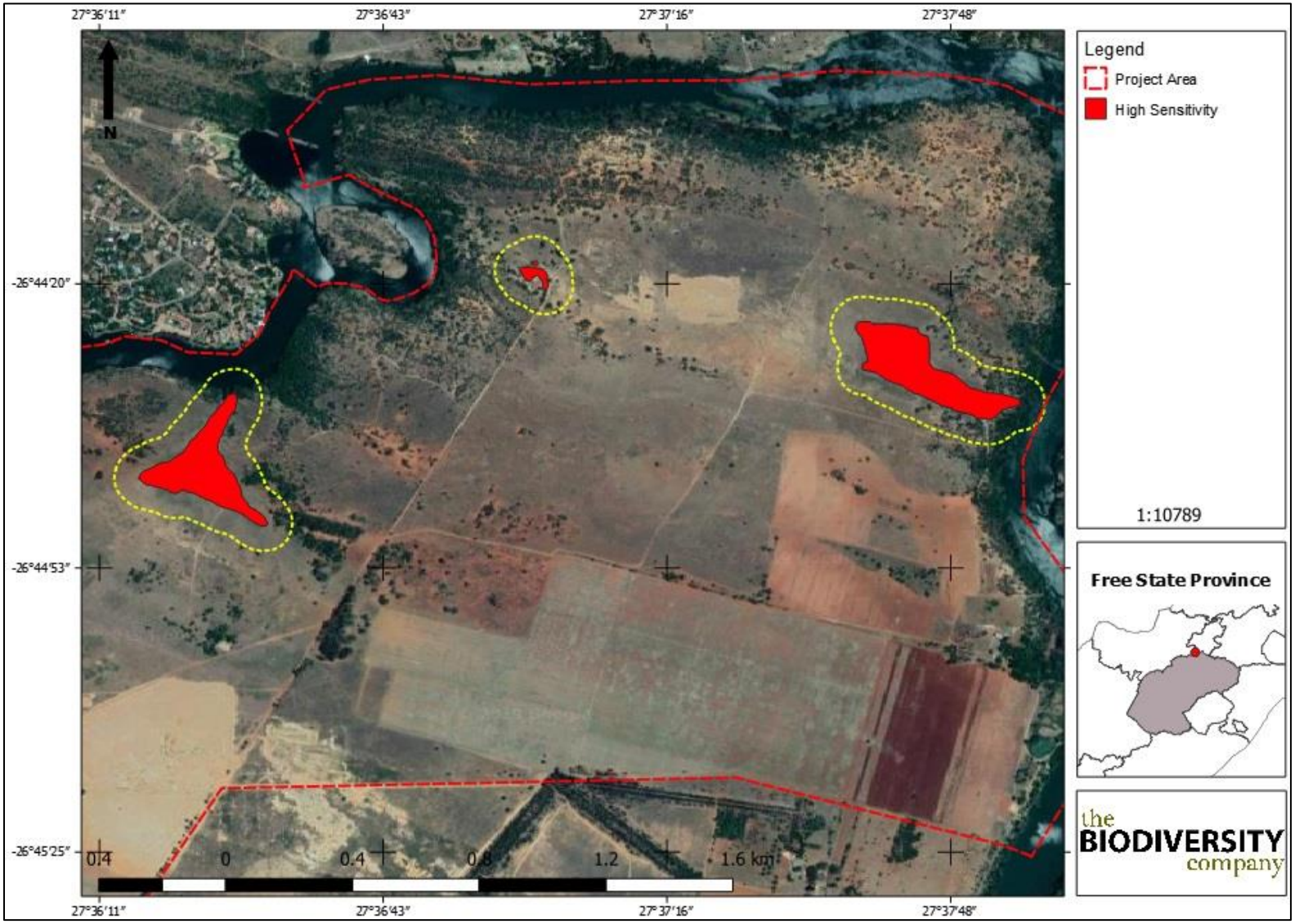


Figure 20: Habitat sensitivity map of the area

9 Impact Assessment

Mining and related activities have significant impacts on wetland resources, often causing irreversible and large-scale degradation across large areas or areas important for the provision of land capability, depending on the logistics behind the mining operations. These disturbances have numerous direct, indirect, short- and long-term potentially adverse effects on the landscape. The mining methodology for this particular project has been deemed to be "roll-over mining", which allows for continues backfilling and rehabilitation.

The proposed development is associated with open cast mining and associated infrastructure which could result in the direct or indirect loss of land capability or and potential of the project area. The cumulative impacts have been increased due to the presence of a sand mine directly east of the project area, named *Barage Bulk Sand Mine* (Greenmined Environmental, 2018).

