Proposed Dalyshope Mine, Lephalale Limpopo Province.

Project Code: UCD6170

Wetland/Riparian Delineation and Functional Assessment: Confirmation and Update

February 2021

Drafted by
Limosella Consulting Pty Ltd
Reg No: 2014/023293/07
Email: antoinette@limosella.co.za
Cell: +27 83 4545 454
www.limosella.co.za

Prepared for:

Turnberry Office Park,
Grosvenor Rd,
Bryanston,
Johannesburg, 2191.

Declaration of Independence

I, **Antoinette Bootsma**, in my capacity as a specialist consultant, hereby declare that I –

I, **Rudi Bezuidenhoudt**, in my capacity as a specialist consultant, hereby declare that I -

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

Antoinette Bootsma (Pr.Sci.Nat)
Ecologist/Botanist
SACNASP Reg. No. 400222-09

2020.08.01
Date

Rudi Bezuidenhoudt (Pr.Sci.Nat)
Ecologist/Botanist
SACNASP Reg. No. 008867

2020.07.28
Date

COMPLIANCE WITH THE APPENDIX 6 OF THE 2017 EIA REGULATIONS

NR.	CONTENT	REFERENCE
a	A specialist report prepared in terms of these Regulations must contain— details of— i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix C
b	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 2
c	An indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1
cA	An indication of the quality and age of base data used for the specialist report;	Section 1.1
cB	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Table 8 - 12
d	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1
e	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
f	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 5
g	An identification of any areas to be avoided, including buffers;	Section 5.4
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3
j	A description of the findings and potential implications of such findings on the impact of the proposed activity [including identified alternatives on the environment] or activities;	Section 3.1
k	Any mitigation measures for inclusion in the EMPr;	Section 4 & Appendix A
l	Any conditions for inclusion in the environmental authorisation;	Section 5.5
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Appendix A
n	A reasoned opinion— i. [as to] whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Executive Summary
o	A description of any consultation process that was undertaken during the course of preparing the specialist report;	-
p	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	-
q	Any other information requested by the competent authority.	None

Document and Quality Control:

Report name: UCD6170 – Dalyshope Proposed Mine			
Nature of Signoff	**Responsible Person**	**Role/Responsibility**	**Qualifications**
Author	Rudi Bezuidenhoudt	Wetland Specialist	BSc Hons, Unisa Pr.Sci.Nat (008867)
Technical Reviewer	Antoinette Bootsma	Senior Wetland Specialist	MSc *Cum Laude,* Unisa, Environmental Science Pr.Sci.Nat (400222/09)
Document number	**Checked by:**	**Electronic Signature:**	**Date**
Technical Review	Antoinette Bootsma	[signature]	2020.03.09
Client review	Danie Otto	[signature]	2020.06.31
Client review	Byron Bester	[signature]	2021.02.11
Final Report	Rudi Bezuidenhoudt	[signature]	2020.11.12

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EXECUTIVE SUMMARY

Limosella Consulting was appointed by Digby Wells to conduct a wetland delineation and assessment report for the proposed Dalyshope Mine. The Dalyshope Project is a Joint Venture (JV) between Anglo American Corporation (AAC) and Universal Coal plc (Universal). AAC is the holder of a Prospecting Right to extract coal. The Remaining Extent of the Farm Dalyshope 232 LQ and the Remaining Extent of the Farm Klaarwater 231 LQ are the directly affected farm portions with respect to this application process. This application considers the establishment of a contractor operated, truck and shovel opencast mine producing approximately 2.4 million tonnes per annum (Mtpa) of thermal coal product for approximately five years. After five years, the mine will ramp up production to approximately 12 Mtpa of product for approximately 25 years from a single open pit (OC1), giving a total life of mine of 30 years.

Fieldwork was conducted on the 11-13th of February 2020.

The terms of reference for the current study were as follows:

- Delineate the wetland and riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake functional and integrity assessment of wetlands areas within the area assessed as specified in General Notice 267 of 24 March 2017;
- Undertake an impact assessment as specified in the NEMA 2014 regulations,
- Undertake a risk assessment as specified in General Notice 509 in published in the Government Gazette 40713 of 24 March 2017,
- Recommend suitable buffer zones, both generic (as required in GDARD, 2014) and scientific as specified in General Notice 267 of 24 March 2017, following Macfarlane *et al* 2015; and
- Discuss appropriate mitigation and management procedures relevant to the conserving wetland areas on the site.

Three wetland systems were recorded on or directly adjacent to OC1. Only small sections of these wetlands and their associated buffer zones are located within the OC1 area. All three these wetlands are classified as **Non-Perennial Episodic Endorheic Depression Pans.** This term refers to the fact that the depression wetlands that are inward draining and only fill (naturally) with water during high rainfall events where it then remains saturated for only small periods during the year, remaining dry the rest of the year based on historical aerial imagery from Google earth timeline function as well as other available historical imagery available.

The important factors relevant to Environmental Authorisation of the project are summarised in Table below:

<table>
<tr><td rowspan="2"></td><td>Quaternary Catchment and WMA areas</td><td>Important Rivers possibly affected</td></tr>
<tr><td>A41E – 1st WMA Limpopo WMA</td><td>In close proximity to the Limpopo River</td></tr>
<tr><td rowspan="4">Integrity and functional assessment</td><td colspan="2">Present Ecological Status (PES): 1.0 (B – 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. The status of these wetlands is likely to remain stable over the next 5 years.</td></tr>
<tr><td colspan="2">Ecological Importance and Sensitivity (EIS): 1.8 (C - Moderate). Wetlands in this category are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers</td></tr>
<tr><td colspan="2">Recommended Ecological Category (REC): B</td></tr>
<tr><td colspan="2">WetEcoServices: Phosphate trapping - 2.4 Erosion control - 2.4 Flood attenuation- 2.9</td></tr>
<tr><td>Buffer zones</td><td colspan="2">Calculated (Macfarlane et al, 2015): 100 m Operational & 100 m Construction</td></tr>
<tr><td>Does the specialist support the development?</td><td colspan="2">Yes. Given that the mitigation measures are adhered to.</td></tr>
</table>

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1 INTRODUCTION

Limosella Consulting was appointed by Digby Wells to conduct a wetland delineation and assessment report for the proposed Dalyshope Coal Mining Project. The Dalyshope Project is a Joint Venture (JV) between Anglo American Corporation (AAC) and Universal Coal plc (Universal), but AAC remains the holder of a Prospecting Right to extract coal. The Remaining Extent of the Farm Dalyshope 232 LQ and the Remaining Extent of the Farm Klaarwater 231 LQ are the directly affected farm portions with respect to this application process.

This application considers the establishment of a contractor-operated, truck and shovel opencast mine producing approximately 2.4 million tonnes per annum (Mtpa) of thermal coal product for approximately five years. After five years, the mine will ramp up production to approximately 12 Mtpa of product for approximately 25 years from a single open pit (OC1), giving a total life of mine of 30 years.

Fieldwork was conducted on the 11-13th of February 2020.

1.1 Project Description

Opencast strip mining using selective mining techniques was the preferred mining method for this deposit. This method suits coal seams that are situated relatively close to surface and in a consistent, flat lying orientation.

The mine is accessed by a boxcut and ramp arrangement located in the north-east corner of the farm Dalyshope. Overburden material is hauled to spoil until such time as sufficient void has been created within the pit to allow for in-pit tipping. Selective mining of the coal seams is not required due to the specification of the product required but selective mining of the partings will be conducted.

The Run of Mine (ROM) coal will be transported to a ROM stockpile at the top of the pit. The ROM coal will be fed into a pit-head primary crusher from where it will be transported by conveyor belt to the ROM stockpiles before the washing plant.

The mine has an average production rate of 6 Mtpa ROM for the first five years and will then increase to an average production rate of 30 Mtpa ROM for the remaining Life of Mine (LOM). ROM coal from the pit will be crushed in a primary crusher at the pit head. The crushed coal will be transported by conveyor belt from the pit head to stockpiles before the washing plant. Coal will be removed from the stockpile and fed into the plant. The washing plant will be in modular format with two modules each capable of a throughput of 1000 tons per hour.

The discard will be taken by conveyor belt back to the pit head where it will be loaded into trucks to be deposited back into the bottom of the pit. The product will be placed on stockpiles before being transported to market. The product will either be transported by road haulers on the district/provincial road or by means of rail should a rail line prove economically viable.

1.1.1 Water Infrastructure

An initial assessment of the predicted raw and potable water demand for the mining operation has been made. Approximately 5 megalitres per day of water will be required for the first 5 years of the operation. This figure will increase as the larger mine is developed. Various options have been considered for the source of the raw water. These options are:

- Raw water is sourced from the Anglo American coal bed methane project situated approximately 30km due east of the mine. Water is sourced from local sewage treatment plants in Lephalale – this source could already be allocated to third parties and an agreement may be made with said third parties for excess allocation
- Boreholes in the vicinity of the mine
- Allocation from the proposed Mokolo water augmentation scheme
- Raw water drawn from the Limpopo River.

A water treatment plant will be required to treat the raw water brought to the mine. Dirty water and clean water are kept separate. “Dirty” areas are served by a system of lined drains that will gravitate towards polluted control dams (PCD) for storage. These dams are sized to accommodate the run-off from a rain storm with a 1:50 year return period. Polluted water dams will be emptied by pumping the settled water to fully enclosed water tanks for re-use. The water tanks will be fully enclosed to minimise evaporation of the scarce water. Storm water cut off drains and deflection berms have been provided to deflect storm-water from the sites. These clean water drains are sized to accommodate a similar 1:50 year storm. Storm-water is redirected towards the natural watercourses in the area. A bio-filter sewage treatment plant will be installed at the mine complex to process raw sewage. The treated “grey” water from the sewage plant will be combined with the dirty water in the PCD.

1.1.2 Power Infrastructure

As this is a contractor operated mine most of the mining operations is carried out by diesel operated equipment. Only the offices and the bulk material handling facilities will require electricity. Temporary power will be sourced from diesel generators until a firm supply from Eskom can be established.

1.1.3 Other infrastructure

Other infrastructure that will be constructed includes:

- Workshop,
- Two PCDs,
- Offices,
- Change-house,
- Stores;
- Laboratory;
- Water distribution,
- Diesel farm
- Brake-test ramp
- LDV and light vehicle access road
- Truck access road
- Provincial road upgrade from Steenbokpan to the mining site.

1.2 Terms of Reference

The terms of reference for the study were as follows:

- Delineate the wetland and riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake functional and integrity assessment of wetlands areas within the area assessed, as specified in General Notice 267 of 24 March 2017;
- Undertake an impact assessment as specified in the NEMA 2014 regulations (as amended),
- Undertake a risk assessment as specified in General Notice 509 in published in the Government Gazette 40713 of 24 March 2017,
- Recommend suitable buffer zones as specified in General Notice 267 of 24 March 2017, following Macfarlane *et al* 2015 ; and
- Discuss appropriate mitigation and management procedures relevant to the conserving wetland areas on the site and downstream of the site.

1.3 Assumptions and Limitations

- The information provided by the client forms the basis of the planning and layouts discussed.
- All wetlands within 500 m of any developmental activities should be identified as per the Department of Human Settlements, Water and Sanitation (DHWS) regulations. To meet the timeframes constraints for the project, wetlands within the study sites were verified on a fine scale based on detailed soil and vegetation sampling. Wetlands that fall outside of the site, but that fall within 500 m of the proposed activities were delineated based on desktop analysis of vegetation gradients visible from aerial imagery.
- The detailed field study was conducted on a single visit of several days and thus would not depict any seasonal variation in the wetland plant species composition and richness.
- Description of the depth of the regional water table and geohydrological and hydropedological processes falls outside the scope of the current assessment (please refer to Digby Wells specialist reports in this regard).
- Floodline calculations fall outside the scope of the current assessment.
- A Red Data scan, fauna and flora, and aquatic assessments were not included in the current study (please see Digby Wells specialist studies in this regard).
- Species composition described for landscape units aimed at depicting characteristic species and did not include a survey for cryptic or rare species.
- The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters.
- Wetland delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, during spatial data conversions to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the no-go areas identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps, and drawings are presented in the current report may become distorted should they be reproduced by for example photocopying and printing.

- The calculation of buffer zones does not consider climate change or future changes to watercourses resulting from increasing catchment transformation.
- **Some sections of the study area were not accessible during the site visit. Wetlands here have been delineated using aerial photography and other visual cues. This area should ideally be assessed during a follow up study.**

2 Definitions and Legal Framework

This section outlines the definitions, key legislative requirements and guiding principles of the wetland study and the Water Use Authorisation process.

The National Water Act, 1998 (Act No. 36 of 1998) [NWA] provides for Constitutional water demands including pollution prevention, ecological and resource conservation and sustainable utilisation. In terms of this Act, all water resources are the property of the State and are regulated by the DHWS. The NWA sets out a range of water use related principles that are to be applied by DWS when taking decisions that significantly affect a water resource. The NWA defines a water resource as including a watercourse, surface water, estuary or aquifer. A watercourse includes a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake, pan or dam, into which or from which water flows; any collection of water that the Minister may declare to be a watercourse; and were relevant its beds and banks.

The NWA defines a wetland as “land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.” In addition to water at or near the surface, other distinguishing indicators of wetlands include hydromorphic soils and vegetation adapted to or tolerant of saturated soils (DWA, 2005).

Riparian habitat often times performs important ecological and hydrological functions, some similar to those performed by wetlands (DWA, 2005). Riparian habitat is also the accepted indicator used to delineate the extent of a river’s footprint (DWAF, 2005). It is defined by the NWA as follows: “Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse, which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas”.

Water uses for which authorisation must be obtained from DHWS are indicated in Section 21 of the NWA. Section 21 (c) and (i) is applicable to any activity related to a watercourse:

Section 21(c): Impeding or diverting the flow of water in a watercourse; and

Section 21(i): Altering the bed, banks, course or characteristics of a watercourse.

Authorisations related to wetlands are regulated by Government Notice 509 of 2016 regarding Section 21(c) and (i). This notice grants General Authorisation (GA) for the above water uses on certain conditions. This regulation also stipulates that water uses must the registered with the responsible authority. Any activity that is not related to the rehabilitation of a wetland and which takes place within 500 m of a wetland are excluded from a GA under either of these regulations, unless the impacts score as low in the requires risk assessment matrix (DWS, 2016) Such an activity requires a Water Use Licence (WUL) from the relevant authority.

Conditions for impeding or diverting the flow of water or altering the bed, banks, course or characteristics of a watercourse (Section 21(c) and (i) activities) include:
9. (3) (b). The water user must ensure that the selection of a site for establishing any impeding or diverting the flow or altering the bed, banks, course or characteristics of a watercourse works:
(i) is not located on a bend in the watercourse;
(ii) avoid high gradient areas, unstable slopes, actively eroding banks, interflow zones, springs, and seeps.

In addition to the above, the proponent must also comply with the provisions of the following relevant national legislation, conventions and regulations applicable to wetlands and riparian zones:

- Convention on Wetlands of International Importance - the Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP).
- National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA].
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- National Environment Management Protected Areas Act, 2003 (Act No. 57 of 2003).
- Regulations GN R.982, R.983, R. 984 and R.985 of 2014, promulgated under NEMA.
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983).
- Regulations and Guidelines on Water Use under the NWA.
- South African Water Quality Guidelines under the NWA.
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 287 of 2002).
- GN 267 (Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals)

3 Locality of the Study Site

The study site is located near the border of South Africa and Botswana near the town of Lephalale. The project area is located on the following farm portions: Nazarov 685 LQ, Klaarwater 231 LQ, Wynberg 215 LQ, Canada 229 LQ, Dalyshope 232 LQ and a section of Matopi 705 LQ.

The proposed open cast pit (Henceforth known as OC1, the main study area) is only located on the farm Dalyshope 232 LQ and forms the main focus area of the report together with the proposed infrastructure located on a small section of Dalyshope and Klaarwater. The approximate coordinates of the proposed open cast pit is 23°34'11.17"S and 27°14'6.27"E (Figure 1).

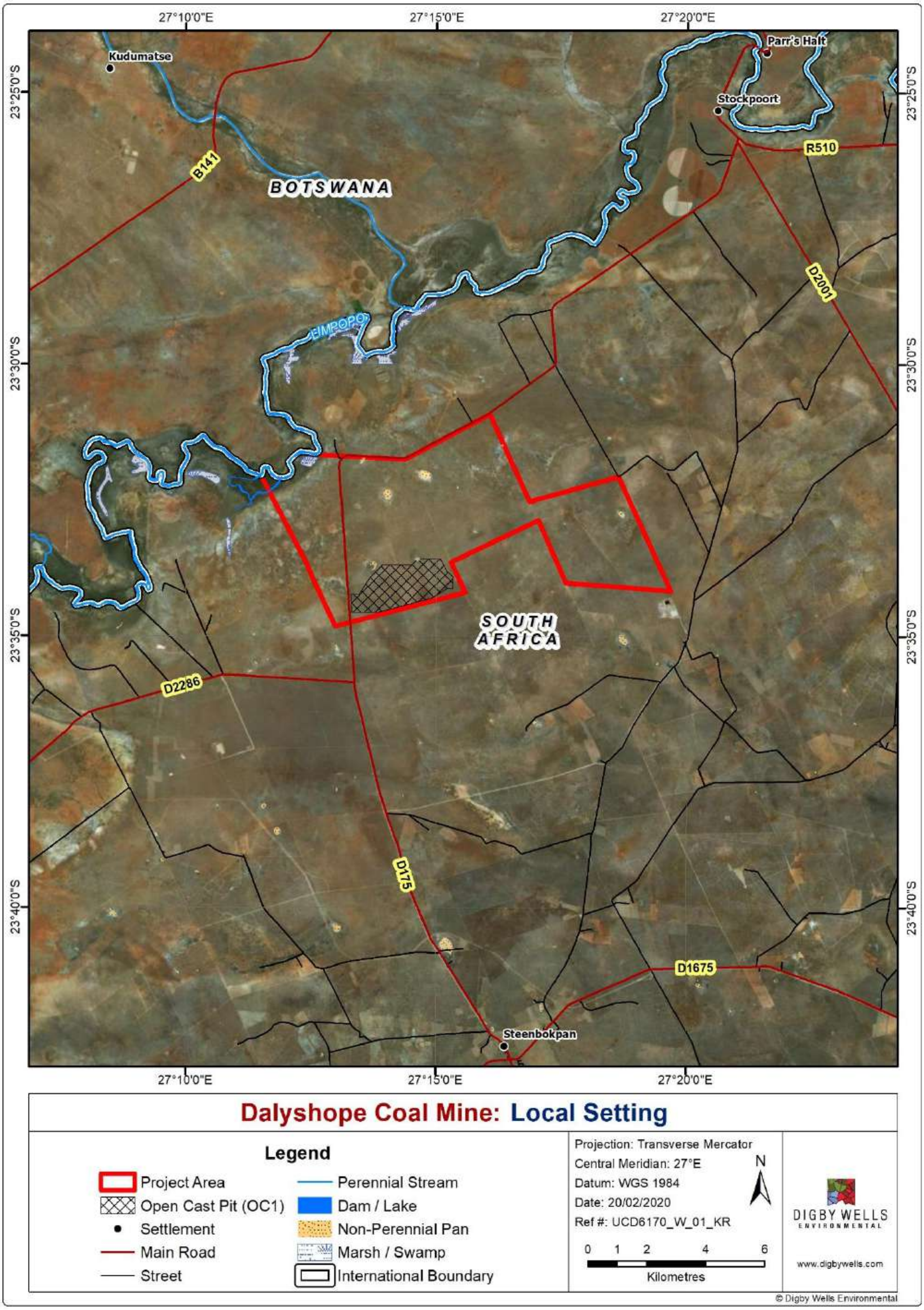

Figure 1: Locality Map Description of the Receiving Environment of the proposed mine.

A review of available literature and spatial data formed the basis of a characterisation of the biophysical environment in its theoretically undisturbed state and consequently an analysis of the degree of impact to the ecology of the study site in its current state.

Quaternary Catchments and Water Management Area (WMA):

As per Macfarlane *et al*, (2009) one of the most important aspects of climate affecting a wetland's vulnerability to altered water inputs is the ratio of Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) (i.e. the average rainfall compared to the water lost due to the evapotranspiration that would potentially take place if sufficient water was available). The site is situated in the Quaternary Catchment A41E. In this catchment, the precipitation rate is much lower than the evaporation rate with a Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) of 0.17. Consequently, watercourses in this area are sensitive to changes in regional hydrology, particularly where their catchment becomes transformed and the water available to sustain them becomes redirected.

