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Proposed Development of an Underground Coal Mine and Associated Infrastructure, near Hendrina, Mpumalanga Province

Wetland Assessment Report

Project Number:

XST3791

Prepared for:

Umcebo Mining (Pty) Ltd

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Project Name:	**Proposed Development of an Underground Coal Mine and Associated Infrastructure, near Hendrina, Mpumalanga Province**
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I, Caroline Ann Wallington as duly authorised representative of Digby Wells and Associates (South Africa) (Pty) Ltd., hereby confirm my independence (as well as that of Digby Wells and Associates (South Africa) (Pty) Ltd.) and declare that neither I nor Digby Wells and Associates (South Africa) (Pty) Ltd. have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of Umcebo Mining (Pty) Ltd, other than fair remuneration for work performed, specifically in connection with the proposed development of an underground coal mine and associated infrastructure, located near Hendrina, Mpumalanga Province.

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EXECUTIVE SUMMARY

Wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, toxicant assimilation, carbon storage, streamflow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity. Digby Wells Environmental was commissioned by Umcebo Mining (Pty) Ltd, a subsidiary of Glencore Operations South Africa (Pty) Ltd, as the environmental consultant for the Hendrina Project and to conduct the wetlands specialist studies to inform the project. Umcebo currently holds two Prospecting Rights (PRs; namely MP 1265 PR and MP 1266 PR) comprising three underground reserve blocks referred to as Mooivley East, Mooivley West and Hendrina South.

The aim of the wetland study was to conduct an assessment on the natural wetland habitats associated with the proposed project area according to recognised methodology that included delineation of all wetlands on site using soil and vegetation indicators; classification of wetlands into hydrogeomorphic units according to the terrain; ecological health assessment; ecosystem services and functionality assessment; and a sensitivity analysis. The proposed activities were then used to complete the impact assessment and mitigation measures proposed.

The project area is predominantly found within the quaternary catchment B12A, which is characterised by the Klein Olifants River, and is characterised by large areas of wetlands; totalling 2 830.2 hectares (ha), which equates to approximately 42 % of the proposed mining right areas. These include three major types of wetlands, being: valley bottom systems, hillslope seeps and pan wetlands, which all function differently and deliver a variety of goods and services. Many of these wetlands are mapped as National Freshwater Ecosystem Priority Areas (NFEPA) and thus are recognised for the role that they play in supporting and provisioning services to the surrounding area and country.

These wetlands are also identified as Ecological Support Areas (ESA) according to the Mpumalanga Biodiversity Sector Plan (2013) in the terrestrial and freshwater assessments. Some areas associated with the Klein Olifants River are designated as Critical Biodiversity Areas (CBA). These findings are further highlighted in the Mining and Biodiversity Guideline Report (2013) as these sensitive areas are designated as highest risk to mining and they are of highest biodiversity importance for national biodiversity strategic goals. These findings together with the in-field detailed assessment of the wetlands allowed a sensitivity analysis to be completed and the table below details these areas.

Table A: Sensitivity Assessment

Sensitivity Rating	Wetland Areas identified
Very High – No Go areas	The Klein Olifants River, the channelled valley bottom systems and the natural pans.
High	All hillslope seep wetlands.
Moderate – High	The 100 m buffer of all wetlands.
Moderate – Low	The 500 m buffer (remaining after 100 m) of all wetlands as well as the impacted pans.

The delineated wetlands constitute 42 % of the three proposed mining right areas and both surface infrastructure and underground mine plan interacts with the wetlands found on site. The current proposed surface infrastructure will directly impact approximately 19 ha of wetland according to the current layout and the underground mine plan currently underlies 897 ha of wetland across all three mining areas, which will range from a depth of 32 m to 128 m.

The project has the potential to result in significant negative impacts on the natural wetlands and has the potential to alter the functioning of these systems and compromise their ecosystem services provided. However, if the recommendations for safety factors are adhered to, as per the recommendations from a comprehensive geotechnical assessment (yet to be completed), the impact can be considerably reduced to minor. The main potential negative impacts are highlighted below in Table i which also summarises the impact score prior to and after the recommended mitigation measures.

It can be concluded that the project will have a residual negative impact to the wetlands and their catchment areas. Umcebo will need to take this into consideration and manage the residual impact with adequate rehabilitation actions and if need be with an offsetting strategy to ensure no-nett-loss of wetland functionality. The monitoring plans throughout the Life of the Mine (LoM) must also inform Umcebo on the impacts to the wetlands and the remedial actions required.

Table i: Summary of Impact Assessment Findings with Mitigation Measures

Activity		Impact	Impact Score prior to mitigation	Recommended Mitigation Actions	Impact Score post-mitigation
Construction Phase					
1	Site Clearance within wetlands and their buffer areas	Removal of wetland soils and vegetation; totalling 18.7 ha.	-105 Moderate	The infrastructure plan must be reviewed, the footprint kept as small as possible and all wetlands must be avoided as far as possible; particularly with respect to Mooivley East infrastructure that is within the seep wetlands draining into the natural pan. The edge of the wetlands and at least a 100m buffer must be clearly demarcated in the field that will last for the duration of the construction phase. Wetland monitoring must be carried out during the construction phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible.	-66 Minor
2	Construction of general infrastructure within wetlands and their buffer areas	Degradation of habitat integrity.	-70 Minor		-32 Negligible
3	Construction of Overland Conveyor across an NFEPA channelled valley bottom wetland	Heavy machinery working with wetland channel and surrounds impacting upon soil, vegetation disturbing fauna.	-84 Moderate		-50 Minor
Operational Phase					
1	Underground Blasting and Mining	Undermining of wetlands leading to hydrological and geomorphic changes to the functioning of the ecosystem; particularly related to groundwater impacts.	-105 Moderate	Avoid undermining of channelled valley bottom wetlands and the Klein Olifants River – see areas deemed as no-go according to the sensitivity analysis. The highest safety factor as possible must be used for areas of shallow mining (32 to 70 m at least) and high safety factors must also be used where undermining of other wetlands is realised. If the possibility of subsidence is reduced to a negligible risk through the use of appropriate safety factors, the probability is considerably reduced. Underground dykes and sills must be carefully managed as this can lead to dewatering of wetlands if undesired aquifers are punctured.	-42 Minor
2	Hauling, Conveying and Stockpiling of Coal	The movement of coal over the channelled valley bottom that is highlighted as an NFEPA wetland and is a tributary to the Klein Olifants has a significant threat to water quality and coal fines that will be transported from the conveyor into the surrounding environment.	-84 Moderate	The conveyor must be covered to prevent windblown coal fines and any potential coal fallout. The conveyor servitude must also have a well-designed stream crossing to allow maintenance vehicles to cross with minimal impact. The wetlands outside of this must be demarcated as no-go areas. The conveyor must be monitored and maintained to best operating standards. This should be done in the dry season. The wetland must be monitored on a regular basis to ensure there is no residual impact to the wetland; and if so remediation measures should be followed.	-40 Minor
Rehabilitation Phase					
1	Removal of infrastructure and surface rehabilitation.	Similarly to the construction phase, the removal of the infrastructure will lead to potential negative impacts on the integrity of the natural wetland systems.	-65 Minor	The edge of the wetlands and at least a 100 m buffer must be clearly demarcated in the field that will last for the duration of the rehabilitation phase.. The rehabilitation footprint kept as small as possible and non-impacted wetlands must be avoided. Wetland monitoring must be carried out during the rehabilitation phase to ensure there is no unnecessary impact to wetlands; and if so that a remedy is put in place as soon as possible.	-36 Minor

Activity		Impact	Impact Score prior to mitigation	Recommended Mitigation Actions	Impact Score post-mitigation
2	Underground mine closure and rehabilitation	Post-mining decant of groundwater will have negative impacts on the wetlands as this water is likely to be of a poor water quality.	-114 Major	Groundwater and wetlands must be monitored post-mining for potential decant. Long-term water treatment options will need to be investigated by Umcebo to prevent polluted decant water from entering the catchment.	-90 Moderate

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LIST OF ACRONYMS & ABBREVIATIONS

CBA	Critical Biodiversity Areas
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DWAF	Department of Water and Forestry
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
ESA	Ecological Support Areas
Ha	Hectares
HGM	hydrogeomorphic
IBA	Important Bird Area
LoM	Life of Mine
mbgl	metres (m) below ground level
MBSP	Mpumalanga Biodiversity Sector Plan
MTPA	Mpumalanga Tourism and Parks Agency
MRA	Mining Right Application
NEMBA	National Environmental Biodiversity Act, 2004 (Act No. 10 of 2004)
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PA	Protected Areas
PCD	Pollution Control Dam
PES	Present Ecological Status
PRA	Prospecting Right Area
ROM	Run of Mine
SANBI	South African Biodiversity Institute
STLM	Steve Tshwete Local Municipality

1 Introduction

Wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, toxicant assimilation, carbon storage, streamflow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity (Kotze *et al*. 2007). The Ramsar Convention on Wetlands refers to wetlands as one of the most important life support systems on earth owing to the services provided. Wetlands are defined according to the National Water Act, 1998 (Act No. 36 of 1998) (NWA) 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."

According to the NWA, a water resource is not only considered to be the water that can be extracted from a system and utilised but the entire water cycle, where the entire ecosystem is acknowledged as a life support system. According to van Wyk *et al.* (2006) the "resource" is defined to include a water course, surface water, estuary and aquifer, on the understanding that a water course includes rivers and springs, the channels in which the water flows regularly or intermittently, wetlands, lakes and dams into or from which water flows, and where relevant, the banks and bed or the system. Basic human needs, societal well-being and economic growth and development are supported by river ecosystem goods and services.

The NWA requires that sufficient water is to be reserved to maintain as well as sustain the ecological functioning of the country's aquatic ecosystems which include rivers, wetlands, groundwater and estuarine systems. If the country's water resources continue to be abused and deteriorate, this will result in an unavoidable loss of key ecosystem services that support social and economic development. The optimal use of natural resources for sustainable economic activity is essential in developing countries. Biodiversity is a vital component for maintaining ecological processes and thus in ensuring sustainability of the ecosystem goods and services which is vital for successful water resource management (MacKay *et al.,* 2004).

South Africa holds extensive coal reserves and coal mining in the Mpumalanga Province which causes destruction of wetlands through direct impacts such as removal of habitat, alteration of flow and contamination of water, but also indirectly through the drawdown of groundwater resources during the dewatering process. Impacts on water resources are significant and include the leaching of acid mine drainage into streams and rivers causing acidification and salinisation by dissolved sulfates. Wetland systems cannot be regarded as isolated entities but rather as complex interlinking systems; furthermore it is estimated that South Africa contains over 10 000 km^2 of hydraulically interlinked coal mines (Ochieng *et al.* 2010).

This report serves to detail the findings of the wetlands ecological assessment of the Hendrina Project, where Umcebo Mining (Pty) Ltd (Umcebo), a subsidiary of Glencore Operations South Africa (Pty) Ltd (Glencore) is proposing the development and operation of a new underground coal mine and associated infrastructure at a site situated approximately 10-22 kilometres (km) south east of Hendrina in the Mpumalanga Province of South Africa (the project).