The resources intended to be mined includes diamonds, sand and aggregates. The proposed mining activities include associated infrastructure for which three different alternatives exist. The proposed infrastructure includes a 2MVA Power Supply, a cut off trench, a drying plant, a fuel bunker, offices, a Pollution Control Dam (PCD), a raw product stockpile, roads, a security check point, two settling ponds, a TMM parking, a wash plant, a water supply line, a weig bridge with an office and a workshop.

9.1 Consideration of the Proposed Site Alternative

A rated criteria options assessment was completed for the proposed project. The method utilises selected criteria and rates them according to suitability on a 1-5 scale with 1 being unsuitable and 5 being suitable. The various selected criteria as well as the results of their specific ratings are presented in the table below (Table 10).

Aspects taken into consideration include the extent of wetlands and their associated buffer zones impacted upon by the proposed activity (see Figure 26), the overall health of the wetlands deemed to be impacted upon by the alternatives as well as the EIS and ecosystem services of these wetlands.

The score for the proposed alternative 1 has been determined to be 20/20 which indicates very little to no risks associated with the proposed layout due to its locality being in excess of 500 m of HGM 1 and HGM 3. The only aspect of this layout within 500 m from these wetlands is the water supply pipeline.

As for "Site Alternative 2", only small sections of the proposed layout are located within 500 m from the wetland, including the proposed water supply pipeline and access roads. This site alternative has been scored 16/20, which indicates the possibility of low risks posed by the construction and operation of this layout.

Lastly, "Site Alternative 3" is located directly within the wetland and has been scored 10/20 which indicates a direct loss of wetlands. The wetlands that will be impacted upon has a low EIS score, a low average ecosystem service score and a "Largely Modified" overall PES score, which has increased this score to 10/20.

Given these statements, it is the specialist's opinion that "Site Alternative 1" be preferred given the lack of impacts expected for this layout. Therefore, only "Site Alternative 1" and the open cast mining operations will be taken into consideration during the impact assessment.

Table 10: Option Assessment

Criteria/Option	Site Alternative 1	Site Alternative 2	Site Alternative 3
Presence and Extent of Wetlands	5	4	1
PES of Associated Wetlands	5	4	3
Ecosystem Services of Associated Wetlands	5	4	3
EIS of Associated Wetlands	5	4	3
Total Suitability	20	16	10

The extent of the deposits proposed to be open cast mined is illustrated in Figure 22, which clearly indicates the absence of the proposed sand deposit directly within HGM 5 and the proposed aggregate deposit located directly within HGM 1 and HGM 3.