Quaternary Catchment A41E is located in the first water management area (WMA), the Limpopo (Government Gazette, 16 September 2016). In this WMA the major rivers include the Limpopo-, Mokolo-, Lephalale-, Mogalakwena-, Sand-, Nzhelele-, Mutale-, and Luvuvhu River.

The watercourses associated with OC1 are classified as Endorheic Depression Pans without channelled inflow. Although the Limpopo River borders the project area in north, the watercourses on the project area are unlikely to drain into the Limpopo River directly.

Hydrology:

Surface water spatial layers such as the National Freshwater Ecosystems Priority Areas (NFEPA) Wetland Types for South Africa (SANBI, 2010) were consulted for the presence of wetlands and rivers. These layers reflect the presence of several small non-perennial pans on the project area and OC1. The north western corner of the project area is bordered by the Limpopo River (Figure 2).

Regional Vegetation:

The proposed mining area falls within the Least threatened **Limpopo Sweet Bushveld** biome (Table 1 & Figure 3) (Mucina & Rutherford, 2012).

Table 1: Conservation status of the Limpopo Sweet Bushveld (Mucina & Rutherford, 2006)

Name of Vegetation type	Limpopo Sweet Bushveld
Code as used in the Book - contains space	SVcb 19
Conservation Target (percent of area)	19%
Description of conservation status	Least threatened
Name of the biome	Central Bushveld
Threats and uses	About 5% transformed, mainly by cultivation.

Geology and soils:

The majority of the Project Area is underlain by Eendagtpan Formation (Figure 4), characterised by Grey, Red or Purple mudstone. With the norther areas adjacent the Limpopo characterised by Alluvium, sandy soil and

River Terrace gravel. Some of the pans are dominated by Cmc (Calcaric) soil form (Figure 5). The main soil form of OC1 is ARo (Ferralic) with the northern section of the Project area classified as Cmx (Chromic).

Limpopo Critical Biodiversity areas and Biodiversity Sector Plan

Critical Biodiversity Areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). These form the key output of a systematic conservation assessment and are the biodiversity sectors inputs into multi-sectoral planning and decision-making. CBA's are therefore areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses (Desmet *et al*, 2009).

In addition, the assessment also made provision for Ecological Support Areas (ESA's), which are areas that are not essential for meeting biodiversity representation targets/thresholds but which, nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas (Desmet *et al*, 2009).

The biodiversity map indicates where Critical Biodiversity Areas (CBA's) occur. CBA's are Terrestrial (T) and Aquatic (A) features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). The CBA's are ranked as follows:

- CBA 1 (including PA's, T1 and A1) which are natural landscapes with no disturbances and which is irreplaceable in terms of reaching conservation targets within the district;
- CBA2 (including T2 and A2) which are near natural landscapes with limited disturbances which has intermediate irreplaceability with regards to reaching conservation targets; and
- In addition, Ecological Support Areas (ESA's) that support key biodiversity resources (e.g. water) or ecological processes (e.g. movement corridors) in the landscape are also mapped. ESA's are functional landscapes that are moderately disturbed but maintain basic functionality and connect CBA's.

The spatial priorities are accompanied by a set of land-use guidelines with the purpose promoting the effective management of biodiversity as required in Section 41(a) of the Biodiversity Act (Act 10 of 2004, as amended) and in terms of the National Environmental Management Act (Act 107 of 1998, as amended). The guidelines provide advice on which land-uses and activities are most compatible with maintaining the ecological integrity of CBAs and ESAs, and other parts of the landscape, based on the desired management objectives for the land and the anticipated impact of each land-use activity on biodiversity patterns and ecological processes (MPSP, 2015).

Based on the described methods the proposed mine and OC1 are located on a section classified as (Figure 6):

- OC1 – Currently undefined; and
- Project Area – Large section classified as CBA1.

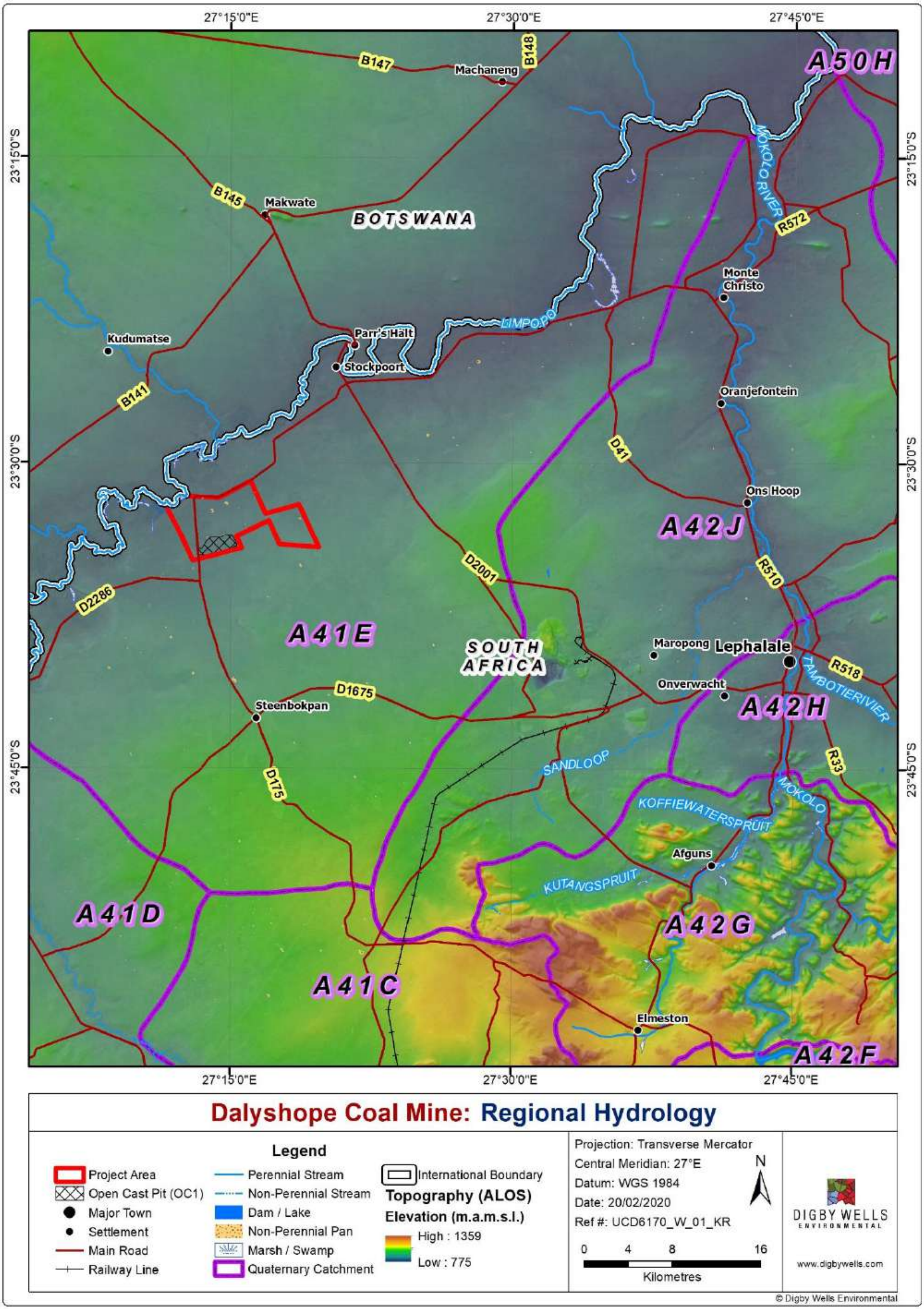

Figure 2: Regional hydrology of the proposed mine.

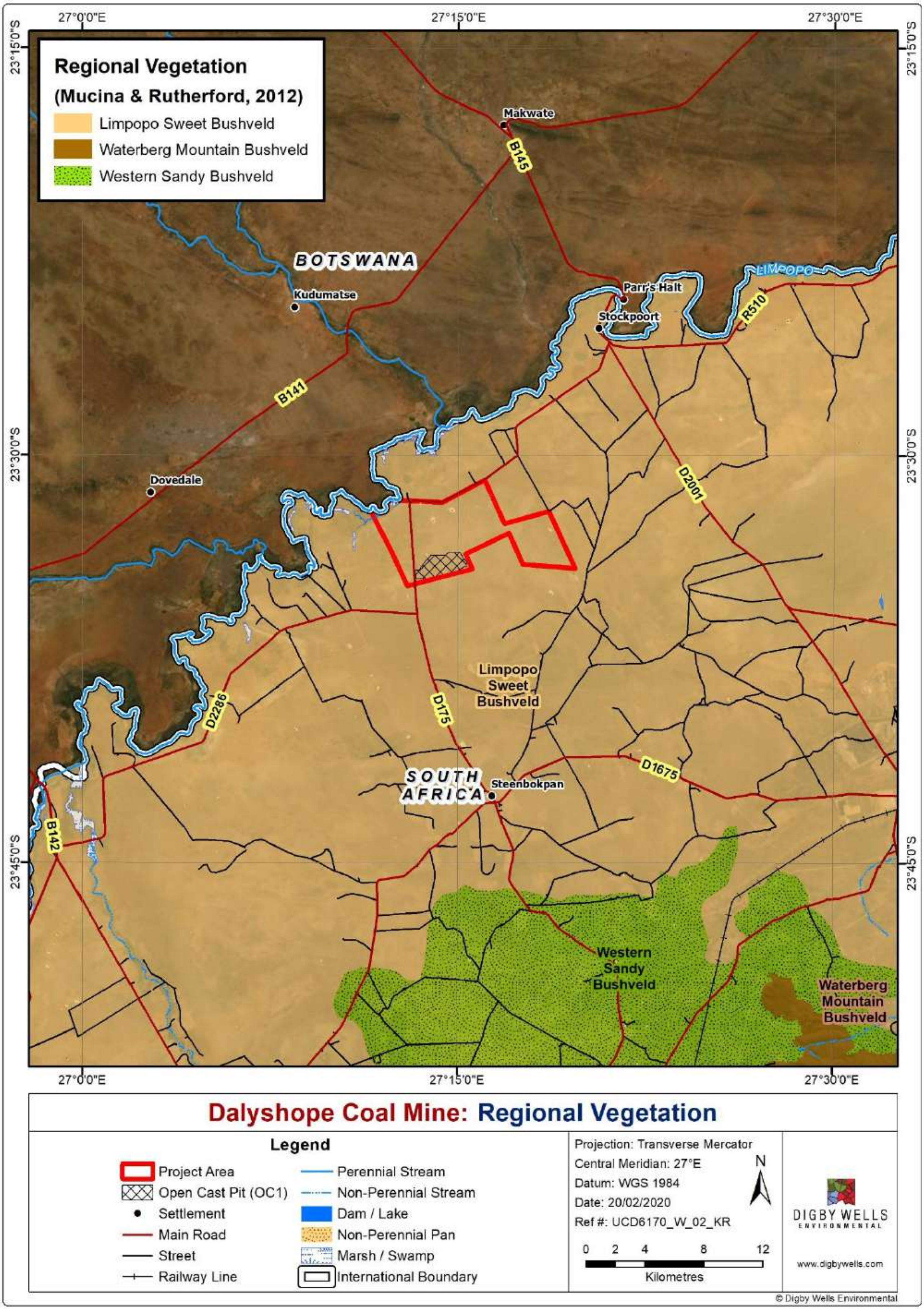

Figure 3: Vegetation of the study site.

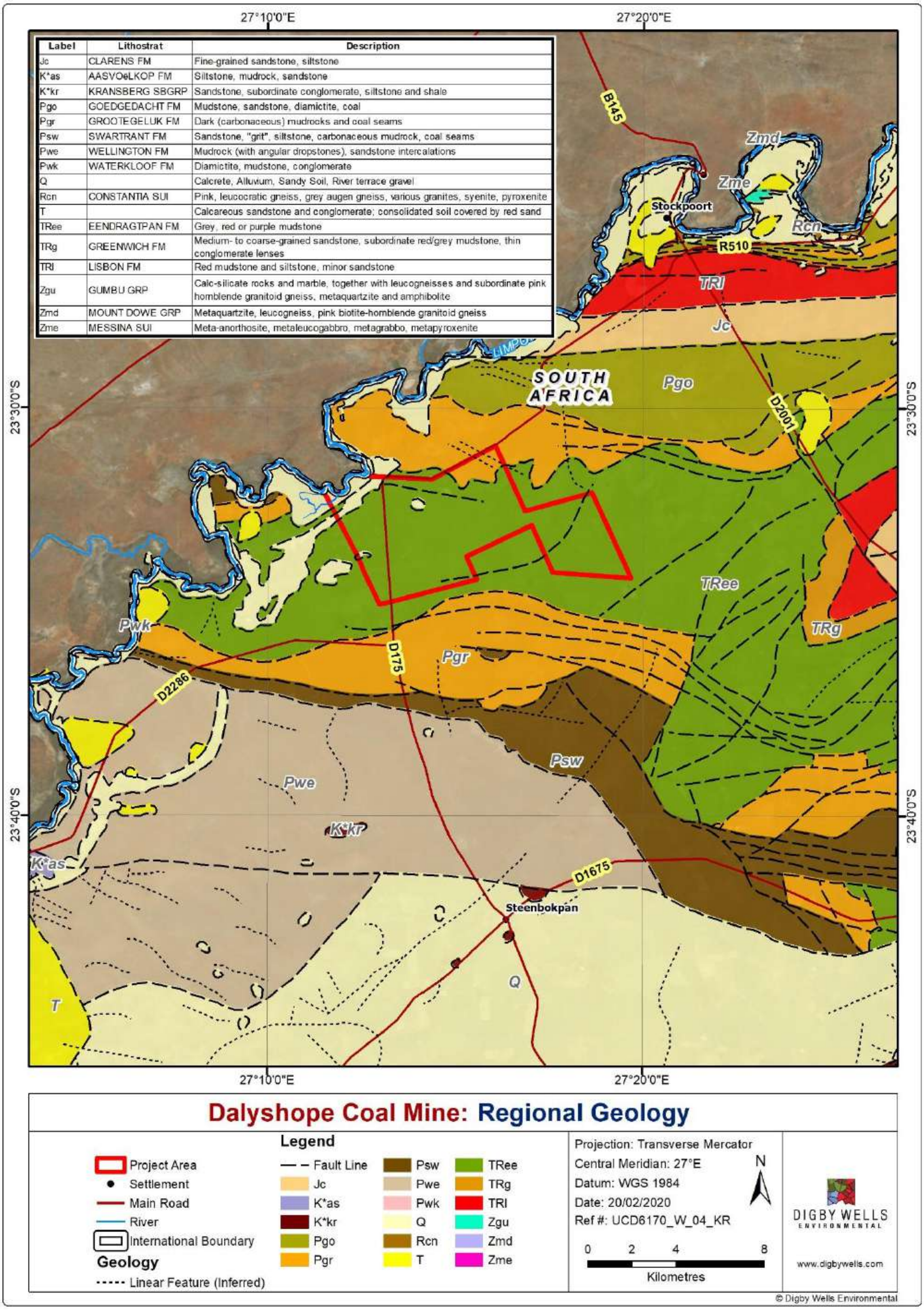

Figure 4: Regional geology of the area (ENPAT) of the proposed mine.

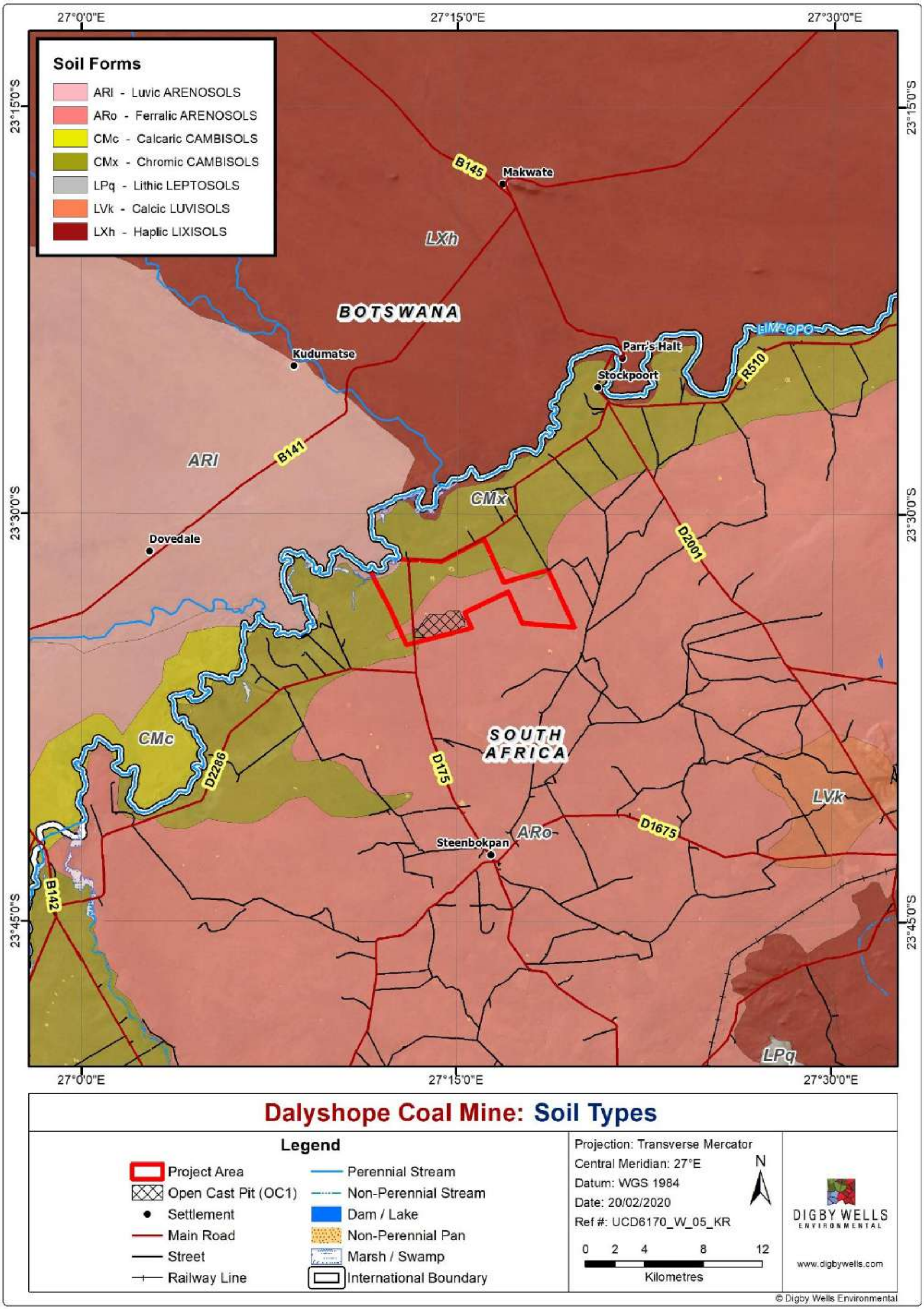

Figure 5: Regional soil of the area of the proposed mine.