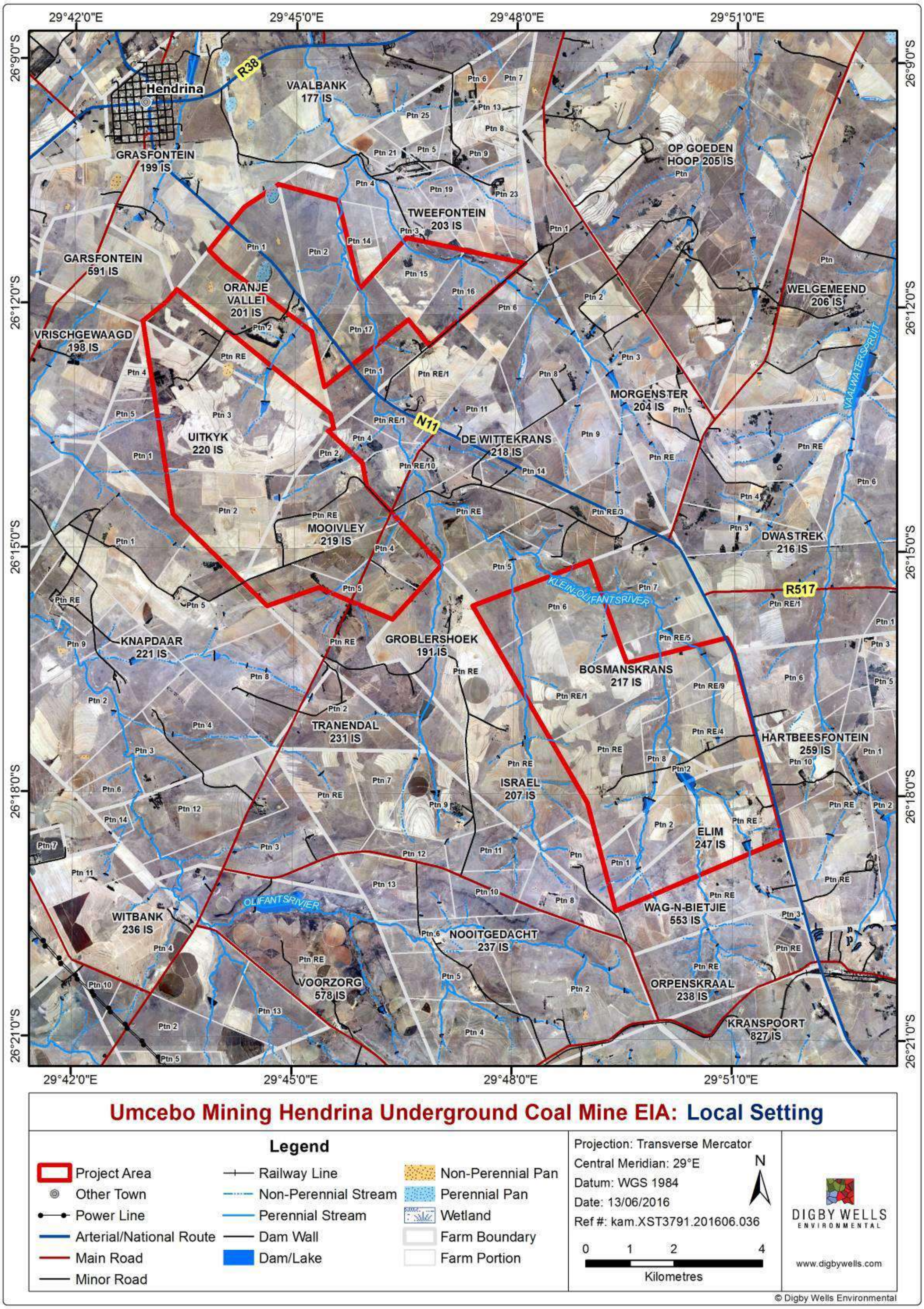
2 Project Overview

2.1 Project Location

The project area proposed to be mined has a combined footprint of 6 714 ha and is located in the Ermelo Coal Field within the Steve Tshwete Local Municipality (STLM) and Msukaligwa Local Municipality (MLM). Umcebo currently holds two Prospecting Rights (PRs) namely MP 1265 PR and MP 1266 PR comprising three underground reserve blocks referred to as Mooivley East, Mooivley West and Hendrina South; as detailed in Table 2-1 below and shown on Plan 1.

Table 2-1: Project Areas and Farms

Prospecting Right (PR) area	Reserve Block area	Farms and portions
MP 1265 PR (3 923 ha)	Mooivley East	▪ Tweefontein 203 IS – Portions 2, 15, 16, 17 and Portion of Portion 14; and ▪ Orange Vallei 201 IS – Portions 1
	Mooivley West	▪ Orange Vallei 201 IS – Portions Remaining Extent (RE) of the farm ▪ Uitkyk 220 IS – Portions 2 and 3; and ▪ Mooivley 219 IS – Portions 2, 4, 5 and RE
MP 1266 PR (2 787 ha)	Hendrina South	▪ Elim 247 IS - Portion RE; ▪ Geluksdraai 240 IS – 1 and 2; ▪ Orpenskraal 238 IS – Portion RE; and ▪ Bosmanskrans 217 IS – Portions 1, 3, 4, 6, 8, 9 and RE.



Plan 1: Project Local Setting

2.2 Mining Method and Approach

Due to the depth of the resource (i.e. 32 m to 128 m), underground mining will be used to access the ore body. Approximately 75 m deep incline shafts (total of three incline shafts for the project) will be constructed to gain access to the underground resource; this will be done through blasting. The two Mooivley reserves comprise two incline shafts each which will be developed to gain access to the two underground areas whilst the Hendrina South reserve comprises an incline shaft to gain access to one underground area. Mooivley West and Hendrina South will be mined at the same time. Once completed, Mooivley East mining activities will commence. The infrastructure utilised for the mining of Hendrina South and Mooivley West will be relocated to Mooivley East once mining has been completed.

The proposed mining method for the extraction of coal will be bord and pillar. In mechanised bord and pillar mining, extraction is achieved by developing a series of roadways (bords) in the coal seam connected by splits (cut-throughs) to form pillars and is done through the use of machinery referred to as a continuous miner. These pillars are left behind as part of a primary roof support system and there is no plan to extract any of the pillars for this project[1]. It is expected that there will be dolerite intrusions and a dyke development section will be deployed for the purpose of mining through these and preparing new mining sections. The overburden material extracted will be stockpiled and used to rehabilitate the incline shafts once mining is completed.

The estimated Life of Mine (LoM) will be 30 years[2] for all mining areas with a production rate of 2.4 million tonnes per annum (at full capacity) to mine a total of approximately 78 million tonnes of Run of Mine (ROM). The mine will reach full production within the first four years. The project is proposed to commence with construction and development when all required licences and authorisations have been granted.

2.3 Associated Mine Infrastructure

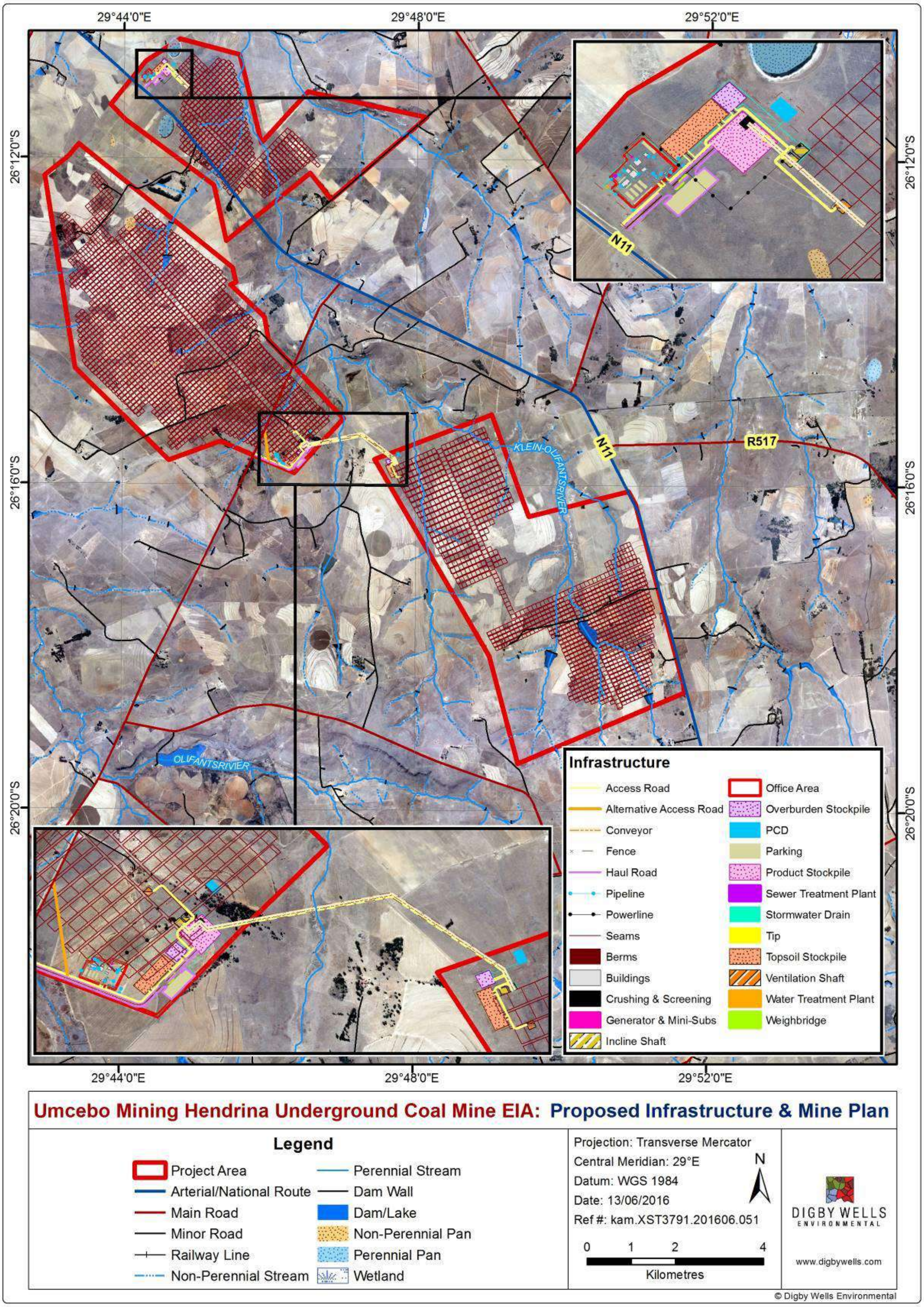
The proposed mine infrastructure includes the following; which is discussed in Section 11:

- Crushing and Screening Plant;
- Overburden and Product Stockpiles;
- Access and Service Roads (with weighbridge);
- Overland Conveyors;
- Three Access Points to the Underground Reserve;

[1] In partial pillar extraction, every alternative pillar is left behind to support the overburden or all the pillars are extracted to allow the roof to collapse in a controlled manner.

[2] The MRA will be made for an initial period of 30 years, the maximum allowed in terms of the provisions of Section 23 of the MPRDA. At the end of this period an application for renewal of the mining right will be made for any remaining reserves.

- Three Ventilation Shafts (one per access point);
- Office Complex (i.e. change house, workshop, offices);
- Three Pollution Control Dams (PCD) and water pipelines;
- Five Aboveground Storage Tanks (storage of diesel);
- Three Waste Bins per Shaft;
- Site fencing located around the Conveyer Belt and each Mining Complex;
- Diesel Generator and Sub-station;
- Water Treatment Plant; and
- Package Sewage Treatment Plant.



Plan 2: Proposed Infrastructure and Mine Plan – No Mitigations

2.4 Project Activities

A list of the project activities is presented in Table 2-2 below. These are the activities that are to be assessed in the Impact Assessment; refer to Section 11.

Table 2-2: Description of Activities to be assessed

Project Phase	Project Activity	Project Structures
Construction	Site Clearance	Topsoil Stockpiles
	Blasting and Excavation	Three Shaft Areas
	Construction of Surface Infrastructure	Crushing and Screening Plant Mine Offices Change House Workshop Overburden and Product Stockpiles Site Fencing Access and Service Roads (with weighbridge) Overland Conveyor Sewage Treatment Plant Three Pollution Control Dams Water Treatment Plant Diesel Storage Tanks Ventilation Shaft per mining right area
	Water Abstraction and Use	Water Tanks and Pipes
	Waste Generation and Disposal	Waste Skips
	Power Generation	Diesel Generator
Operations	Underground Blasting and Mining	Heavy Machinery and Equipment
	Stockpiling	Waste Rock Berms Product Stockpile
	Hauling/Conveying of Coal	Overland Conveyor Belt Haul and Access Roads
	Plant and Equipment Operations	Crushing and Screening Plant Workshop and Diesel Storage Tanks
	Water Use and Storage	Pollution Control Dam and Jo Jo Tanks
	Waste Generation and Storage	Sewage Treatment Plant Waste Skips
	Power Generation	Diesel Generator

Project Phase	Project Activity	Project Structures
Mine Decommissioning and Closure (Rehabilitation Phase)	Removal of infrastructure and surface rehabilitation	Crushing and Screening Plant Mine Offices Change House Workshop Overburden and Product Stockpiles Site Fencing Access and Service Roads (with weighbridge) Overland Conveyor Sewage Treatment Plant Three Pollution Control Dam Water Treatment Plant Diesel Storage Tanks Ventilation Shaft per mining right area
	Waste Generation and Disposal	Waste Skips

3 Terms of Reference

The aim of the wetlands assessment through Scoping and Environmental Impact Assessment (EIA) phase is to provide a report and accompanying maps regarding the following:

- Desktop scoping investigation of the potential wetlands for the project area;
- The identification and the delineation of wetlands within the area;
- A description and characterisation of the identified wetland areas;
- Determination of the wetland ecological health, importance and sensitivity as well as a description of ecological services provided by the wetlands;
- Assessment of potential impacts to the wetlands from the activities; and
- Discussion of recommended mitigation measures to be taken into account through the mitigation hierarchy.

3.1 Policy and Legal Framework

The wetlands assessment aims to support the following regulations, regulatory procedures and guidelines:

- The National Water Act, 1998 (Act No. 36 of 1998);
- Section 24 of the Constitution of the Republic of South Africa ,1996 (Act No. 108 of 1996);

- National Environmental Management Biodiversity Act ,2004 (Act No. 10 of 2004) (NEM:BA);
- Section 5 of the National Environmental Management Act ,1998 (Act No. 107 of 1998) (NEMA);
- Department of Water and Forestry (DWAF) Guidelines for the Delineation of Wetlands (2005);
- Mining and Biodiversity Guideline (DEA *et al*., 2013);
- Mpumalanga Biodiversity Sector Plan2014 (MTPB,;
- Wetland Management Series (published by Water Research Commission (WRC, 2007);
- National Freshwater Ecosystems Priority Areas (NFEPA, Nel *et al.,* 2011); and
- SANBI, in collaboration with the DWS report on "Wetland offsets: a Best-Practice Guideline for South Africa" (Macfarlane, *et al.,* 2014).