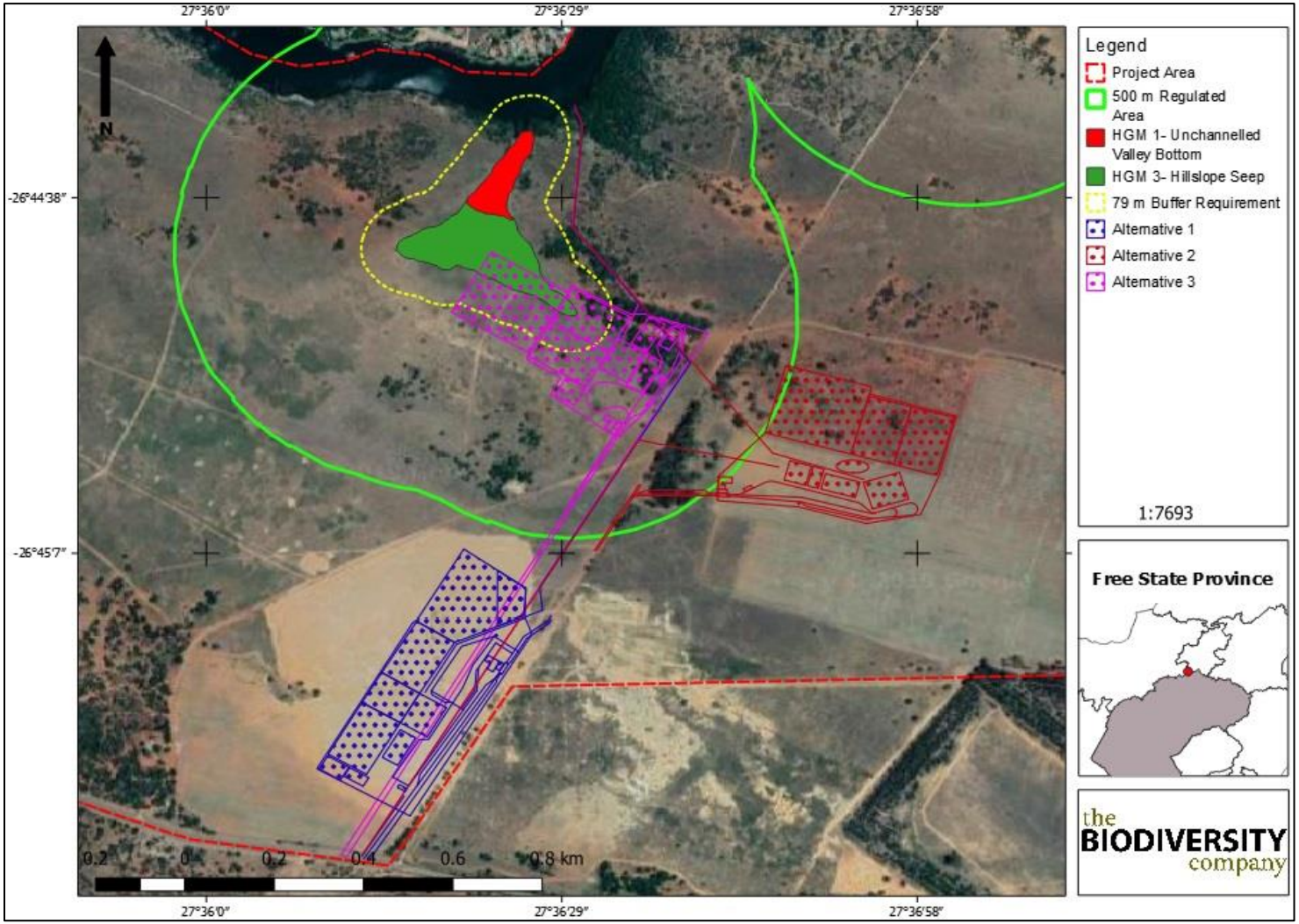


Figure 21: Locality of wetlands in comparison to the proposed alternative infrastructure layouts

