FAUNAL, FLORAL, WETLAND AND AQUATIC ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETVLEI COLLIERY OUTSIDE MIDDELBURG, MPUMALANGA PROVINCE

Prepared for

WSP Group

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SECTION D – Wetland Assessment

Prepared by: **Scientific Aquatic Services**
Report author **N. Cloete**
Report reviewers **S. van Staden (Pri. Sci. Nat)**
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Scientific Aquatic Services CC
CK Reg No 2003/078943/23
Vat Reg. No. 4020235273
91 Geldenhuis Road
Malvern East Ext 1
2007
Tel: 011 616 7893
Fax: 086 724 3132
E-mail: admin@sasenvironmental.co.za

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ACRONYMS

CSIR	Council of Scientific and Industrial Research
DEMC	Desired Ecological Management Class
DWA	Department of Water Affairs
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EAP	Environmental Assessment Practitioner
HGM	Hydrogeomorphic
NFEPA	National Freshwater Ecosystem Priority Areas
PEMC	Present Ecological management Class
PES	Present Ecological State
RHP	River Health Programme
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, wetland and aquatic assessment as part of the Environmental Assessment (EIA) and authorisation process for the proposed Rietvlei Colliery, hereafter referred to as the “subject property”. The subject property is situated south-east of the R555, outside Middelburg, Mpumalanga Province (25°40’18.59”S 29°39’16.47”E). The total area of the proposed opencast footprint extends over approximately 747.16ha.

The subject property is surrounded by properties on which agricultural activities dominate. The ecological assessment was done with special focus on areas earmarked for mining footprint as well as areas of considered of higher ecological importance and sensitivity. The surrounding area was however considered as part of the desktop assessment of the area. The land is currently used for forestry purposes with areas of edible crop lands also located on the subject property.

The purpose of the report is to present the delineation of the wetland resources associated with the development as well as to provide a summary of the wetland Present Ecological State (PES) and function prior to the proposed construction activities and to allow informed decision making by the authorities, proponent and Environmental Assessment Practitioner (EAP) consultants.

2 WETLAND ASSESSMENT METHODOLOGY

2.1 Desktop study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the wetland feature present within the subject property, is located. Aspects considered as part of the literature review are discussed in the sections that follow.

2.1.1 Ecostatus

Studies undertaken by the Institute for Water Quality Studies assessed all quaternary catchments as part of the Resource Directed Measures for Protection of Water Resources. In these assessments, the Ecological Importance and Sensitivity (EIS),

Present Ecological Management Class (PEMC) and Desired Ecological Management Class (DEMC) were defined, and serve as a useful guideline in determining the importance and sensitivity of aquatic ecosystems prior to assessment, or as part of a desktop assessment.

Water resources are generally classified according to the degree of modification or level of impairment. The classes used by the South African River Health Programme (RHP) are presented in Table 1 below and will be used as the basis of classification of the systems in this field, and desktop study.

Table 1: Classification of River Health Assessment Classes in Line with the RHP.

Class	Description
A	Unmodified, natural
B	Largely natural, with few modifications
C	Moderately modified
D	Largely modified
E	Extensively modified
F	Critically modified

2.1.2 National Freshwater Ecosystem Priority Areas (NFEPA)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission, South African National Biodiversity Institute (SANBI), Department of Water Affairs (DWA), South African Institute of Aquatic Biodiversity and South African National Parks. The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable natural resource, with economic, aesthetic, spiritual, cultural and recreational value. The integrity of freshwater ecosystems in South Africa is however declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information regarding the conservation status of rivers, wetland habitat and wetland features present within the subject property.

2.2 Classification System for Wetlands and other Aquatic Ecosystems in South Africa

All wetland features encountered within the subject property were assessed using the *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems* (Ollis *et al*., 2013), hereafter referred to as the classification system.

A summary of Levels 1 to 4 of the proposed classification system for Inland Systems are presented in Table 2 and 3, below.

Table 2: Proposed classification structure for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table 3: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

2.2.1 Level 1: Inland systems

For the proposed Classification System, Inland Systems are defined as ***an aquatic ecosystem that have no existing connection to the ocean***[1] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but ***which are inundated or saturated with water, either permanently or periodically.*** It is important to bear in mind, however, that certain Inland Systems may have had an historical connection to the ocean, which in some cases may have been relatively recent.

[1] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

2.2.2 Level 2: Ecoregions

For Inland Systems, the regional spatial framework that has been included at Level 2 of the proposed Classification System is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al.,* 2005). There are a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland (figure below). DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

2.2.3 Level 2: NFEPA Wet Veg Groups

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) group's vegetation types across the country according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

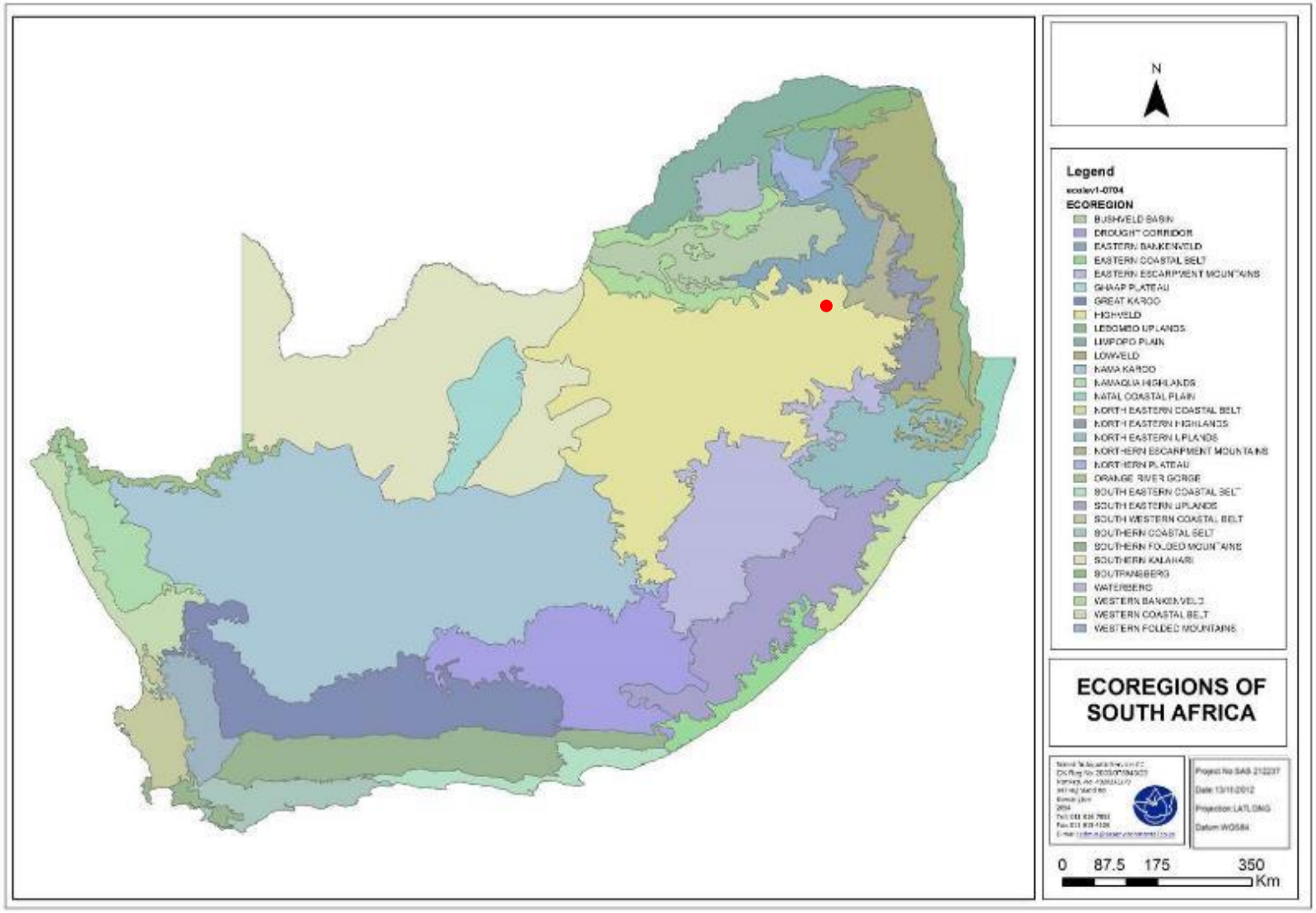

Figure 1: Map of Level 1 Ecoregions of South Africa, with the approximate position of the subject property indicated in red.

2.2.4 Level 3: Landscape Setting

At Level 3 of the proposed classification System, for Inland Systems, a distinction is made between four Landscape Units (Table 2) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et al.,* 2013):

- ***Slope*****:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley.
- ***Valley floor:*** The base of a valley, situated between two distinct valley side-slopes.
- ***Plain:*** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.
- ***Bench (hilltop/saddle/shelf):*** an area of mostly level or nearly level high ground (relative to the broad surroundings). This including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately permendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

2.2.5 Level 4: Hydrogeomorphic Units

Eight primary HGM Types are recognised for Inland Systems at Level 4A of the proposed classification system (Table 3), on the basis of hydrology and geomorphology (Ollis *et al*., 2013), namely:

- ***River:*** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
- ***Channelled valley-bottom wetland:*** a valley-bottom wetland with a river channel running through it.
- ***Unchannelled valley-bottom wetland:*** a valley-bottom wetland without a river channel running through it.
- ***Floodplain wetland:*** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank.
- ***Depression:*** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.