4 Details of the Specialist

The following specialists were part of the wetland ecological assessment:

- **Caroline Wallington**: Wetland Consultant; received a Bachelor of Science and Honours in Botany from the University of Cape Town (UCT) and is currently doing her MSc in Environmental Science at the University of the Witwatersrand part-time. She is an environmental consultant specialising in wetland assessments that form part of baseline assessments, EIA's, and other projects. She also does terrestrial floral assessments, biodiversity land management plans and land rehabilitation. Caroline is competent in wetland assessment methodology and has experience in most Provinces of South Africa as well as in African countries outside South Africa including Malawi and the Democratic Republic of Congo (DRC). Caroline is the lead wetland consultant for this project and report writer.
- **Crystal Rowe** (Pr. Sci. Nat. Botanical Science), wetland and flora specialist: received a Bachelor of Science and Honours in Botany at Nelson Mandela Metropolitan University (NMMU) and is an environmental consultant specialising in vegetation and wetland assessments. Experience includes ecological impact assessments, baseline vegetation assessments, estuarine ecological state assessments and wetland health assessments. Project experience includes various countries such as the DRC, Ethiopia, the Ivory Coast, Mali, Mozambique, Sierra Leone and extensively within South Africa. Crystal is the support wetland consultant on this project and report reviewer.

5 Aims and Objectives

The aim of the wetland study was to conduct an assessment on the natural wetland habitats associated with the proposed project area. This assessment determined the wetland boundaries and the baseline ecological state prior to the development. This information was to inform the project on the risks associated with the wetland ecosystems so that mitigation measures can be carried out according to best practice and to set a baseline against which to monitor, if the project is to go ahead.

6 Methodology

The approach followed for the wetlands study is shown in the simple flow diagram below, Figure 6-1, and each stage is briefly discussed in the following sections. This report details the results from the field investigation and the formal impact assessment and mitigation recommendations according to the mitigation hierarchy.

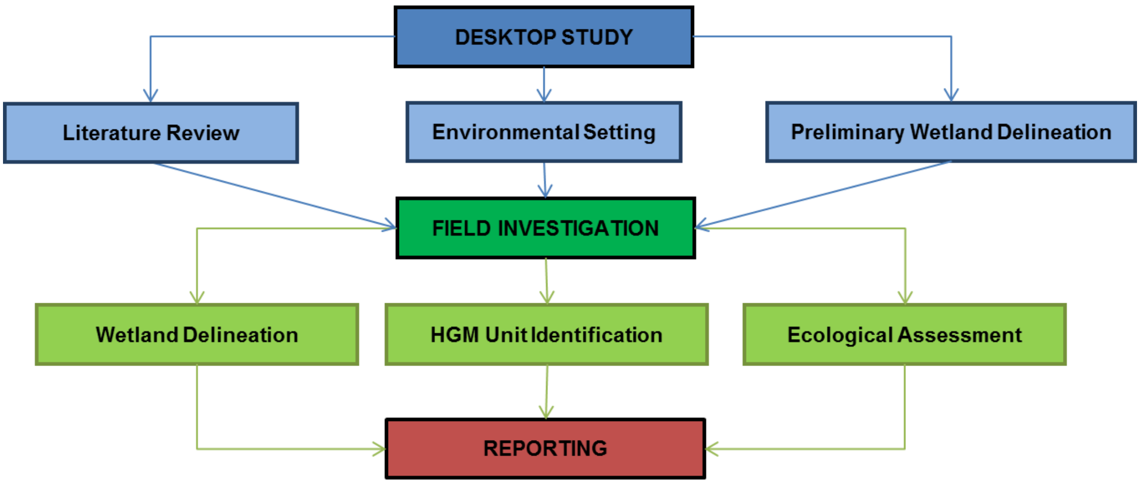


Figure 6-1: Simplified methodology followed for the wetland study

6.1 Literature Review and Desktop Assessment

Baseline and background information was researched and used to understand the area prior to fieldwork and to complete the screening (desktop) assessment. A regional understanding of the project area is gained through this process, which enables more accurate ecological assessment to be done. The information reviewed is summarised in Figure 6-2 and is detailed in this section.

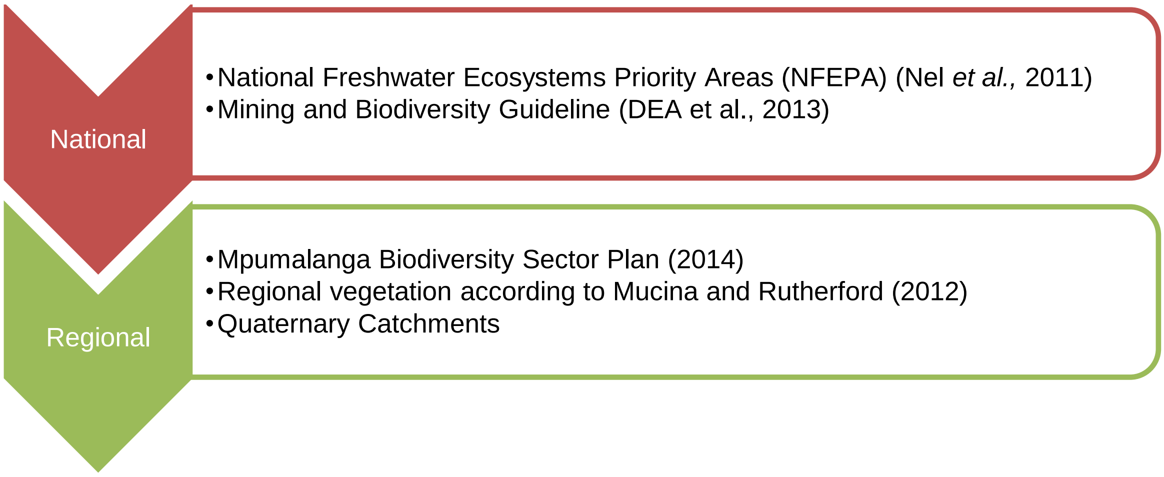


Figure 6-2: Flow Diagram Indicating the Different Levels of Screening Assessment Data Sourcing

6.1.1 National Freshwater Ecosystem Priority Areas

The NFEPA project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel *et al.* 2011). The spatial layers (FEPA's) include the nationally delineated wetland areas that are classified into hydrogeomorphic (HGM) National Freshwater Ecosystem Priority Areas (NFEPA) project types and ranked in terms of their biodiversity importance. These layers were assessed to evaluate the importance of the wetland areas located within the project area.

Whilst being an invaluable tool, it is important to note that the NFEPA's were delineated and studied at a desktop and low resolution level. Thus, the wetlands delineated via the ground-truthing work done through this study may differ from the NFEPA layers. The NFEPA assessment does, however, hold significance from a national perspective. The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity and Table 6-1 below indicates the criteria that were considered for the ranking of wetland areas.

Table 6-1: NFEPA Wetland Classification Ranking Criteria

Criteria	Rank
Wetlands that intersect with a RAMSAR site.	1
Wetlands within 500 m of an IUCN threatened frog point locality; Wetlands within 500 m of a threatened waterbird point locality; Wetlands (excluding dams) with the majority of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5
Any other wetland (excluding dams).	6

6.1.2 Mpumalanga Biodiversity Sector Plan

The MBSP is a spatial tool that forms part of the national biodiversity planning tools and initiatives that are provided for in national legislation and policy. The MBSP was published in 2014 by the Mpumalanga Tourism and Parks Agency (MTPA) and comprises a set of maps of biodiversity priority areas accompanied by contextual information and land-use guidelines for use in land-use and development planning, environmental assessment and regulation, and natural resource management. Strategically the MBSP enables the province to:

- Implement the NEM:BA, 2004 provincially, and comply with requirements of the National Biodiversity Framework,2009 (NBF) and certain international conventions;
- Identify those areas of highest biodiversity that need to be considered in provincial planning initiatives, and
- Address threat of climate change (ecosystem-based adaptation).

The publication includes terrestrial and freshwater biodiversity areas that are mapped and classified in Protected Areas (PA's, Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) or Other Natural Areas (ONAs). Wetlands in Mpumalanga Province have been extensively degraded and, in many cases, irreversibly modified and lost through a combination of inappropriate land-use practices. Wetlands represent ecosystems of high value for delivering, managing and storing good quality water for human use, and they are vulnerable to harmful impacts. It is therefore in the interest of national water security that all wetlands are protected by law. The management objectives of these areas are summarised below.

Table 6-2: Mpumalanga Biodiversity Sector Plan Categories

Map category	Definition	Desired management objectives
PA	Those areas that are proclaimed as protected areas under national or provincial legislation, including gazetted protected environments.	Areas that are meeting biodiversity targets and therefore must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.
CBAs	Areas that are required to meet biodiversity targets, for species, ecosystems or ecological processes. CBA Wetlands are those that have been identified as FEPA wetlands that are important for meeting biodiversity targets for freshwater ecosystems.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
ESAs	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services. ESAs Wetlands are those that are non-FEPA and ESA Wetland Clusters are clusters of wetlands embedded within a largely natural landscape that function as a unit, and allow for the migration of species such as frogs and insects between individual wetlands.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised.

Map category	Definition	Desired management objectives
ONAs	Areas that have not been identified as a priority in the current systematic biodiversity plan, but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.	An overall management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. These areas offer the greatest flexibility in terms of management objectives and permissible land-uses, but some authorisation may still be required for high-impact land-uses.
Heavily or Moderately Modified Areas	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritised for conservation action.	Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximise ecological functionality and authorisation is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilised and restored where possible, especially for soil carbon and water-related functionality.

6.1.3 Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline was developed collaboratively by the South African Biodiversity Institute (SANBI), the Department of Environmental Affairs (DEA), the Department of Mineral Resources (DMR), the Chamber of Mines and the South African Mining and Biodiversity Forum in 2013 to provide the mining sector with a manual to integrate biodiversity into the planning process to allow informed decision about mining development and environmental authorisations. The aim of the guideline is to explain the value for mining companies to consider biodiversity management throughout the planning prices. The guideline highlights the importance of biodiversity in managing the social, economic and environmental risk of the proposed mining project. The country has been mapped into biodiversity priority areas including the four categories listed in Table 6-3 below, each with associated risks and implications. The guideline describes six key principles to achieve the objectives through each stage of the mining life-cycle, which are summarised in Figure 6-3 below.

Table 6-3: Mining and Biodiversity Guideline Categories (SANBI, 2013)

Category	Risk and Implications for Mining
Legally protected	Mining prohibited; unless authorised by ministers of both the DEA and DMR.
Highest Biodiversity Importance	Highest Risk for Mining: the EIA process must confirm significance of the biodiversity features that may be seen as a fatal flaw to the proposed project. Specialists must provide site-specific recommendations for the application of the mitigation hierarchy that informs the decision making processes of mining licences, water use licences and environmental authorisations. If granted, authorisations should set limits on allowed activities and specify biodiversity related management outcomes.
High Biodiversity Importance	High Risk for Mining: the EIA process must confirm the significance of the biodiversity features for the conservation of biodiversity priority areas. Significance of impacts must be discussed as mining options are possible but must be limited. Authorisations may set limits and specify biodiversity related management outcomes.
Moderate Biodiversity Importance	Moderate Risk for Mining: the EIA process must confirm the significance of the biodiversity features and the potential impacts as mining options must be limited but are possible. Authorisations may set limits and specify biodiversity related management outcomes.