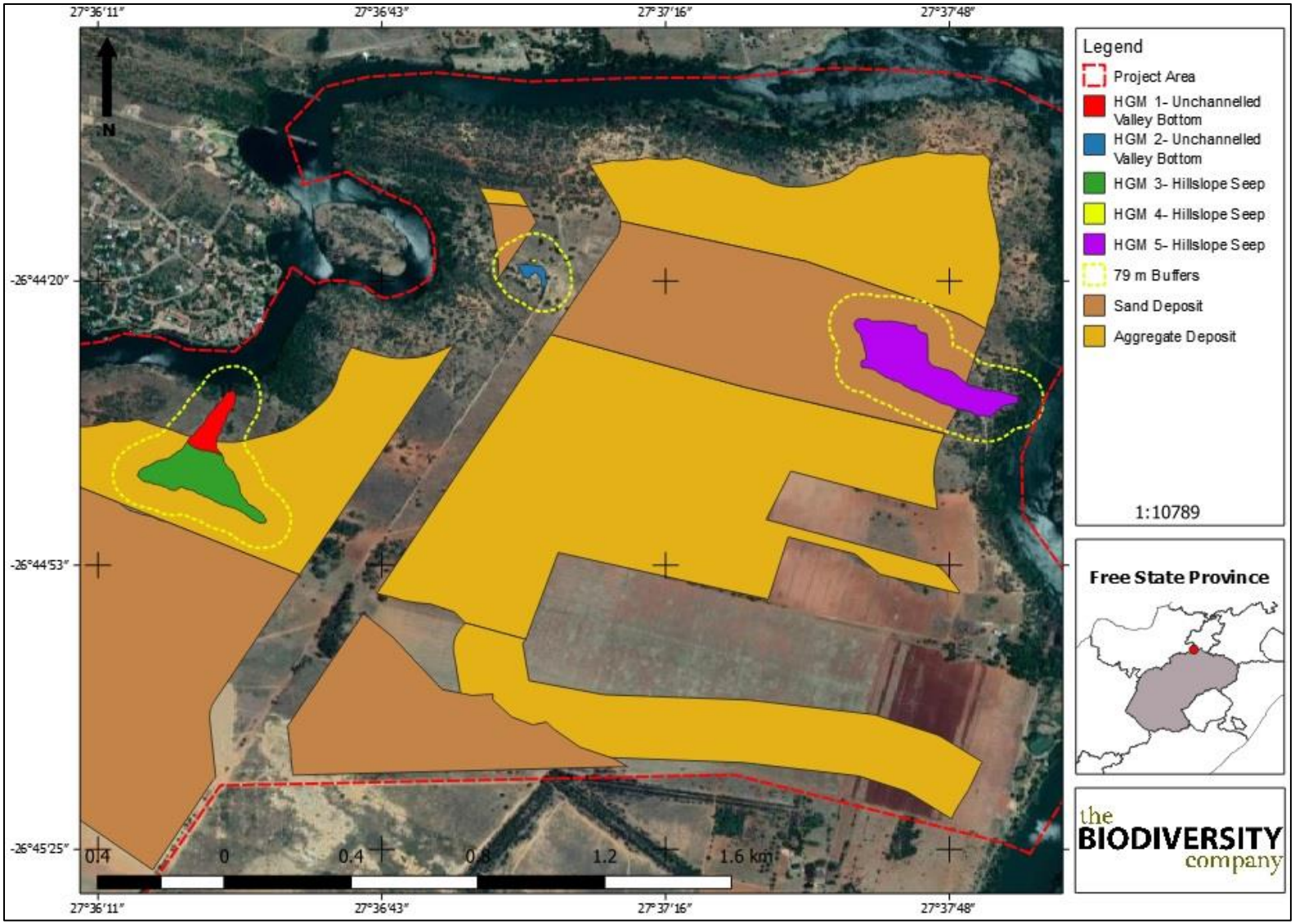


Figure 22: Extent of the proposed open cast areas

9.2 Current Impacts

During the field survey the current impacts that have a negative impact on the area were identified. These impacts are described in detail in Section 7.2.7- "The Ecological Health Assessment".

9.3 Expected Impacts

The following sections include the expected impacts relevant to each of the relevant phases (planning, construction, operational, decommissioning as well as rehabilitation and closure) and the proposed activities (open cast mining and associated infrastructure).

9.3.1 Planning Phase

- Planning for the proposed open cast mining operations; and
- Planning for the proposed infrastructure areas;

9.3.2 Construction Phase

The following potential impacts were considered in regard to the delineated wetlands:

- The construction of the open cast pits;
- Stockpiling during the construction phase;
- The construction of access roads;
- The construction of the water supply pipeline; and
- Construction related traffic.

9.3.3 Operational Phase

- The operation of the open cast pits;
- Stockpiling during the operational phase;
- The operation of access roads; and
- The operation of the water supply pipeline;

9.3.4 Decommissioning

- Backfilling of the open cast pits;
- The decommissioning of access roads;
- The decommissioning of the water supply pipeline; and
- Decommissioning related traffic.

9.3.5 Rehabilitation and Closure

- Rehabilitation of all degraded areas (regardless of the distance of the disturbed area to delineated wetlands); and

- Annual monitoring.

9.4 Assessment of Significance

A summary of the final significance ratings and the priority factor relevant to the open cast mining activities and the associated infrastructure (Alternative 1) is illustrated in Figure 11.

During the planning phase, all of the expected impacts have been scored a final significance rating of "Low Negative". During the construction phase, two impacts have been scored "High Negative", namely "the excavation/construction of open cast pits" and "the construction of stockpiles". During the operational phase, two impacts have been scored "High Negative" final significance ratings, namely "the operation of the open cast mining areas" and "the continues construction and operation of stockpiles". During the decommissioning phase, one "High Negative" final significance rating and one "Medium Negative" final significance rating has been scored for "the backfilling of open cast pits" and "the removal of stockpiles" respectively. As for the rehabilitation and closure phase, all of the relevant impacts have been scored "Low Negative" final significance ratings.

Table 11: Priority factor and final significance of all expected impacts

Phase	Impact Name	Alternative	Priority Factor	Final Significance
Planning	Planning for Open Cast Mining	Open Cast Mining	High	Low Negative
	Planning for Infrastructure	Infrastruture (Alternative 1)	Medium	Low Negative
Construction	Excavation of Open Cast Pits	Open Cast Mining	High	High Negative
	Construction of Stockpiles	Open Cast Mining and Infrastructure (Alternative 1)	High	High Negative
	Construction of Access Roads	Open Cast Mining and Infrastructure (Alternative 1)	Medium	Low Negative
	Construction of Water Supply Pipelines	Infrastruture (Alternative 1)	Medium	Low Negative
	Traffic During Constrction	Open Cast Mining and Infrastructure (Alternative 1)	Medium	Low Negative
Operational	Operation of Open Cast Mine	Open Cast Mining	High	High Negative
	Continues Construction and Operatin of Stockiles	Open Cast Mining	High	High Negative
	Operation of Access Roads	Open Cast Mining and Infrastructure (Alternative 1)	Medium	Low Negative
	Operation of the Water Supply Pipeline	Infrastruture (Alternative 1)	Medium	Low Negative
Decommissioning	Backfilling of Open Cast Pits	Open Cast Mining	High	High Negative