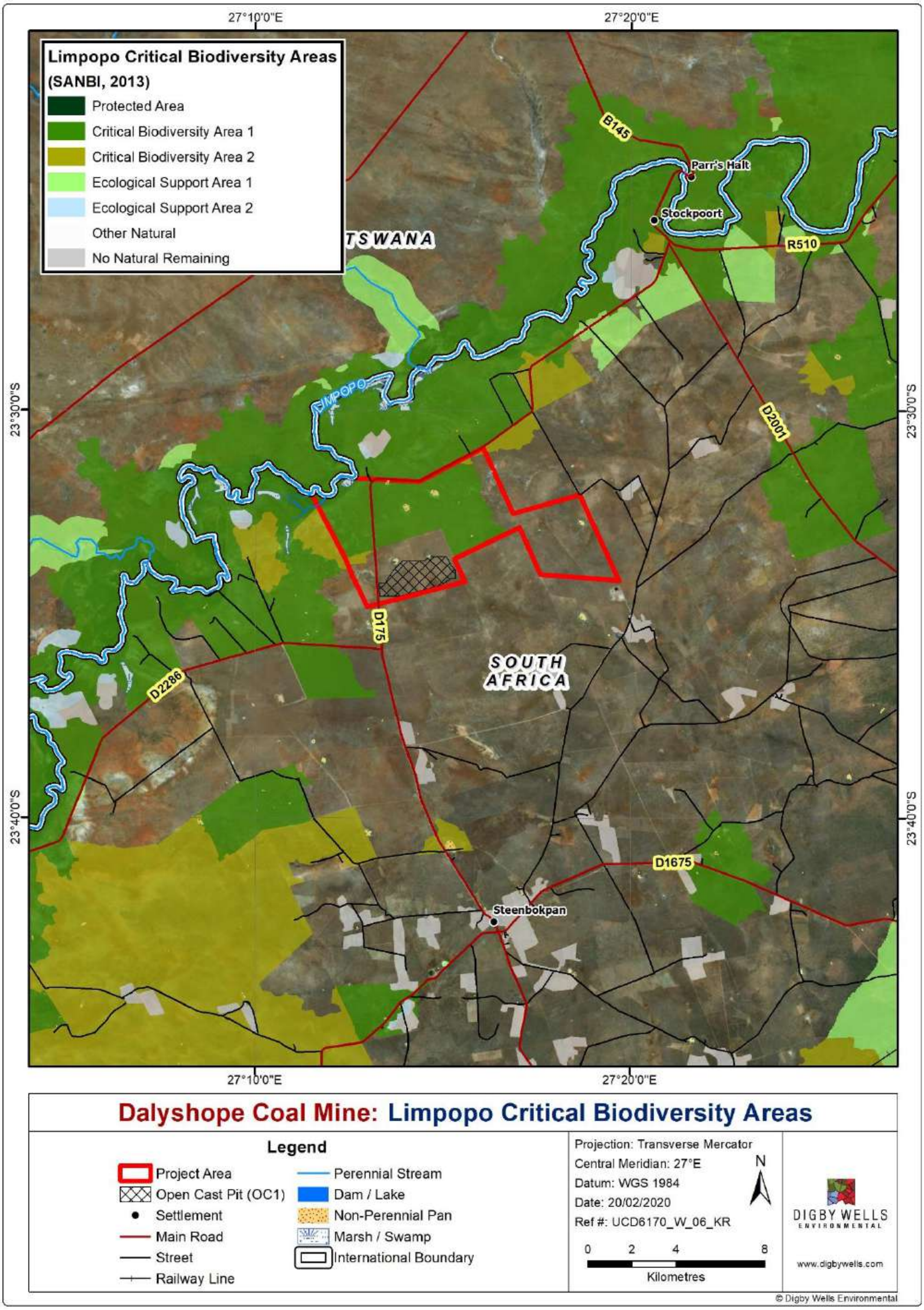

Figure 6: Limpopo Conservation Areas associated with the proposed mine.

4 METHODOLOGY

The delineation method documented by the DHWS in their document "Updated manual for identification and delineation of wetlands and riparian areas" (DWAF, 2008), and the Minimum Requirements for Biodiversity Assessments (GDACE, 2014) as well as the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis et al, 2013) was followed throughout the field survey. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas such as soil and vegetation forms as well as the terrain unit indicator.

A hand held Garmin Montana 650 and/or a Samsung S10 smartphone was used to capture GPS co-ordinates in the field. 1:50 000 cadastral maps and available GIS data were used as reference material for the mapping of the preliminary watercourse boundaries. These were converted to digital image backdrops and delineation lines and boundaries were imposed accordingly after the field survey. Applications used on the smartphone includes GPX Viewer Pro and Google Earth.

Following a desktop assessment and previous wetland report (Digby Wells, 2013) highlighted wetlands areas were identified to be groundtruthed in the field, soil and vegetation sampling on site informed a fine scale delineation. Functional and integrity assessments were conducted to indicate the baseline status of the wetlands identified. In the current study the wetland area was assessed using, WET-Health (Macfarlane et al, 2007), EIS (DWAF, 1999) and Wet-EcoServices, (Kotze et al, 2006). The assessment of potential impacts follows the 2014 NEMA regulations (as amended).

In order to ease the legibility of the report, details regarding the methods used in each phase of the wetland assessment are presented in Appendix A.

5 Results and Discussion

5.1 Land Use, Cover and Ecological State

The total project area comprises approximately 4970 hectares with OC1 only occupying 542 ha. Only small sections of OC1 is occupied by depression pans which account to 35.41 ha including their calculated buffer zones. No other wetlands are located within 500 m of the three depression pan wetlands recorded on the OC1 study area.

Currently the majority of OC1 is used for cattle farming, as well as some game farming. The land has undergone only small changes from as early as 1955 (Figure 8) and subsequently the vegetation composition of the study area has remained fairly consistent since 1955. The ecological integrity of the study area remains high. This is due to the small historical development footprint. A large number of avifaunal and faunal species, as well as floral species, were recorded during the site visit, although they do not form the focus of this assessment.

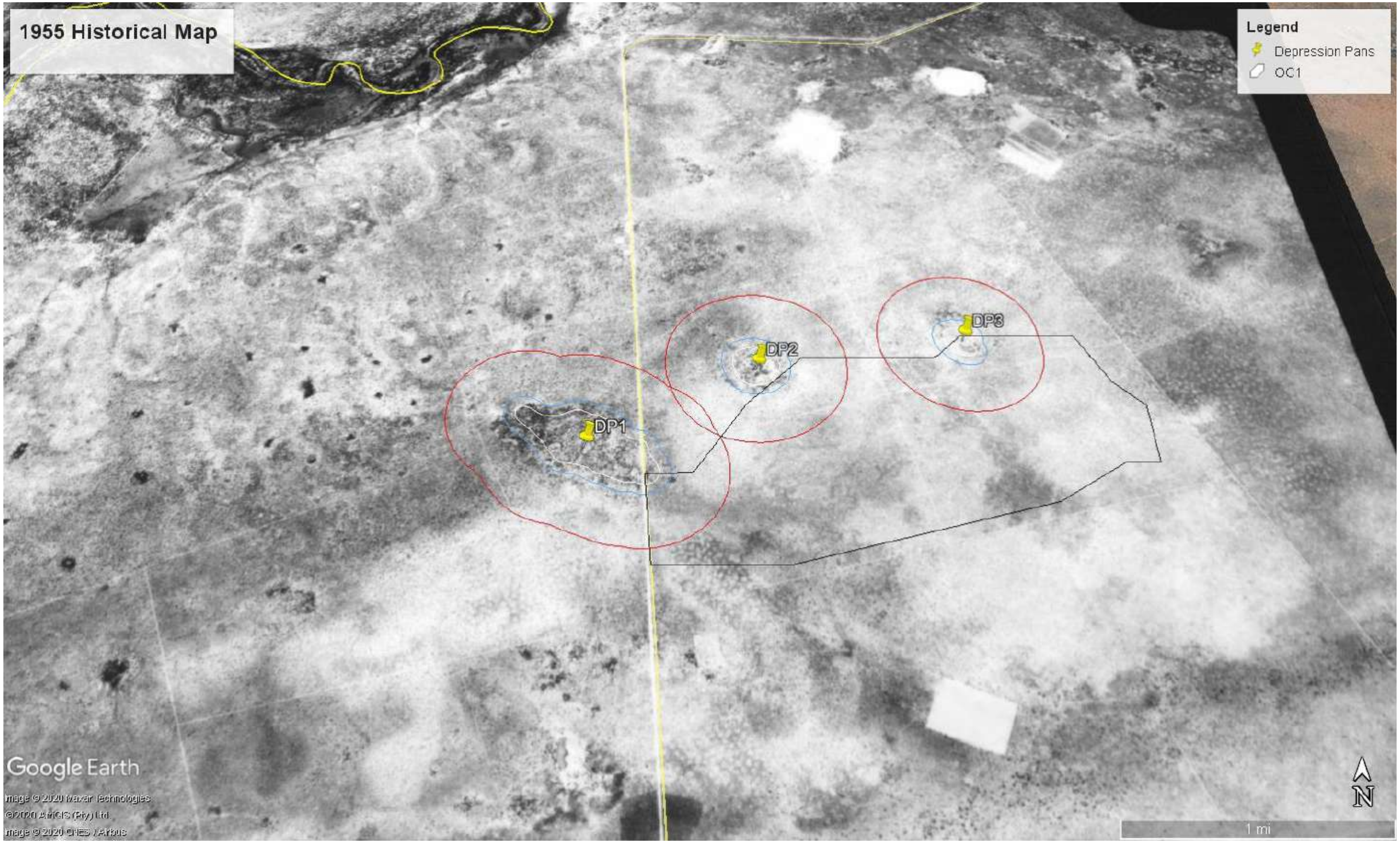

Figure 7:1955 Historical aerial image of the project area with focus on OC1, indicating no significant changes in the environment. Points 1, 2 and 3 indicate the wetlands likely to be directly impacted by the proposed mining.

5.2 Wetland Classification and Delineation

Three wetland were recorded on or directly adjacent to OC1. Only small sections of these wetlands and the associated buffer zones are located on the OC1 area. It should be noted that a significant area of proposed infrastructure is located in wetland DP2 as set for the future life of the mine.

All three these wetlands are classified as **Non-Perennial Episodic Endorheic Depression Pans** (Figure 9)**.** Indicating that the depression wetlands only fill (naturally) with water during high rainfall events where it then remains saturated for only small periods during the year, remaining dry the rest of the year. Based on the vegetation occurring in the pan, it can be described as dominated by grassland or wooded. In this case all three wetlands (DP1, DP2 and DP3) are classified as wooded depression pans.

Although no consensus has been reached regarding the formation of pans (Marshall and Harmse, 1992), Goudie & Wells (1995) suggested that **pans** are generally formed by aeolian deflation on susceptible surfaces (Goudie & Wells, 1995). However, five models have been proposed (Verhagen, 1991; De klerk *et all*, 2016; Goudie & Wells, 1995) (Figure 10):

- *The biogenetic model:* This model suggests that pans were frequently visited by hoofed animals to obtain water and salt.
- *The deflation model:* This model considers wind deflation as the main factor in the formation and propagation of pans
- *Drainage derangement:* The choking of drainage lines
- *The lithological model:* This model suggests that the underlying lithology is the decisive factor in pan formation.
- *The ecological model: "*This model incorporates the principles of excavation by hoofed animals and deflation and states that these depressions continued to be excavated until there was an absence of animals, which then allowed the depression to be re-colonized by vegetation. The resulting soil formation and humus production caused the soil water to become more acidic and leach into the pan floor and flanks, allowing perched water to infiltrate. This reduced the depression's salinity and stimulated further plant development. Gradually the depression becomes increasingly filled with sand and soil until it is again frequented by animals. Where animals are absent, the depression may disappear when it is completely filled with plants"

It is likely that pans are formed by a combination of these models as opposed to only one model. System such as pans are dynamic and ever-changing and in order to understand each pan independently these systems should be studied based on their substrate composition, hydrological function, water quality and quantity, and species composition (De Klerk *et al,* 2016)

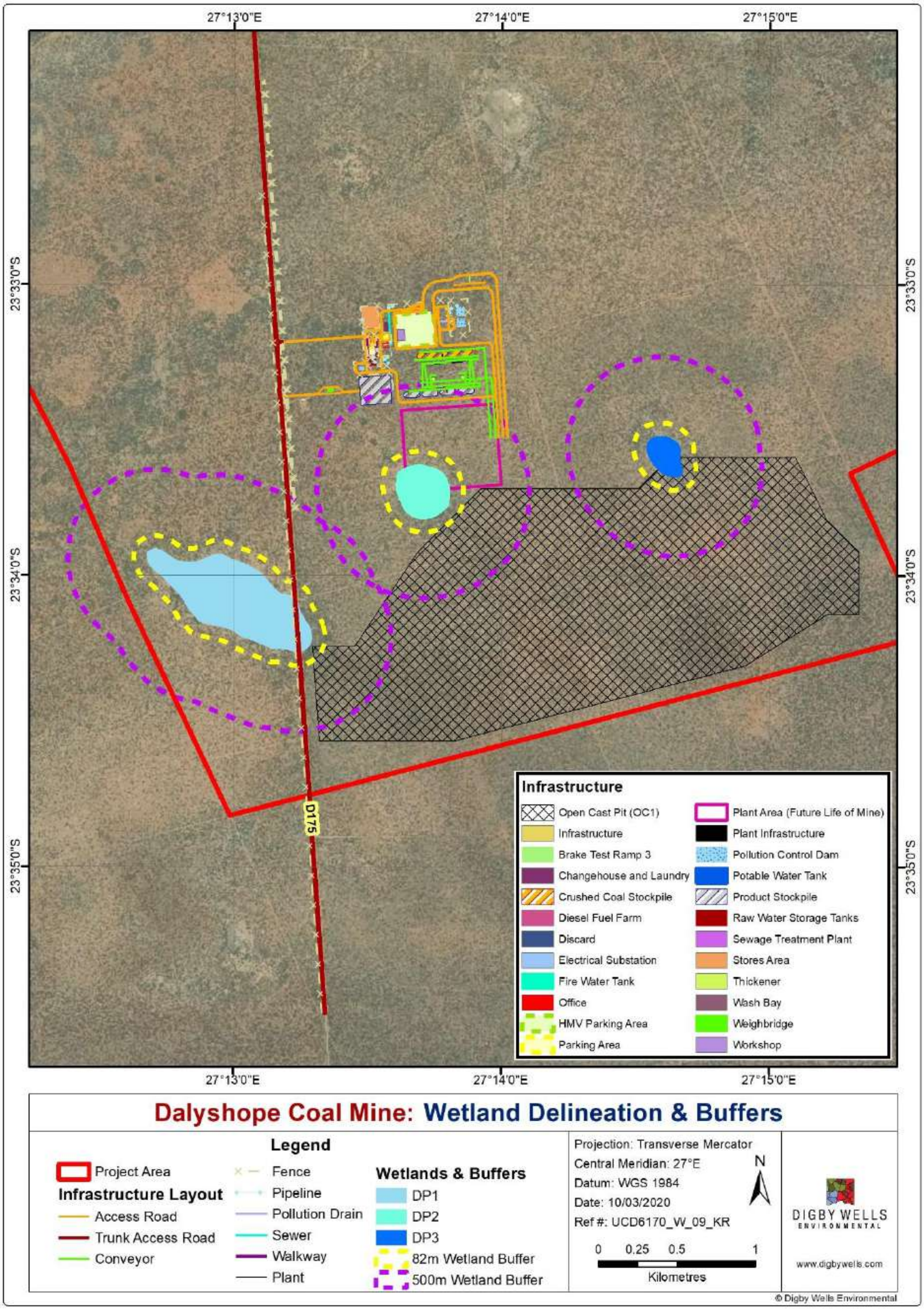

Figure 8: Preliminary Wetland delineation for OC1. White indicates the wetland boundary, Blue indicates the 100 m calculated buffer zone, and purple indicates the 500 m regulated area.

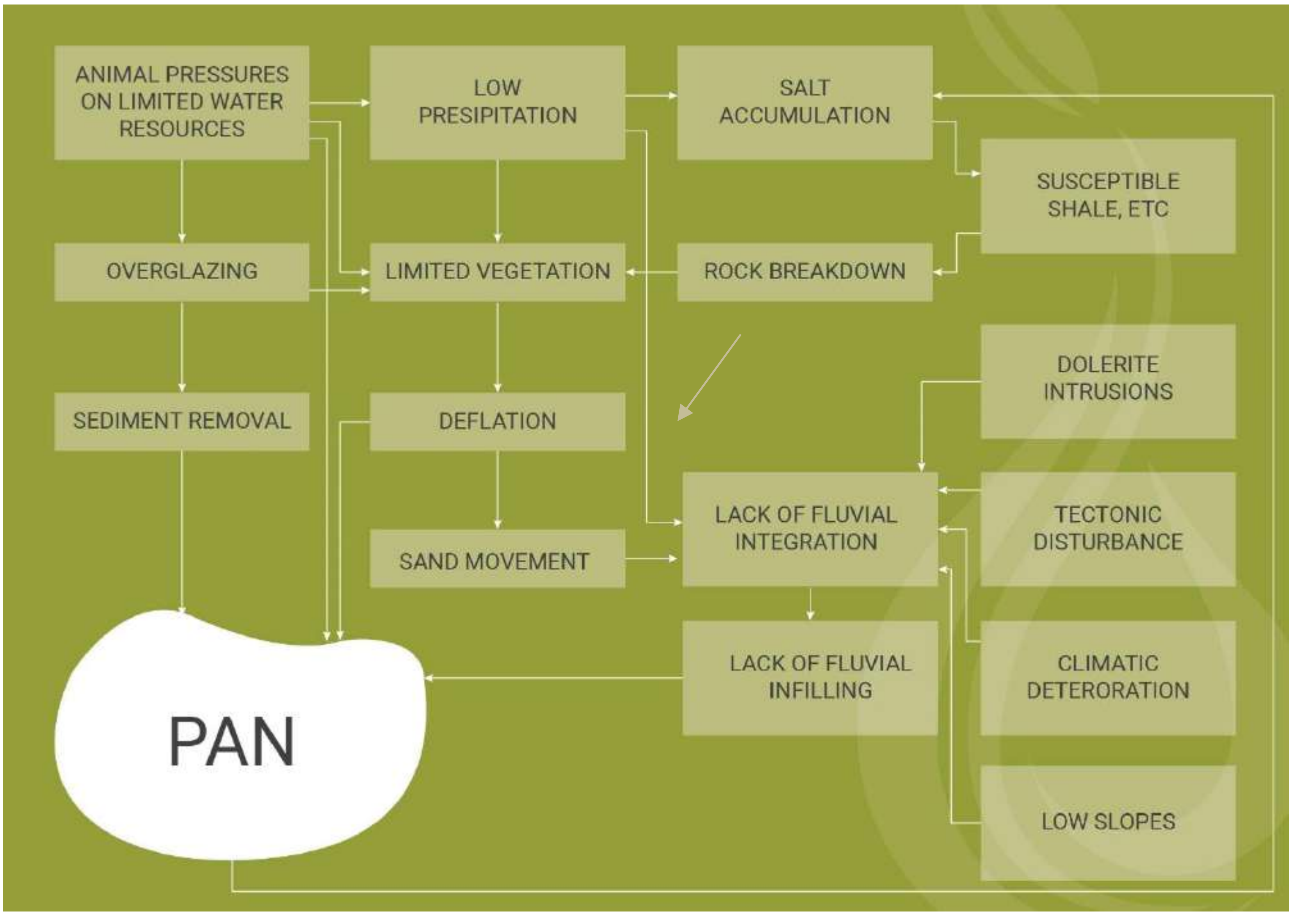

Figure 9: A model of pan development (Goudie & Thomas, 1995).

5.2.1 Soil Indicators & Vegetation Indicators

The depression pans are weakly developed and is unlikely to hold water for large periods of time. The dominant soil of the three pans were identified as Longlands soil. The soil was characterised by an albic subsoil on top of a soft plinthic layer. Longlands soil can be described as a potential seasonal to temporary wetland soil. Manganese may be associated with iron in some plinthic materials in this soil form. An absolute enrichment with iron oxides can occur in situations where intermittent wetness from a fluctuating water table and gives rise to the reduction and mobilization of iron and its migration and reprecipitation as mottles, nodules, concretions and vesicular cement (ferricrete). The wetland soils had a high clay content with clear redoximoprhic features such as mottling. This layer is forms a barrier to the vertical infiltration of surface water (SCWG, 2018).

The soil samples indicated various redoximorphic features consistent with wetland soils such as mottling and gleying which is easily distinguished from the terrestrial soil forms of the area which consisted of thick red apedal soil of the Hutton form.

Figure 10: Soil characteristics showing clear signs of mottling (Top right and Left) and an indication of Longlands soil showing an orthic topsoil horizon on an albic subsoil horizon on a soft plinthic layer (Bottom)

The vegetation of the depression pans is characterised by terrestrial woody species similar in composition to the surrounding terrestrial areas but in higher densities and abundance in the pan areas (Figure 12). The dominant woody species of the pan and the pan fringes include: *Vachellia erioloba, Vachellia karroo, Senegalia mellifera, Vachellia tortilis, Boscia albitrunca, Boscia foetida, Carissa bispinosa, Chamaecrista mimosoides, Combretum apiculatum, Combretum hereroense, Combretum* imberbe, *Dichrostachys cinerea, Elephantorrhiza elephantine, Grewia bicolor, Grewia flava, Sclerocarya birrea, Terminalia sericea* and *Ziziphus mucronata.*

Figure 11: General characteristics of the pan wetlands including dense woodland vegetation and some grass and herbaceous cover.