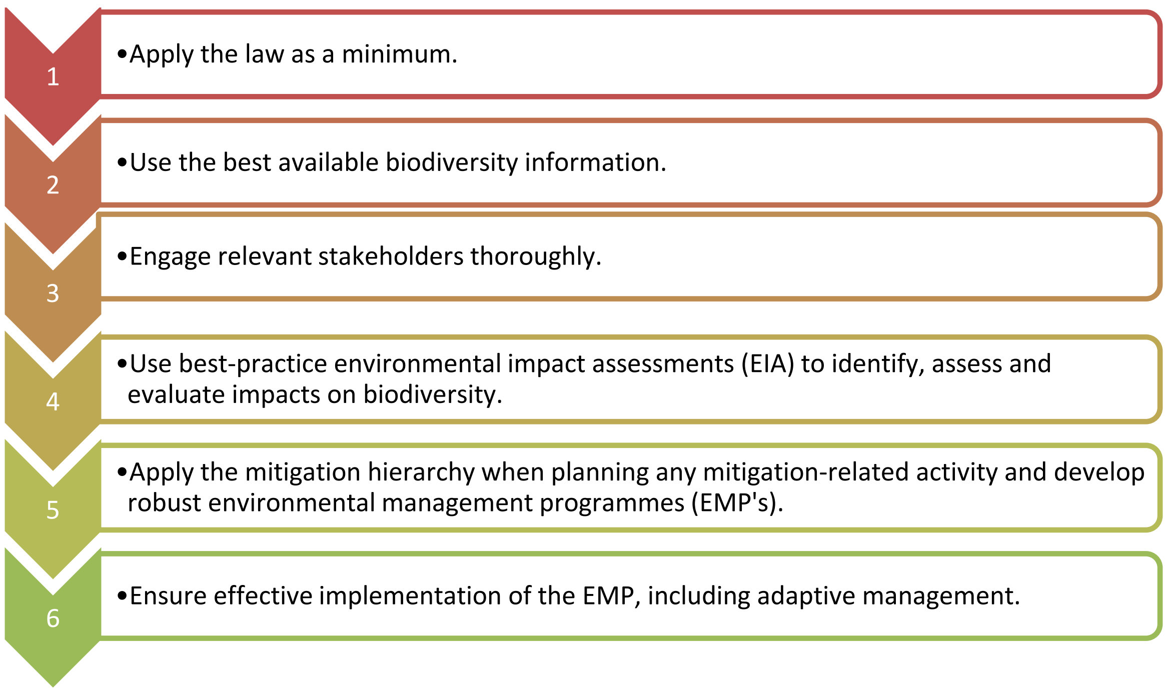


Figure 6-3: Mining and Biodiversity Guideline Six Key Principles Summary

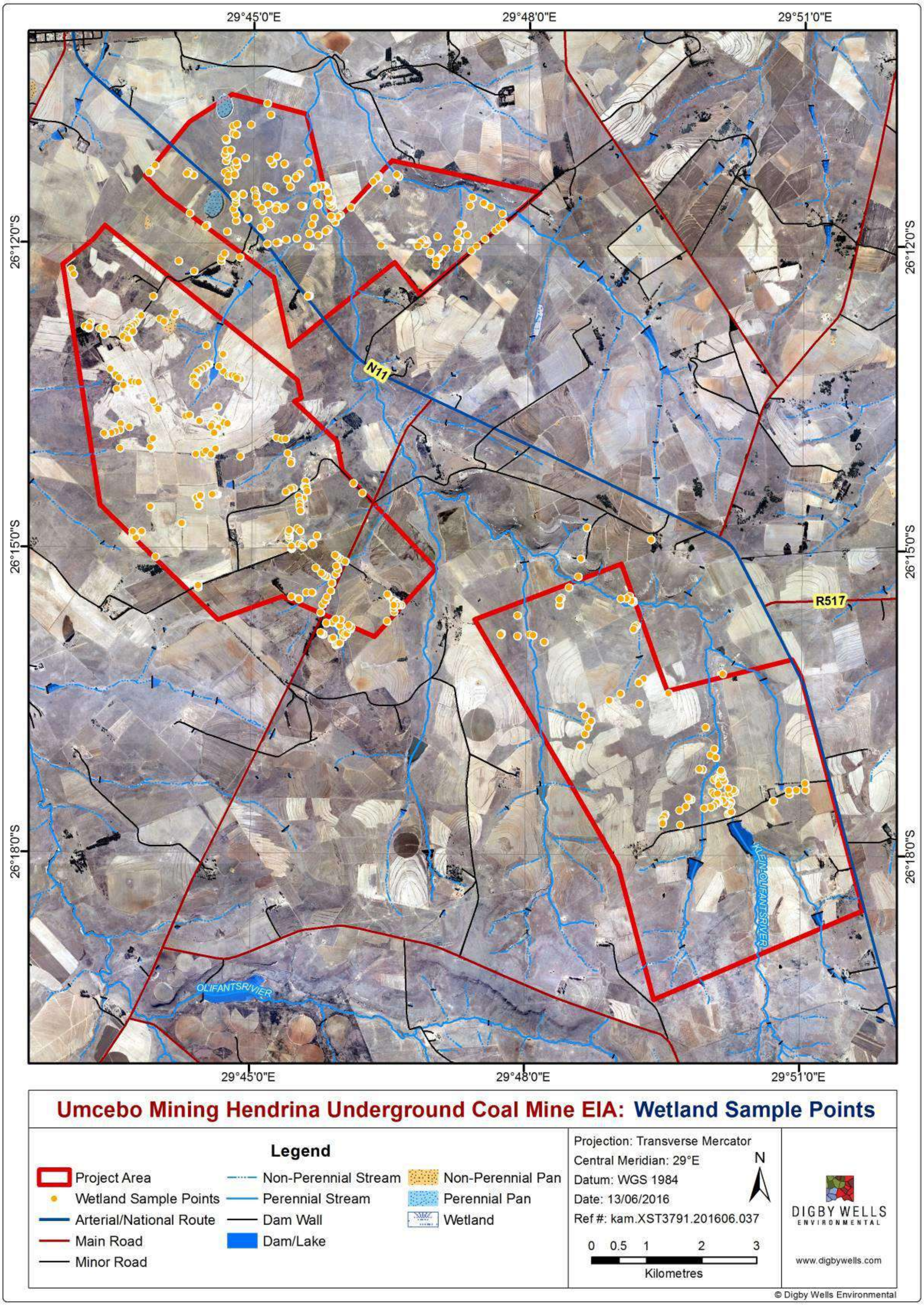
6.2 Wetland Fieldwork Identification and Seasonal Influence

In-field wetland assessments were done in March, April and May 2016 and covered the areas as shown in the field map (Plan 3), which followed the methodology described below. The wetland delineation procedure considers four attributes to determine the limitations of the wetland, in accordance with DWAF[3] guidelines (2005). The four attributes are:

- Terrain Unit Indicator – helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator – identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator – identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- Vegetation Indicator – identifies hydrophilic vegetation associated with frequently saturated soils.

In accordance with the definition of a wetland in the NWA, vegetation is the primary indicator of a wetland, which must be present under normal circumstances. However, the soil indicators tend to be the most important in practice. The remaining indicators are then used in a confirmatory role. The reason for this is that the response of vegetation to changes in the soil moisture regime or management are relatively quick and may be transformed, whereas the morphological indicators in the soil are significantly more long-lasting and will hold the indications of frequent and prolonged saturation long after a wetland has been drained (DWAF, 2005).

[3] now Department of Water and Sanitation (DWS)

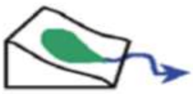


Plan 3: Wetlands Sample Points

6.2.1 Terrain Unit Indicator

Terrain Unit Indicator (TUI) includes areas such as depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of aerial imagery and regional contours (DWAF, 2005). The HGM Unit system of classification focuses on the hydro-geomorphic setting of wetlands which incorporates geomorphology; water movement into, through and out of the wetland; and landscape / topographic setting. Once wetlands have been identified, they are categorised into HGM Units as shown in Table 6-4. HGM Units are then assessed individually for Present Ecological State (PES) and ecological services.

Table 6-4: Description of the difference Hydrogeomorphic Units for Wetland Classification

Hydromorphic wetland type	Diagram	Description
Floodplain		Valley bottom areas with a well-defined stream channel stream channel, gently sloped and characterised by floodplain features such as oxbow depression and natural levees and the alluvial (by water) transport and deposition of sediment , usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom with a channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from the channel entering the wetland and also from adjacent slopes.
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterised by colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.
Isolated hillslope seepage		Slopes on hillsides that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.

Hydromorphic wetland type	Diagram	Description
Pan/Depression		A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. It is inward draining). It may also receive subsurface water. An outlet is usually absent and so this type of wetland is usually isolated from the stream network.

6.2.2 Soil Indicators

Hydromorphic soils are taken into account for the Soil Form Indicator (SFI) which will display unique characteristics resulting from prolonged and repeated water saturation (DWAF, 2005). The continued saturation of the soils results in the soils becoming anaerobic and thus resulting in a change of the chemical characteristics of the soil. Iron and manganese are two soil components which are insoluble under aerobic conditions and become soluble when the soil becomes anaerobic and thus begin to leach out into the soil profile. Iron is one of the most abundant elements in soils and is responsible for the red and brown colours of many soils.

In practice, the Soil Wetness Indictor (SWI) is used as the primary indicator (DWAF, 2005). Hydromorphic soils are often identified by the colours of various soil components. The frequency and duration of the soil saturation periods strongly influences the colours of these components. Grey colours become more prominent in the soil matrix the higher the duration and frequency of saturation in a soil profile (DWAF, 2005). A feature of hydromorphic soils are coloured mottles which are usually absent in permanently saturated soils and are most prominent in seasonally saturated soils, and are less abundant in temporarily saturated soils (DWAF, 2005). For a soil horizon to qualify as having signs of wetness in the temporary, seasonal or permanent zones, a grey soil matrix and/or mottles must be present.

6.2.3 Vegetation Indicator

As one move along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas plant communities undergo distinct changes in species composition. Valuable information for determining the wetland boundary and wetness zone is derived from the change in species composition. A supplementary method for employing vegetation as an indicator is to use the broad classification of the wetland plants according to their occurrence in the wetlands and wetness zones (Kotze and Marneweck, 1999; DWAF, 2005). This is summarised in Table 6-5 below. When using vegetation indicators for delineation, emphasis is placed on the group of species that dominate the plant community, rather than on individual indicator species (DWAF, 2005). Areas where soils are a poor indicator (black clay, vertic soils), vegetation (as well as topographical setting) is relied on to a greater extent and the use of the wetland species classification as per Table 6-5 becomes more important.

Table 6-5: Classification of Plant Species according to occurrence in Wetlands (DWAF, 2005)

Type	Description
Obligate Wetland species (OW)	Almost always grow in wetlands: >99% of occurrences.
Facultative Wetland species (FW)	Usually grow in wetlands but occasionally are found in non-wetland areas: 67 – 99 % of occurrences.
Facultative species (F)	Are equally likely to grow in wetlands and non-wetland areas: 34 – 66% of occurrences.
Facultative dry-land species (fd)	Usually grow in non-wetland areas but sometimes grow in wetlands: 1 – 34% of occurrences.

6.3 Wetland Ecological Health Assessment

According to Macfarlane *et al.* (2009) the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. A WET-Health assessment was done on the wetlands in accordance with the method described by Kotze *et al.* (2007) to determine the integrity (health) of the characterised HGM units for the project area. A PES analysis was conducted to establish baseline integrity (health) for the associated wetlands.

The health assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to or deviation from natural conditions. The overall health score of the wetland is calculated using Equation 1, which provides a score ranging from 0 (pristine) to 10 (critically impacted in all respects). The rationale for this is that hydrology is considered to have the greatest contribution to health. The PES is determined according to Table 6-6.

Equation 1: Overall Wetland Ecological Health Score

$$Wetland\ Health = \frac{3(Hydrology)\ + 2(Geomorphology) + 2(Vegetation)}{7}$$

Table 6-6: Impact scores and Present Ecological State categories used by Wet-Health

Description	Combined Impact Score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota has taken place.	1-1.9	B

Description	Combined Impact Score	PES Category
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
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable.	6-7.9	E
Modifications have reached a critical level and ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

6.4 Wetland Ecosystem Service and Functional Assessment

Two methodologies are used to understand the goods and services provided by the wetlands as well as determine their relative importance and sensitivity. These methodologies are described below.

6.4.1 WET-EcoServices Assessment

In accordance with the method described by Kotze *et al.* (2007), an ecological functional assessment of the associated wetland was undertaken. This methodology provides for a scoring system to establish the services of the wetland ecosystem. The onsite wetlands are grouped according to homogeneity and assessed utilizing the functional assessment technique, WET-EcoServices, developed by Kotze *et al,* (2007) to provide an indication of the benefits and services. This methodology computes a score out of 4 for each index and provides an indication of the ecological services offered by the different HGM units for the study area. Results are given in the form of a radial plot showing the relative importance of the 15 indices. Ecoservices rated as high are scored more than or equal to 2.8.

6.4.2 Wetland Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) tool was derived to assess the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term. The methodology outlined by DWAF (1999) and updated in Rountree and Kotze, (2012, in Rountree *et al*. (2012) was used for this study.

In this method there are three suites of importance criteria; namely:

- **Ecological Importance and Sensitivity**: incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWS and thus enabling consistent assessment approaches across water resource types;
- **Hydro-functional Importance**: which considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- **Importance in terms of Basic Human Benefits**: this suite of criteria considers the subsistence uses and cultural benefits of the wetland system.

These determinants are assessed for the wetlands on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. It is recommended that the highest of these three suites of scores be used to determine the overall Importance and Sensitivity category of the wetland system, as defined in Table 6-7.

Table 6-7: Interpretation of Overall EIS Scores for Biotic and Habitat Determinants (Rountree & Kotze, 2012)

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

6.5 Potential Environmental Impacts and Risks

Details of the impact assessment methodology used to determine the significance of impacts to wetland ecosystems is 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 6-10. 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 Wetlands Assessment Report. The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 6-9, which is extracted from Table 6-8. The description of the significance ratings is discussed in Table 6-10. 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 6-8: Impact Assessment Parameter Ratings

Rating	Intensity/ Replicability		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.