	Removal of Stockpiles	Open Cast Mining	High	Medium Negative
	Decommissioning of Access Roads	Open Cast Mining and Infrastructure (Alternative 1)	Medium	Low Negative
	Decommissioning of Water Supply Pipeline	Infrastruture (Alternative 1)	Medium	Low Negative
	Traffic During Decommissioning	Open Cast Mining and Infrastructure (Alternative 1)	Medium	Low Negative
Rehabilitation and Closure	Rehabilitation of all Degraded Areas	Open Cast Mining and Infrastructure (Alternative 1)	Medium	Low Negative
	Annual Monitoring	Open Cast Mining and Infrastructure (Alternative 1)	Medium	Low Negative

9.4.1 Planning Phase

The planning phase is an integral part of a mining operation given the fact that poor planning could result in the degradation of sensitive areas. This includes the planning of the construction, operational, decommissioning and rehabilitation and closure phases relevant to open cast mining and the associated infrastructure.

The final significance rating for the planning phase of the proposed open cast mining activities has been scored -4.5 ("Low Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

Planning for the proposed open cast mining operations- Open Cast Mining					
Impact Name	**Planning for the proposed open cast mining operations**				
Alternative	**Open Cast Mining**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	4	3	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	1	1
Environmental Risk (Pre-mitigation)					-3,25
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-2,25
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3

Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	2,00
Final Significance	-4,50

The post-mitigation significance rating for the planning phase of the proposed infrastructure layout has been scored -3 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

Planning for the proposed infrastructure areas- Infrastructure (Alternative 1)					
Impact Name	**Planning for the proposed infrastructure areas.**				
Alternative	**Alternative 1**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	3	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	1	1
Environmental Risk (Pre-mitigation)					-3,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-2,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-3,00

9.4.2 Construction Phase

The construction phase for open cast mining includes extensive excavations, stockpiling, the construction of the proposed water supply pipeline (for infrastructure layout alternative 1) and associated traffic.

The final significance rating for the construction phase of the proposed open cast mining activities has been scored -42.5 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

The construction of the open cast pits- Open Cast Mining					
Impact Name	**The construction of the open cast pits**				
Alternative	**Open Cast Mining**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	5
Extent of Impact	3	3	Reversibility of Impact	5	5
Duration of Impact	3	4	Probability	5	5
Environmental Risk (Pre-mitigation)					-20,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-21,25
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-42,50

The final significance rating for the construction phase relevant to stockpiling activities has been scored -26 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

Stockpiling- Open Cast Mining					
Impact Name	**Stockpiling**				
Alternative	**Open Cast Mining**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	3	3	Reversibility of Impact	4	3

Duration of Impact	3	4	Probability	4	4
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-13,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-26,00

The final significance rating for the construction phase relevant to access roads has been scored -8.25 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

The construction of access roads- Open Cast Mining and Infrastructure (Alternative 1)					
Impact Name	**The construction of access roads**				
Alternative	**Open Cast Mining and Infrastructure (Alternative 1)**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	3	Reversibility of Impact	3	2
Duration of Impact	3	4	Probability	4	2
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-5,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					

Prioritisation Factor	1,50
Final Significance	-8,25

The final significance rating for the construction phase relevant to the water supply pipeline has been scored -8.25 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

The construction of the water supply pipeline- Infrastructure (Alternative 1)					
Impact Name	**The construction of the water supply pipeline**				
Alternative	**Infrastructure (Alternative 1)**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	3	Reversibility of Impact	3	2
Duration of Impact	3	4	Probability	4	2
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-5,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-8,25

The final significance rating for construction related traffic has been scored -8.25 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

Traffic- Open Cast Mining and Infrastructure (Alternative 1)					
Impact Name	**Traffic**				
Alternative	**Open Cast Mining and Infrastructure (Alternative 1)**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**

Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	3	Reversibility of Impact	3	2
Duration of Impact	3	4	Probability	4	2
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-5,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-8,25

9.4.3 Operational Phase

The operational phase for open cast mining includes extensive excavations, stockpiling, the operation of the proposed water supply pipeline (for infrastructure layout Alternative 1) and the operation of access roads.

The final significance rating for the operation phase relevant to open cast mining has been scored -42.5 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

The operation of the open cast pits- Open Cast Mining					
Impact Name	**The operation of the open cast pits**				
Alternative	**Open Cast Mining**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	5
Extent of Impact	3	3	Reversibility of Impact	5	5
Duration of Impact	4	4	Probability	5	5
Environmental Risk (Pre-mitigation)					-21,25
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-21,25
Degree of confidence in impact prediction:					High
Impact Prioritisation					

Public Response	3
Issue has received an intense meaningful and justifiable public response	
Cumulative Impacts	3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	2,00
Final Significance	-42,50

The final significance rating for the operation phase relevant to stockpiling has been scored -30 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