Some remnants of pipes and water pumping infrastructure were recorded in two of the pans suggesting that water has been pumped in these areas at least during some periods. In these areas hydrophytic vegetation was recorded in a higher number than in the rest of the pan area. The hydrophytic plants recorded in the pans include: *Kyllinga alba, Marsilea ephippiocarpa, Fuirena pachyrrhiza, Schoenoplectus muricinux, Pycreus betschuanus* and *Schoenoplectus decipiens.*

Only a small number of exotic/invasive plant species were recorded on the study area and specifically within the pan wetlands. *Sesbania bispinosa* was recorded in dense stands in the pans were water remains for longer (possibly pumped), other species include *Schkuhria pinnata.* The grass species *Chloris virgate,* which is a good indicator of disturbance was also recorded within disturbed areas in the pans. Several other grass species were recorded such as: *Cynodon dactylon, Digitaria eriantha, Enneapogon cenchroides, Eragrostis pallens,* *Eragrostis rotifer, Melinis repens subsp. repens, Panicum repens*, *Setaria incrassate* and *Urochloa mosambicensis.*

Other species recorded include: *Cucumis sp., Harpagophytum procumbens, Hibiscus physaloides, Hibiscus trionum, Ipomoea hackeliana, Momordica balsamina, Pupalia lappacea, Ruellia patula, Sansevieria aethiopica* and *Sarcostemma viminale.*

5.3 Wetland Functional Assessment

As previously mentioned the area in general including the depression pans have undergone few major changes since as early as 1955. The main concerns related to wetland functionality is the area where water naturally, and possibly artificially by means of pumped-water, pools within the pans. These pools function as watering areas for the cattle and wildlife located on the farm. This leads to some degree of trampling, which leads to an increase in sedimentation and in some cases the footpaths create flow paths. The impact on the hydrology is, however, limited.

The vegetation composition of the pans is mostly natural with only small section where invasion of *Sesbania bispinosa* has occurred in the pools within the pans. The geomorphology of the pans is dynamic and as a result will have some changes from time to time. These are considered to be a natural part of the dynamics of pan wetlands. Only DP1 has a road and fences that transect the wetland and thus have some impact due to water and sediment input from the dirt road.

The three depression wetlands are very similar to each other with the same general impacts, hydrology, geomorphology and vegetation. They have thus been assessed together and share the same scores.

5.3.1 Scores

DP2 and DP3 scored a PES of **B - 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. The wetland conditions recorded on the study site are likely to remain stable over the next 5 years. DP1 is more impacted with a regional road bisecting the pan along with fencing on both sides and subsequently scored a PES of **C - Moderately modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact. The wetland conditions recorded on the study site are likely to remain stable over the next 5 years. With the PES scores of the wetland are reflected in Table 2 below.

The ecosystem services provided by the wetland on the study site is summarised in the table below (Table 3). The table lists scores from the lowest scores to the highest.

Table 2: Summary of hydrology, geomorphology and vegetation health assessment for the depression pans wetlands on the study site (Macfarlane *et al,* 2009).

Wetland Unit	Hydrology		Geomorphology		Vegetation		Overall Score	
	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
DP1	2.6	0	1.5	0	1.6	-1	2.0	0
PES Category and Projected Trajectory	**C**	→	**B**	→	**B**	↓	**C**	→
DP2 & DP3	1.1	0	0.8	0	1.2	-1	1.0	0
PES Category and Projected Trajectory	**B**	→	**A**	→	**B**	↓	**B**	→

Table 3: Results and brief discussion of the Ecosystem Services provided by the wetland on the study site.

Function	Score	Significance
Cultural significance	0.3	Very Low
Water supply for human use	0.4	Very Low
Natural resources	0.4	Very Low
Cultivated foods	0.4	Very Low
Streamflow regulation	0.7	Very Low
Education and research	0.8	Very Low
Threats	1.0	Low
Opportunities	1.0	Low
Carbon storage	1.3	Low
Tourism and recreation	1.6	Low
Nitrate removal	2.1	Moderate
Toxicant removal	2.1	Moderate
Sediment trapping	2.2	Moderate
Maintenance of biodiversity	2.3	Moderate
Phosphate trapping	2.4	Moderate
Erosion control	2.4	Moderate
Flood attenuation	2.9	Moderate

Ecological Importance and Sensitivity (EIS)

The EIS score of **1.8** for the wetlands fall into a category characterised by **Moderate** ecological importance and sensitivity. Wetlands that fall into this category are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers (DWAF, 1999) (Table 4).

Table 4: WIS including EIS scores obtained for the wetland on the study site. (DWAF, 1999).

WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Ecological importance & sensitivity	**1.8**	**3.0**
Hydro-functional importance	1.1	2.5
Direct human benefits	0.3	3.0

5.4 Buffer Zones

A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted (DWAF, 2005). A development has several impacts on the surrounding environment and on a wetland. The development changes habitats, the ecological environment, infiltration rate, amount of runoff and runoff intensity of the site, and therefore the water regime of the entire site. An increased volume of stormwater runoff, peak discharges, and frequency and severity of flooding is therefore often characteristic of transformed catchments. The buffer zone identified in this report serves to highlight an ecologically sensitive area in which activities should be conducted with this sensitivity in mind.

Table 3: Generic functions of buffer zones relevant to the study site (adapted from Macfarlane *et al*, 2010)

Primary Role	Buffer Functions
Maintaining basic aquatic processes, services and values.	• Groundwater recharge: Seasonal flooding into wetland areas allows infiltration to the water table and replenishment of groundwater. This groundwater will often discharge during the dry season providing the base flow for streams, rivers, and wetlands.
Reducing impacts from upstream activities and adjoining land uses	• Sediment removal: Surface roughness provided by vegetation, or litter, reduces the velocity of overland flow, enhancing settling of particles. Buffer zones can therefore act as effective sediment traps, removing sediment from runoff water from adjoining lands thus reducing the sediment load of surface waters. • Removal of toxics: Buffer zones can remove toxic pollutants, such hydrocarbons that would otherwise affect the quality of water resources and thus their suitability for aquatic biota and for human use. • Nutrient removal: Wetland vegetation and vegetation in terrestrial buffer zones may significantly reduce the amount of nutrients (N & P), entering a water body reducing the potential for excessive outbreaks of microalgae that can have an adverse effect on both freshwater and estuarine environments. • Removal of pathogens: By slowing water contaminated with faecal material, buffer zones encourage deposition of pathogens, which soon die when exposed to the elements.

Buffer zones have been shown to perform a wide range of functions and have therefore been widely proposed as a standard measure to protect water resources and their associated biodiversity. These include (i) maintaining basic hydrological processes; (ii) reducing impacts on water resources from upstream activities and adjoining landuses; (iii) providing habitat for various aspects of biodiversity. A brief description of each of the functions and associated services is outlined in Table 3 above.

Despite limitations, buffer zones are well suited to perform functions such as sediment trapping, erosion control and nutrient retention which can significantly reduce the impact of activities taking place adjacent to water resources. Buffer zones are therefore proposed as a standard mitigation measure to reduce impacts of land uses / activities planned adjacent to water resources. These must however be considered in conjunction with other mitigation measures.

Figure 7 images represent the buffer zone setback for the wetlands discussed in this report.

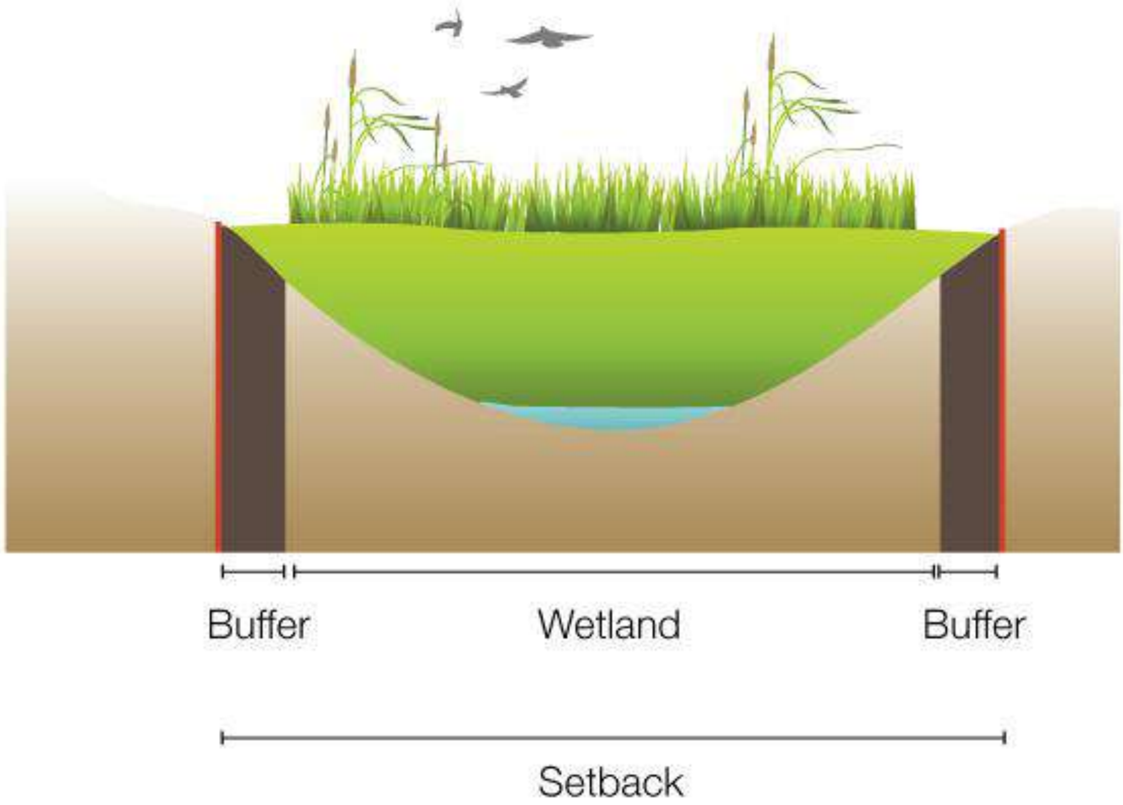

Figure 12: Wetland Buffer Setback.

Buffer calculation tools were developed and are published as "Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries. Consolidated Report" by the Water Research Comission (Macfarlane *et al* 2015). This buffer tools aims to calculate the best suited buffer for each wetland or section of a wetland based on numerous on-site observations. The resulting buffer area can thus have large differences depending on the current state of the wetland as well as the nature of the proposed development. Developments with a high risk factor such as mining are likely to have a larger buffer area compared to a residential development with a lower risk factor. The minimum accepted buffer for low risk developments are however 15 meters from the edge of the wetland (Macfarlane, *et al* 2015). It should be further noted that species such as the Giant bullfrog (*Pyxicephalus adspersus)* and Saddle Billed Stork (*Ephippiorhynchus senegalensis)* are likely to occur on the study site and subsequently could require a larger buffer zone (Digby Wells, Fauna and Flora Impact Assessment, 2020).

The calculated buffer zone following Macfarlane *et al* (2015) is 100 m for both the operational and construction phase. Being inward draining systems, pans are vulnerable to pollution in their catchment. Pollutants draining into these pans become concentrated and significantly affect water quality. Thus the calculated buffer zones may not be large enough for pans unless the direct catchment of the pans are also excluded from any harmful activities.

It should be noted that the buffer calculation tool does not take into account the effects of climate change or cumulative impacts to changes hydrology resulting from transformed catchments. Therefore, a conservative approach to the application of buffer zones is encouraged. Furthermore, the buffer recommended in this report should be reviewed to include possible sensitive fauna species.

5.5 Summary of Findings

Table 6 provides a summary of the results recorded for each wetland unit potentially affected by the proposed development.

Table 5: Summary of results for each wetland unit discussed

Classification (SANBI, 2013)	PES (Macfarlane *et al*, 2007)	EIS (DWAF, 1999)	WetEcoServices (3 most prominent scores)	Scientific Buffers		REC
				Construction	Operational	
DP1	2.0 C	1.8 – Moderate	Phosphate trapping – 2.4 Erosion control – 2.4 Flood attenuation- 2.9	82 m (100 m)	82 m (100 m)	B
DP2 & DP3	1.0 B					

6 Potential Impacts Identified and Mitigation Measures

Development has several impacts on the surrounding environment and particularly on a wetland. Particularly mining affects surface and subsurface water flow in a catchment and consequently affects recharge and discharge of water and the hydrological expression in wetlands.

Table 6: Proposed Project Activities

Project Phase	Project Activity
Construction Phase	Site/vegetation clearance
	Access and haul road construction
	Infrastructure construction
	Diesel storage and explosives magazine

Project Phase	Project Activity
	Topsoil stockpiling
• Operational Phase	Open pit establishment
	Removal of rock (blasting)
	Stockpiling (rock dumps, soils, ROM, discard dump) establishment and operation
	Diesel storage and explosives magazine
	Operation of the open pit workings
	Operating processing plant
	Operating sewage treatment plant
	Water use and storage on-site – during the operation water will be required for various domestic and industrial uses. Two pollution control dams will be constructed that capture water from the mining area which will be stored and used accordingly
	Storage, handling and treatment of hazardous products (including fuel, explosives and oil) and waste
	Maintenance activities – through the operations maintenance will need to be undertaken to ensure that all infrastructure in operating optimally and does not pose a threat to human or environmental health. Maintenance will include haul roads, processing plant, machinery, water and stormwater management infrastructure, stockpile areas, dumps, etc
Decommissioning Phase	Demolition and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation of the final land rehabilitation.
	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation
	Post-closure monitoring and rehabilitation

The Mitigation Hierarchy is as follows (Figure 13):

1. Avoid or Prevent;
2. Minimise;
3. Rehabilitate; or

4. Offset.

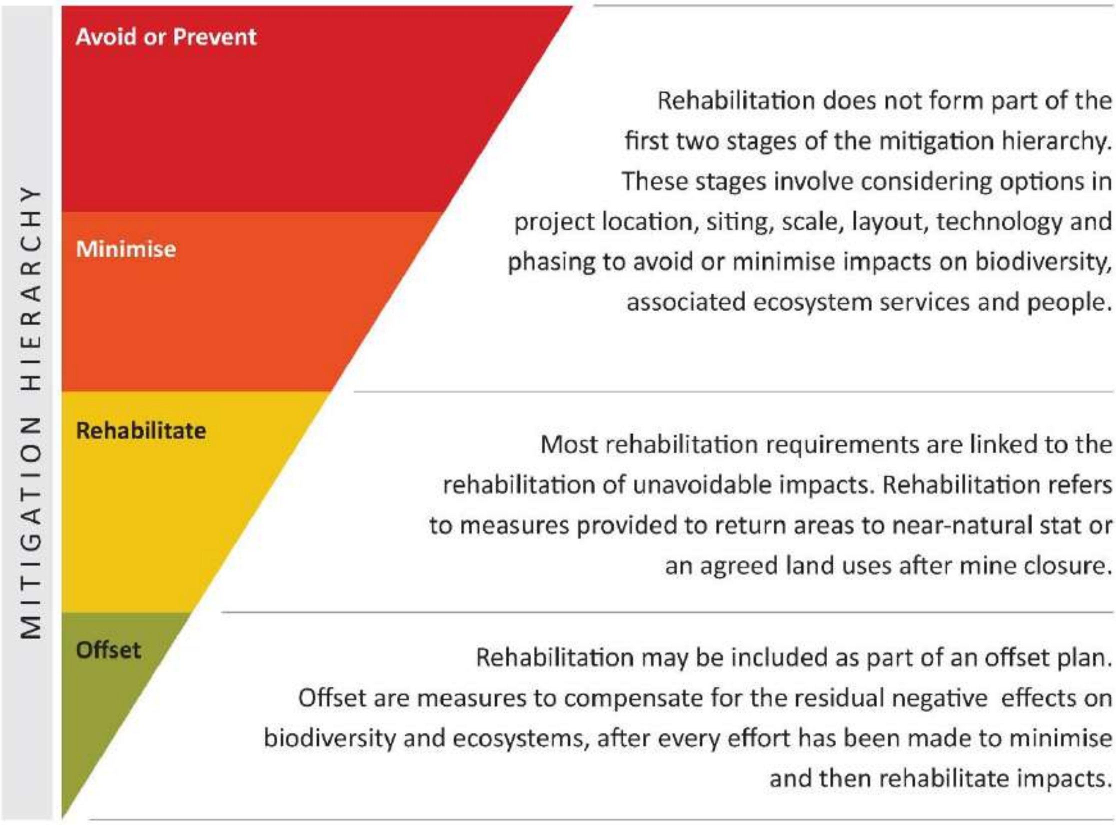

Figure 13: Mitigation hierarchy (SANBI, 2012).

6.1.1 Avoid or Prevent

The development proposal should demonstrate that alternative options have been exhaustively explored. These include consideration of alternative locations, reduced development footprint, different layouts and siting of mine elements.

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6.1.2 Minimise

Since opencast mining implies the loss of the wetland in its current form, the only way to minimise the impact is to adjust the layout.

6.1.3 Rehabilitate/Reinstate

The outcomes of rehabilitation should be focused on three major areas namely (SANBI et al, 2015) (Figure 14):

- Water and Resource and Indirect services;
- Ecosystem Conservation; and
- Species of Conservation Concern.

Endorheic pans are depressions in the landscape formed by an impervious layer which traps surface water flow to form a pool of standing water in which specialised organisms can survive and complete their life cycles. Whilst it is possible to landscape such a feature, successful rehabilitation of pans is not reflected in the literature since settling of soil layers is unpredictable and occurs over decades. Rehabilitation of the wetlands should include the maintenance and/or enhancement of water resources, managing and protecting habitat and making sure any species of concern is maintained. However, it should be considered and mined out sections of the pit must be backfilled, compacted and rehabilitated as soon as possible. Rehabilitation must include covering with a topsoil layer as well as vegetation thereof. Installation of a soil cover will significantly decrease water infiltration and contamination.

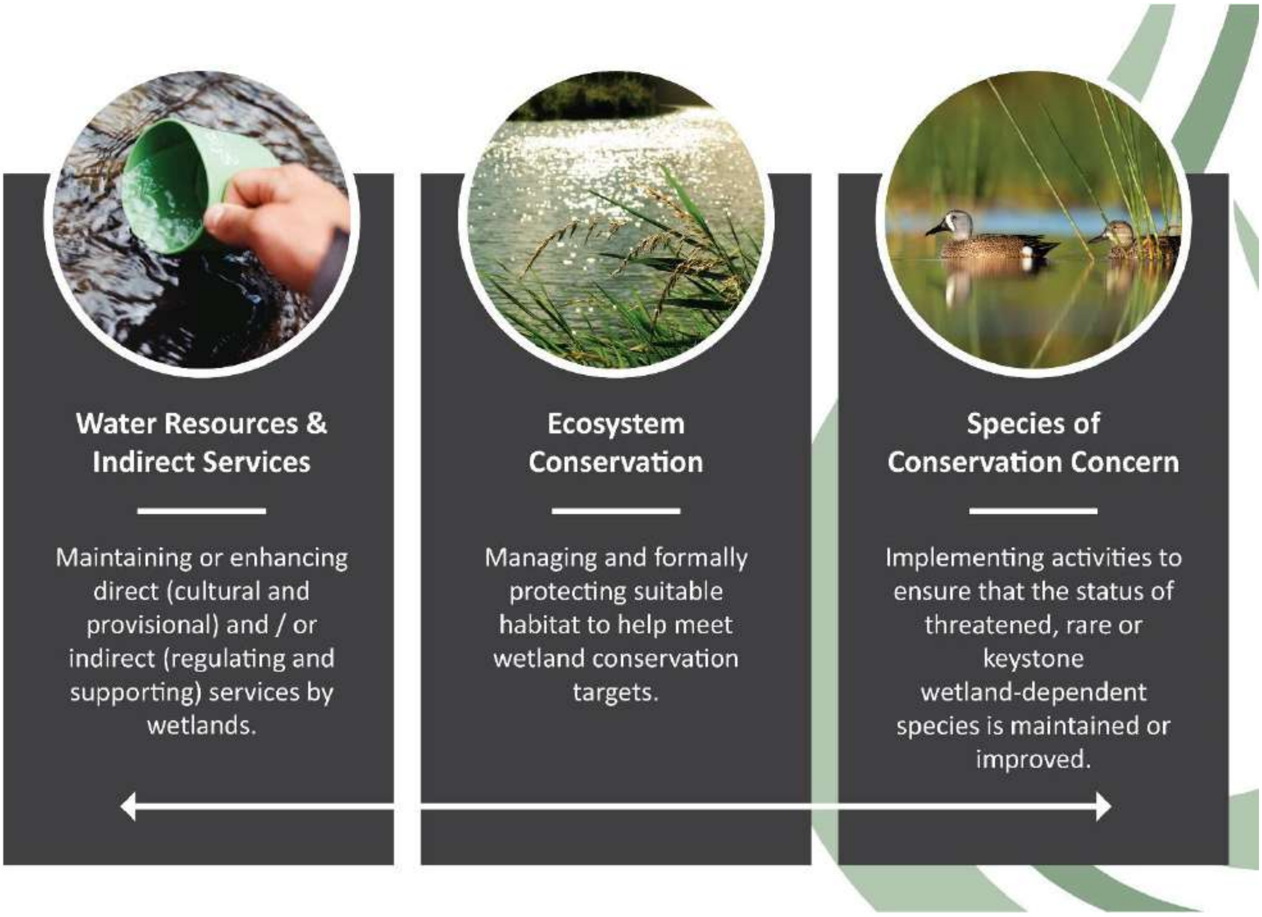

Figure 14: Themes targeted through wetland rehabilitation activities (adapted from SANBI *et al*, 2016 and DWS, 2014).