Rating	Intensity/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
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.
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.

Rating	Intensity/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
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/ Replicability		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.	Very limited/Isolated 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.

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Table 6-9: Probability/Consequence Matrix

Significance

Probability																																						
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 6-10: 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 significant and usually a long-term change to the (natural and / or social) environment and result in major 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) (-)

7 Assumptions and Limitations

The following assumptions or limitations were noted during the assessment;

- Fieldwork was undertaken in the late summer and autumn season (March - May) of 2016. Not all grasses and forbs were in full flower and therefore not all of them were identifiable; and
- Field assessments were completed to assess as much of the site as possible; however it was not possible to ground-truth every wetland boundary and thus some extrapolation was required. This was due to the extent of the project area (~7 000 ha) and the vast presence of wetlands encountered on site; and in addition the vegetation was largely modified due to agriculture and the soil indicators thus became the major determinant. The proposed infrastructure areas, shallow coal zones and the sensitive wetlands identified on desktop level (e.g. the Klein Olifants River) were focussed upon.

8 Baseline Environment

8.1 Climate

The project area falls within the central Mpumalanga Province climatic zone; characterised by strong unimodal summer rainfall (October to March), warm summers and cold dry winters with frost. Precipitation falls mainly in November, December and January and occurs in the form of showers and thunderstorms, which are often extreme and sometimes accompanied by hail. The area has a mean annual precipitation of around 700 mm, please refer to the GroundwaterWater Report (Digby Wells, 2016) for more information.

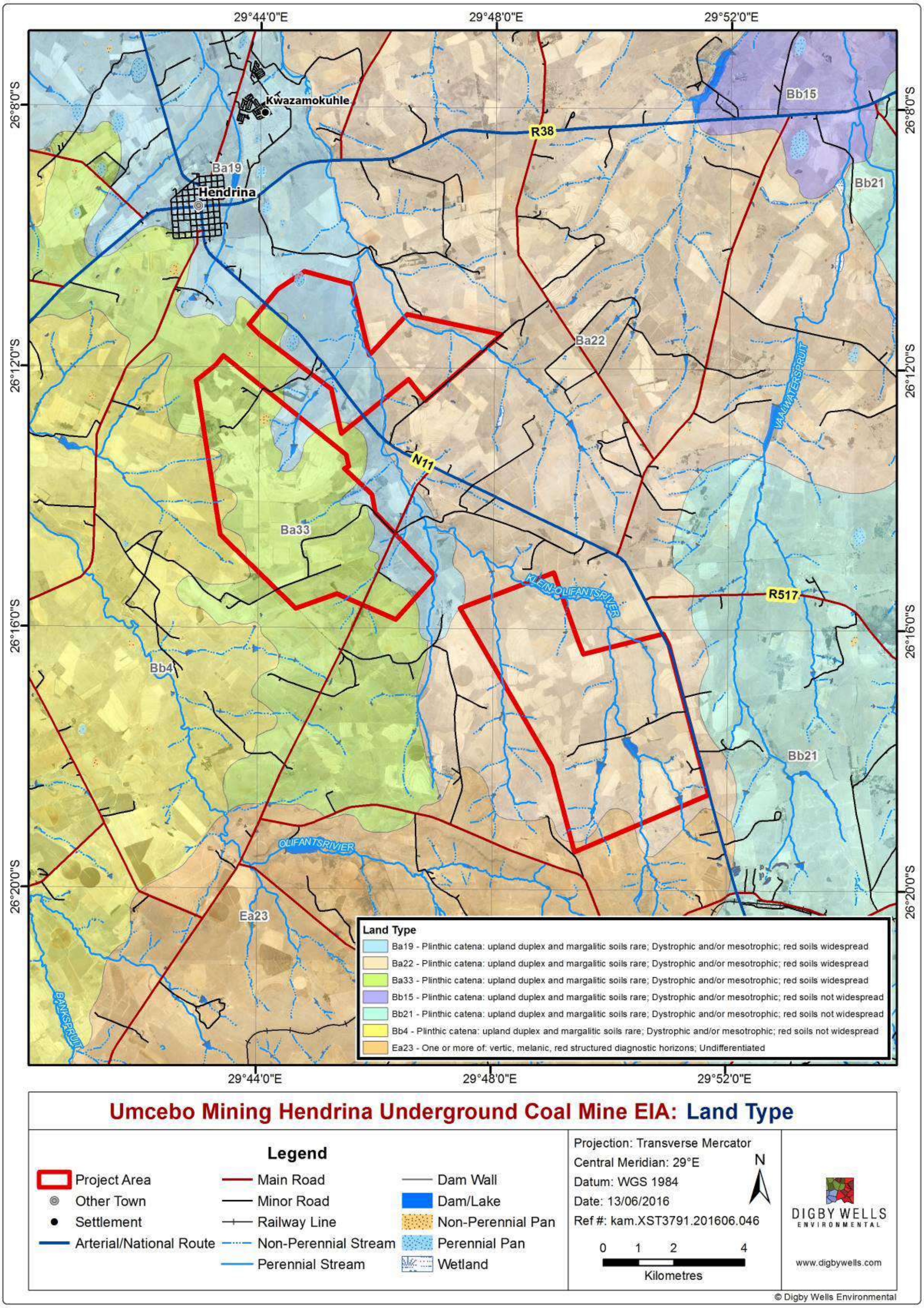
8.2 Geology and Groundwater

The proposed project is situated in the Ermelo Coalfield of the Mpumalanga Coalfields, which is underlain by pre-Karoo rocks that were subject to glaciation and resulted in the deposition of the Dwyka tillite. The Ecca Group (which contains the coal-bearing Vryheid Formation) sits on the Dwyka Formation, and consists of feldspathic sandstone, shale, mudstone and coal. The Vryheid Formation contains five bituminous coal seams named A, B, C, D and E; with A at the top and E at the bottom, and are separated by mainly arenaceous sediments. The coal seams are generally flat with a regional shallow south-westerly dip. The A-seam has been largely removed by erosion and is usually overlain by a sandstone layer. Dolerite intrusions in the form of sills and dykes are present over the entire Ermelo Coal Field and correlate to the hilltops within the project area.

There are three aquifers within the area, classified as the upper weathered Ecca aquifer, the fractured aquifers within the unweathered Ecca sediments and the aquifers below the Ecca sediments, also called the pre-Karoo aquifer. The upper aquifer consists mostly of highly weathered coarse grained sandstone, with shale and siltstone in some areas. The fractured aquifer consists of unweathered, interlaminated sequences of sandstone and shale, fresh sandstone, carbonaceous shale, coal and in some instances dolerite. All groundwater movement is along secondary structures such as fractures, cracks and joints. Refer to the Groundwater Report for more information (Digby Wells, 2016).

8.3 Land Type

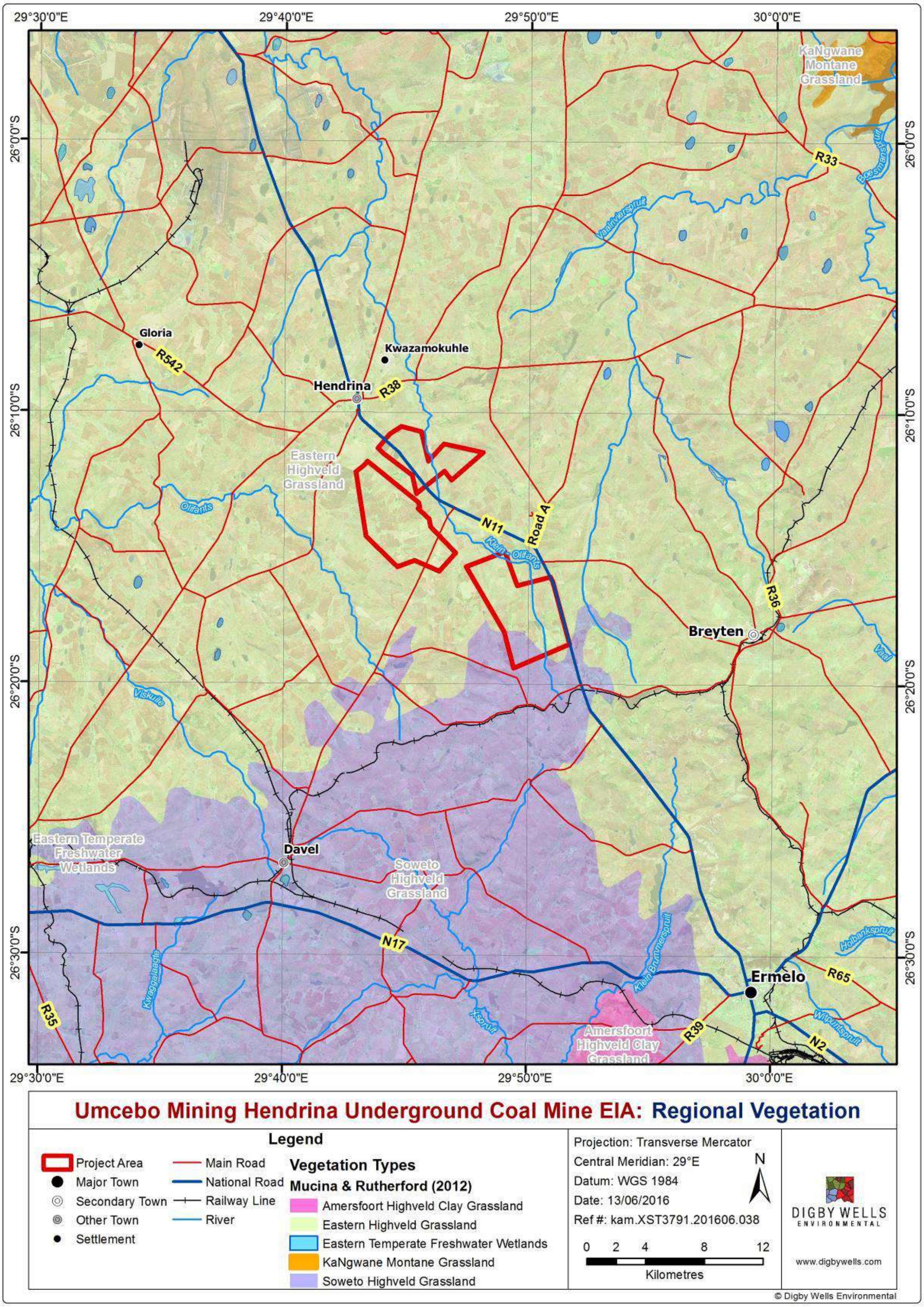
The project area is predominantly found within 3 different land types being Ba22, Ba33 and Ba19, shown in Plan 4, and these are regional land units with similar soils and landscape characteristics within which the ecosystems are found. These land types give a scene setting for potential wetlands to be found. It can be summarised that these land types are similarly characterised by forced lateral drainage in the slopes by the presence of underlying impermeable layers on foot slope positions causing hydromorphic soil formation such as Longlands and Fernwood form soil formation (E, medium textured subsoil over a G horizon or E only, respectively). Intermittent perched water tables allowed the formation of subsoil soft plinthite and E horizons, proving that seasonally wet conditions prevail in the landscape. This supports conditions that lead to the development of extensive hillslope seepage wetlands found within the study area. In addition pans are found on the crests of the landscape. Please refer to the Soils, Land Use and Land Capability Report that formed part of this EIA (ESS, 2016).