Stockpiling - Open Cast Mining					
Impact Name	**Stockpiling**				
Alternative	**Open Cast Mining**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	4
Extent of Impact	3	3	Reversibility of Impact	5	4
Duration of Impact	4	4	Probability	5	4
Environmental Risk (Pre-mitigation)					-21,25
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-15,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-30,00

The final significance rating for the operation phase relevant to access roads has been scored -6.75 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

The operation of access roads- Open Cast Mining and Infrastructure (Alternative 1)					
Impact Name	**The operation of access roads**				
Alternative	**Open Cast Mining and Infrastructure (Alternative 1)**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	4	3	Probability	3	2
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-4,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-6,75

The final significance rating for the operation phase relevant to water supply pipeline has been scored -6.75 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

The operation of the water supply pipeline- Infrastructure (Alternative 1)					
Impact Name	**The operation of the water supply pipeline**				
Alternative	**Infrastructure (Alternative 1)**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	4	3	Probability	3	2
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					

See Section 10- "Mitigation Measures"	
Environmental Risk (Post-mitigation)	-4,50
Degree of confidence in impact prediction:	High
Impact Prioritisation	
Public Response	2
Issue has received a meaningful and justifiable public response	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.	
Prioritisation Factor	1,50
Final Significance	-6,75

9.4.4 Decommissioning Phase

The decommissioning phase for open cast mining includes backfilling of open cast pits, the removal of stockpiles as well as the decommissioning of access roads and the water supply pipeline.

The final significance rating for the backfilling of open cast pits has been scored -20 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

Backfilling of the open cast pits- Open Cast Mining					
Impact Name	**Backfilling of the open cast pits**				
Alternative	**Open Cast Mining**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	3	2	Reversibility of Impact	4	3
Duration of Impact	3	2	Probability	4	4
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-10,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3

The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	2,00
Final Significance	-20,00

The final significance rating for the decommissioning of stockpiles has been scored -15 ("Medium Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

Removal of stockpiles - Open Cast Mining					
Impact Name	**Removal of stockpiles**				
Alternative	**Open Cast Mining**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	3
Extent of Impact	3	2	Reversibility of Impact	3	3
Duration of Impact	3	2	Probability	3	3
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-7,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-15,00

The final significance rating for the decommissioning of access roads has been scored -6 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

The decommissioning of access roads- Open Cast Mining and Infrastructure (Alternative 1)	
Impact Name	**The decommissioning of access roads;**
Alternative	**Open Cast Mining and Infrastructure (Alternative 1)**
Phase	**Decommissioning**
Environmental Risk	

Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	3	2
Environmental Risk (Pre-mitigation)					-8,25
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-6,00

The final significance rating for the decommissioning of the water supply pipelines has been scored -6 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

The decommissioning of the water supply pipeline- Infrastructure (Alternative 1)					
Impact Name	**The decommissioning of the water supply pipeline**				
Alternative	**Infrastructure (Alternative 1)**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	3	2
Environmental Risk (Pre-mitigation)					-8,25
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2

Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.	
Prioritisation Factor	1,50
Final Significance	-6,00

9.4.5 Rehabilitation and Closure Phase

The rehabilitation and closure phase for open cast mining and the decommissioned infrastructure includes rehabilitation of all degraded areas as well as annual monitoring.

The final significance rating for the rehabilitation of degraded areas during the rehabilitation and closure phase relevant to open cast mining has been scored -6 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of wetlands.

Rehabilitation of all degraded areas- Open Cast Mining and Infrastructure (Alternative 1)					
Impact Name	**Rehabilitation of all degraded areas**				
Alternative	**Open Cast Mining and Infrastructure (Alternative 1)**				
Phase	**Rehab and closure**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	2
Extent of Impact	2	2	Reversibility of Impact	2	2
Duration of Impact	3	2	Probability	2	2
Environmental Risk (Pre-mitigation)					-4,50
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-6,00

The final significance rating for annual monitoring during the rehabilitation and closure phase relevant to open cast mining has been scored -6 ("Low Negative") with a prioritisation factor

of 1.5 (“Medium”) given the public response, the cumulative impact and the irreplaceable loss of wetlands.

Open Cast Mining and Infrastructure (Alternative 1					
Impact Name	**Annual Monitoring**				
Alternative	**Open Cast Mining and Infrastructure (Alternative 1**				
Phase	**Rehab and closure**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	2
Extent of Impact	2	2	Reversibility of Impact	2	2
Duration of Impact	3	2	Probability	2	2
Environmental Risk (Pre-mitigation)					-4,50
Mitigation Measures					
See Section 10- “Mitigation Measures”					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-6,00

10 Mitigation Measures

The following sections describe relevant mitigation measures recommended for the conservation of wetland areas. It is worth noting that all of the expected impacts rated a final significance rating of “High Negative” are not included in this section given the fact that no mitigation measures are expected to decrease these scores.