A general rehabilitation and Monitoring plan is included in Appendix A. The potential impacts, mitigations and risk scores are summarised in the table below (Table):

Table 7: Potential impacts, mitigations and risk scores

Activities	Potential impacts	Mitigation type	Potential for residual risk
Whether listed or not listed. (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport,	(E.g. dust, noise, drainage surface disturbance, flying rock, surface water contamination, groundwater contamination, air pollution, etc.)	Modify, remedy, control, or stop through (e.g. noise control measures, stormwater control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc.) E.g. Modify through alternative method, control through noise control, control through	Medium

Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc.		management and monitoring, remedy through rehabilitation.	
Construction phase of an open cast mine through depression pan wetlands/sections thereof	Loss of wetland habitat, compaction of soils, sedimentation, pollution and alien invasive plant establishment.	• Proposed excavations and infilling should be signed off by a hydropedologist. This is to advise on the impact of moisture displacement the proposed activities may have on the sustainability of infrastructure development and the environment. • Development should include measures to ensure that the flowpaths and storage mechanisms in the soil should be disturbed as little as possible, to sustain hydrological and biogeochemical connectivity.	High
Operation of the open cast mine through a pan wetland/sections thereof	Permanent loss of wetland habitat and hydrological connectivity in the landscape, pollution, invasion of alien invasive species	• Particular note should be taken of the soil characteristics including their erodibility and recharge properties. • Permanent changes to regional hydrology should be quantified. • Control of alien invasive plants should form part of the maintenance plan • The likelihood of reestablishment of wetland function after mining, through rehabilitation should be investigated in a multidisciplinary team and	High

		should be based on relevant case studies where this has been achieved in the past. • A wetland offset strategy should be formulated should the wetlands be mined.	

6.2 Impacts and Mitigations

The construction and operation of the mining activities have various potential negative impacts on the watercourses associated with the site and downstream areas. These impacts are discussed below (Tables 8 to 12) as well as the DWS (2016)

They show that the expected risk score falls within the Low and Medium risk categories. Activities which score in the high and Medium category refers to risk and impact on watercourses that are notable and require mitigation measures on a higher level, which cost more and require specialist input. Activities which fall within this category should be authorised through a Water Use Licence.

The impact and risk assessment should be reviewed to include fauna and flora sensitivities and geohydrological parameters. The proposed development layout should be overlaid onto the wetland and buffer zones to confirm impacts discussed below. Expected impacts (excluding changes to geohydrological processes) are further associated with changes to topography and surface water runoff, shallow interflow and pollution.

Table 8: Changes in water flow regime impact ratings

Nature: Changing the quantity and fluctuation properties of the wetlands by restricting water flow or increasing flood flows
ACTIVITY: The sources of this impact includes the compaction of soil, the removal of vegetation and surface water redirection. Intercepting lateral interflow by mining upslope will result in changes to water volumes available to support specialised wetland habitats, particularly in the seepage wetland.
Mitigation: • Critical recharge areas should be determined in a hydropedological assessment. • A temporary fence or demarcation must be erected around No-Go Areas outside the proposed works area prior to any construction taking place as part of the contractor planning phase when compiling work method statements to prevent access to the adjacent portions of the watercourse. • Effective stormwater management should be a priority during both construction and operational phase. This should be monitored as part of the EMP. • High energy stormwater input into the watercourses should be prevented at all cost. Changes to natural flow of water (surface water as well as water flowing within the soil profile) should be taken into account during the design phase and mitigated effectively
Cumulative impacts: Construction and operational activities may result in cumulative impact to the water courses within the local catchments and beyond. It is very important that protective measures should be put into place and monitored. A rehabilitation plan should be put into action should any degradation be observed as a result from stormwater or sediment input. Increases in stormwater flows will cause degradation downstream unless mitigated at the design level. **Drying out of wetlands and loss of hydrological zonation (loss of catchment) should be monitored and addressed through an offset program**
Residual Risks: Impacts to the flow characteristics of these watercourses are likely to be high.

Table 9: Changes in sediment entering and exiting the system impact ratings

Nature: Changes in sediment entering and exiting the system.
Activity: Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount). Construction and operational activities will result in earthworks and soil disturbance as well as the removal of natural vegetation. This could result in the loss of topsoil, sedimentation of the watercourse and increase the turbidity of the water. Possible sources of the impacts include: • Earthwork activities during construction • Clearing of surface vegetation will expose the soils, which in rainy events would wash through the watercourse, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive trees can spread easily into these eroded soil. • Disturbance of soil surface • Disturbance of slopes through creation of roads and tracks adjacent to the watercourses • Erosion (e.g. gully formation, bank collapse)
Mitigation: • Consider the various methods and equipment available and select whichever method(s) that will have the least impact on watercourses. • Water may seep into trenching and earthworks. It is likely that water will be contaminated within these earthworks and should thus be cleaned or dissipated into a structure that allows for additional sediment input and slows down the velocity of the water thus reducing the risk of erosion. Effective sediment traps should be installed. • Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. • Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction and that plan must be implemented immediately upon completion of construction.

• Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access. • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas. • Runoff from the mining area must be managed to avoid erosion and pollution problems. • Implementation of best management practices • Source-directed controls • Buffer zones to trap sediments • Monitoring should be done to ensure that sediment pollution is timeously dressed
Cumulative impacts: Expected to be high. Should mitigation measure not be implemented and changes made to the bed or banks of watercourse unstable channel conditions may result causing erosion, meandering, increased potential for flooding and movement of bed material, which will result in property damage adjacent to and downstream of the site. Reversing this process is unlikely and should be prevented in the first place.
Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

Table 10: Introduction and spread of alien vegetation impact ratings.

Nature: Introduction and spread of alien vegetation.
Activity: The moving of soil and vegetation resulting in opportunistic invasions after disturbance and the introduction of seed in building materials and on vehicles. Invasions of alien plants can impact on hydrology, by reducing the quantity of water entering a watercourse, and outcompete natural vegetation, decreasing the natural biodiversity. Once in a system alien invasive plants can spread through the catchment. If allowed to seed before control measures are implemented alien plans can easily colonise and impact on downstream users.
Mitigation: • Weed control • Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area and returning it where possible afterwards. • Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance and take immediate corrective action where invasive species are observed to establish. • Rehabilitate or revegetate disturbed areas
Cumulative impacts: Regular monitoring should be implemented during construction, rehabilitation including for a period after rehabilitation is completed.
Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

Table 11: Loss and disturbance of watercourse habitat and fringe vegetation impact ratings.

Nature: Loss and disturbance of watercourse habitat and fringe vegetation.
Activity: Disturbance of soil/water processes upslope from the wetlands may cut off interflow that feeds downslope wetlands
Mitigation: • Drying out of wetlands and loss of hydrological zonation (loss of catchment) should be monitored and addressed through an offset program • Critical recharge areas should be determined in a hydropedological assessment.
Cumulative impacts: Expected to be very High. Will definitely result in a high degree of irreplaceable loss of resources. **Drying out of wetlands and loss of hydrological zonation (loss of catchment) should be monitored and addressed through an offset program**
Residual Risks: Expected to be high.

Table 12: Changes in water quality due to pollution impact ratings.

Nature: Changes in water quality due to pollution.
Activity: Construction and operational activities may result in the discharge of solvents and other industrial chemicals, leakage of fuel/oil from vehicles and the disposal of sewage resulting in the loss of sensitive biota in the wetlands/rivers and a reduction in watercourse function. This includes wind-blown coal dust during the operational phase
Mitigation: • Provision of adequate sanitation facilities located outside of the watercourse or its associated buffer zone. • Implementation of appropriate stormwater management around the excavation to prevent the ingress of run-off into the excavation and to prevent contaminated runoff into the watercourse. • The development footprint must be fenced off from the watercourses and no related impacts may be allowed into the watercourse e.g. water runoff from cleaning of equipment, vehicle access etc. • Maintenance of construction vehicles / equipment should not take place within the watercourse or watercourse buffer. • Control of waste discharges • Maintenance of buffer zones to trap sediments with associated toxins • Ensure that no operational activities impact on the watercourse or buffer area. This includes edge effects. • Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse • Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse • Regular independent water quality monitoring should form part of operational procedures in order to identify pollution • Treatment of pollution identified should be prioritized according to best practice guidelines.
Cumulative impacts: Expected to be moderate. Once in the system it may take many years for some toxins to be eradicated.
Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

Risk Matrix spreadsheet presented in Table 13 below.

Table 13: Impact scores before and after implementation of mitigation

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: R. Bezuidenhoudt SACNASP Reg. No. 008867

				Severity																
Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Veg etation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures
C	Construction phase of an open cast mine in close proximity to a wetland (Dep Pan 1) and through another wetland (Dep Pan 2)	Clear vegetation	Changes to topography and surface water runoff, interception of interflow, pollution and alien invasive species establishment	5	5	5	5	5	1	3	9	1	5	5	2	**13**	**117**	**M**	**80%**	• A hydropedologists should inform on the proposed development to inform possible changes in the hydrological flow regime into the wetlands. • A wetland offset strategy should be formulated if a wetland is proposed to be mined through.
		Establishment of access roads		2	5	2	1	3	1	1	4.5	1	2	5	2	**10**	**45**	**L**	**80%**	
O	Opeartion of open cast mine in close proximity to a wetland (Dep Pan 1) and through another wetland (Dep Pan 2)	Day to day operation of the mine	Permanent loss of wetland habitat and hydrological connectivity through interception of interflow water, loss of hydrological zonation, pollution, invasion of alien invasive species	5	5	5	5	5	2	5	12	5	5	5	2	**17**	**204**	**H**	**80%**	• Control of alien invasive plants should form part of the maintenance plan • A wetland offset strategy should be formulated if a wetland is proposed to be mined through. • Monitoring of the wetland integrity and water quality should be conducted throughout the life of the mine.

7 Conclusions and Recommendations

Three wetlands were recorded on or directly adjacent to OC1. Only small sections of these wetlands and their associated buffer zones are located within the OC1 area. All three these wetlands are classified as **Non-Perennial Episodic Endorheic Depression Pans.** This term refers to the fact that the depression wetlands only fill (naturally) with water during high rainfall events where it then remains saturated for only small periods during the year, remaining dry the rest of the year.

The important factors relevant to Environmental Authorisation of the project are summarised in Table 14 below:

Table 14: Summary of findings

	Quaternary Catchment and WMA areas	Important Rivers possibly affected
	A41E – 1st WMA Limpopo WMA	In close proximity to the Limpopo River
Integrity and functional assessment	Present Ecological Status (PES): 1.0 (**B – 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. The status of these wetlands is likely to remain stable over the next 5 years.	
	Ecological Importance and Sensitivity (EIS): 1.8 (**C - Moderate**). Wetlands in this category are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers	
	Recommended Ecological Category (REC): **B**	
	WetEcoServices: Phosphate trapping - 2.4 Erosion control - 2.4 Flood attenuation- 2.9	
Buffer zones	Calculated (Macfarlane *et al*, 2015): **100 m Operational & 100 m Construction**	
Does the specialist support the development?	Yes. Given that the mitigation measures are adhered to.	

A mine has impacts on the surrounding environment and particularly on wetlands including depression pan wetlands. A mine changes habitats, the ecological environment, infiltration rates, amount of runoff and runoff intensity of stormwater, and therefore the hydrological regime of the area. A range of management measures are available to address threats posed to water resources. The mitigation measures proposed are intended to prevent further degradation to the watercourses. It is importance to note that this section aims to highlight areas where mitigation measures can be increased. The details of the mitigation measures that are finally put in place should ideally be based on local issues but must necessarily take into consideration the physical and economic feasibility of mitigation. It is important that any mitigation be implemented in the context of an Environmental Management Program to to ensure accountability and ultimately the success of the mitigation.

It is further also important to note that during extreme rainfall events a large volume of water flows could potentially damage structures and roads and an increased in hard surfaces are likely to increase flood peaks (Figure 15).

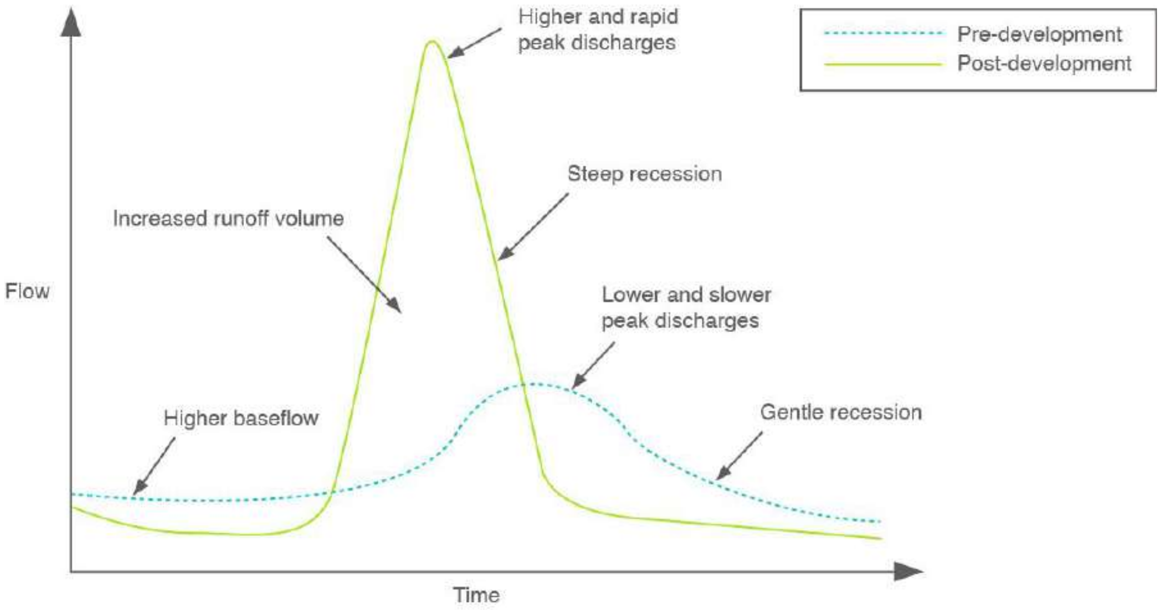

Figure 15: Changes in flood peaks because of development

The risk assessment reflects a **Medium** score during the construction phase and a **High** score during operation of the mine. This is because the wetlands affected by mining will be permanently changed, particularly in terms of their hydrology.

Site-specific mitigation measures/recommendations include:

- No mining/development should occur within the wetland areas or the associated buffer zones, or ideally no development within the catchment of the pans.
- Proposed excavations should be signed off by a hydropedologist. This is to advise on the impact of moisture displacement the proposed activities may have on the sustainability of infrastructure development and the environment;
- Development should include measures to ensure that the flowpaths and storage mechanisms in the soil should be disturbed as little as possible, to sustain hydrological and biogeochemical connectivity. Particular note should be taken of the soil characteristics including their erodibility and recharge properties. Permanent changes to regional hydrology should be quantified;
- Control of alien invasive plants should form part of the maintenance plan; and
- The likelihood of reestablishment of wetland function after mining, through rehabilitation should be investigated in a multidisciplinary team and should be based on relevant case studies where this has been achieved in the past.

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APPENDIX A: REHABILITATION OBJECTIVES

Table 15 below provides rehabilitation actions to be applied to wetlands affected by mining activities, including roads and other associated activities. These rehabilitation actions can be refined to auditable targets for wetlands identified during an offset assessment.

Table 15: Rehabilitation actions

Impacts	Rehabilitation
Reestablishment of vegetation cover Where bare soil occurs, or where mine activities cease and aim to revegetate disturbed areas	• Compacted areas should be ripped, and topsoil replaced if possible • Ripping shall be done to a depth of 250mm in two directions at right angles. • All sloped areas must be re-vegetated by seeding with a grass mixture containing species naturally occurring in the area as determined by a Landscape Architect, Botanist or Horticultural specialist. Sloped areas where vegetation has been removed or destroyed should be replanted as soon as possible to avoid erosion. • Seeds must be thorough mixed before applying. • The seeds must be applied according to the required rates. • Application rates can be increased in areas that are unfavorable or steep, but no more than double the recommendations. • Seeds can be mixed with a spreading agent such as river sand, bran or finely sifted kraal to ensure even distribution. • Manure or agricultural lime and granular fertiliser mix can be applied prior to reseeding. • Once complete, the seeded area must be watered and patted down gently. • Badly damaged areas and areas where grazing commonly takes place, should be fenced in to allow for rehabilitation to take place without further impacting on the areas • Areas where minimal disturbances took place, can be ripped and allowed to naturally re-vegetate (take note that this excludes sloped areas) • If natural re-vegetation is unsuccessful, corrective action should be taken and includes seeding and planting by an appropriate specialist as stipulated in the EMP • All rehabilitated areas must be monitored for the presence of exotic and alien plant species. • Should the presence of exotic/alien plant species be observed it should be removed appropriately. • All disturbed areas that will requiring rehabilitation must be mulched to encourage vegetation re-growth. Mulch used must be free from alien seed. These areas must be cordoned off so that vehicles or construction personnel cannot gain access to these areas • Badly damaged areas and areas where grazing, water collection or washing commonly takes place (e.g. in proximity to informal settlements), should be fenced in to allow for rehabilitation to take place without further impacting on the areas. Once rehabilitation

Impacts	Rehabilitation
	was observed to be successful during monitoring, the fenced may be removed (at least two years). The reason for fencing must be communicated to the community using the areas and the fence should be monitored regularly • In areas where the topsoil is shallow with underlying bedrock, it is important to ensure that erosion is kept to a minimum by encouraging rapid vegetation growth and/or to use structures approved by an engineer to all the sediment on site
Resloping	• In order to promote vegetation growth and establishment, the slope angle must be a maximum of 1(V):3(H). • In areas where this is not possible, or where further disturbance to the wetland will prove to be significant, a slope of no steeper than 1:2 should be achieved. • Slope reshaping must follow the natural slope and topography of the surrounding undisturbed area and wetland to the east of the artificial channel. • Areas for resloping must be ripped or loosened to a depth of 150mm to prepare soils for revegetation and allow water penetration into the soils. • Ripping must be done manually with hand tools. • No vehicles are permitted in the area in order to prevent further disturbance to the wetland. • Ripping must be done during the late dry season to prevent erosion and collapse of the banks. • Slope stabilization should be considered for areas where erosion is identified as a risk. Materials used for stabilization should be biodegradable over 2 years (for example hessian or GeoJute sheets). These textiles should be placed vertically on the slopes and overlap at the edges. They can be fastened with wooden stakes at 1m intervals.
Soil Compaction Soil compaction is likely to occur on access roads, and temporary work platforms where heavy vehicles and personnel move around. Soil compaction will decrease permeability of the soil, negatively impact the sub-surface flows and compromise vegetation establishment.	• Areas where soil has been compacted should be ripped to encourage vegetation growth • Ripping shall be done to a depth of 250 mm in two directions at right angles. • Do not rip and / or scarify areas under wet conditions, as the soil will not break up and compaction will be worsened • Do not permit vehicular or pedestrian access into natural areas or into seasonally wet areas during and immediately after rainy periods, until such a time that the soil has dried out (DAWF, 2005) • Rip and / or scarify all disturbed (and other specified) areas of the construction site, including temporary access routes and roads, compacted during the execution of the Works. (DWAF, 2005)

<table>
<tr><th>Impacts</th><th>Rehabilitation</th></tr>
<tr><td>Erosion Control</td><td>A site specific erosion control plan should be formulated based on the depth and width of gullies present in the identified target wetlands
Erosion control measures may include the following:
Gabions Installation
- To further retard run-off water and increase infiltration, pack stones on the contour.
- This traps sediment and seed and vegetation soon establishes itself.
Erosion Control Blankets:
- Temporarily stabilise and protect disturbed soil from raindrop impact and surface erosion;
- Increase infiltration;
- Decrease compaction and soil crusting;
- Conserve soil moisture;
- Slope stabilisation;
- Soil erosion control;
- Stream bank stabilisation;
- Erosion protection of drainage slopes.</td></tr>
<tr><td></td><td>Erosion control measures and bank stabilization should include the following:

Gabions Installation:
To further retard run-off water and increase infiltration, pack stones on the contour.
This traps sediment and seed and vegetation soon establishes itself.
Erosion Control Blankets:
Stream bank stabilisation;
Erosion protection of drainage slopes.
Revegetation:
Grass seeds may be locally harvested or imported from a reputable local source. Refer to Tables 2, 3 and 4 for plant species mixes to be used in the revegetation in the wetland and terrestrial areas.</td></tr>
</table>

Impacts	Rehabilitation
	• A minimum grass cover of 80% to be obtained within all reseeded areas and planted species must be strong and healthy after the first growing season. • Where wetland sedges and rushes are planted in the vicinity of the culverts within the main channel, staked erosion control blankets are to be placed where a slopes steeper than 1(V):3(H) is noted. • Floral growth and establishment must be monitored as per the rehabilitation plan compiled for the project. All alien species are to be manually removed from the vicinity of the wall, with particular attention paid to eradication of NEMBA Category 1b species including *Eucalyptus sp, Phytolacca octandra, Solanum sisymbriifolium* and *Acacia mearnsii*. Refer to Table 5 for a list of alien species to be removed manually.
Spread of Alien Invasive Species	• A specific Alien Plant Control Plan should be formulated for wetlands targeted for offsets • All alien seedlings and saplings must be removed as they become evident for the duration of construction • Manual / mechanical removal is preferred to chemical control • Use destumping - removing the stumps of felled trees and has the potential for high environmental impacts, through sedimentation especially if stumps are uprooted where possible such as the *Acacia mearnsii* areas.