Plan 4: Land Type

8.4 Regional Vegetation

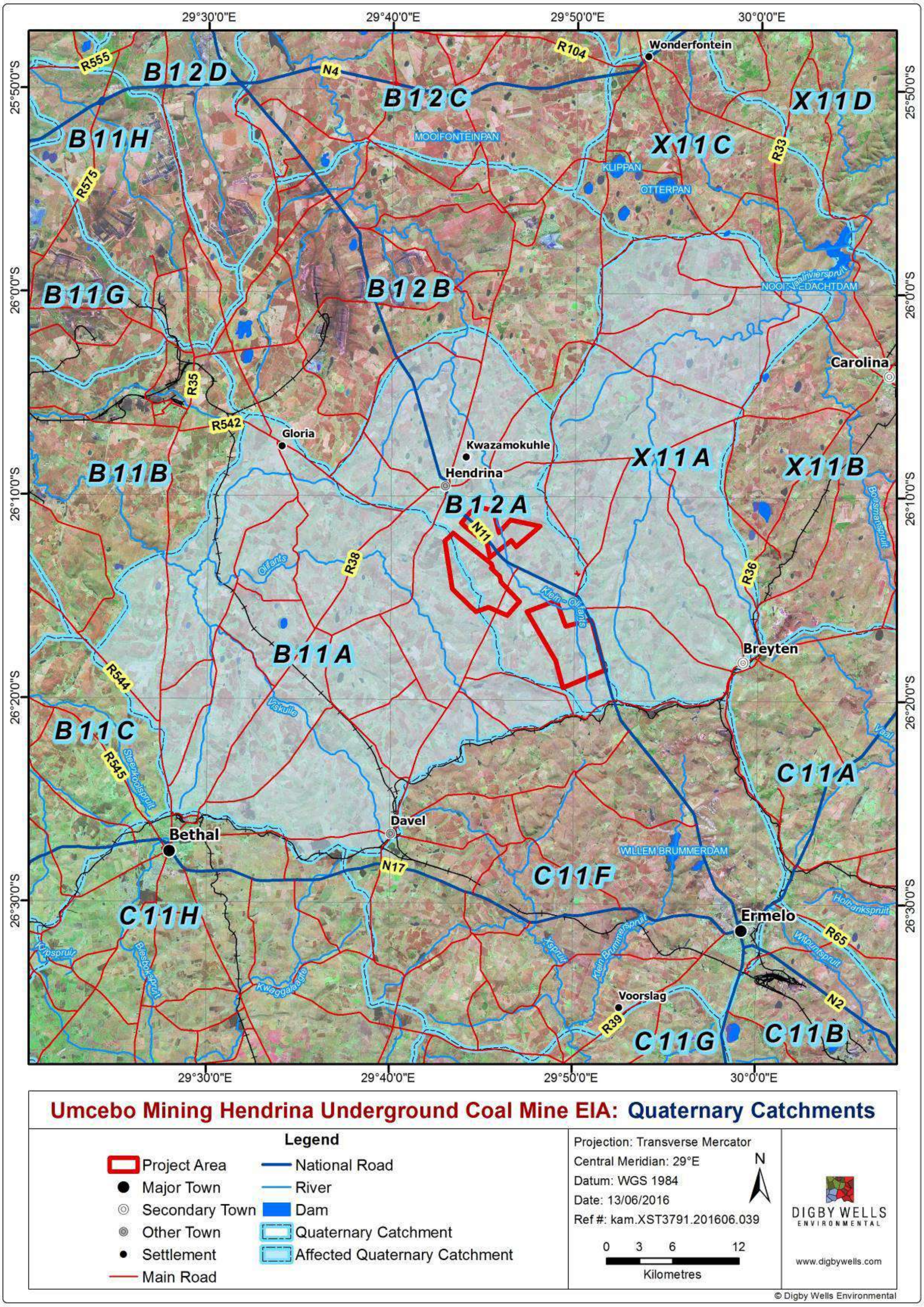
The Grassland Biome (within which the project area falls) is an ecological and economically important biome of South Africa, however at least 30 % of its area has been irreversibly transformed with only 1,9 % being formally conserved. As a result, the National Biodiversity Strategy and Action Plan has identified the grasslands biome as one of the spatial priorities for conservationaction (DEA, 2005). Specifically, the project is found predominantly within the regional vegetation type Eastern Highveld Grassland as described by Mucina and Rutherford (2012) (Plan 5). A small section of the southern project area is found within the Soweto Highveld Grasslands. Both of these Grasslands are listed as threatened ecosystems according to the list gazetted in NEM:BA being the “National list of ecosystems that are threatened and in need of protection”. This results in several implications in terms of development within these areas. Refer to the Fauna and Flora Report for more information regarding floral biodiversity of the project area (Digby Wells, 2016b).



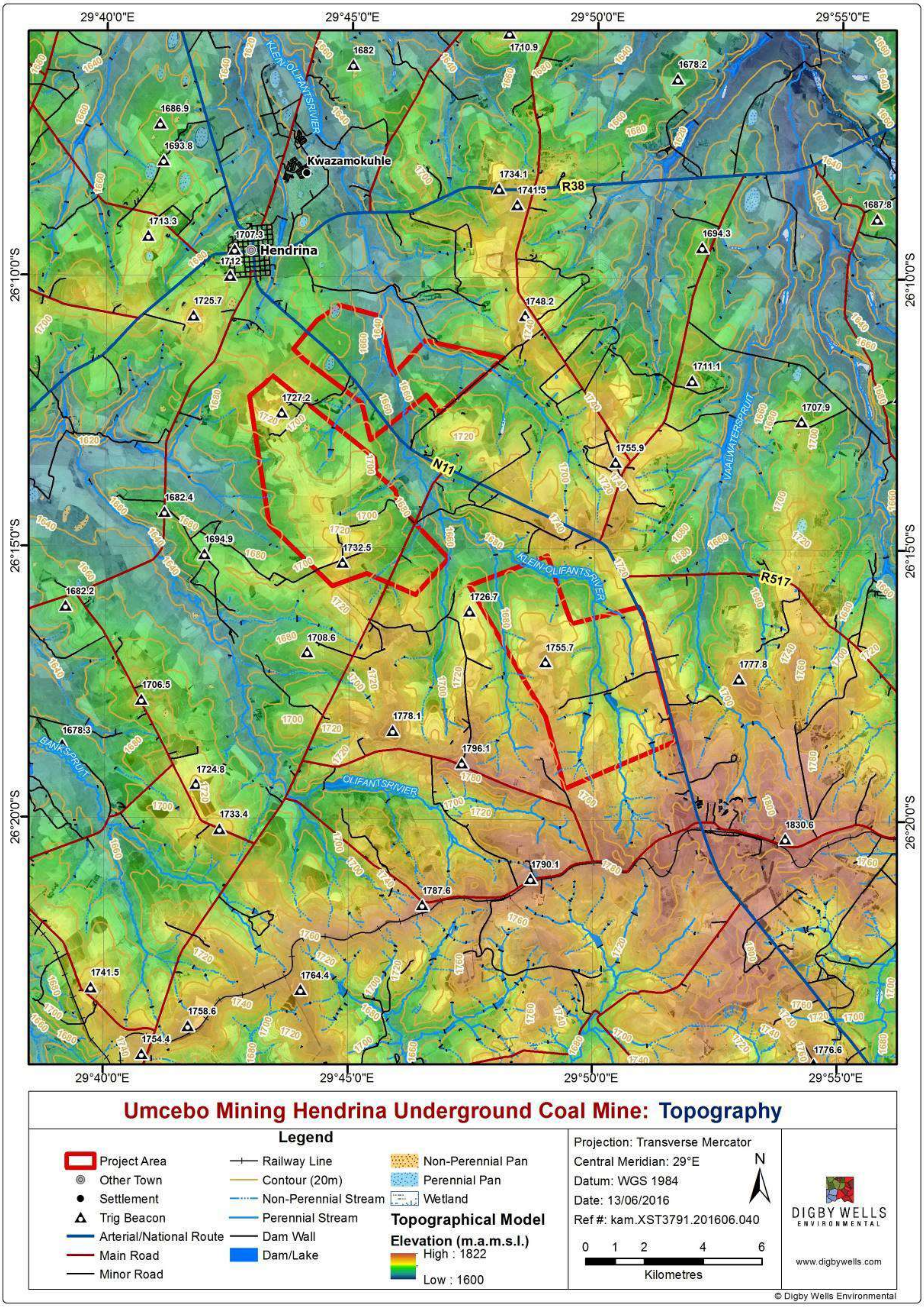
Plan 5: Regional Vegetation (Mucina and Rutherford, 2012)

8.5 Drainage and Catchments

The project area is found predominantly within the quaternary catchment B12A, which is characterised by the Klein Olifants River (sub-quaternary reach B12A-01309). In addition, the western portion of the project area expands into the quaternary catchment B11A and the south-eastern edge of the project area stretches partly over the catchment divide between B11A and X11A, as shown in Plan 6. The landscape is characterised by an undulating terrain within these catchments as shown in Plan 7. It is in the valley bottom areas where water collects and wetlands are likely to be present. Refer to the Aquatic Ecology Report (Digby Wells, 2016) as well as the Surface Water Report (Digby Wells, 2016) for more information regarding the catchment characteristics.



Plan 6: Quaternary Catchments



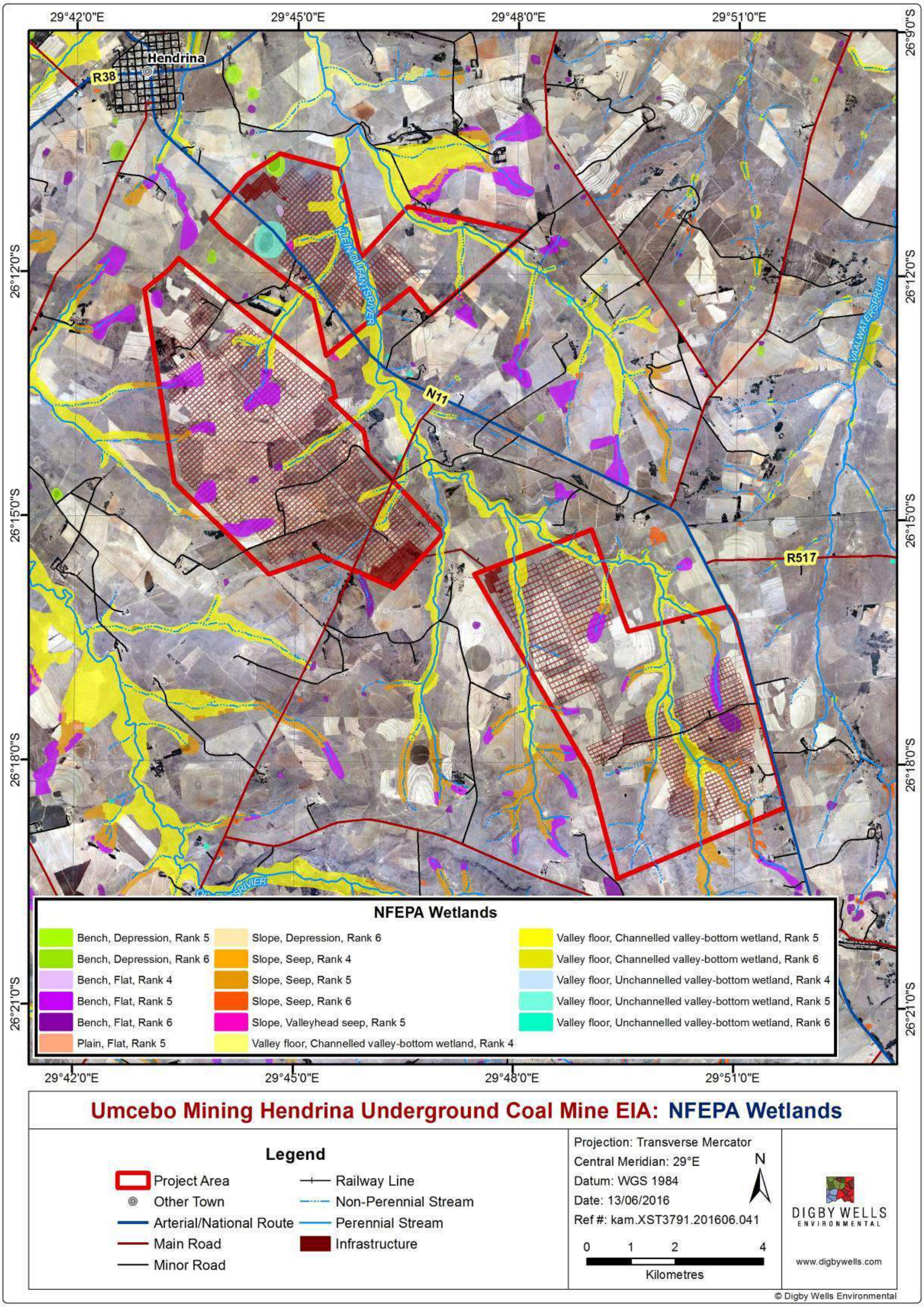
Plan 7: Topography

8.6 National Freshwater Ecosystem Priority Areas

The NFEPA project provides information of wetland and river ecosystems for integrating into freshwater ecosystem and biodiversity planning and decision-making processes as discussed in section 6.1.1. The project area is characterised by many NFEPA wetlands as shown in Plan 8. The wetland types that dominate the landscape are channel valley bottom wetlands with hillslope seep and bench wetlands connected to them. In addition, there are some pan or depression wetlands within the site. The largest wetland present is associated with the Klein Olifants River that runs through the project areas.

These wetlands are mostly of rank 5 but there are also rank 4 and 6 present in the project area. Rank 4 wetlands are those (excluding dams) in A, B or C PES and associated with more than three other wetlands. Rank 5 wetlands are those (excluding dams) within a sub-quaternary catchment containing impacted Working for Wetland sites. These wetlands are earmarked for future rehabilitation by the Working for Wetlands program. Rank 6 wetlands are all other wetlands that are identified as FEPA wetlands but do not fall within rank 1 to 5. Refer to section 6.1.1 for more details on the ranking system of NFEPA wetlands.