The first step according to the mitigation hierarchy (DEA, 2013) is to avoid impacts towards sensitive areas. According to the layout of the deposits intended to be mined and the proposed infrastructure Alternative 1, only the proposed water supply pipeline, the aggregate deposit and the sand deposit is located within the 79 m wetland buffer zones. Therefore, the impacts from these components cannot be avoided. The impact assessment results indicate that the only impacts expected to have a higher final significance rating than “Low Negative” is associated with the open cast mining operations for the aggregate deposits. As for the decommissioning of stockpiles, a final significance rating of “Medium Low” can be reached after mitigation measures are applied. Mitigation measures for the construction, operation and

decommissioning phases of the water supply pipeline as well as the decommissioning phase of the stockpiles is described in the following sections.

As for the threats posed by the mining operations, the following step according to the mitigation hierarchy (see Figure 23) is to rehabilitate all of the affected wetland areas. Even though rehabilitation is standard practice for an open cast mining operation, a wetland offset is recommended by the specialist herein given the fact that direct loss of wetland areas is inevitable in HGM 1, 3 and 5's cases. In addition to the recommended mitigation measures described for the decommissioning of stockpiles, rehabilitation focussing on affected areas is recommended given the final significance score of "Medium Negative".

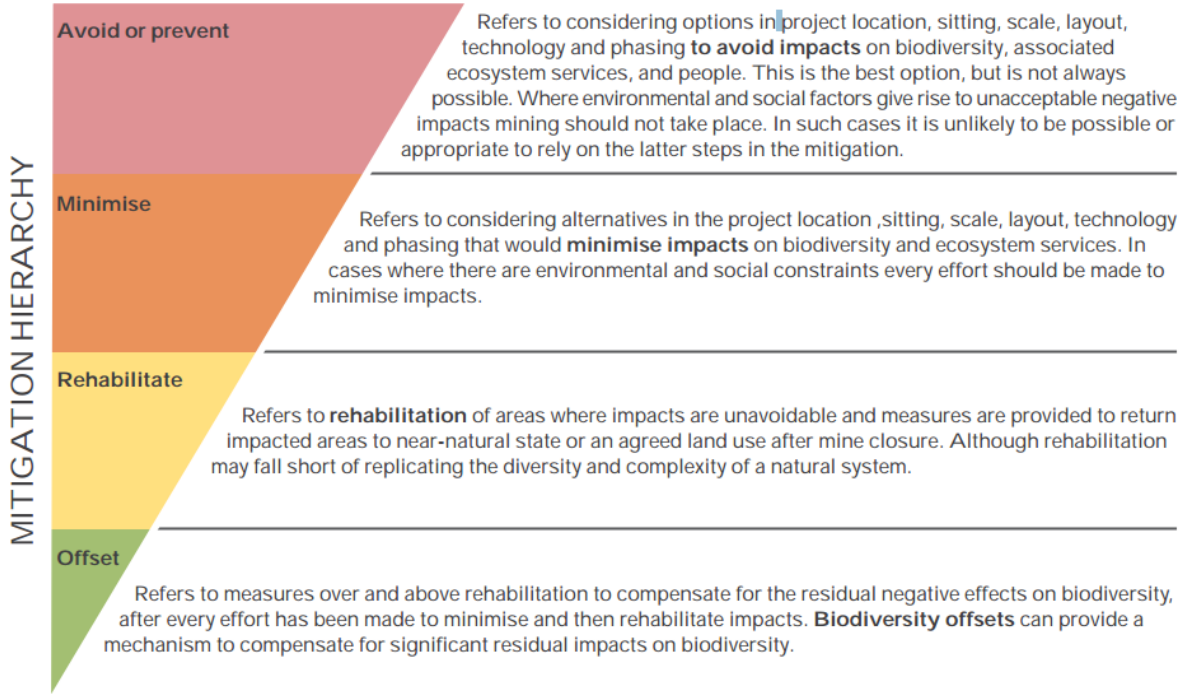


Figure 23: The mitigation hierarchy as described by the DEA (2013)

10.1 Construction of Water Supply Pipelines

The following mitigation measures are provided for the pipeline section located within the recommended buffer zone:

- The footprint area of the pipeline should be kept a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas.
- All construction activities and access must make use of the existing roads;
- Silt traps and fences must be placed in the preferential flow paths along the proposed pipeline route to prevent sedimentation of the watercourse; and
- Where possible, existing access routes and walking paths must be made use of.