- ***Wetland Flat:*** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat
- ***Seep:*** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the Classification System to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for “channel”, “flat” and “valleyhead seep”) is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et al.,* 2008) and WET-EcoServices (Kotze *et al.,* 2009).

2.3 WET-Health

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing promote their conservation and wise management.

2.3.1 Level f Evaluation

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution;
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment; and
- Due to security risks on site and the limited time spent on site this study was undertaken as a level 1 assessment

2.3.2 Framework for the Assessment

A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

2.3.3 Units of Assessment

Central to WET-Health is the characterisation of hydrogeomorphic (HGM) units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the *Classification System for Wetlands and other Aquatic Ecosystems* in Section 2.2.

2.3.4 Quantification of Present State of a wetland

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 State score. This takes the form of assessing the spatial *extent* of impact of individual activities 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 impact scores and Present State categories are provided in Table 4.

Table 4: Impact scores and categories of present State used by WET-Health for describing the integrity of wetlands.

Impact category	Description	Impact score range	Present State category
None	Unmodified, natural	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1-1.9	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.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E

Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

2.3.5 Assessing the Anticipated Trajectory of Change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or from within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (Table 5).

Table 5: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

2.3.6 Overall health of the wetland

Once all HGM units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area weighting the scores calculated for each HGM unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provides a summary of impacts, Present State, Trajectory of Change and Health for individual HGM units and for the entire wetland.

2.4 Wetland function assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[2] The assessment of the ecosystem services supplied by the identified wetlands was conducted

[2] Department of Water Affairs and Forestry, South Africa *Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999*

according to the guidelines as described by 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 service is provided:

- Flood attenuation
- Stream flow regulation
- Sediment trapping
- Phosphate trapping
- Nitrate removal
- Toxicant removal
- Erosion control
- Carbon storage
- Maintenance of biodiversity
- Water supply for human use
- Natural resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland.

Table 6: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

2.5 Environmental Importance and Sensitivity (EIS) Method of assessment

The method used for the EIS determination was adapted from the method as provided by DWA (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 median of the determinants is used to assign the EIS category as listed in Table 7 and 8 below.

Table 7: Score sheet for determining the EIS.

Determinant	Score	Confidence
PRIMARY DETERMINANTS		
1. Rare & Endangered Species		
2. Populations of Unique Species		
3. Species/taxon Richness		
4. Diversity of Habitat Types or Features		
1. Migration route/breeding and feeding site for wetland species		
6. PES as determined by WET-Health assessment		
7. Importance in terms of function and service provision		
MODIFYING DETERMINANTS		
8. Protected Status according to NFEPA Wetveg		
9. Ecological Integrity		
TOTAL		
MEDIAN		
OVERALL EIS		

Table 8: EIS Category definitions.

EIS Category	Range of Median	Recommended Ecological Management Class[3]
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these floodplains is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these floodplains may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2	C

[3] Ed's note: Author to confirm exact wording for version 1.1

Low/marginal Wetlands that is not ecologically important and sensitive at any scale. The biodiversity of these floodplains is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1	D

2.6 Recommended Ecological Category (REC)

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability, but carries a higher risk of ecosystem failure." [4]

The REC (Table 9) was determined based on the results obtained from the PES, reference conditions and EIS of the resource (sections above). Followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired REC.

A wetland may receive the same class for the PES as the REC if the wetland is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the wetland feature.

Table 9: Description of REC classes.

Category	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

2.7 Wetland delineation

For the purposes of this investigation, a wetland habitat is defined in the National Water Act (1998) as including the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas.

The wetland zone delineation took place according to the method presented in the final draft of "A practical field procedure for identification and delineation of wetlands and riparian areas" published by the DWA in February 2005. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

[4] Department of Water Affairs and Forestry, South Africa *Version 1.0 of Resource Directed Measures for Protection of Water Resources 1999*

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils and
- The presence of alluvial soils in stream systems.

By observing the evidence of these features, in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWA, 2005).

Riparian and wetland zones can be divided into three zones (DWA, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant part of the rainy season and the temporary zone surrounds the seasonal zone and is only saturated for a short period of the year, but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

3 RESULTS

3.1 Wetland System Characterisation

Several wetland and pan features were identified within the subject property. The wetland and pan features identified during the assessment of the subject property were categorised according to the method provided by Ollis *et al*., (2013) outlined in Section 2.2. The results of the classification, which show that the features were classified as an Inland system falling within the Highveld Ecoregion, are presented in Table 10 below and conceptually presented in Figure 2:

Table 10: Classification system for the wetland features within the subject property.

Wetland feature location	Level 1: System	Level 2: Regional Setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit HGM Type
Rietvlei Colliery	**Inland:** An ecosystem that has no existing connection to the ocean but which is inundated or saturated with water, either permanently or periodically.	**Highveld Ecoregion:** The subject property falls within the Highveld Ecoregion **WetVeg Group:** Mesic Highveld Grassland Group 4	**Plain:** An extensive area of low relief. These areas are characterised by relatively level, gently undulating or uniformly sloping land with a very gently gradient that is not located in a valley	***Depression:*** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates
			Valley floor: The base of a valley, situated between two distinct valley side-slopes	***Channelled valley-bottom wetland:*** a valley-bottom wetland with a river channel running through it
			Bench (hilltop/saddle/shelf): an area of mostly level or nearly level high ground (relative to the broad surroundings)	**Wetland flat:** A level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench

Both the DWA Ecoregions and the NFEPA WetVeg groups were applied as the default special frameworks at Level 2. The relevant DWA 1 Ecoregion is the Highveld ecoregion (Ecoregion 11, Kleynhans *et al*., 2005), while the relevant NFEPA WetVeg Group is the Mesic Highveld Grassland (Nel *et al*., 2011). At Level 3 (Landscape Unit), the landscape setting of the wetland features is a “plain; valley floor and bench”. At Level 4 (HGM Unit), the wetland features can be classified as depressions, channelled valley bottoms and wetland flats.

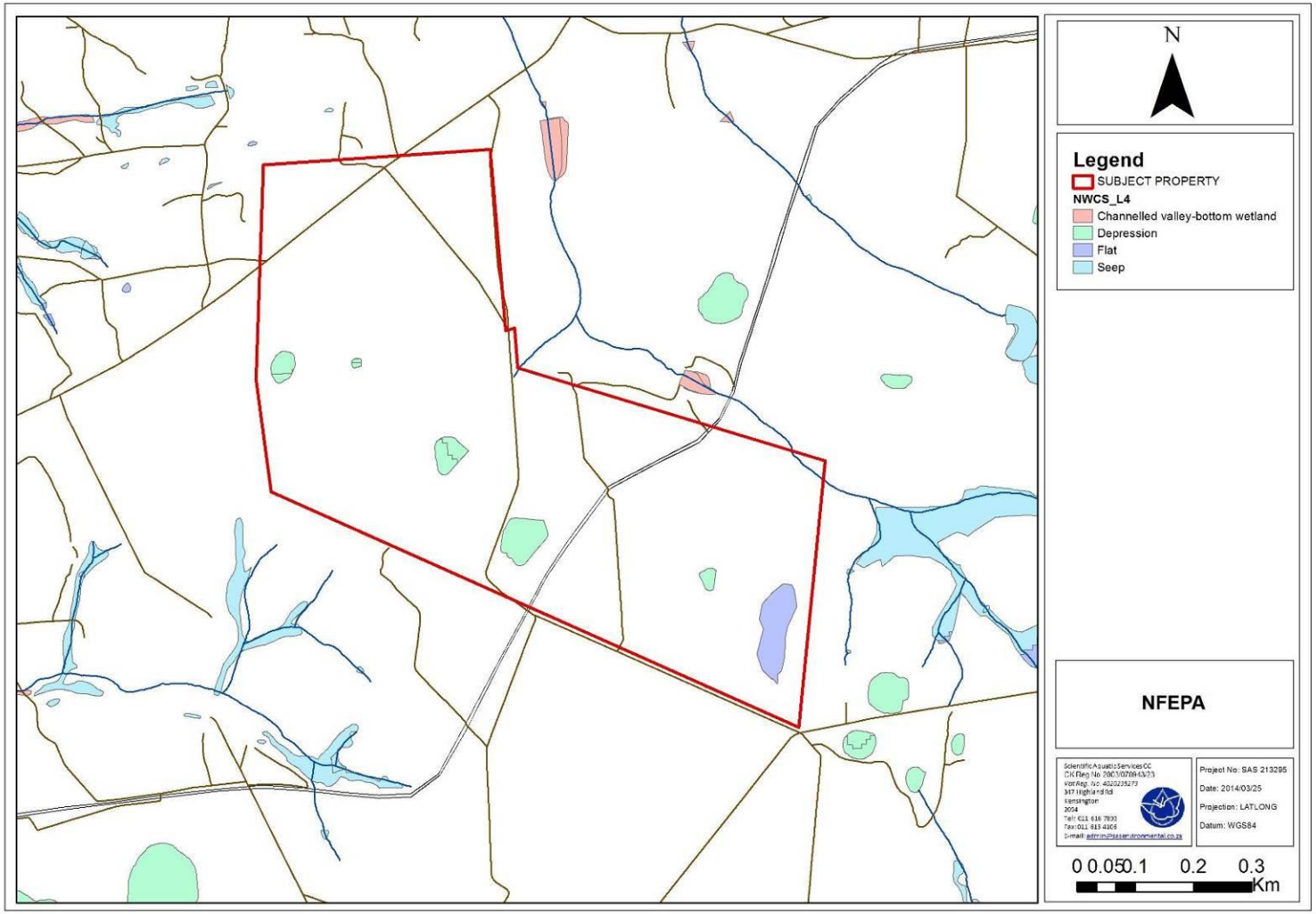

Figure 2: Locality map of the type of wetland features within the subject property.