The only proposed surface infrastructure that is directly placed on NFEPA wetlands is the conveyor that will cross a channeled valley bottom wetland between Mooivley West and Hendrina South Mining Right Areas. The proposed mine plan underlies NFEPA wetlands as well as their buffer and catchment areas as shown in Plan 8. It is nationally recognised that no mining should take place within a 1km buffer area of NFEPA wetlands as best practice and thus the NFEPA wetland pose a significant risk to the project (Nel *et al.,* 2011).



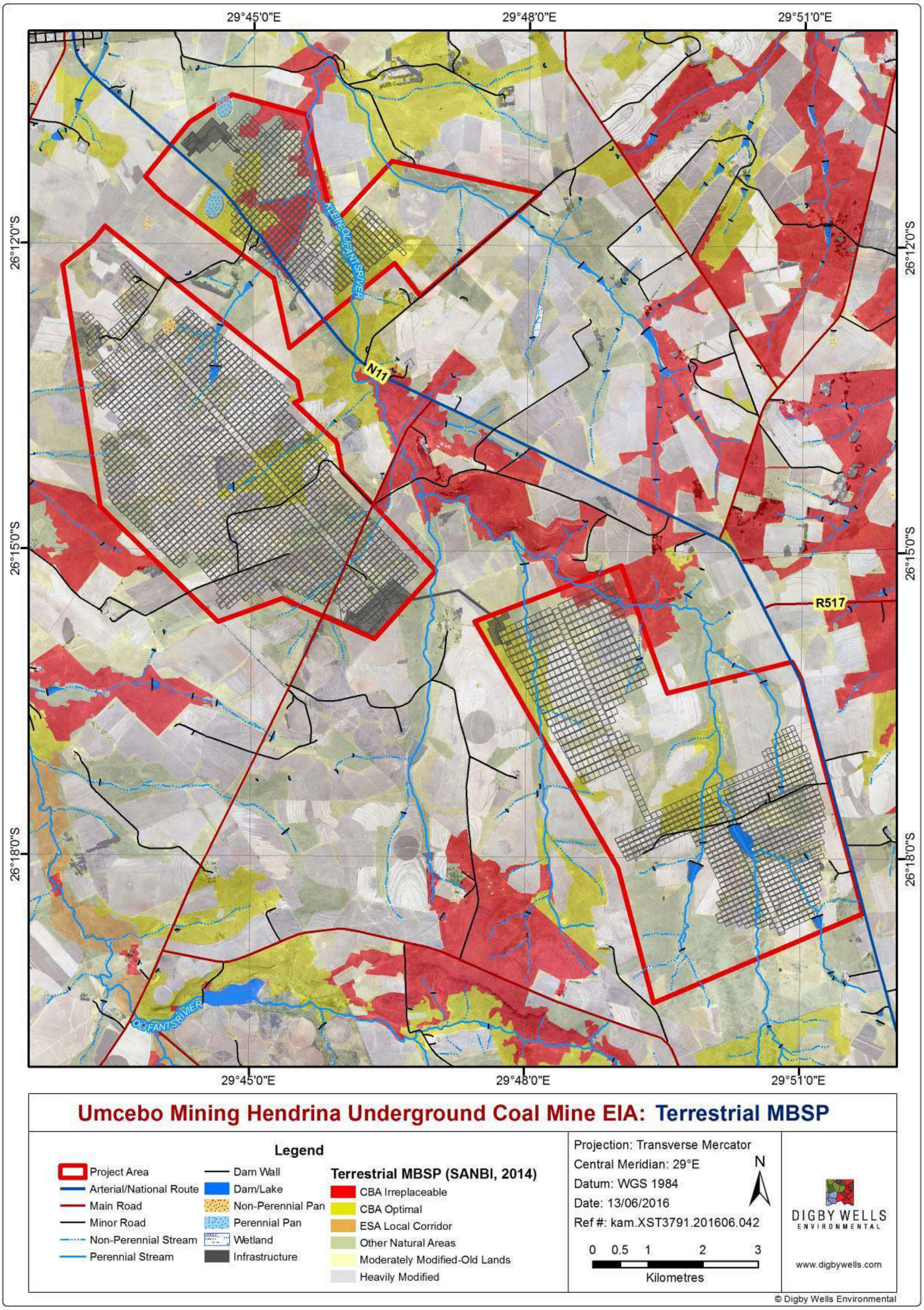
Plan 8: NFEPA Wetlands

8.7 Mpumalanga Biodiversity Sector Plan

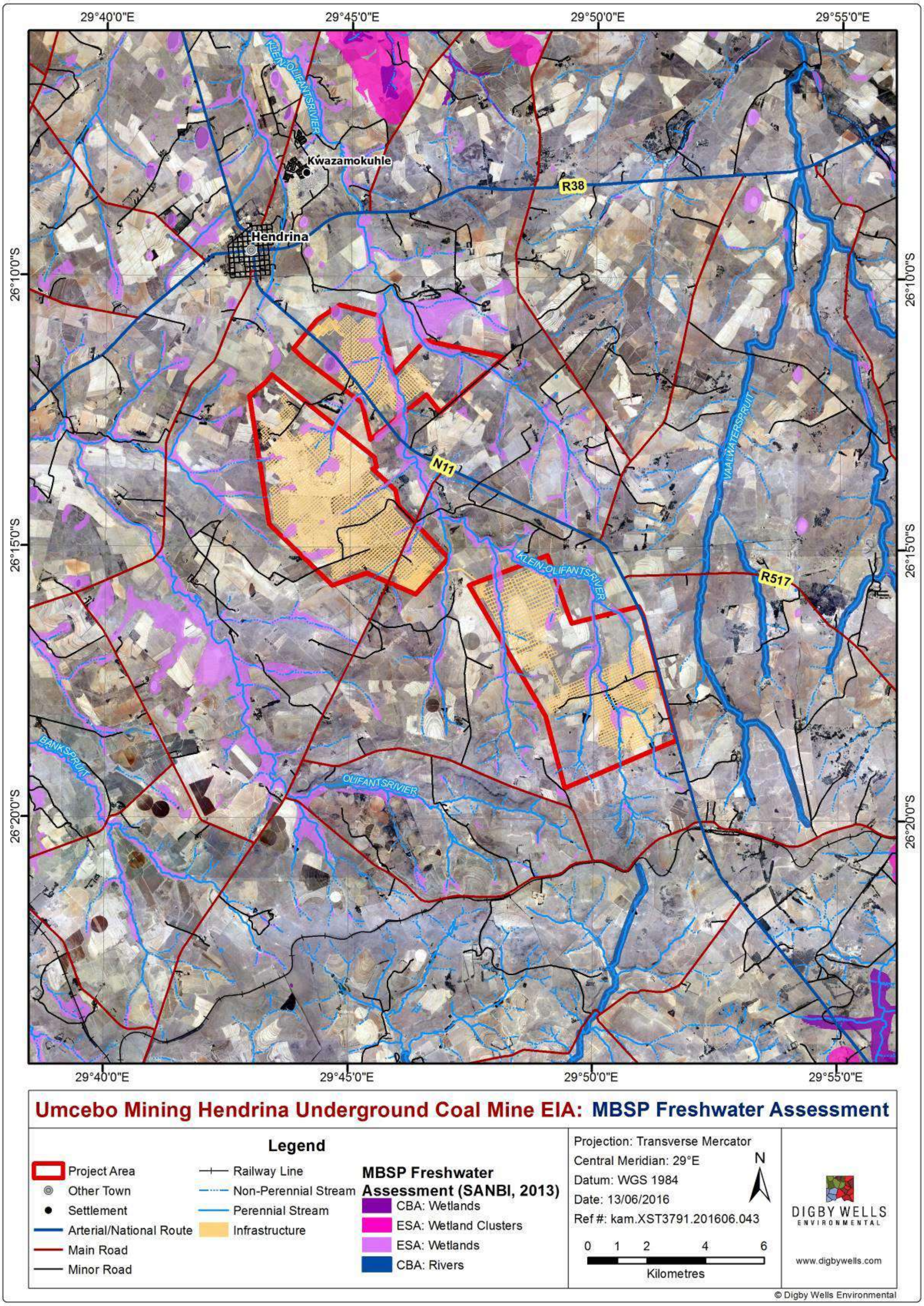
The MBSP (2013) is a spatial tool that forms part of the national biodiversity planning as discussed in Section 6.1.2. The terrestrial MBSP has delineated a considerable area within and immediately around the project area as Critical CBAs and Optimal ESAs shown as red and yellow in Plan 9 respectively. According to the guidelines from the MSBP, CBAs must be kept in a natural state with no further loss of habitat; where only low-impact, biodiversity-sensitive land-uses are appropriate. This is particularly an issue in the Mooivley East and Hendrina South MRA.

With respects to ESAs, the land use goal should be to maintain the ecosystem in a functional, near-natural state; however, some habitat loss is acceptable. This means that a greater range of land-uses over wider areas is appropriate for these areas but they are subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised. The remainder of the project area is classified as either natural or modified areas. It is important to note that this is a large scale project and some local scale discrepancies may exist; however the findings were mostly verified in the field. Although natural areas were not pristine as they are subject to grazing and / or grass bailing, these areas are mapped and regarded as natural habitat for naturally occurring fauna and flora species. Refer to the Fauna and Flora Report (Digby Wells, 2016) for the mapped habitat zones for the project area.

The freshwater MBSP is largely correlated with the NFEPA as this is one of the main technical layers used in the assessment. These are shown for the project area in Plan 10. The project area is characterised by wetland ESAs, which are associated with the Klein Olifants River as well as the many other valley bottom systems, hillslope seeps and depression wetlands. The surface infrastructure associated with Hendrina South and Mooivley West crosses a wetland ESA.



Plan 9: Terrestrial MBSP (2014)

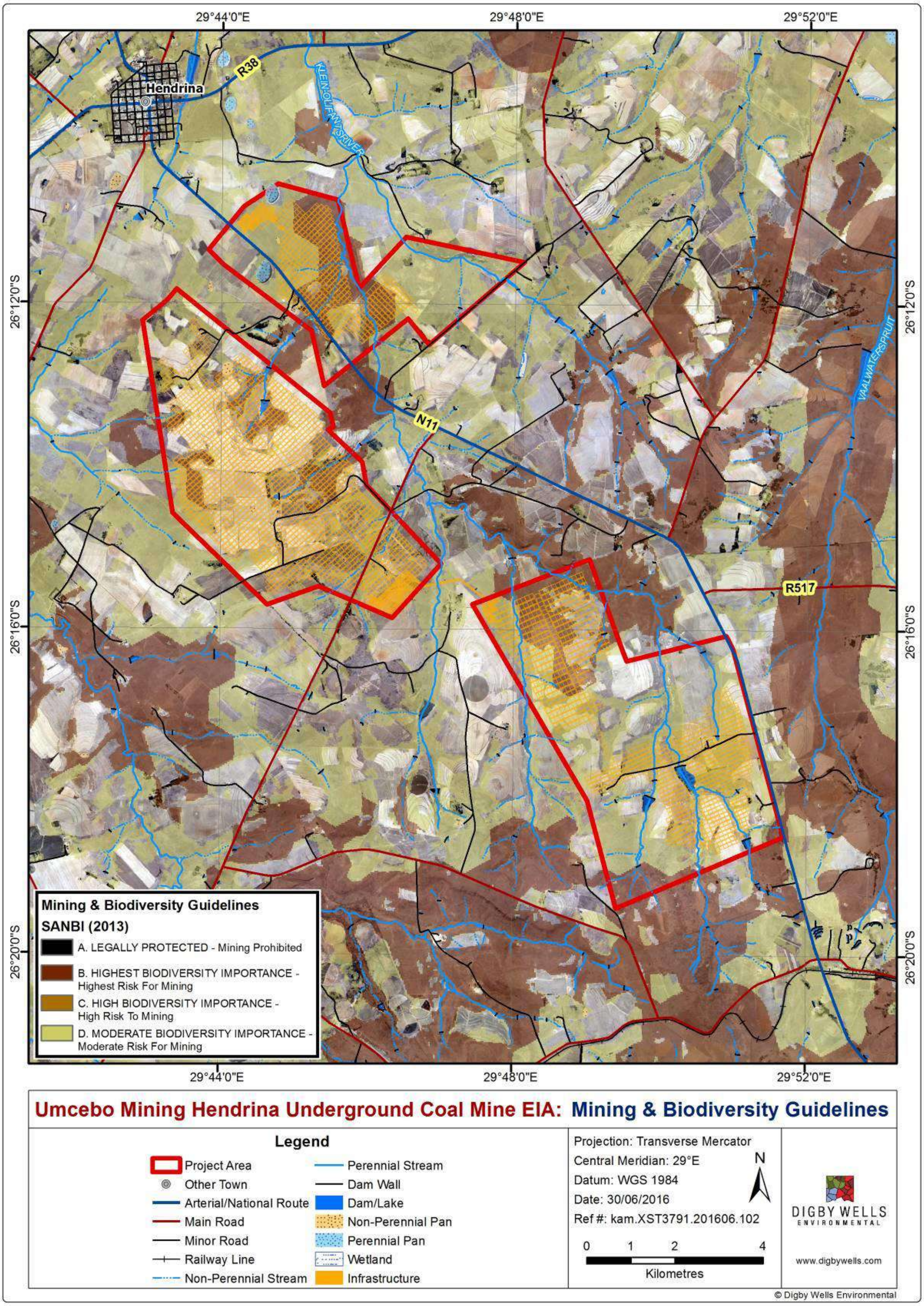


Plan 10: Freshwater MBSP (2014)

8.8 Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline (2013) can be seen as a cumulative finding of all available biodiversity and ecological related information with a final mapped area. The assessment looks at NFEPA and regional biodiversity plans such as the MBSP. This is shown in Plan 11 below. The project area is characterised by some areas regarded as being highest risk to mining projects, which is seen to be parts of the Klein Olifants River and some natural grassland that remains in the area.