MONITORING PLAN

Monitoring refers to the repetitive and continued observation, measurement and evaluation of environmental criteria to follow changes over a period of time and to assess the efficiency of control measures. The monitoring plan aims to establish whether rehabilitation was successful and whether target integrity scores have been achieved (Table 16).

Three monitoring frequencies are recommended:

1. Seasonal monitoring: rehabilitation success, as well as signs of erosion, sedimentation and the presence of alien vegetation should be monitored twice during the summer months: once at the start and once at the end of the rainy season.

2. Rapid monitoring: For the first two years following revegetation or erosion control, monitoring should take place immediately after heavy rainfall to ensure that rehabilitated areas are intact and that no erosion and subsequent sedimentation took place.

3. Annual monitoring: After the first three years following rehabilitation, annual monitoring should be done to ensure the continued integrity of rehabilitated areas. Furthermore, an annual external audit should be conducted by an independent, suitably qualified specialist to ensure that rehabilitation targets are met, and that corrective action is identified timeously.

Problems such as failed re-vegetation should be remediated as soon as it is recorded in the monitoring process. Corrective action should be taken and can include the re-initiation of rehabilitation in severe cases or by correction of the problem (e.g. mend broken fences). It is recommended that fixed point photography is used to monitor vegetation and soil stability. This involves taking pictures of the areas monitored from the same point during each monitoring event. The images can be compared and serves as a record of the success of rehabilitation or the failure thereof.

Table 16: Monitoring plan: construction

Variables	Methods	Monitoring Frequency	Indicator	Corrective Action
Vegetation cover	• On-site inspection • Assess landscape functionality • Monitor species cover abundance and ensure that natural species cover increase (compare to vegetation the identified reference sites) • Fixed point photography	• Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually • Annual audit assessment should report on the integrity of vegetation cover	• Wetland re-vegetation shall be considered successful if the cover of herbaceous and/or woody species is at least 80 percent of the type, density, and distribution of the vegetation in reference wetland areas that were not disturbed by mining	• If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern • Prevent grazing in rehabilitated areas • If re-vegetation is not successful at the end of 2 years, develop and implement (in consultation with a professional wetland ecologist) a remedial re-vegetation plan to actively re-vegetate the wetland. Continue re-vegetation efforts until wetland re-vegetation is successful • If wetland rehabilitation is successful at the end of 3 years, report on the status of the vegetation (e.g. using photographic record) and only monitor annually or if maintenance activities might have disturbed the area again • Where protected plant species are dying or no recruitment of seedlings are apparent, consult the local authority or a specialist
Plant species composition	• Fixed transect to determine the species composition	• Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Cover of herbaceous and/or woody species is at least 80 percent of the type, density, and distribution of the vegetation in reference wetland areas that were not disturbed by mining	• If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern. • If exotic plants have colonised the area the exotic plants should be removed.

Variables	Methods	Monitoring Frequency	Indicator	Corrective Action
Alien Invasive Plant Species	• Monitor the emergence of alien invasive plant species in or around rehabilitated areas • On-site inspection • Fixed point photography	• Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually • Annual audit assessment should report on the density and distribution of patches of alien plants	• Establishment of alien invasive plant species in rehabilitated areas or in watercourses	• Remove emergent invasive vegetation from the rehabilitated footprint and servitude as soon as it becomes apparent • Manual labour is preferred above chemical or manual removal. • Do not use herbicides or pesticides in or within 200 meters of wetland areas

APPENDIX B: METHODOLOGY

The delineation method documented by the Department of Water Affairs and Forestry in their document "*Updated manual for identification and delineation of wetlands and riparian areas*" (DWAF, 2008), and the *Minimum Requirements for Biodiversity Assessments* (GDACE, 2009) as well as the *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems* (Ollis *et al,* 2013) was followed throughout the field survey. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas such as soil and vegetation forms as well as the terrain unit indicator. A hand held Garmin Montana 650 was used to capture GPS co-ordinates in the field. 1:50 000 cadastral maps and available GIS data were used as reference material for the mapping of the preliminary watercourse boundaries. These were converted to digital image backdrops and delineation lines and boundaries were imposed accordingly after the field survey.

7.1 Wetland and Riparian Delineation

Wetlands are delineated based on scientifically sound methods, and utilizes a tool from the Department of Water and Sanitation 'A practical field procedure for identification and delineation of wetlands and riparian areas' (DWAF, 2005) as well as the "Updated manual for identification and delineation of wetlands and riparian areas" (DWAF, 2008). The delineation of the watercourses presented in this report is based on both desktop delineation and groundtruthing. The wetland delineation and assessment report submitted by the TUT (2009) was also used as a reference against which field data collected during the current assessment was verified.

Desktop Delineation

A desktop assessment was conducted with wetland and riparian units potentially affected by the proposed activities identified using a range of tools, including:

- 1: 50 000 topographical maps;
- SA Water Resources, such as National Freshwater Ecosystem Priority Areas (NFEPA);
- Recent, relevant aerial and satellite imagery, including Google Earth.

All areas suspected of being wetland and riparian habitat based on the visual signatures on the digital base maps were mapped using google earth.

Ground Truthing

Wetlands were identified based on one or more of the following characteristic attributes (DWAF, 2005) (Figures 16 & Figure 17):

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The presence of plants adapted to or tolerant of saturated soils (hydrophytes);
- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation; and
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing within 50cm of the soil surface.

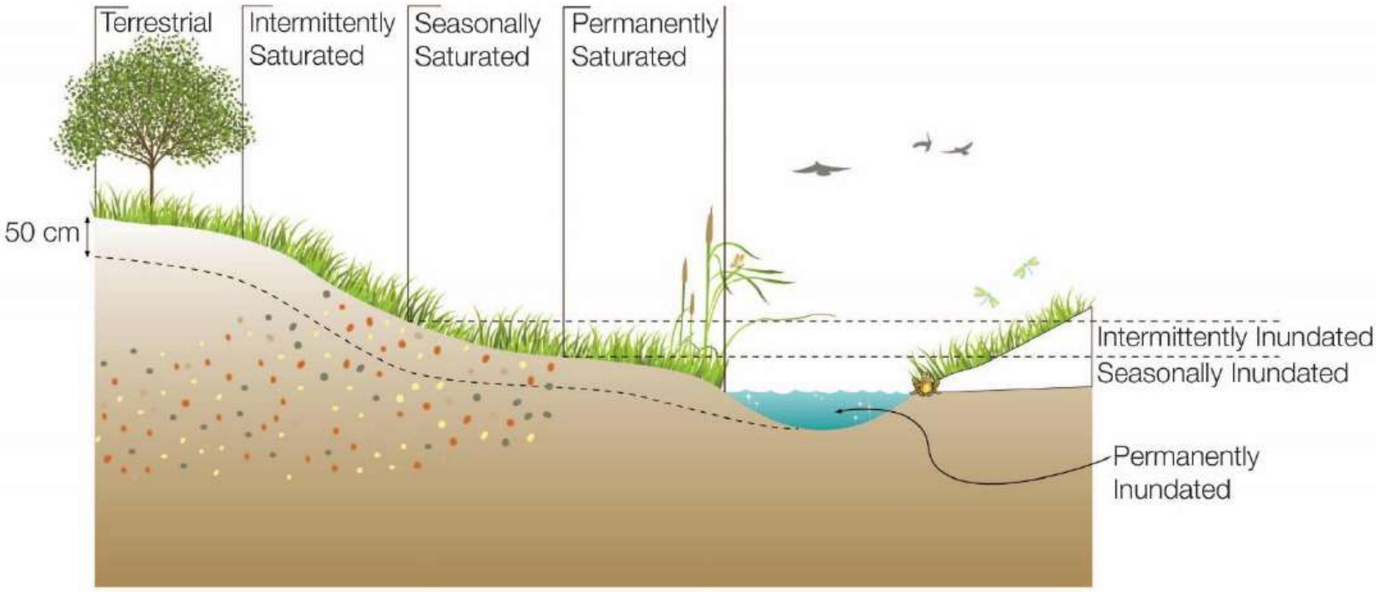


Figure 16: Typical cross section of a wetland (Ollis, 2013)

The Terrain Unit Indicator

The terrain unit indicator (Figure 9) is an important guide for identifying the parts of the landscape where wetlands might possibly occur. Some wetlands occur on slopes higher up in the catchment where groundwater discharge is taking place through seeps. An area with soil wetness and/or vegetation indicators, but not displaying any of the topographical indicators should therefore not be excluded from being classified as a wetland. The type of wetland which occurs on a specific topographical area in the landscape is described using the Hydrogeomorphic classification which separates wetlands into 'HGM' units. The classification of Ollis, *et al*. (2013) is used, where wetlands are classified on Level 4 as either Rivers, Floodplain wetlands, Valley-bottom wetlands, Depressions, Seeps, or Flats (Figure 17).

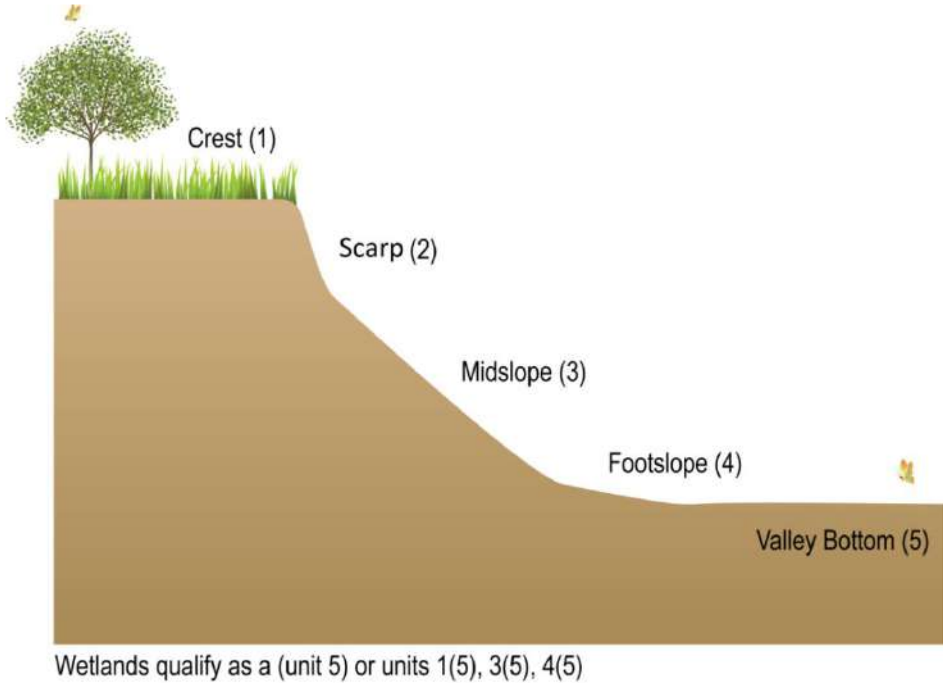


Figure 17. Terrain units (DWAF, 2005).

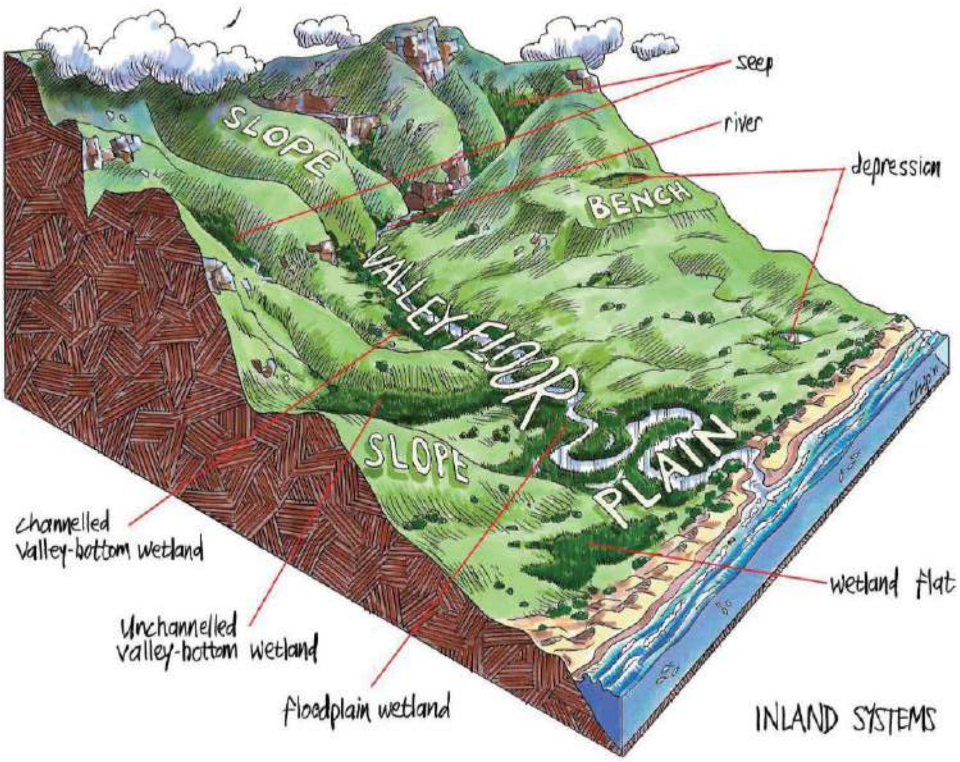


Figure 18: Wetland Units based on hydrogeomorphic types (Ollis *et al.* 2013)

<u>Riparian Indicators</u>

Riparian habitat is classified primarily by identifying riparian vegetation along the edge of the macro stream channel. The macro stream channel is defined as the outer bank of a compound channel and should not be confused with the active river bank. The macro channel bank often represents a dramatic change in the energy with which water passes through the system. Rich alluvial soils deposit nutrients making the riparian area a highly productive zone. This causes a very distinct change in vegetation structure and composition along the edges of the riparian area (DWAF, 2008).

The marginal zone includes the area from the water level at low flow, to those features that are hydrologically activated for the greater part of the Year (WRC Report No TT 333/08 April, 2008). The non-marginal zone is the combination of the upper and lower zones (Figure 19).

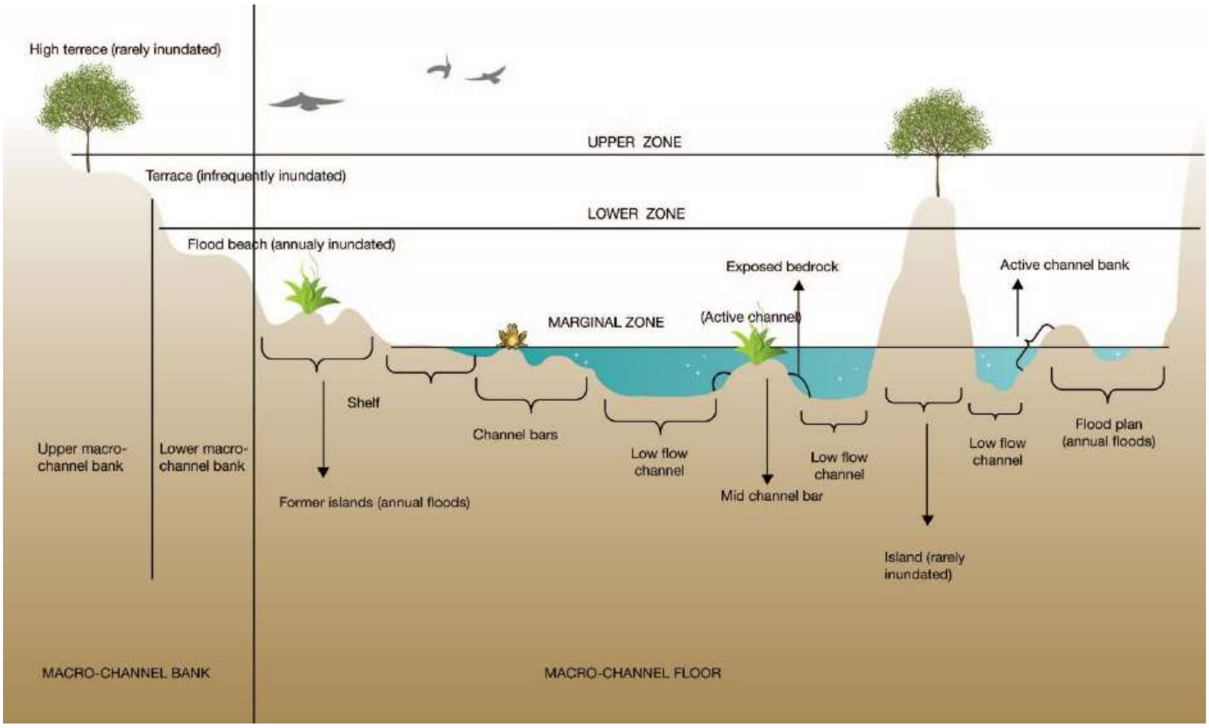


Figure 19: Schematic diagram illustrating an example of where the 3 zones would be placed relative to geomorphic diversity (Kleynhans *et al*, 2007)

The vegetation of riparian areas is divided into three zones, the marginal zone, lower non-marginal zone and the upper non-marginal zone (Table 17). The different zones have different vegetation growth.

Table 17: Description of riparian vegetation zones (Kleynhans *et al*, 2007).

	Marginal	**(Non-marginal) Lower**	**(Non-marginal) Upper**
Alternative descriptions	Active features Wet bank	Seasonal features Wet bank	Ephemeral features Dry bank
Extends from	Water level at low flow	Marginal zone	Lower zone
Extends to	Geomorphic features / substrates that are hydrologically activated (inundated or moistened) for the Greater part of the year.	Usually a marked increase in lateral Elevation.	Usually a marked decrease in lateral elevation
Characterized by	See above ; Moist substrates next to water's edge; water loving- species usually vigorous due to near permanent access to soil moisture	Geomorphic features that are hydrologically activated (inundated or moistened) on a Seasonal basis. May have different species than marginal zone	Geomorphic features that are hydrological activated (inundated or moistened) on an Ephemeral basis. Presence of riparian and terrestrial species Terrestrial species with increased stature

Riparian Area:

A riparian area can be defined as a linear fluvial, eroded landform which carries channelized flow on a permanent, seasonal or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The “river” includes both the active channel (the portion which carries the water) as well as the riparian zone (Figure 20) (Kotze, 1999).