Several wetland and pan features were identified within the subject property. The pan features were characterised as endorheic depression systems and the wetland features as a flat seepage according to the National Freshwater Ecosystem Priority Areas (NFEPA) water management database. Further to this the wetland features within the subject property was divided into two broad categories namely wetland features with permanent zones of saturation and wetland features with no permanent zones of saturation (Figure 3).

The table below identifies the two broad wetland feature types, based on the levels of inundation observed in the systems.

Table 11: The two broad wetland feature types identified within the subject property.

Wetland features with a permanent zone of saturation (Permanent wetland)	Wetland features with no permanent zone of saturation (Seasonal Wetland)
Pan 1	Pan 4
Pan 2	Pan 5
Pan 3	Wetland 1
Pan 6	Wetland 2
Selons River	Wetland 3
	Wetland 4
	Wetland 5
	Wetland 6
	Wetland 7

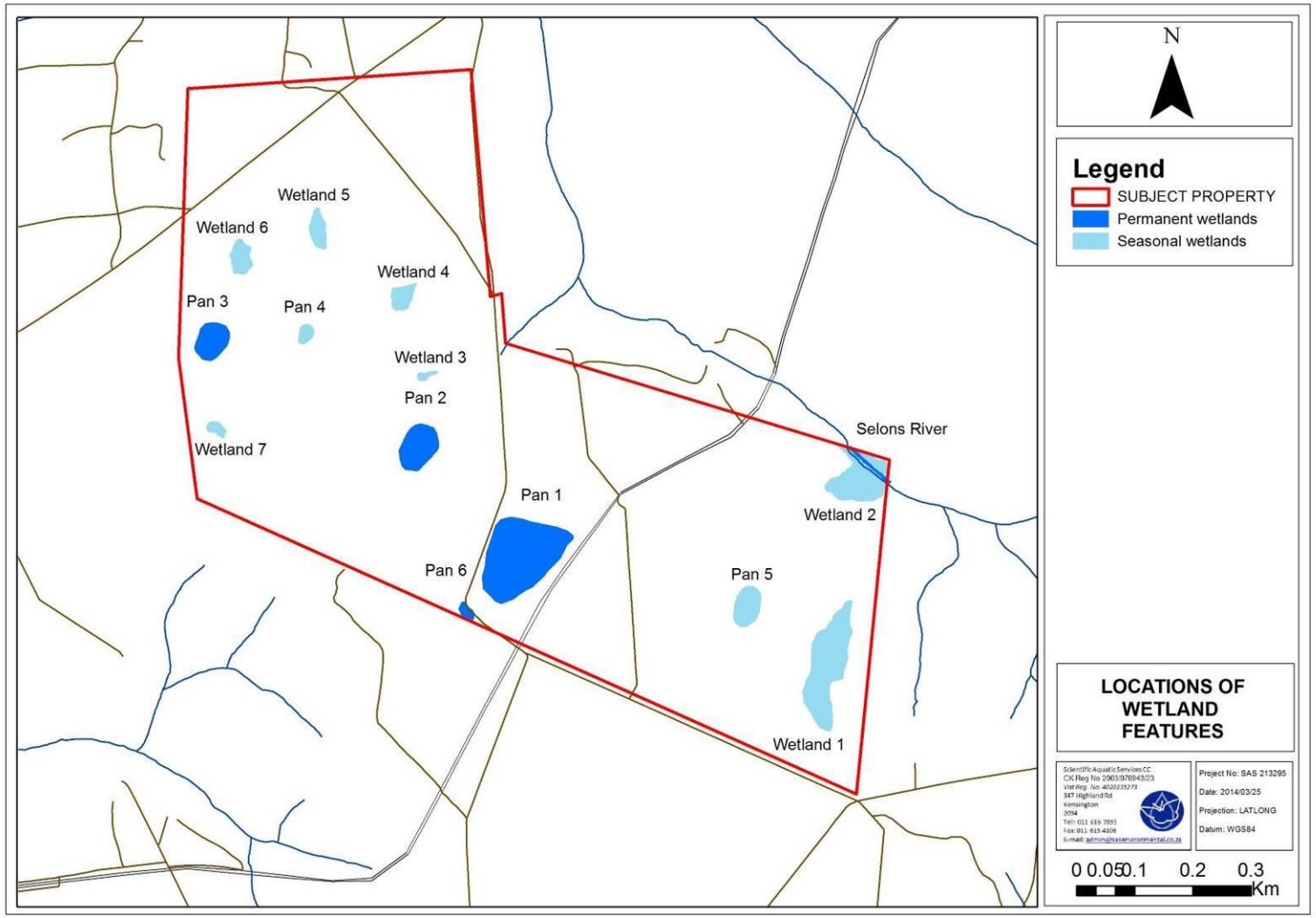

Figure 3: Location of the permanent and seasonal wetland features within the subject property.

Pan features 1 to 3 and 6 have mostly natural vegetation occurring, with very little alien encroachment except close to the main road and cultivated lands. These pan features could provide very good habitat for avifaunal species.

The Selons River was located on the northeastern corner of the subject property. This river system is classified as a NFEPA river, providing suitable habitat for avifaunal and aquatic species. Some transformation has occurred within the river system due to grazing of livestock and vegetation clearance resulting in erosion of the riverbanks.

Exotic and invader vegetation species occurred within the seasonal wetland features (Pan 4-5; Wetland 1-7). Although some alien encroachment occurred due to the adjacent plantation and agricultural activities, pockets of well-vegetated habitat still occur within these features and will allow flora and fauna species to occur.

Upon the assessment of the subject property, the various wetland vegetation components were assessed. Dominant species were characterised as either wetland or terrestrial species. The wetland species were then further categorised as temporary, seasonal and permanent zone species. This characterisation is presented in the tables below, including the terrestrial species identified on the subject property.

Table 12: Main floral species identified during the wetland delineation in the permanent wetland features (Pan 1-3, 6 and the Selons River) within the subject property.

Terrestrial species	Temporary species	Seasonal species	Permanent species
Acacia mearnsii	*Brachiaria serrata*	*Andropogon eucomus*	*Cyperus esculentis*
Eragrostis chloromelas	*Cyperus esculentis*	*Brachiaria serrata*	*Cyperus rotundus*
Eragrostis rigida	*Cyperus longus*	*Eragrostis heteromera*	*Imperata cylindrica*
Eragrostis gummiflua	*Cyperus marginatus*	*Eragrostis gummiflua*	*Kylinga alba*
Eucalyptus grandis	*Cyperus rupestris*	*Helichrysum pilosellum*	*Mariscus congesta*
Denekia capensis	*Eragrostis curvula*	*Homeria pallida*	*Miscanthus junceus*
Gazania krebsiana	*Eragrostis rigida*	*Hypoxis rigida*	*Phragmites australis*
Hyparrhenia hirta	*Kylinga alba*	*Monopsis decipiens*	*Typha capensis*
Ipoemoea purpurea	*Mariscus congesta*	*Kylinga alba*	*Verbena bonariensis*
Lopholaena coriifolia	*Senecio gregatus*	*Pelargonium luridum*	
Seriphium plumosum	*Taraxicum officinalis*	*Paspalum dilatatum*	
Taraxicum officinalis	*Verbena bonariensis*	*Senecio inaequidens*	
		Sporobulus pyramidalis	
		Wahlenbergia caledonica	

Table 13: Main floral species identified during the wetland delineation in the seasonal wetland features (Pan 4-5, Wetland 1-7) within the subject property.

Terrestrial species	Temporary species	Seasonal species
**Acacia mearnsii*	*Cyperus esculentis*	*Andropogon eucomus*
Eragrostis chloromelas	*Cyperus longus*	*Cyperus marginatus*
Eragrostis rigida	*Cyperus marginatus*	*Cyperus rupestris*
Eragrostis curvula	*Cyperus rupestris*	*Eragrostis heteromera*
Eragrostis gummiflua	*Eragrostis rigida*	*Helichrysum pilosellum*
**Eucalyptus grandis*	*Imperata cylindrica*	*Homeria pallida*
Denekia capensis	*Kylinga alba*	*Hypoxis rigida*
Gazania krebsiana	*Mariscus congesta*	*Monopsis decipiens*
Hyparrhenia hirta	*Senecio gregatus*	*Paspalum dilatatum*
**Ipomoea purpurea*	**Verbena bonariensis*	*Pelargonium luridum*
Lopholaena coriifolia		*Senecio inaequidens*
**Seriphium plumosum*		*Sporobulus pyramidalis*
Themeda triandra		*Wahlenbergia caledonica*

3.2 Wetland Function Assessment

The wetland function and service provision were assessed according to the method defined in section 2.4 of this report, taking into consideration the desktop and field assessment results. The average scores for the wetland feature are presented in the table below as well as the radar plot in the figure that follows. The findings of the assessment are then discussed highlighting wetland features of increased significance from an ecoservice point of view and emphasising ecoservices provided by the various wetlands that are of increased significance

Table 14: Wetland functions and service provision for the permanent wetland features.