10.2 Decommissioning/Removal of Stockpiles

- All decommissioning activities and supporting aspects (i.e. laydown areas, ablutions etc) must be located within the existing footprint area of the dumps being removed;
- Vegetation along the edges of the dumps (where removal of the dumps is not active) should be left as is, and only be removed when the rest of the dump has been removed;
- All soils compacted as a result of the stockpile removal should be ripped (two directions), profiled and a seed-mix applied for re-vegetation of the area;
- All removal activities and access must make use of the existing access routes as much as possible. The number of access routes and working areas must be minimised, and the footprint area of these must be reduced and demarcated;
- Silt traps and fences must be placed in the preferential flow paths and downslope along the working area to prevent sedimentation of the watercourse; and
- A temporary cut-off trench should be excavated around the stockpiles for any unwanted spillages from the removal process. This will ensure that discard material does not end up in the surrounding watercourses.

10.3 General Mitigation Measures

- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- It is preferable that construction takes place during the dry season (as much as possible) to reduce the erosion potential of the exposed surfaces;
- Prevent uncontrolled access of vehicles through the water resources system that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;
- All chemicals and toxicants to be used for the construction must be stored outside the channel system and in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;
- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced;
- Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the wetland systems;
- All removed soil and material must not be stockpiled within the system. Stockpiling should take place outside of the watercourse. All stockpiles must be protected from

erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;

- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No dumping of construction material on-site may take place; and
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported.

11 Recommendations

The following recommendations have been made to ensure that all wetland areas are conserved;

- A wetland offset assessment for HGM 1, 3 and 5 is recommended given the fact that a final significance rating of “High Negative” has been determined for various mining-related activities which will result in a direct loss of wetland areas. The findings and recommendations from this assessment must be included in the water use license agreement;
- A rehabilitation plan must be set up for all stockpiles located within the 79 m buffer of the wetland areas given the fact that a final significance rating of “Medium Negative” has been recorded for the decommissioning of stockpiles;
- The wetland buffer zones for HGM 2 and HGM 4 must be strictly adhered to;
- All of the recommended mitigation measures must be adhered to; and
- A suitable rehabilitation plan must be set-up for all proposed activities as part of the rehabilitation and closure phase.

12 Conclusions

12.1 Wetland Ecology

The findings from this assessment indicate the presence of five wetland areas all divided into separate HGM units. These systems generally provide intermediate/moderate ecosystem services and is moderately to largely modified in their current states. These wetland areas are expected to be degraded by the proposed activities.

12.2 Impact Statement

The delineated wetlands are expected to be impacted upon to a final significance rating of low to high depending on the extent of the wetlands and the location thereof in comparison to the proposed open cast areas and infrastructure layouts.

Wetland offsets and rehabilitation has been recommended given the direct loss of wetlands expected for HGM 1, 3 and 5.

13 References

Department of Environmental Affairs. 2013. Mining and biodiversity guideline- Mainstreaming biodiversity into the mining sector.

Department of Water Affairs and Forestry (DWAF) 2005. Final draft: A practical field procedure for identification and delineation of wetlands and Riparian areas.

Greenmined Environmental. 2018. Mining of sand, aggregate and alluvial diamonds on portion 4 of the farm Woodlands 407, Ngwathe Local Municipality, Free State province.

Kotze DC, Marneweck GC, Batchelor AL, Lindley DC, Collins NB. 2009. A Technique for rapidly assessing ecosystem services supplied by wetlands. Mondi Wetland Project.

Land Type Survey Staff. (1972 - 2006). Land Types of South Africa: Digital Map (1:250 000 Scale) and Soil Inventory Databases. Pretoria: ARC-Institute for Soil, Climate, and Water.

Macfarlane, D.M., Bredin, I.P., Adams, J.B., Zungu, M.M., Bate, G.C. & Dickens, C.W.S. 2014. Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries.

Mucina, L. and Rutherford, M.C. (Eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelizia 19. South African National Biodiversity Institute, Pretoria South African.

National Environmental Management Act. 1998. National Environmental Management Act (act no. 107 of 1998)- Environmental management framework regulations.

Nel JL, Murray KM, Maherry AM, Petersen CP, Roux DJ, Driver A, Hill L, Van Deventer H, Funke N, Swartz ER, Smith-Adao LB, Mbona N, Downsborough L and Nienaber S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Ollis DJ, Snaddon CD, Job NM, and Mbona N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.

Rountree MW, Malan H and Weston B (editors). 2012. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study. Report No XXXXXXXXX. Water Research Commission, Pretoria.

SASA, S. A. (1999). Identification & management of the SOILS of the South African sugar industry. Mount Edgecombe: South African Sugar Association Experiment Station.

Soil Classification Working Group. (1991). Soil Classification A Taxonomic system for South Africa. Pretoria: The Department of Agricultural Development.