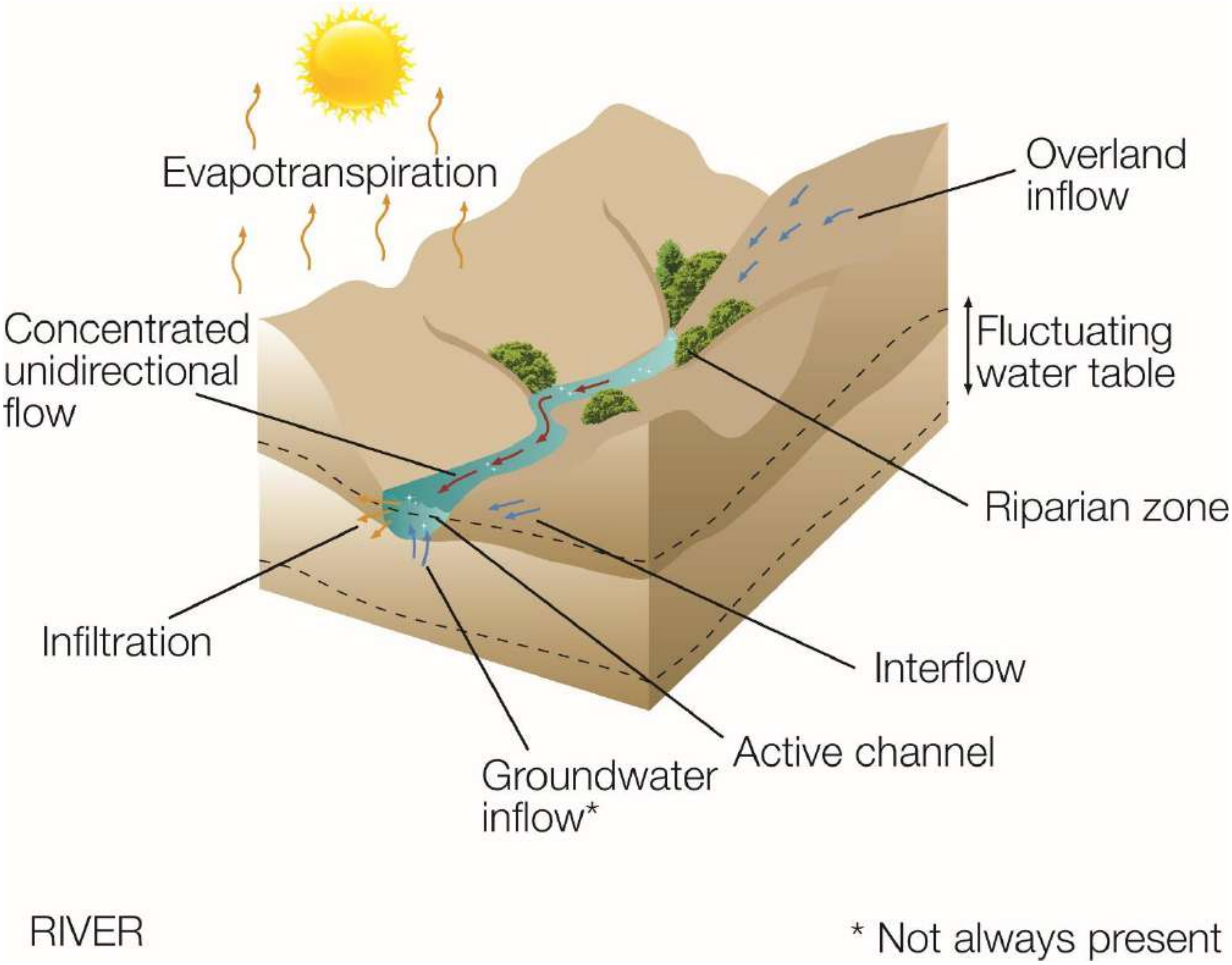


Figure 20: A schematic representation of the processes characteristic of a river area (Ollis *et al*, 2013).

Riparian areas can be grouped into different categories based on their inundation period per year. Perennial rivers are rivers with continuous surface water flow, intermittent rivers are rivers where surface flow disappears but some surface flow remains, temporary rivers are rivers where surface flow disappears for most of the channel (Figure 21). Two types of temporary rivers are recognized, namely “ephemeral” rivers that flow for less time than they are dry and support a series of pools in parts of the channel, and “episodic” rivers that only flow in response to extreme rainfall events, usually high in their catchments (Seaman *et al*, 2010). The riparian areas recorded on site are thus classified as episodic streams due to the high elevation of these streams.

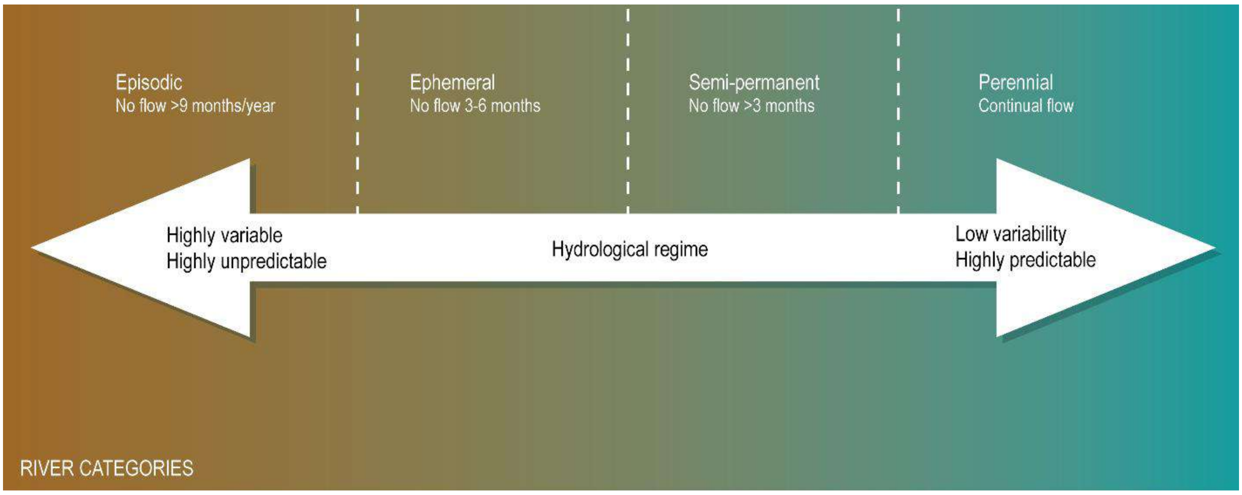


Figure 21: The four categories associated with rivers and the hydrological continuum. Dashed lines indicate that boundaries are not fixed (Seaman *et al*, 2010).

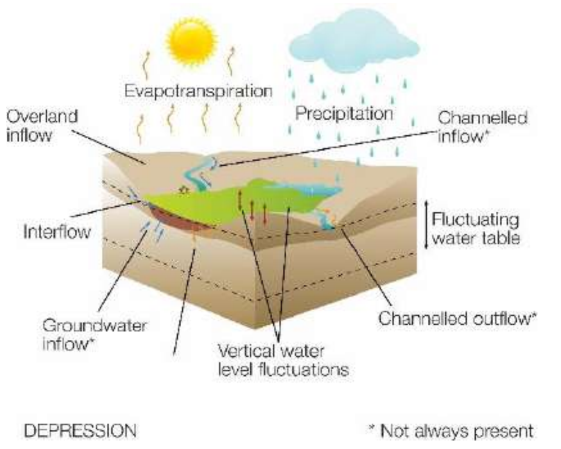
7.2 Wetland Classification and Delineation

The classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification (SANBI, 2009). The current wetland study follows the same approach by classifying wetlands in terms of a functional unit in line with a level three category recognised in the classification system proposed in SANBI (2009). HGM units take into consideration factors that determine the nature of water movement into, through and out of the wetland system. In general HGM units encompass three key elements (Kotze *et al*, 2005):

- Geomorphic setting - This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment);
- Water source - There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
- Hydrodynamics - This refers to how water moves through the wetland.

The classification of wetland areas found within the study site and/or within 500 m of the study site (adapted from Brinson, 1993; Kotze, 1999, Marneweck and Batchelor, 2002 and DWAF, 2005) are as follows (Table 18):

Table 18: Wetland Types and descriptions

Wetland Type:	Description:
Depressional pans 	Small (deflationary) depressions which are circular or oval in shape; usually found on the crest positions in the landscape. The topographic catchment area can usually be well-defined (i.e. a small catchment area following the surrounding watershed). Although often apparently endorheic (inward draining), many pans are "leaky" in the sense that they are hydrologically connected to adjacent valley bottoms through subsurface diffuse flow paths.

7.3 Wetland Functionality, Status and Sensitivity

Wetland functionality is defined as a measure of the deviation of wetland structure and function from its natural reference condition. The natural reference condition is based on a theoretical undisturbed state extrapolated from an understanding of undisturbed regional vegetation and hydrological conditions. In the current assessment the hydrological, geomorphological and vegetation integrity was assessed for the wetland unit associated with the study site, to provide a Present Ecological Status (PES) score (Macfarlane *et al*, 2007) and an Environmental Importance and Sensitivity category (EIS) (DWAF, 1999). The impacts observed for the affected wetland are summarised for each wetland under section 3.2. These impacts are based on evidence observed during the field survey and land-use changes visible on aerial imagery.

The allocations of scores in the functional and integrity assessment are subjective and are thus vulnerable to the interpretation of the specialist. Collection of empirical data is precluded at this level of investigation due to project constraints including time and budget. Water quality values, species richness and abundance indices, surface and groundwater volumes, amongst others, should ideally be used rather than a subjective scoring system such as is presented here.

The functional assessment methodologies presented below take into consideration subjective recorded impacts to determine the scores attributed to each functional Hydrogeomorphic (HGM) wetland unit. The aspect of wetland functionality and integrity that are predominantly addressed include hydrological and geomorphological function (subjective observations) and the integrity of the biodiversity component (mainly based on the theoretical intactness of natural vegetation) as directed by the assessment methodology.

In the current study the wetland was assessed using, WET-Health (Macfarlane *et al*, 2007), EIS (DWAF, 1999) and WetEcoServices, (Kotze *et al*, 2006).

7.3.1 <u>Present Ecological Status (PES) – WET-Health</u>

A summary of the three components of the WET-Health Namely Hydrological; Geomorphological and Vegetation Health assessment for the wetlands found on site is described in Table 19. A Level 1 assessment was used in this report. Level 1 assessment is used in situations where limited time and/or resources are available.

Table 19: Health categories used by WET-Health for describing the integrity of wetlands (Macfarlane *et al*, 2007)

Description	Impact Score Range	PES Score	Summary
Unmodified, natural.	0.0.9	A	Very High
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.	1-1.9	B	High
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	Moderate
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D	Moderate
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	Low
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	Very Low

A summary of the change class, description and symbols used to evaluate wetland health are summarised in Table 20.

Table 20: Trajectory class, change scores and symbols used to evaluate Trajectory of Change to wetland health (Macfarlane *et al*, 2007)

Change Class	Description	Symbol
Improve	Condition is likely to improve over the over the next 5 years	(↑)
Remain stable	Condition is likely to remain stable over the next 5 years	(→)
Slowly deteriorate	Condition is likely to deteriorate slightly over the next 5 years	(↓)
Rapidly deteriorate	Substantial deterioration of condition is expected over the next 5 years	(↓↓)

7.3.2 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) score forms part of a larger assessment called the Wetland Importance and Sensitivity scoring system which also addresses hydrological importance and direct human benefits relevant to a HGM unit. Both PES and EIS form part of a larger reserve determination process documented by the Department of Water and Sanitation.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (DWAF, 1999). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use.

The Ecological Importance and Sensitivity of the wetlands is represented are described in the results section. Explanations of the scores are given in Table 21.

Table 21: Environmental Importance and Sensitivity rating scale used for the estimation of EIS scores (DWAF, 1999)

Ecological Importance and Sensitivity Categories	**Rating**
Very High Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in major rivers	>3 and <=4
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands 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
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers	>1 and <=2
Low/Marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers	>0 and <=1

7.3.3 Present Ecological Category (EC): Riparian

In the current study, the Ecological Category of the riparian areas was assessed using a level 3 VEGRAI (Riparian Vegetation Response Assessment Index) (Kleynhans et al, 2007) and QHI (Quick Habitat Integrity) to calculate the ecological category of the river system (Table 22).

Table 22: Generic ecological categories for EcoStatus components (modified from Kleynhans, 1996 & Kleynhans, 1999)

ECOLOGICAL CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

7.3.4 Quick Habitat Integrity Model

To accommodate a less-detailed process, a desktop habitat integrity assessment (using the Quick Habitat Integrity model) that allows for a coarse assessment was developed. This assessment rates the habitat according to a scale of 0 (close to natural) to 5 (critically modified) according to the following metrics (Seaman *et al*, 2010):

- Bed modification.
- Flow modification.
- Introduced Instream biota.
- Inundation.
- Riparian / bank condition.
- Water quality modification.

7.3.5 Recommended Ecological Category (REC)

The REC is determined by the Present Ecological State of the water resource and the importance and/or sensitivity of the water resource. Water resources which have Present Ecological State categories in an E or F ecological category are deemed unsustainable by the DWS. In such cases the REC must automatically be increased to a D.

Where the PES is in the A, B, C, D or E the EIS components must be checked to determine if any of the aspects of importance and sensitivity (Ecological Importance; Hydrological Functions and Direct Human Benefits) are high or very high. If this is the case, the feasibility of increasing the PES (particularly if the PES is in a low C or D category) should be evaluated. This is recommended to enable important and/or sensitive wetland water resources to maintain their functionality and continue to provide the goods and services for the environment and society.

If:

- PES is in an E or F category:
  The REC should be set at at least a D, since E and F EC's are considered unsustainable.
  - The PES category is in a A, B, C or D category, AND the EIS criteria are low or moderate OR the EIS criteria are high or even very high, but it is not feasible or practicable for the PES to be improved:
- The REC is set at the current PES.
  - The PES category is in a B, C or D category, AND the EIS criteria are high or very high AND it is feasible or practicable for the PES to be improved:
- The REC is set at least one Ecological Category higher than the current PES." (Rountree *et al,* 2013).

8 Impact Assessments

8.1 NEMA (2014) Impact Ratings

As required by the 2014 NEMA regulations, impact assessment should provide quantified scores indicating the expected impact, including the cumulative impact of a proposed activity. This assessment follows the format presented below (Table 23 & 24):

Table 23: Criteria for Assessment of mpacts

Severity (Magnitude)	
The severity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as	
(I)nsignificant	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
(M)oderate	The affected environment is altered, but functions and processes continue, albeit in a modified way.
(V)ery High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Duration	
The lifetime of the impact that is measured in relation to the lifetime of the proposed development.	
(T)emporary	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.
(S)hort term	The impact will be relevant through to the end of a construction phase (1.5–2 years).
(M)edium term	The impact will last up to the end of the development phases, where after it will be entirely negated.
(L)ong term	The impact will continue or last for the entire operational lifetime i.e. exceed 30 years of the development, but will be mitigated by direct human action or by natural processes thereafter.
(P)ermanent	This is the only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact is transient.

Spatial scale	
Classification of the physical and spatial scale of the impact	
(F)ootprint	The impacted area extends only as far as the activity, such as the footprint occurring within the total site area.
(S)ite	The impact could affect the whole, or a significant portion of, the site.
(R)egional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
(N)ational	The impact could have an effect that expands throughout the country (South Africa).
(I)nternational	Where the impact has international ramifications that extend beyond the boundaries of South Africa.
Probability	
This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:	
(I)mprobable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).
(P)ossible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chance of this impact occurring is defined as 25%.
(L)ikely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chance of this impact occurring is defined as 50%.
(H)ighly Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chance of this impact occurring is defined as 75%.
(D)efinite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

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Table 24: Assessment Criteria: Ranking Scales

PROBABILITY		MAGNITUDE	
Description / Meaning	Score	Description / Meaning	Score
Definite/don't know	5	Very high/don't know	10
Highly probable	4	High	8
Probable	3	Moderate	6
Possible	2	Low	4
Improbable	1	Insignificant	2
DURATION		**SPATIAL SCALE**	
Description / Meaning	Score	Description / Meaning	Score
Permanent	5	International	5
Long Term	4	National	4
Medium Term	3	Regional	3
Short term	2	Local	2
Temporary	1	Footprint	1/0

Determination of Significance – With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. The Significance Rating (SR) is determined as follows:

Significance Rating (SR) = (Extent + Intensity + Duration) x Probability

Identifying the Potential Impacts without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a value for each impact (prior to the implementation of mitigation measures). Significance without mitigation is rated on the following scale (Table 25):

Table 25: Significance Rating Scales without mitigation

SR < 30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30 < SR < 60	Medium (M)	Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR > 60	High (H)	Impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An impact which could influence the decision about whether or not to proceed with the project.

8.2 DWS (2015) Impact Register and Risk Assessment

Section 21(c) and (i) water uses (Impeding or diverting low and/or impacts to the bed and banks of watercourses) are non-consumptive and their impacts more difficult to detect and manage. They are also generally difficult to clearly quantify. However, if left undetected these impacts can significantly change various attributes and characteristics of a watercourse, and water resources, especially if left unmanaged and uncontrolled.

Risk-based management has value in providing an indication of the potential for delegating certain categories of water use “risks” to DWS regional offices (RO) or Catchment Management Agencies (CMA). Risk categories obtained through this assessment serve as a guideline to establish the appropriate channel of authorisation of these water uses

The DWS has therefore developed a risk assessment matrix to assist in quantifying expected impacts. The scores obtained in this assessment are useful in evaluating how the proposed activities should be authorised.

The formula used to derive a risk score is as follows:

RISK = CONSEQUENCE x LIKELIHOOD

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

LIKELIHOOD = FREQUENCY OF THE ACTIVITY + FREQUENCY OF THE IMPACT +LEGAL ISSUES + DETECTION

Table 26 below provides a description of the classes into which scores are sorted, and their implication for authorization.

Table 26: An extract from DWS (2016) indicating the risk scores and classes as well as the implication for the appropriate authorization process

RATING	CLASS	MANAGEMENT DESCRIPTION	AUTHORISATION	DELEGATION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands are excluded.	GA	Regional Head
56 – 169	(M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.	WUL	Regional Head
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.	WUL	Director General

APPENDIX C: ABBREVIATED CVS OF PARTICIPATING SPECIALISTS

Name:	**ANTOINETTE BOOTSMA nee van Wyk**
ID Number	7604250013088
Name of Firm:	Limosella Consulting
SACNASP Status:	Professional Natural Scientist # 400222-09 Botany and Ecology

EDUCATIONAL QUALIFICATIONS

- MSc Ecology, University of South Africa (2017) Awarded with distinction. Project Title: Natural mechanisms of erosion prevention and stabilization in a Marakele peatland; implications for conservation management
- Short course in wetland soils, Terrasoil Science (2009)
- Short course in wetland delineation, legislation and rehabilitation, University of Pretoria (2007)
- B. Sc (Hons) Botany, University of Pretoria (2003-2005). Project Title: A phytosociological Assessment of the Wetland Pans of Lake Chrissie
- B. Sc (Botany & Zoology), University of South Africa (1997 - 2001)

PUBLICATIONS

- A.A. Boostma, S. Elshehawi, A.P. Grootjans, P.L Grundling, S. Khosa. *In Press.* Ecohydrological analysis of the Matlabas Mountain mire, South Africa. Mires and Peat
- P.L. Grundling, A Lindstrom., M.L. Pretorius, A. Bootsma, N. Job, L. Delport, S. Elshahawi, A.P Grootjans, A. Grundling, S. Mitchell. 2015. Investigation of Peatland Characteristics and Processes as well as Understanding of their Contribution to the South African Wetland Ecological Infrastructure Water Research Comission KSA 2: K5/2346
- A.P. Grootjans, A.J.M Jansen , A, Snijdewind, P.C. de Hullu, H. Joosten, A. Bootsma and P.L. Grundling. (2014). In search of spring mires in Namibia: the Waterberg area revisited. Mires and Peat. Volume 15, Article 10, 1–11, http://www.mires-and-peat.net/, ISSN 1819-754X © 2015 International Mire Conservation Group and International Peat Society
- Haagner, A.S.H., van Wyk, A.A. & Wassenaar, T.D. 2006. *The biodiversity of herpetofauna of the Richards Bay Minerals leases.* CERU Technical Report 32. University of Pretoria.
- van Wyk, A.A., Wassenaar, T.D. 2006. *The biodiversity of epiphytic plants of the Richards Bay Minerals leases.* CERU Technical Report 33. University of Pretoria.