Ecosystem service	Wetland features with a permanent zone of saturation				
	Pan 1	Pan 2	Pan 3	Pan 6	Selons River
Flood attenuation	0.8	0.9	0.8	0.7	1.2
Streamflow regulation	0	0	0	0	2.4
Sediment trapping	1	0.6	1.6	0.6	1
Phosphate assimilation	1.9	1.6	1.6	1.6	1.6
Nitrate assimilation	2.1	1.9	1.9	2	2.1
Toxicant assimilation	2	1.9	1.8	1.8	1.9
Erosion control	1.6	1.9	1.5	1.3	1.4
Carbon Storage	2.7	2.6	2.7	2.3	2
Biodiversity maintenance	2.1	1.3	1.5	1.7	1.6
Water Supply	1.5	1.2	1.3	1.3	1.5
Harvestable resources	1.2	0.6	0.6	0.8	0.6
Cultural value	0	0	0	0	0
Cultivated foods	1	0.6	0.6	0.8	0.6
Tourism and recreation	0.75	0.5	0.5	0.4	0.5
Education and research	1	0.8	0.5	0.8	0.8
SUM	**19.7**	**16.4**	**16.9**	**16.1**	**19.2**
Average score	**1.3**	**1.1**	**1.1**	**1.1**	**1.3**

Table 15: Wetland functions and service provision for the seasonal wetland features

Ecosystem service	Wetland features with no permanent zone of saturation		
	Pan 4-5	Wetland 2	Wetland 1,3-7
Flood attenuation	0.9	0.9	0.8
Streamflow regulation	0	1.8	0
Sediment trapping	0.75	0.5	0.5
Phosphate assimilation	1.7	1.6	1.3
Nitrate assimilation	2	2.2	1.4
Toxicant assimilation	1.8	1.8	1.3
Erosion control	1.6	1.4	1.1
Carbon Storage	1.7	1.7	1.3
Biodiversity maintenance	0.9	1.3	0.9
Water Supply	1.2	1.2	0.3
Harvestable resources	0.2	0.8	0
Cultural value	0	0	0
Cultivated foods	0.2	0.8	0
Tourism and recreation	0.1	0.1	0.1
Education and research	0.5	0	0.5
SUM	**13.6**	**16.1**	**9.5**
Average score	**0.9**	**1.1**	**0.6**

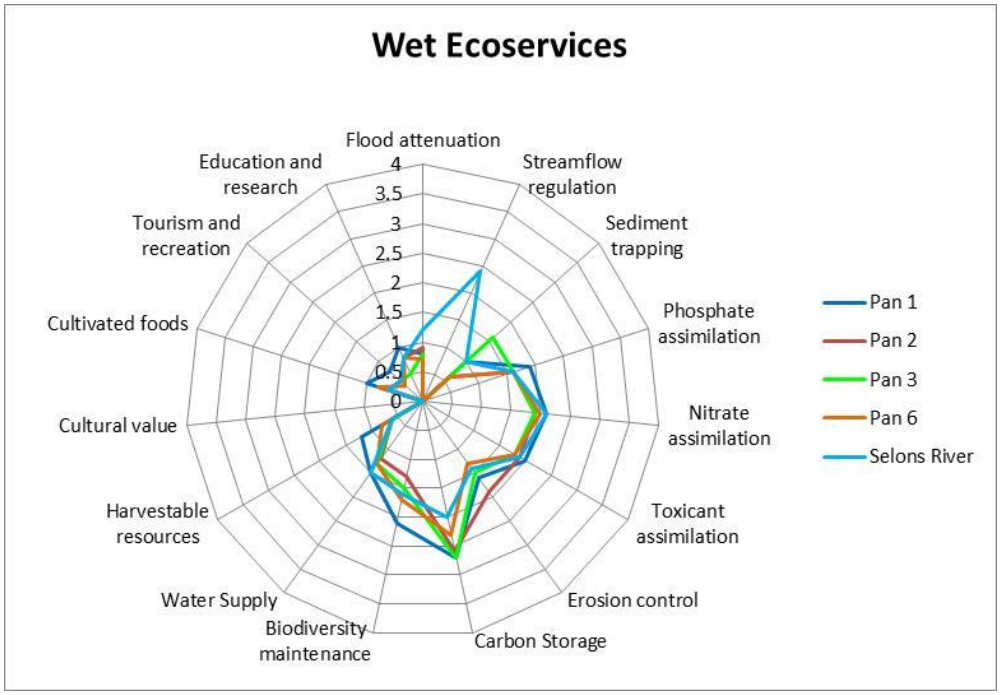

Figure 4: Radar plot of wetland services provided by the wetland features with a permanent zone.

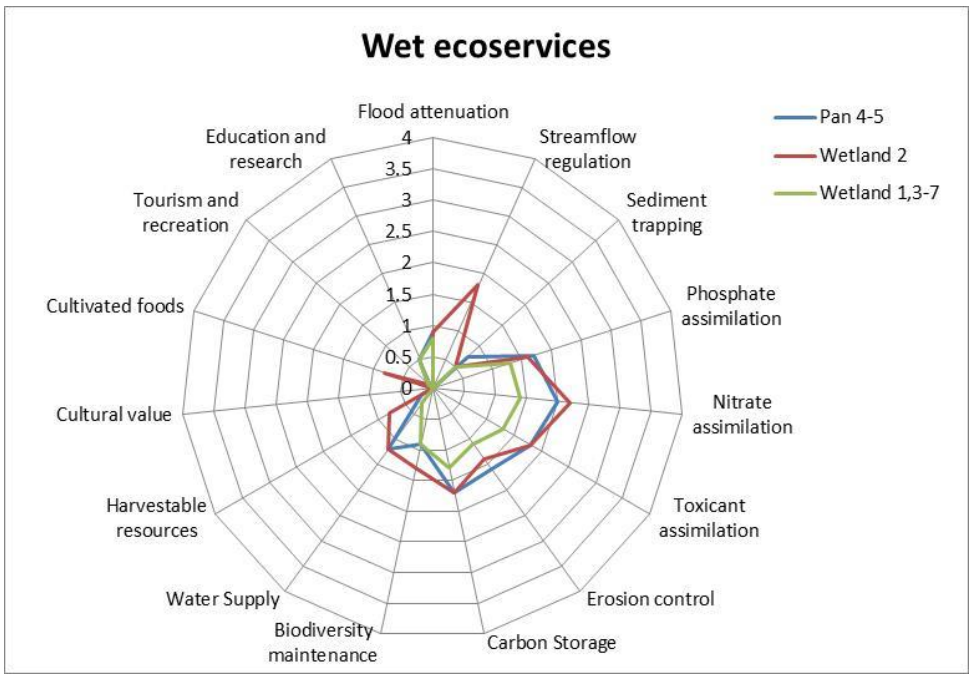

Figure 5: Radar plot of wetland services provided by the wetland features with no permanent zones.

Wetland features with permanent zone of saturation

From the results of the assessment of the permanent features, it is evident that Pan 1 and the Selons River have an intermediate level of ecological function and service provision and Pan 2, 3 and 6 has a moderately low level of ecological function and service provision.

The Pan features 1-3 and 6 are the most important in terms of carbon storage. These results obtained were mainly due to the fact that these pan features have higher peat content and little soil disturbances, thus increasing the wetlands contribution to trapping carbon. The Selons River was most important in terms of streamflow regulation and nutrient assimilation.

Thus from the overall scores obtained from the wetland ecoservices calculation it was found that Pan feature 1 and the Selons River was the most important in terms of services and function, therefore obtaining a higher service value than the Pans 2, 3 and 6.

Wetland features with no permanent zone of saturation

From the results of the assessment, it is evident that all of the seasonal wetland features on the subject property have a moderately low level of ecological function and service provision. These wetland features and pans are the most important in terms of nitrate assimilation. The results obtained were mainly due to the fact that all of the wetland features with no permanent zone of saturation display diffuse flow characteristics causing a seepage area to occur. Agricultural practises surround some parts of these wetlands, causing water and possibly some fertilisers to wash off into the wetland sections. This increases the nutrient levels within the wetlands, thus lowering the water quality.

3.3 Wet-Health

Wetlands protect and regulate water resources, performing vital functions such as flood attenuation, recharging of ground water, nutrient assimilation, filtering of pollutants and prevention of soil erosion. Wetland ecosystems comprise the abiotic characteristics of an area, including climate, geology and soil, water, nutrient supply and radiant energy, together with a biotic community suited to the prevailing environmental conditions and natural disturbance regimes.

A system in which natural inputs of resources or toxins has not been modified by recent human intervention, and which experiences levels of disturbance that are regarded as natural, is considered to be in a ‘natural reference condition’. Here, it is worth recognising that humans have long influenced disturbance regimes in Southern Africa through practices such as veld burning. These low-impact disturbances should be regarded as part of the natural disturbance regime. Given this context, wetland health is defined as a measure of the similarity of a wetland to a natural or reference condition. In thinking about wetland health, it is appropriate to consider ‘deviation’ from the natural or reference condition. For the purposes of the WET-Health assessment, the state of a wetland is a measure of the extent to

which human impacts have caused the wetland to differ from the natural reference condition (Macfarlane *et. al.* 2008).

A Level 1 WET-Health assessment was applied to the features within the subject property. The table below summarises the scores received for the three modules assessed; namely hydrology, geomorphology and vegetation.

Table 16: Summarised results of the WET-Health results for the wetland features.

Wetland feature	Hydrology		Geomorphology		Vegetation		Overall score
	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
Pan 1	C	↓↓	A	↓↓	C	↓	C
Pan 2	D	→	A	→	D	↓	C
Pan 3	C	→	A	→	C	↓↓	B
Pan 6	C	→	A	↓	D	↓↓	C
Selons River and Wetland 2	B	→	A	→	C	↓	B
Pan 4	C	→	B	↓	E	↓	C
Pan 5	D	→	B	↓	E	↓↓	D
Wetland 1, 3-7	D	→	B	↓	E	↓↓	D

The present hydrological state of the wetland features calculated a score falling between Category B (A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place) and Category D (A large change in ecosystem processes and loss of natural habitat and biota and has occurred). The present geomorphological state of the features calculated a score falling between a Category A (A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place) and a Category B (A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place). The current vegetation status within the wetland features was calculated with a score falling between Category C (A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact) and Category E (Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota).

The above results indicate that moderate to high levels of modifications of hydrology, geomorphology and vegetation have occurred. Modifying factors include historic and current agricultural activities such as vegetation clearing for crop cultivation, plantation and grazing activities contributing to increased erosion and sediment input. Considering the current rate of transformation of the landscape and proximity and expansion of plantation and agricultural activities in the vicinity, deviation from a Category B-D is expected in all of the systems, unless mitagatory measures are implemented to prevent further deterioration.

The overall score for the wetland systems that aggregates the scores for the three modules, namely hydrology, geomorphology and vegetation, was calculated using the formula[5] as provided by the Wet-Health methodology. The overall score calculated for each wetland feature was determined (Table 16). Due to the forestry and agricultural activities, deterioration from this categories are expected. It can be concluded from the WET-Health assessment that Pan feature 1, 3; the Selons River and Wetland feature 2 have a higher function in terms of the three modules as mentioned above.

3.3.1 Wetland EIS Assessment

The results of the wetland function assessment and WET-Health assessment were used to obtain the EIS assessment, for which the results are presented in the tables below.

Wetland features with a permanent zone of saturation

The scores of 2.0 to 2.89 calculated during the assessment indicate that the permanent wetland features falls into the “high” EIS category (category ‘B’). It should be noted that the high EIS score was obtained primarily as a result of habitat diversity and ecological function and status of the wetland features.

Wetland features with no permanent zones of saturation

The scores of 1.33 to 1.56 calculated during the assessment indicate that the seasonal wetland features falls into the “moderate” EIS category (category ‘C’). It should be noted that the lower EIS score was obtained primarily as a result of historical agricultural practices such as crop cultivation and grazing may have contributed to the present condition of these pans through water attenuation, increased siltation and clearing of natural vegetation.

[5] [(Hydrology score) x 3 + (geomorphology score) x2 + (vegetation score) x 2)]/ 7 = PES

Table 17: Wetland EIS Score for the wetland features with permanent zones located within the subject property.

Determinant	Permanent Wetland feature									
	Pan 1		Pan 2		Pan 3		Pan 6		Selons River	
	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence
PRIMARY DETERMINANTS										
1. Rare & Endangered Species	2	4	2	4	2	4	1	4	2	3
2. Populations of Unique Species	1	4	1	4	1	4	1	4	2	3
3. Species/taxon Richness	2	4	1	4	1	4	1	3	2	4
4. Diversity of Habitat Types or Features	2	3	1	4	2	3	1	3	2	3
5. Migration route/breeding and feeding site for wetland faunal and avifaunal species	3	3	2	3	2	3	1	3	2	3
6. PES as determined by WET Health assessment	3	4	3	4	4	4	3	4	4	4
7. Importance in terms of function and service provision	3	4	2	4	2	4	2	3	3	4
MODIFYING DETERMINANTS										
8. Protected Status according to NFEPA WetVeg	4	4	4	4	4	4	4	4	4	4
9. Ecological Integrity	3	3	2	3	2	3	4	3	3	3
TOTAL	**26**		**18**		**20**		**18**		**24**	
MEAN	**2.89**		**2.0**		**2.22**		**2.0**		**2.67**	
OVERALL EIS	**B**		**B**		**B**		**B**		**B**	

Table 18: Wetland EIS Score for the wetland features with only temporary and seasonal zones located within the subject property.

Determinant	Permanent Wetland feature							
	Pan 4		Pan 5		Wetland 2		Wetland 1, 3-7	
	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence
PRIMARY DETERMINANTS								
1. Rare & Endangered Species	0	3	0	3	0	3	0	4
2. Populations of Unique Species	1	4	1	3	1	3	0	4
3. Species/taxon Richness	1	4	1	3	1	2	1	4
4. Diversity of Habitat Types or Features	1	4	1	3	1	3	1	3
5. Migration route/breeding and feeding site for wetland faunal and avifaunal species	1	3	0	4	1	3	1	3
6. PES as determined by WET Health assessment	3	4	3	4	4	4	3	4
7. Importance in terms of function and service provision	1	3	1	3	1	3	1	4
MODIFYING DETERMINANTS								
8. Protected Status according to NFEPA WetVeg	4	4	4	4	4	4	4	4
9. Ecological Integrity	1	3	1	3	1	4	1	4
TOTAL	**13**		**12**		**14**		**12**	
MEAN	**1.44**		**1.33**		**1.56**		**1.33**	
OVERALL EIS	**C**		**C**		**C**		**C**	

3.3.2 Recommended Ecological Category (REC)

The results of the wetland function assessment and WET-Health assessment, together with the results of the EIS assessment, were used to form the REC. It is thus recommended that the REC for the wetland and pan features not to be mined is improved where possible and no further degradation occurs as a result of the mining activities. Strict mitigation measures needs to be implemented to ensure that the wetland function is restored. This could ensure that the impact on the wetland features and pans that may result in a decrease of the PES can be mitigated as far as possible.

3.4 Wetland Delineation and Sensitivity mapping

During the assessment, the following temporary zone indicators were used:

- Terrain units were used to determine in which parts of the landscape the wetland feature is most likely to occur.
- The soil form indicator was used to determine the presence of soils that are associated with prolonged and frequent saturation, as well as variation in the depth of the saturated soil zone within 50cm of the soil surface. This indicator was used to identify gleyed soils where the soil is a greyish/greenish/bluish colour due to the leaching out of iron. Whilst mottling was not extensive, it was present in the temporary zone. These factors were utilised to aid in determining the location of the wetland zones and their boundaries.
- The vegetation indicator was used in the identification of the wetland boundary through the identification of the distribution of both facultative and obligate wetland vegetation associated with soils that are frequently saturated. Changes in vegetation density and levels of greening were also considered during the delineation process.
- Surface water was absent during the field assessment, but saturated soils were noted within some of the wetland areas.

Despite the fact that the wetland feature shows severe transformation due to alien encroachment and soil alterations, these features could provide habitat for avifaunal and wetland floral species. The following guidelines for buffers around the wetlands are suggested by the Department of Water Affairs (2000):

No person in control of a mine or activity may:

(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding

boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;

The 1:100 year flood-line restriction is the internationally accepted norm for the placement of anything that may be in danger of failing or have a potential safety hazard. This norm is also reflected in section 144 of the National Water Act in respect of the locality of townships. Although certain of the regulations refer to the 1:50 year flood-line requirement (see sub regulations 4(b) below), the aspects referred to in this sub regulation is considered to potentially have a big impact on the water resources, therefore the more conservative minimum requirement is set.

This sub regulation should be interpreted similarly to sub regulation 4(b) below, which stipulates *whichever is the greatest*. This implies that the mine or activity should comply with both requirements stipulated in this sub regulation, namely the 1:100 year flood-line and the horizontal distance of 100m.

The 1:100 year flood-line should be determined by a suitably qualified person, e.g. hydrologist, civil engineer, agricultural engineer, etc., who can professionally be held liable for his/her calculations in the case of a disaster (loss of human life, extreme water pollution, etc.).

*(b) except in relation to a matter contemplated in regulation 10**,** carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest*.

The figure below illustrates the sensitivity of the subject property. High and medium sensitivity areas included pan feature 1 and 3 and 6 and the Selons River with associated 100m buffers. Low sensitivity was allocated to the seasonal wetland sections. The remainder of the site is considered very low due to the complete vegetation transformation of agricultural and plantation activities. The mining activities and structures must also ensure no de-watering of the sensitive wetland areas occur during the mining process as a result of open pit mining methods.

It can be concluded that the mining footprint and activities will have a significant effect on the permanent wetland features (Pan 1-3, 6 and the Selons River) specifically referring to the highly sensitive features should mitigation measures not be implemented. Thus planning of the mining footprint should consider higher sensitivity areas as “no-go” areas. Based on the observations of the study, mining infrastructure should, as far as possible, be limited to the previously disturbed areas, such as the crop fields and plantation areas. Should mining

activity occur within any of the wetland features, relevant authorisation should be deemed according to the National Environmental Management Act (NEMA) 107 of 1998 and Sections 21 c and i of the National Water Act 36 of 1998.

Clean and dirty water systems need to be clearly separated in line with the requirements of Regulation GN704 of the National Water Act (Act 36 of 1998) in order to minimise the impact on the wetland resources on the subject property and on adjacent farms. Specific attention must be paid to preventing decant during both the operational phase of the mine and beyond closure. Specific attention must be given to preventing runoff from dirty water areas or discharge of effluent from reaching the pan features to be retained as well as the Selons River.