- Wassenaar, T.D., van Wyk, A.A., Haagner, A.S.H, & van Aarde, R.J.H. 2006. *Report on an Ecological Baseline Survey of Zulti South Lease for Richards Bay Minerals*. CERU Technical Report 29. University of Pretoria

KEY EXPERIENCE

The following projects provide an example of the application of wetland ecology on strategic as well as fine scale as well as its implementation into policies and guidelines. (This is not a complete list of projects completed, rather an extract to illustrate diversity);

- More than 90 external peer reviews as part of mentorship programs for companies including Gibb, Galago Environmental Consultants, Lidwala Consulting Engineers, Bokamoso Environmental Consultants, 2009 ongoing
- More than 300 fine scale wetland and ecological assessments in Gauteng, Mpumalanga, KwaZulu Natal, Limpopo and the Western Cape 2007, ongoing
- Strategic wetland specialist input into the Open Space Management Framework for Kyalami and Ruimsig, City of Johannesburg, 2016
- Fine scale wetland specialist input into the ESKOM Bravo Integration Project 3, 4, 5 and Kyalami – Midrand Strengthening.
- Wetland/Riparian delineation and functional assessment for the proposed maintenance work of the rand water pipelines and valve chambers exposed due to erosion in Casteel A, B and C in Bushbuckridge Mpumalanga Province
- Wetland/Riparian delineation and functional assessment for the Proposed Citrus Orchard Establishment, South of Burgersfort (Limpopo Province) and North of Lydenburg (Mpumalanga Province).
- Scoping level assessment to inform a proposed railway line between Swaziland and Richards Bay. April 2013.
- Environmental Control Officer. Management of onsite audit of compliance during the construction of a pedestrian bridge in Zola Park, Soweto, Phase 1 and Phase 2. Commenced in 2010, ongoing.
- Fine scale wetland delineation and functional assessments in Lesotho and Kenya. 2008 and 2009;
- Analysis of wetland/riparian conditions potentially affected by 14 powerline rebuilds in Midrand, Gauteng, as well submission of a General Rehabilitation and Monitoring Plan. May 2013.
- Wetland specialist input into the Environmental Management Plan for the upgrade of the Firgrove Substation, Western Cape. April 2013
- An audit of the wetlands in the City of Johannesburg. Specialist studies as well as project management and integration of independent datasets into a final report. Commenced in August 2007

- Input into the wetland component of the Green Star SA rating system. April 2009;
- A strategic assessment of wetlands in Gauteng to inform the GDACE Regional Environmental Management Framework. June 2008.
- As assessment of wetlands in southern Mozambique. This involved a detailed analysis of the vegetation composition and sensitivity associated with wetlands and swamp forest in order to inform the development layout of a proposed resort. May 2008.
- An assessment of three wetlands in the Highlands of Lesotho. This involved a detailed assessment of the value of the study sites in terms of functionality and rehabilitation opportunities. Integration of the specialist reports socio economic, aquatic, terrestrial and wetland ecology studies into a final synthesis. May 2007.
- Ecological studies on a strategic scale to inform an Environmental Management Framework for the Emakazeni Municipality and an Integrated Environmental Management Program for the Emalahleni Municipality. May and June 2007

Name:	**RUDI BEZUIDENHOUDT**
ID Number	880831 5038 081
Name of Firm:	Limosella Consulting
Position:	Wetland Specialist
SACNASP Status:	Cert. Nat. Sci (Reg. No. 500024/13)
Nationality:	South African
Marital Status:	Single
Languages:	Afrikaans (mother tongue), English

EDUCATIONAL QUALIFICATIONS

- B.Sc. (Botany & Zoology), University of South Africa (2008 - 2012)
- B.Sc. (Hons) Botany, University of South Africa (2013 – Ongoing)
- Introduction to wetlands, Gauteng Wetland Forum (2010)
- Biomimicry and Constructed Wetlands. Golder Associates and Water Research Commission (2011)
- Wetland Rehabilitation Principles, University of the Free State (2012)
- Tools for Wetland Assessment, Rhodes University (2011)
- Wetland Legislation, University of Free-State (2013)
- Understanding Environmental Impact Assessment, WESSA (2011)
- SASS 5, Groundtruth (2012)
- Wetland Operations and Diversity Management Master Class, Secolo Consulting Training Services (2015)

- Tree Identification, Braam van Wyk – University of Pretoria (2015)
- Wetland Buffer Legislation – Eco-Pulse & Water Research Commission (2015)
- Wetland Seminar, ARC-ISCW & IMCG (2011)
- Tropical Coastal Ecosystems, edX (2015 – ongoing)

KEY EXPERIENCE

➢ **Wetland Specialist**

This entails all aspects of scientific investigation associated with a consultancy that focuses on wetland specialist investigations. This includes the following:

- Approximately 200+ specialist investigations into wetland and riparian conditions on strategic, as well as fine scale levels in Gauteng, Limpopo, North-West Province Mpumalanga KwaZulu Natal, North-West Province, Western Cape, Eastern Cape & Northern Cape
- Ensuring the scientific integrity of wetland reports including peer review and publications.

Large Eskom projects include:

- Eskom 88kV Rigi – Sonland
- Eskom 88kV Simmerpan Line
- Eskom 88kV Meteor Line
- Eskom 88kV Kookfontein – Jaguar
- Eskom 132kV Dipomong
- Eskom 132kV Everest – Merapi
- Eskom 132kV Vulcan – Enkangala
- Eskom 400kV Helios – Aggenys
- Eskom 400kV Hendrina – Gumeni
- Eskom 765kV Aries – Helios
- Eskom 765kV Aries – Kronos
- Eskom 765kV Kronos – Perseus
- Eskom 765kV Perseus – Gamma
- Eskom 765kV Helios – Juno
- Eskom 765kV Aries- Helios

➢ **Biodiversity Action Plan**

This entails the gathering of data and compiling of a Biodiversity action plan.

➢ **Wetland Rehabilitation**

This entailed the management of wetland vegetation and rehabilitation related projects in terms of developing proposals, project management, technical investigation and quality control.

➢ **Wetland Ecology**

Experience in the delineation and functional assessment of wetlands and riparian areas in order to advise proposed development layouts, project management, report writing and quality control.

- **Environmental Controlling Officer**

Routine inspection of construction sites to ensure compliance with the City's environmental ordinances, the Environmental Management Program and other laws and by-laws associated with development at or near wetland or riparian areas.

  - Soweto Zola Park 2011-2013
  - Orange Farm Pipeline 2010-2011

- **Wetland Audit**

Audit of Eskom Kusile power station to comply with the Kusile Section 21G Water Use Licence (Department of Water Affairs, Licence No. 04/B20F/BCFGIJ/41, 2011), the amended Water Use Licence (Department of water affairs and forestry, Ref. 27/2/2/B620/101/8, 2009) and the WUL checklist provided by Eskom.

  - Kusile Powerstation 2012-2013.

EMPLOYEE EXPERIENCE:

- **GIS Specialist – AfriGIS**

  January 2008 – August 2010

  Tasks include:

- GIS Spatial layering
- Google Earth Street View Mapping
- Data Input

- **Wetland Specialist - Limosella Consulting**

  September 2010 – Ongoing

  Tasks include:

- GIS Spatial layering
- Wetland and Riparian delineation studies, opinions and functional assessments including data collection and analysis
- Correspondence with stakeholders, clients, authorities and specialists
- Presentations to stakeholders, clients and specialists
- Project management
- Planning and executing of fieldwork
- Analysis of data
- GIS spatial representation
- Submission of technical reports containing management recommendations
- General management of the research station and herbarium
- Regular site visits

- Attendance of monthly meetings
- Submission of monthly reports

MEMBERSHIPS IN SOCIETIES

- Botanical Society of South African
- SAWS (South African Wetland Society) Founding member
- SACNASP (Cert. Nat. Sci. Reg. No. 500024/13)

APPENDIX D: DWE IMPACT ASSESSMENT

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

Nature = Positive (+1) or negative (-1) impact

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts.

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven as indicated in Table 0-3. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in this report. The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 0-2, which is extracted from Table 0-1. The description of the significance ratings is discussed in Table 0-3.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 0-1: Impact Assessment Parameter Ratings

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or highly sensitive environments. Irreplaceable damage to highly sensitive cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or moderate to highly sensitive environments. Irreplaceable damage to cultural/social resources of moderate to highly sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Serious loss and/or damage to physical or biological resources or highly sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
4	Serious loss and/or damage to physical or biological resources or moderately sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	<u>Very limited/Isolated</u> Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 0-2: Probability/Consequence Matrix

Probability	Significance																																					
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Consequence																																					

Table 0-3: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

IMPACT DESCRIPTION: Changes in water flow regime impact ratings				
Dimension	**Rating**	**Motivation**		**Significance**
PRE-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	Impact will be permanent until decommissioning phase, hence Project Life.	Consequence: Moderately detrimental (-11)	Significance: Moderate - negative (-77)
Extent	Local (3)	Only expected to affect the development area and immediate surroundings.		
Intensity x type of impact	High - negative (-5)	Most areas are only likely to be marginally affected, but the instream component at the intake area is likely to affect channel morphology.		
Probability	Definite (>80%) (7)	Without mitigation measures, the potential impact is highly probable, especially within semi-arid region.		
POST-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	As for pre-mitigation	Consequence: Moderately detrimental (-10)	Significance: Minor - negative (-60)
Extent	Local (3)	Mitigation measures should be established within the operational area, hence limited the extent of the potential effects.		
Intensity x type of impact	Moderately high - negative (-4)	Mitigation should limit intensity of the potential impact, by reducing runoff volumes.		
Probability	Highly probable (<80%) (6)	Mitigation should notably reduce the probability of occurrence.		

IMPACT DESCRIPTION: Changes in sediment entering and exiting the system impact ratings				
Dimension	**Rating**	**Motivation**		**Significance**
PRE-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	Impact will be permanent until decommissioning phase, hence Project Life.	Consequence: Moderately detrimental (-10)	Significance: Minor - negative (-70)
Extent	Local (3)	Only expected to affect the development area and immediate surroundings.		
Intensity x type of impact	Moderately high - negative (-4)	Loss of connectivity likely to reduce available refuge habitat and potential altered hydrology.		
Probability	Definite (>80%) (7)	Without mitigation measures (i.e. relocation outside wetland areas), the potential impact is highly probable.		
POST-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	As for pre-mitigation	Consequence: Slightly detrimental (-9)	Significance: Minor - negative (-54)
Extent	Local (3)	As for pre-mitigation		
Intensity x type of impact	Moderate - negative (-3)	As for pre-mitigation		
Probability	Highly probable (<80%) (6)	Mitigation will almost certainly reduce the probability of occurrence.		

IMPACT DESCRIPTION: Introduction and spread of alien vegetation

Dimension	Rating	Motivation		Significance
PRE-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	Impact will be permanent until decommisioning phase, hence Project Life.	Consequence: Moderately detrimental (-10)	Significance: Minor - negative (-60)
Extent	Local (3)	Proposed road reserve/s are likely to only provide sufficient width for two vehicles/heavy machinery to pass alongside.		
Intensity x type of impact	Moderately high - negative (-4)	Potentially sensitive areas (i.e. lateral floodplain areas) of the river are likely to be fragmented and potential loss of fish breeding/nursery grounds.		
Probability	Highly probable (<80%) (6)	Without mitigation measures, the potential impact is highly probable.		
POST-MITIGATION				
Duration	Short term (<1yr) (2)	As for pre-mitigation	Consequence: Slightly detrimental (-8)	Significance: Negligible - negative (-32)
Extent	Local (3)	As for pre-mitigation		
Intensity x type of impact	Moderate - negative (-3)	Marginally decreased due to 'stream simulation' design of bridge crossing.		
Probability	Probable (<50%) (4)	Mitigation will marginally reduce probability of fish communities being affected.		

IMPACT DESCRIPTION: Loss and disturbance of watercourse habitat and fringe vegetation

Dimension	Rating	Motivation		Significance
PRE-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	Impact will be permanent until decommisioning phase, hence Project Life.	Consequence: Moderately detrimental (-11)	Significance: Moderate - negative (-77)
Extent	Local (3)	Remaining outside of the floodplain area is likely to limit extent to local area.		
Intensity x type of impact	High - negative (-5)	Impact perceived to be serious and upon highly sensitive areas.		
Probability	Definite (>80%) (7)	Without mitigation measures, the potential impact is highly probable.		
POST-MITIGATION				
Duration	Beyond project life (6)	As for pre-mitigation	Consequence: Moderately detrimental (-13)	Significance: Moderate - negative (-78)
Extent	Local (3)	As for pre-mitigation		
Intensity x type of impact	Moderately high - negative (-4)	Remaining outside buffer areas will reduce intensity of the impact.		
Probability	Highly probable (<80%) (6)	Mitigation is expected to reduce the probabilty of eliciting an impact.		

IMPACT DESCRIPTION: Changes in water quality due to pollution

Dimension	Rating	Motivation		Significance
PRE-MITIGATION				
Duration	Long term (6-15 yrs) (4)	Assumed to remain post-closure due to expensive removal and rehabilitation costs.	Consequence: Moderately detrimental (-10)	Significance: Minor - negative (-60)
Extent	Local (3)	Occurrence within the river suggested notable downstream migratio nof impacts, especially during the wet season.		
Intensity x type of impact	Moderate - negative (-3)	Bed and channel modification resulting in habitat modification and potentil habitat loss, which will most likely deter inhabiting aqautic biota.		
Probability	Highly probable (<80%) (6)	Without mitigation measures, the potential impact is definite.		
POST-MITIGATION				
Duration	Short term (<1yr) (2)	Removal and rehabilitation following closure of the operation.	Consequence: Slightly detrimental (-7)	Significance: Negligible - negative (-28)
Extent	Local (3)	As for pre-mitigation		
Intensity x type of impact	Low - negative (-2)	As for pre-mitigation		
Probability	Probable (<50%) (4)	Mitigation may reduce the perceived impact marginally, but not expected to be sustainable.		

IMPACT DESCRIPTION: Changes in water flow regime impact ratings

Dimension	Rating	Motivation		Significance
PRE-MITIGATION				
Duration	Long term (6-15 yrs) (4)	Impact will be permanent until decommissioning phase, hence Project Life.	Consequence: Moderately detrimental (-12)	Significance: Minor - negative (-72)
Extent	Local (3)	Creation of exclusion zone may faciliate rivereine self-regulation and restoration.		
Intensity x type of impact	High - negative (-5)	A few years during the LoM is expected to ntably improve the condition of the adjacent riparian banks.		
Probability	Highly probable (<80%) (6)	Without mitigation measures, the potential impact is only at probable.		
POST-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	As for pre-mitigation	Consequence: Slightly detrimental (-9)	Significance: Minor - negative (-54)
Extent	Local (3)	As for pre-mitigation		
Intensity x type of impact	Moderate - negative (-3)	As for pre-mitigation		
Probability	Highly probable (<80%) (6)	Mitigation will most probably be outside. Playing with the overnight issues at the laboratoryso as o save the budget.		

IMPACT DESCRIPTION: Changes in sediment entering and exiting the system impact ratings				
Dimension	**Rating**	**Motivation**		**Significance**
PRE-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	Impact will be permanent until decommissioning phase, hence Project Life.	Consequence: Moderately detrimental (-10)	Significance: Minor - negative (-60)
Extent	Limited (2)	Potential exent of the zone of influence during the wet season, especially the wet saeson.		
Intensity x type of impact	High - negative (-5)	Open pit exhibits potential to seep and cause substantial water quality impairment.		
Probability	Highly probable (<80%) (6)	Without mitigation,		
POST-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	As for pre-mitigation	Consequence: Slightly detrimental (-9)	Significance: Minor - negative (-36)
Extent	Limited (2)	As for pre-mitigation		
Intensity x type of impact	Moderately high - negative (-4)	Mitigation will maximise local job creation		
Probability	Probable (<50%) (4)	Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised		

IMPACT DESCRIPTION: Introduction and spread of alien vegetation				
Dimension	**Rating**	**Motivation**		**Significance**
PRE-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	Equal to the duration of the construction phase	Consequence: Slightly detrimental (-9)	Significance: Minor - negative (-36)
Extent	Local (3)	Most positions will be filled by persons living in the project area; some from elsewhere in the country and from abroad		
Intensity x type of impact	Moderate - negative (-3)	About 50 local jobs will be created per road		
Probability	Probable (<50%) (4)	Without appropriate mitigation, forecosts of majority local recruitment might not be achieved		
POST-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	As for pre-mitigation	Consequence: Slightly detrimental (-7)	Significance: Negligible - negative (-28)
Extent	Limited (2)	As for pre-mitigation		
Intensity x type of impact	Low - negative (-2)	Mitigation will maximise local job creation		
Probability	Probable (<50%) (4)	Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised		

IMPACT DESCRIPTION: Loss and disturbance of watercourse habitat and fringe vegetation

Dimension	Rating	Motivation		Significance
PRE-MITIGATION				
Duration	Long term (6-15 yrs) (4)	Equal to the duration of the construction phase	Consequence: Moderately detrimental (-11)	Significance: Minor - Negligible - negative (-33)
Extent	Local (3)	Most positions will be filled by persons living in the project area; some from elsewhere in the country and from abroad		
Intensity x type of impact	Moderately high - negative (-4)	About 50 local jobs will be created per road		
Probability	Unlikely (<25%) (3)	Without appropriate mitigation, forecosts of majority local recruitment might not be achieved		
POST-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	As for pre-mitigation	Consequence: Slightly detrimental (-8)	Significance: Negligible - negative (-32)
Extent	Limited (2)	As for pre-mitigation		
Intensity x type of impact	Moderate - negative (-3)	Mitigation will maximise local job creation		
Probability	Probable (<50%) (4)	Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised		

IMPACT DESCRIPTION: Changes in water quality due to pollution

Dimension	Rating	Motivation		Significance
PRE-MITIGATION				
Duration	Long term (6-15 yrs) (4)	Equal to the duration of the construction phase	Consequence: Moderately detrimental (-12)	Significance: Minor - negative (-72)
Extent	Local (3)	Most positions will be filled by persons living in the project area; some from elsewhere in the country and from abroad		
Intensity x type of impact	High - negative (-5)	About 50 local jobs will be created per road		
Probability	Highly probable (<80%) (6)	Without appropriate mitigation, forecosts of majority local recruitment might not be achieved		
POST-MITIGATION				
Duration	Medium term (1-5 yrs) (3)	As for pre-mitigation	Consequence: Slightly detrimental (-9)	Significance: Minor - negative (-45)
Extent	Limited (2)	As for pre-mitigation		
Intensity x type of impact	Moderately high - negative (-4)	Mitigation will maximise local job creation		
Probability	Likely (<65%) (5)	Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised		

IMPACT DESCRIPTION: Vegetation Clearing				
Dimension	**Rating**	**Motivation**		**Significance**
PRE-MITIGATION				
Duration	Immediate (<1yr) (1)	Equal to the duration of the construction phase	Consequence: Negligible (-5)	Significance: Negligible - negative (-35)
Extent	Limited (2)	Most positions will be filled by persons living in the project area; some from elsewhere in the country and from abroad		
Intensity x type of impact	Low - negative (-2)	About 50 local jobs will be created per road		
Probability	Definite (>80%) (7)	Without appropriate mitigation, forecosts of majority local recruitment might not be achieved		
POST-MITIGATION				
Duration	Immediate (<1yr) (1)	As for pre-mitigation	Consequence: Negligible (-4)	Significance: Negligible - negative (-28)
Extent	Limited (2)	As for pre-mitigation		
Intensity x type of impact	Very low - negative (-1)	Mitigation will maximise local job creation		
Probability	Definite (>80%) (7)	Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised		

APPENDIX E: GLOSSARY OF TERMS

Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area
Hydrophyte	any plant that grows in water or on a substratum that is at least periodically deficient in oxygen as a result of soil saturation or flooding; plants typically found in wet habitats
Hydromorphic soil	soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils)
Seepage	A type of wetland occurring on slopes, usually characterised by diffuse (i.e. unchannelled, and often subsurface) flows
Sedges	Grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family.
Soil profile	the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991)
Wetland:	"*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." (National Water Act; Act 36 of 1998).
Wetland delineation	the determination and marking of the boundary of a wetland on a map using the DWAF (2005) methodology. This assessment includes identification of suggested buffer zones and is usually done in conjunction with a wetland functional assessment. The impact of the proposed development, together with appropriate mitigation measures are included in impact assessment tables