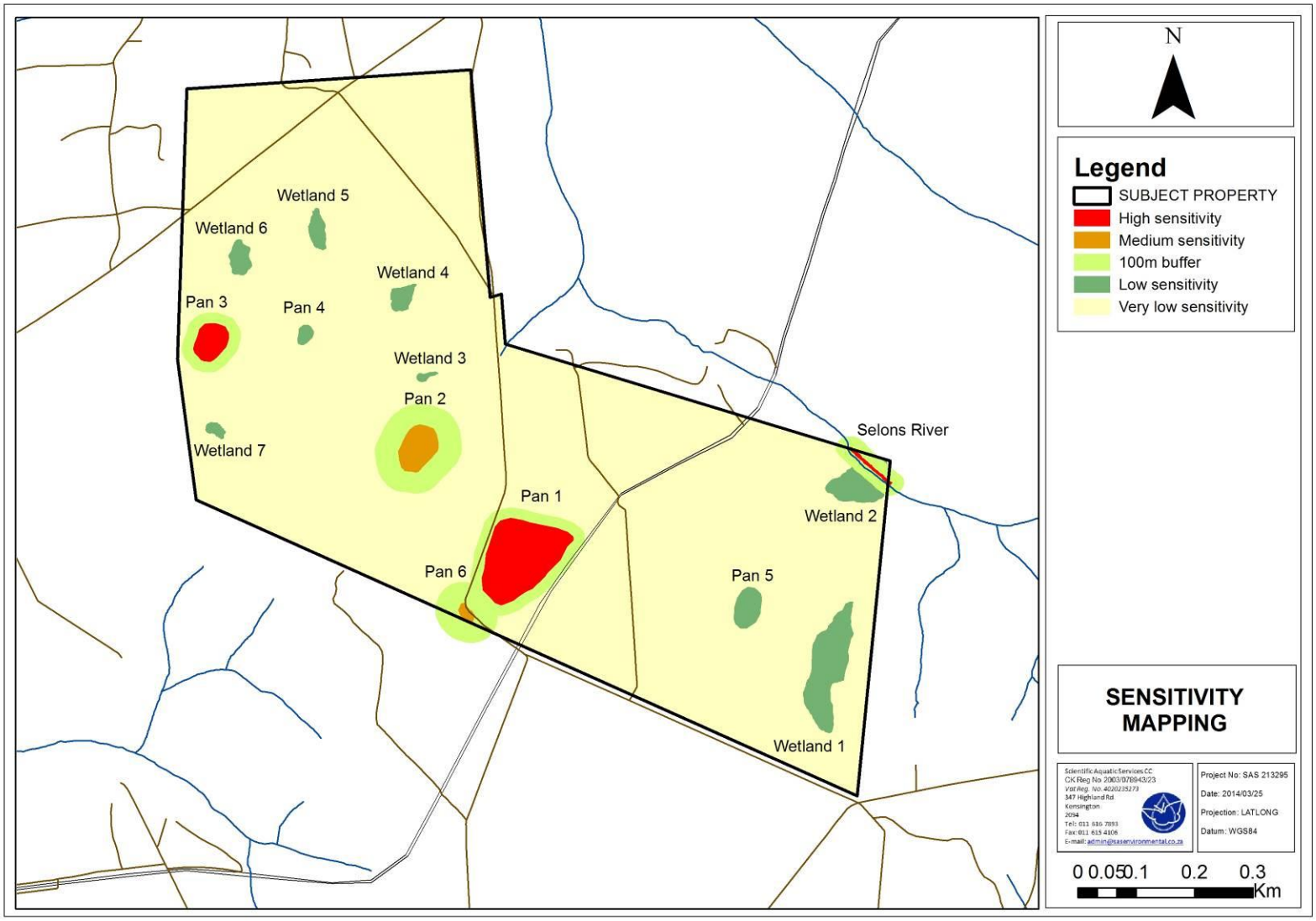

Figure 6: Sensitivity mapping with the associated wetland buffer zone.

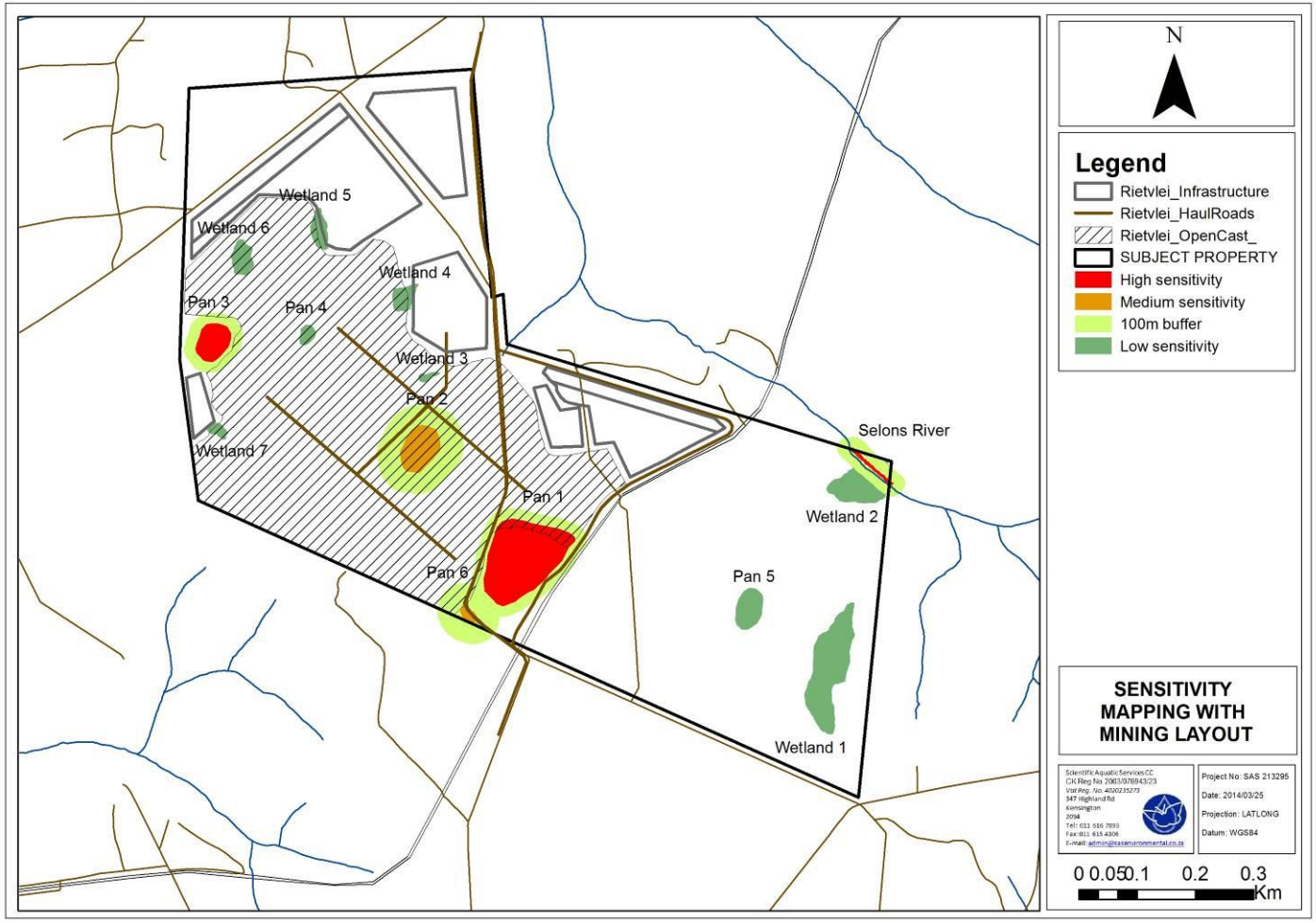

Figure 7: Sensitivity Map with the proposed mining layout for the subject property.

4 IMPACT ASSESSMENT

The tables below serve to summarise the significance of potential impacts on the wetland communities occurring on or directly adjacent to the subject property. A summary of all potential pre-construction, construction, operational and decommissioning and closure phase impacts is provided. The sections below present the impact assessment according to the method described in Section A. In addition, it also indicates the required mitigatory and management measures needed to minimise potential ecological impacts and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures, assuming that they are fully implemented.

4.1 Impact Discussion

All proposed development activities that may result in an impact on the wetland communities of the subject property are discussed below.

4.1.1 IMPACT 1: Loss of wetland habitat and ecological structure

Activities leading to impact

Pre-Construction	Construction	Operational	Decommissioning & Closure
Planning of infrastructure within sensitive wetland areas	Site clearing and the removal of vegetation	Ongoing disturbance of soils with general operational activities	Disturbance of soils as part of demolition activities
Inadequate design of infrastructure leading to risks of pollution	Site clearing and the disturbance of soils	Spillages and seepage of hazardous waste material into the groundwater	Ongoing seepage and runoff from mining infrastructure to the groundwater regime
Inadequate design of infrastructure leading to changes to system hydrology	Earthworks in the vicinity of wetland areas leading to increased runoff and erosion and altered runoff patterns	Risk of discharge from the mining infrastructure	Ongoing risk of discharge from mining infrastructure beyond closure
	Topsoil stockpiling adjacent to wetlands and runoff from stockpiles	Potential contamination from mining infrastructure, general dirty water areas as well as spillages of hydrocarbons, has the potential to contaminate the groundwater environment which in turn can affect water quality in surface water sources in the area	Potential contamination from the decommissioning of mining infrastructure

	Waste material spills and waste refuse deposits into the wetland features	Runoff, seepage and potential discharge from mining infrastructure such as pipelines	Vehicles may impact upon sensitive riparian and wetland areas resulting in a loss of habitat
	Movement of construction vehicles within wetlands	Dumping of hazardous and non-hazardous waste into the wetland areas	Decommissioning activities may lead to wetland habitat transformation and alien plant species proliferation
	Dumping of hazardous and non-hazardous waste into the wetland areas may result in a loss of wetland habitat and ecological structure	Erosion and sedimentation of wetlands	Ineffective rehabilitation may lead to habitat transformation and alien vegetation encroachment
		Inadequate separation of clean and dirty water areas	Ongoing erosion and sedimentation of wetlands
		Loss of instream flow due to abstraction for water for production and the formation of a cone of dewatering from open pits	
		Topsoil stockpiling adjacent to wetlands and runoff from stockpiles may contaminate wetland features	

Aspects of wetland ecology affected

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Direct impact on wetland habitat due to erosion, sedimentation and increased runoff	Direct impact on wetland habitat due to erosion, sedimentation and increased runoff	Direct impact on wetland habitat during decommissioning
	Loss of wetland biodiversity due to vegetation clearance	Loss of wetland biodiversity due to alien floral encroachment	Loss of wetland biodiversity due to alien floral encroachment and mismanagement of wetland rehabilitation
	Contamination of wetland soils and surface water impacting foraging and breeding habitat for wetland/riverine species	Contamination of wetland soils	Ongoing contamination of wetland soils
	Contamination of water within wetlands	Contamination of water within wetlands	Ongoing contamination of water within wetlands
	Compaction and loss of wetland soils	Compaction and loss of wetland soils	Compaction and loss of wetland soils during decommissioning

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Sedimentation and incision leading to altered habitats	Sedimentation and incision leading to altered habitats	Sedimentation and incision leading to altered habitats
	Changes to the wetland community due to alien invasion vegetation leading to altered habitat conditions	Changes to the wetland community due to alien invasion vegetation leading to altered habitat conditions	Changes to the wetland community due to alien invasion vegetation leading to altered habitat conditions
		Dewatering of wetlands and loss of habitat	Continued dewatering of wetlands and loss of habitat

Without Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	4	3	3	3	5	7	11	77 (Medium-High)

Essential mitigation measures:

- A sensitivity map has been developed for the subject property, indicating the various wetland features, which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during the planning/ pre-construction and construction phases of the proposed development activities to aid in the conservation of ecology within the subject property.
- It must be ensured that planning of mining infrastructure includes consideration of adjacent wetland / pan areas to ensure that these areas are avoided as far as possible.
- Development / mining impacts on the affected wetland features should be managed to minimise impacts on adjacent wetland features.
- Edge effects of activities including erosion and alien / weed control need to be strictly managed in these areas.
- Access into adjacent wetland / pan areas, particularly by vehicles, is to be strictly controlled.
- All vehicles should remain on designated roads with no indiscriminate driving through adjacent wetland / pan areas.
- Ensure that all stockpiles are well managed and have measures such as berms and hessian curtains implemented to prevent erosion and sedimentation.
- Run-off from dirty water areas entering wetland habitats must be prevented and clear separation of clean and dirty water in the vicinity of the proposed infrastructure must take place. Oil must be prevented from entering the clean water system.
- Pollution control dams should be off stream structures and not within the natural drainage system of the area, thereby minimising impacts loss of instream flow and downstream recharge.

- Ensure that seepage from dirty water systems is prevented as far as possible.
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.
- All spills should be immediately cleaned up and treated accordingly.
- Appropriate sanitary facilities must be provided for the life of the mine and all waste removed to an appropriate waste facility.
- Effective waste management must be implemented in order to prevent construction related waste from entering the wetland environment.
- All adjacent wetland systems must be monitored for erosion and incision.
- Erosion berms may be installed in any areas where soil disturbances within the vicinity of the wetland features have occurred to prevent gully formation and siltation of the aquatic resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has slope of less than 2%, berms every 50m should be installed.
    - Where the track slopes between 2% and 10%, berms every 25m should be installed.
    - Where the track slopes between 10% and 15%, berms every 20m should be installed.
    - Where the track has slope greater than 15%, berms every 10m should be installed

Recommended mitigation measures

- Restrict construction to the drier winter months if possible to avoid sedimentation of wetland features in the vicinity of the proposed mine development areas.
- Desilt all adjacent wetland areas affected by mining and runoff from dirty water areas.

With Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	3	3	3	4	4	6	11	66 (Medium-Low)

Probable latent impacts:

- Sedimentation of the systems may lead to altered wetland habitats.
- Wetland and riparian habitat within the study area may be permanently altered or lost if mining activities are undertaken within the features and inadequate rehabilitation takes place.
- Erosion and incision of the adjacent wetland areas may occur

4.1.2 IMPACT 2: Changes to wetland ecological and sociocultural service provision

Activities leading to impact

Pre-Construction	Construction	Operational	Decommissioning & Closure
Poor planning leading to the placement of infrastructure within wetland areas	Site clearing and the removal of vegetation	Operational activities within wetland and riparian features presently considered important in terms of biodiversity, tourism and recreation	Closure related activities within wetland and riparian features presently considered important in terms of biodiversity, tourism and recreation
Inadequate design of infrastructure leading to changes to instream habitat that would reduce assimilation capability	Site clearing and the removal of vegetation leading to loss in ecological and sociocultural services dependent on abundance of vegetation present and surface roughness	Ongoing disturbance leading to loss in ecological and sociocultural services dependent on abundance of vegetation present and surface roughness	Site clearing and the removal of vegetation leading to loss in ecological and sociocultural services dependent on abundance of vegetation present and surface roughness
Poor planning leading to the placement of infrastructure within wetland and riparian features leading to loss in ecological and sociocultural services dependent on abundance of vegetation present and surface roughness	Construction of infrastructure leading to changes to instream habitat that would reduce assimilation capability	Loss of water volumes for abstraction by farmers due to abstraction for water for production and the loss of base flow in the riverine resources in the area	Seepage from any latent discard dumps and dirty water areas leading to a loss in ecological and sociocultural services
	Construction related activities resulting in changes to riparian and instream characteristics that are important in terms of flood attenuation, streamflow regulation and sediment trapping	Operation related activities resulting in changes to riparian and instream characteristics that are important in terms of flood attenuation, streamflow regulation and sediment trapping	Decommissioning and closure related activities resulting in changes to riparian and instream characteristics that are important in terms of flood attenuation, streamflow regulation and sediment trapping

Aspects of floral ecology affected

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Loss of phosphate, nitrate and toxicant removal abilities	Loss of phosphate, nitrate and toxicant removal abilities	Loss of phosphate, nitrate and toxicant removal abilities
	Loss of carbon storage capabilities	Loss of carbon storage capabilities	Loss of carbon storage capabilities

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Inability to support biodiversity	Inability to support biodiversity	Inability to support biodiversity
	Loss of water supply to the local community	Loss of water supply to the local community	Loss of water supply to the local community

Without Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	4	3	4	3	5	7	12	84 (Medium-High)

Essential mitigation measures:

- A sensitivity map has been developed for the subject property, indicating the various wetland features, which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during the planning/ pre-construction and construction phases of the proposed development activities to aid in the conservation of ecology within the subject property.
- It must be ensured that planning of mining infrastructure includes consideration of adjacent wetland areas to ensure that these areas are avoided as far as possible.
- All demarcated sensitive zones outside of the construction area must be kept off limits during any development and closure phases of the mine.
- The development footprint area must be limited to what is absolutely essential in order to minimise environmental damage.
- Run-off from dirty water areas entering adjacent wetland habitats must be prevented and clear separation of clean and dirty water in the vicinity of the proposed shaft must take place. Oil must be prevented from entering the clean water system.
- It must be ensured that seepage from dirty water systems is prevented as far as possible.
- It must be ensured that the mine process water system is managed in such a way as to prevent discharge to the receiving environment.
- Edge effects of activities including erosion and alien / weed control need to be strictly managed in wetland areas.
- As much vegetation growth as possible should be promoted within the proposed mine development area in order to protect soils. In this regard, special mention is made of the need to use indigenous vegetation species where hydroseeding, wetland and rehabilitation planting (where applicable) are to be implemented.
- Implement effective waste management in order to prevent construction related waste from entering the wetland environment.
- All wetland areas must be rehabilitated upon decommissioning to ensure that wetland functions are

re-instated during decommissioning and all disturbed wetland areas adjacent to the mining development must be re-vegetated with indigenous wetland species

Recommended mitigation measures

- Desilt all wetland areas affected by mining and runoff from dirty water areas.
- Restrict activities to winter months in order to limit impact on wetland species utilising wetlands as foraging and breeding habitat
- Re-vegetate all disturbed areas with indigenous wetland species.

With Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	3	3	3	3	3	6	9	54 (Medium-Low)

Probable latent impacts

- Ability for features to provide ecological and sociocultural services may be permanently lost or reduced if mining activities are undertaken within 100 meter of the features and inadequate rehabilitation takes place.

4.1.3 IMPACT 3: Impact on wetland hydrological function

Activities leading to impact

Pre-Construction	Construction	Operational	Decommissioning & Closure
Placement of infrastructure within wetland areas	Site clearing and the removal of vegetation leading to increased runoff and erosion	Ongoing disturbance of soils with general operational activities	Disturbance of soils as part of demolition activities
Inadequate design of infrastructure leading to changes in hydrological function and sediment control capacity	Site clearing and the disturbance of soils leading to increased erosion	Earthworks in the vicinity of wetland areas leading to increased runoff and erosion and altered runoff patterns	Earthworks in the vicinity of wetland areas leading to increased runoff and erosion and altered runoff patterns
	Earthworks in the vicinity of wetland areas leading to increased runoff and erosion and altered runoff patterns	Topsoil stockpiling adjacent to wetlands and runoff form stockpiles leading to sedimentation of the system	Movement of construction vehicles within wetlands
	Construction of stream crossings altering stream and base flow patterns and water velocities	Movement of construction vehicles within wetlands	Altered hydrology due to in channel stormwater dams

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Topsoil stockpiling adjacent to wetlands and runoff form stockpiles leading to sedimentation of the system	Altered hydrology due to stormwater channels and dams	Movement of construction vehicles within wetlands
	Movement of construction vehicles within wetlands	Increased runoff volumes due to increased paved and other impervious surfaces	
	Increased runoff volumes due to increased paved and other impervious surfaces	Dewatering of wetlands and loss of habitat	

Aspects of floral ecology affected

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Change in flood peak flows	Change in flood peak flows	Incision of wetland areas and erosion of wetland habitat
	Concentration and canalisation of flow	Concentration and canalisation of flow	Sediment deposition
	Incision of wetland areas and erosion of wetland habitat	Incision of wetland areas and erosion of wetland habitat	
	Sediment deposition	Sediment deposition	

Without Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	3	2	3	3	5	5	11	55 (Medium Low)

Essential mitigation measures:

- A sensitivity map has been developed for the subject property, indicating the various wetland features, which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during the planning/ pre-construction and construction phases of the proposed development activities to aid in the conservation of ecology within the subject property.
- It must be ensured that planning of mining infrastructure includes consideration of adjacent wetland areas to ensure that these areas are avoided as far as possible.
- Keep all demarcated sensitive zones outside of the construction area off limits during development phases.
- Prevent run-off from dirty water areas entering wetland habitats.

- Ensure that seepage from dirty water systems is prevented as far as possible.
- Ensure that the mine process water system is managed in such a way as to prevent discharge to the receiving environment.
- Implement effective waste management in order to prevent construction related waste from entering the wetland environment.
- All wetland areas must be rehabilitated upon decommissioning to ensure that wetland functions are re-instated during decommissioning and all disturbed wetland areas adjacent to the mining development must be re-vegetated with indigenous wetland species.
- It must be ensured that all activities potentially impacting on geohydrological resources are managed according to the relevant DWA Licensing regulations and groundwater monitoring requirements.
- Post closure groundwater management will need to be very carefully managed to ensure that no impact on the wetland areas takes place after mine closure has taken place.
- Future mine planning should ensure that mining activities does not lead to a reduction of stream flow or dewatering of any wetland areas.

Recommended mitigation measures

- Desilt all adjacent wetland areas affected by mining and runoff from dirty water areas.
- Re-vegetate all disturbed areas with indigenous wetland species upon closure

With Management	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
	2	2	2	2	4	4	8	32 (Low)

Probable latent impacts

- Impacts on water quality may affect service provision of wetland features to both the local community and the environment beyond closure.
- Sedimentation of the systems may lead to altered wetland habitats.
- Erosion and incision of the wetland areas may occur

4.2 Impact Assessment Conclusion

Based on the above assessment it is evident that there are three possible impacts on the wetland ecology within the subject property. The table below summarises the findings indicating the significance of the impact before management takes place and the likely impact if management and mitigation takes place. In the consideration of mitigation it is assumed that a high level of mitigation takes place but which does not lead to prohibitive costs.

From the table it is evident that prior to management measures being put in place, all of the impacts are medium-high to medium-low level impacts. If effective management takes place, all impacts could be reduced to a lower level impact with impacts on the loss of wetland habitat and loss of wetland ecoservices being moderately low and impacts on impacted hydrology of the systems being regarded as a low level impact.

Table 19: A summary of the results obtained from the assessment of the wetland ecological impacts.

Impact	Unmanaged	Managed
1: Loss of wetland habitat and ecological structure	Medium-High	Medium-Low
2: Change to wetland ecological and sociocultural service provision	Medium-High	Medium-Low
3: Impact on wetland hydrological function	Medium-Low	Low

4.3 Cumulative impacts

Due to extensive mining and beneficiation in the Middelburg and surrounding areas, along with extensive agriculture, the regional cumulative impacts as a result of loss of wetlands is considered to be highly significant. It is also critically important to consider the general impact from mining activities in the greater Olifants catchment, which includes coal mining as well as platinum group metals and the severe impact from the urban areas of Mpumalanga. In particular, specific mention is made of the impact of urban runoff and the release of treated and raw sewage effluent into the riverine systems in the area. Seepage from mining facilities such as waste dumps, TSF and general dirty water areas, agricultural activities, as well as spillages of hydrocarbons, has the potential to contaminate the groundwater environment which in turn can affect water quality in surface water sources in the area.

Within the Olifants catchment there has been significant impact on wetlands due to erosion, incision, and sedimentation into the wetlands. These impacts have led to the loss of wetlands and the loss of the wetland's ability to function naturally.

Cumulative impacts associated with the mine include:

- The loss of wetland habitat, functioning and ecoservice provision as a result of mining activities within the Middelburg region, which may in turn impact on water resources and vegetation structure.
- Loss of wetland connectivity and dewatering of wetlands due to mining activities will have a detrimental impact on faunal species utilising riparian zones as migratory corridors and the overall biodiversity in the area.

The impact on the wetland resources in the vicinity of the Middelburg operations could lead to an overall reduction of the assimilative capacity of wetlands in the Olifants catchment and lead to a general loss of ecological and socio-cultural services within this important water resource.

5 RECOMMENDATIONS

After conclusion of this ecological assessment, it is the opinion of the ecologists that the proposed activity be considered favourably provided that the following essential mitigation measures as listed below are adhered to:

Mining footprint

- A sensitivity map has been developed for the subject property, indicating the various wetland features, which are considered to be of increased ecological importance. It is recommended that this sensitivity map be considered during the planning/ pre-construction and construction phases of the proposed development activities to aid in the conservation of ecology within the subject property.
- All demarcated sensitive zones outside of the construction area must be kept off limits during any development and closure phases of the mine.
- It must be ensured that planning of mining infrastructure includes consideration of adjacent wetland areas to ensure that these areas are avoided as far as possible.
- Edge effects of activities including erosion and alien / weed control need to be strictly managed in these areas.
- Ensure that seepage from dirty water systems is prevented as far as possible.
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.
- All spills should be immediately cleaned up and treated accordingly.
- Appropriate sanitary facilities must be provided for the life of the mine and all waste removed to an appropriate waste facility.
- Effective waste management must be implemented in order to prevent construction related waste from entering the wetland environment.
- Restrict construction to the drier winter months if possible to avoid sedimentation of wetland features in the vicinity of the proposed mine development areas.

Wetland features

- Development / mining impacts on the affected wetland features should be managed to minimise impacts on adjacent wetland features.

- Run-off from dirty water areas entering wetland habitats must be prevented and clear separation of clean and dirty water in the vicinity of the proposed infrastructure must take place. Oil must be prevented from entering the clean water system.
- Pollution control dams should be off stream structures and not within the natural drainage system of the area, thereby minimising impacts loss of instream flow and downstream recharge.
- All adjacent wetland systems must be monitored for erosion and incision.
- Desilt all adjacent wetland areas affected by mining and runoff from dirty water areas
- It must be ensured that all activities potentially impacting on geohydrological resources are managed according to the relevant DWA Licensing regulations and groundwater monitoring requirements.
- Post closure groundwater management will need to be very carefully managed to ensure that no impact on the wetland areas takes place after mine closure has taken place.
- Future mine planning should ensure that mining activities does not lead to a reduction of stream flow or dewatering of any wetland areas.

Vehicle access

- Access into adjacent wetland / pan areas, particularly by vehicles, is to be strictly controlled.
- All vehicles should remain on designated roads with no indiscriminate driving through adjacent wetland / pan areas.

Soils

- Ensure that all stockpiles are well managed and have measures such as berms and hessian curtains implemented to prevent erosion and sedimentation.
- Erosion berms may be installed in any areas where soil disturbances within the vicinity of the wetland features have occurred to prevent gully formation and siltation of the aquatic resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has slope of less than 2%, berms every 50m should be installed.

- Where the track slopes between 2% and 10%, berms every 25m should be installed.
- Where the track slopes between 10% and 15%, berms every 20m should be installed.
- Where the track has slope greater than 15%, berms every 10m should be installed

Rehabilitation

- As much vegetation growth as possible should be promoted within the proposed mine development area in order to protect soils. In this regard, special mention is made of the need to use indigenous vegetation species where hydroseeding, wetland and rehabilitation planting (where applicable) are to be implemented.
- All wetland areas must be rehabilitated upon decommissioning to ensure that wetland functions are re-instated during decommissioning and all disturbed wetland areas adjacent to the mining development must be re-vegetated with indigenous wetland species.

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