The majority of the project area is regarded as being of moderate risk to mining projects, which is again highly associated with the wetland bodies of the landscape and any remaining natural habitats. Where intensive agriculture is present, no risk level has been mapped for these areas. The proposed surface infrastructure is located within areas of moderate risk as seen on Plan 11. Underground mining areas are associated with these areas too but also include some areas of higher risk.



Plan 11: Mining and Biodiversity Guideline

9 Wetland Assessment Findings

This section discusses the results of the on-site verification specialist study done on the project area by the wetland specialists.

9.1 Delineation and Classification

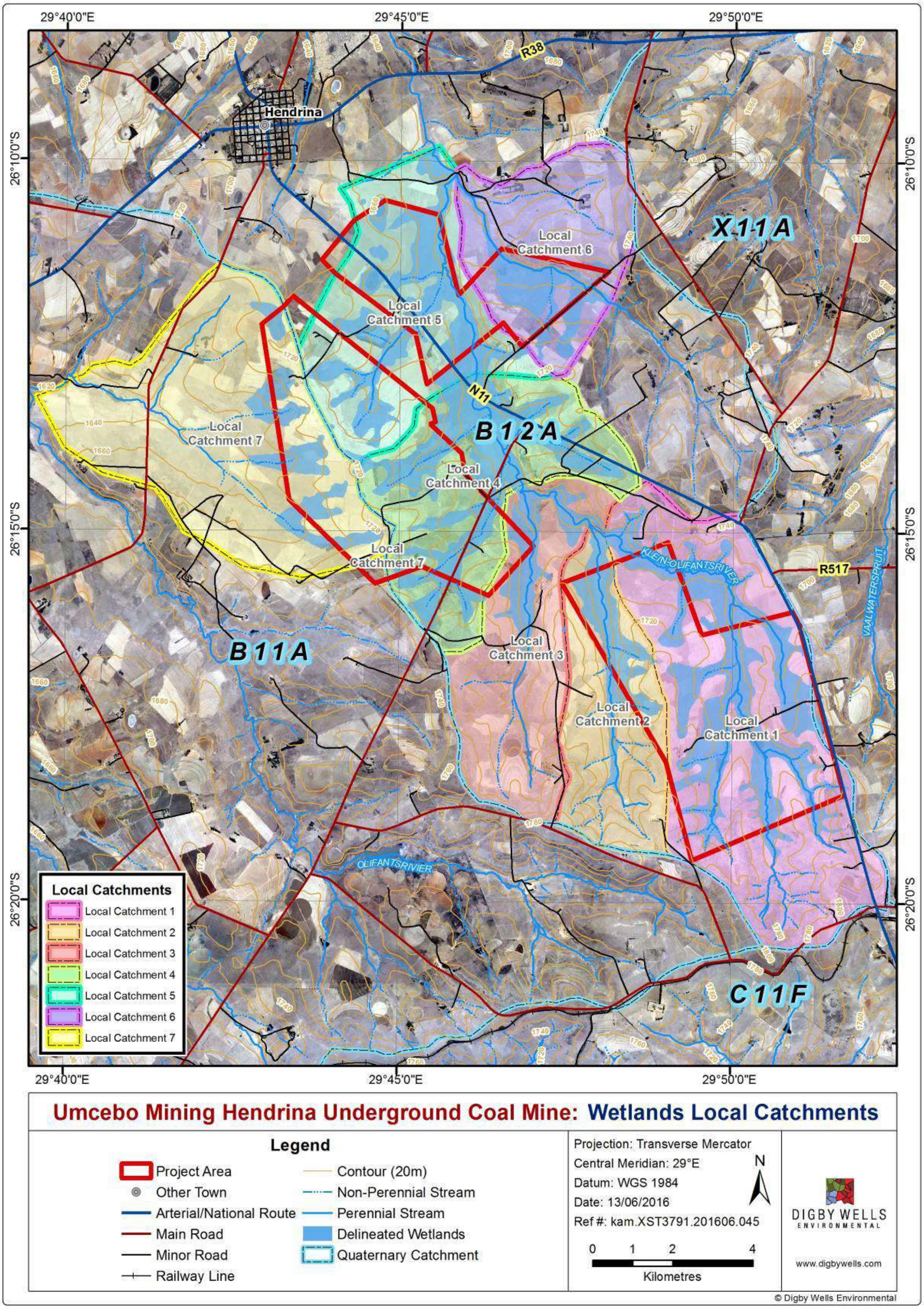
All wetland areas were assessed according to the methodology outlined in section 6; where a map of the sample points is presented in Plan 3. Contours (5 m) were then used together with imagery and knowledge gained to extrapolate to all areas and give a final delineation of wetland areas; as well as to define their HGM unit. The project area was found to be extensively characterised by wetlands including three broad wetland types being: valley bottom wetlands, hillslope seep wetlands and depression wetlands. Details of the indicative findings are detailed in the sub-sections that follow and final wetland results are then discussed.

9.1.1 Indicators

9.1.1.1 Terrain Indicator

The topography is typical of the Highveld lower ecoregion with gentle slopes and many valley systems present as shown in the topographical map of Plan 7. This landscape and the wetlands are characterised by seven local catchments within which the wetlands are delineated; see Plan 12 below. Catchments one to six are all within the Quaternary Catchment B12A whereas catchment seven (western area) is in Quaternary Catchment B11A. Detailed imagery and contours, together with in-field assessment, allows the geomorphic setting of the wetland and catchments to be understood and the HGM[4] to be determined. This is important for understanding the specific functionality of the wetland and determining the potential risks from mining activities on the wetland.

[4] Refer to Table 6-4 for the brief definition of the HGM units of wetlands.



Plan 12: Wetland Local Catchments

9.1.1.2 Soils Indicators

Soils were a major indicator during the wetland assessments and examples of soils assessed are shown in Figure 9-1. A separate soil study was undertaken and the major soil types and their characteristics are defined. Refer to the full report for more information (ESS, 2016).

Figure 9-1: Examples of soil samples a) terrestrial red uniform soil; b) temporary wetland zone soils such as Longlands where an E-horizon is present indicating lateral movement of water; c-e) soils showing iron mottling indicating seasonally wet soils; and f) wetland soils showing gleying

9.1.1.3 Vegetation Indicators

Natural or near-natural floristic indicators were present in many parts of the study area that aided in the confirmation of wetland presence. However, large areas of wetlands were transformed by cultivated fields and soil was the major indicator as described in the previous section. The three broad types of wetlands (valley bottoms, hillslope seeps and pans) differed in vegetation composition from each other as well as from the terrestrial habitats. Refer to the Fauna and Flora Report (Digby Wells, 2016) for further detail on the different broad habitat types. Species that were characteristic of the permanently wet zones where standing water was present included the hydrophytes: *Typha capensis* (Common Bulrush), *Leersia hexandra* (Rice Grass), *Imperata cylindrica* (Cottonwool Grass) and *Arundinella nepalensis* (River Grass) as well as various hydromorphic sedges that had colonised.

The seasonal hillslope seep wetland community was made up of both hydrophytes and facultative hydrophytes that included the grasses: *Andropogon eucomus* (Snowflake Grass), *Agrostis lachnantha* (Bent Grass), *Eragrostis gummiflua* (Gum Grass) and *Imperata cylindrica* (Cottonwool Grass), as well as some *Cyperus* spp. and forbs such as *Persicarya lapathifolia*. Common and characteristic plant species found to colonise pan edges included: *Cyperus semitrifidus*; *Juncus effusus* (Common Rush), *Persicaria lapatholia* and *Agrostis lachnantha* (Bent Grass).

Figure 9-2: Common characteristic flora species associated with the wetlands: a) *Cyperus congestus*; b) *Pennisetum sphacelatum* (Bull Grass); c) *Schoenoplectus brachycerus*; d) *Cyperus denudatus* (Winged Sedge); e) *Eleusine coracana* (Goose Grass); f) *Agrostis lacnantha* (Bent Grass); g) *Eragrostis gummiflua* (Gum Grass)

9.1.2 Wetland Delineation

The project area is characterised by large areas of wetlands as delineated according to the indicators discussed in the above section and are shown in Plan 13; totalling 2 830.2 ha in the MRA's (Table 9-1). Wetlands were delineated beyond and between the boundaries of the three MRA's to show the connectedness of these ecosystems in the catchment areas. Extensive hillslope seep wetlands were found in the project area with channelled and unchannelled wetlands in the valley bottoms. In addition, pan wetlands were found typically on the catchment divide in high lying areas.

Table 9-1: Total areas of Wetland HGM units per MRA

Wetlands HGM Unit	Mooively East MRA (ha)	Mooivley West MRA (ha)	Hendrina South MRA (ha)	All MRAs (ha)
Klein Olifants River	55.3	-	200.4	255.7
Channelled Valley Bottoms	56.3	2.9	136.4	195.6
Valley Bottoms	1.3	76.4	87.6	165.3
Seeps	524.2	759.5	891.2	2,174.9
Pans	33.7	4.9	-	38.6
Total Wetlands (ha)	**670.8**	**843.8**	**1,315.6**	**2,830.2**

The project area was therefore found to be in alignment with the land and vegetation type (described in section 8) where Highveld grassland is the dominant natural terrestrial habitat and seasonal seep wetlands are present on the mid-to-lower slopes of the landscape with (non) perennial permanent wetlands in the drainage lines. This is generalised in Figure 9-3 below where the landscape is characterised by a typical change in soil and floral species composition. The next section discusses the ecological setting and condition of the wetlands present as well as their functional role in the landscape.

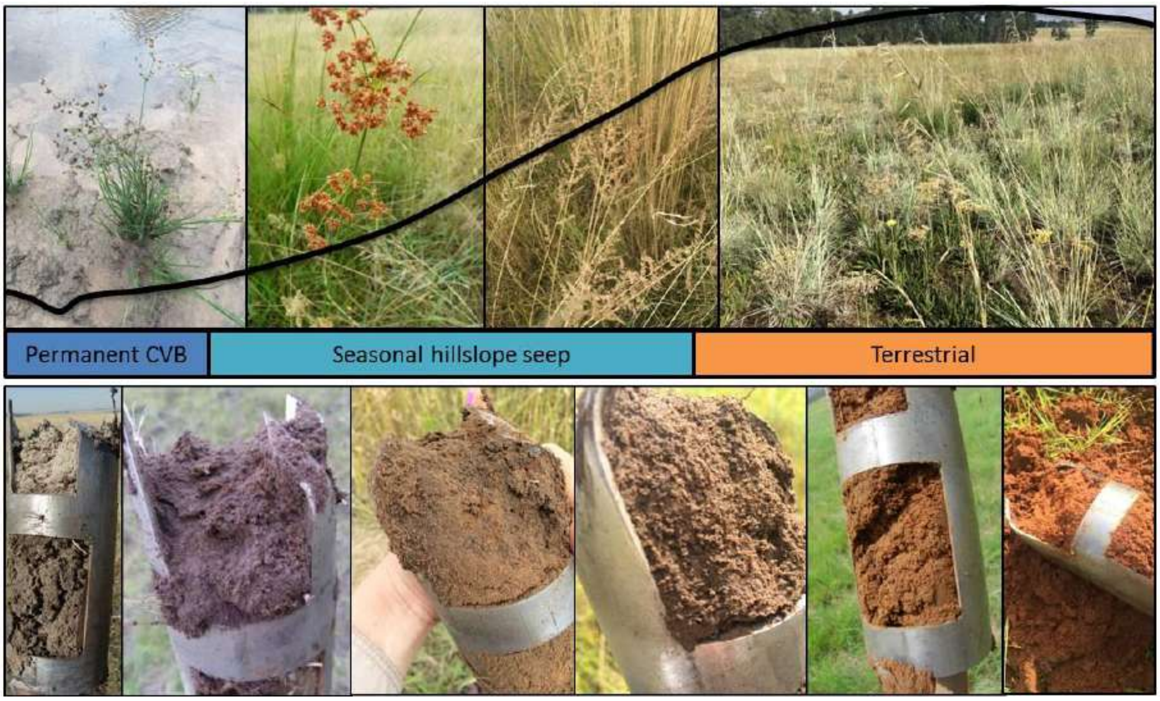
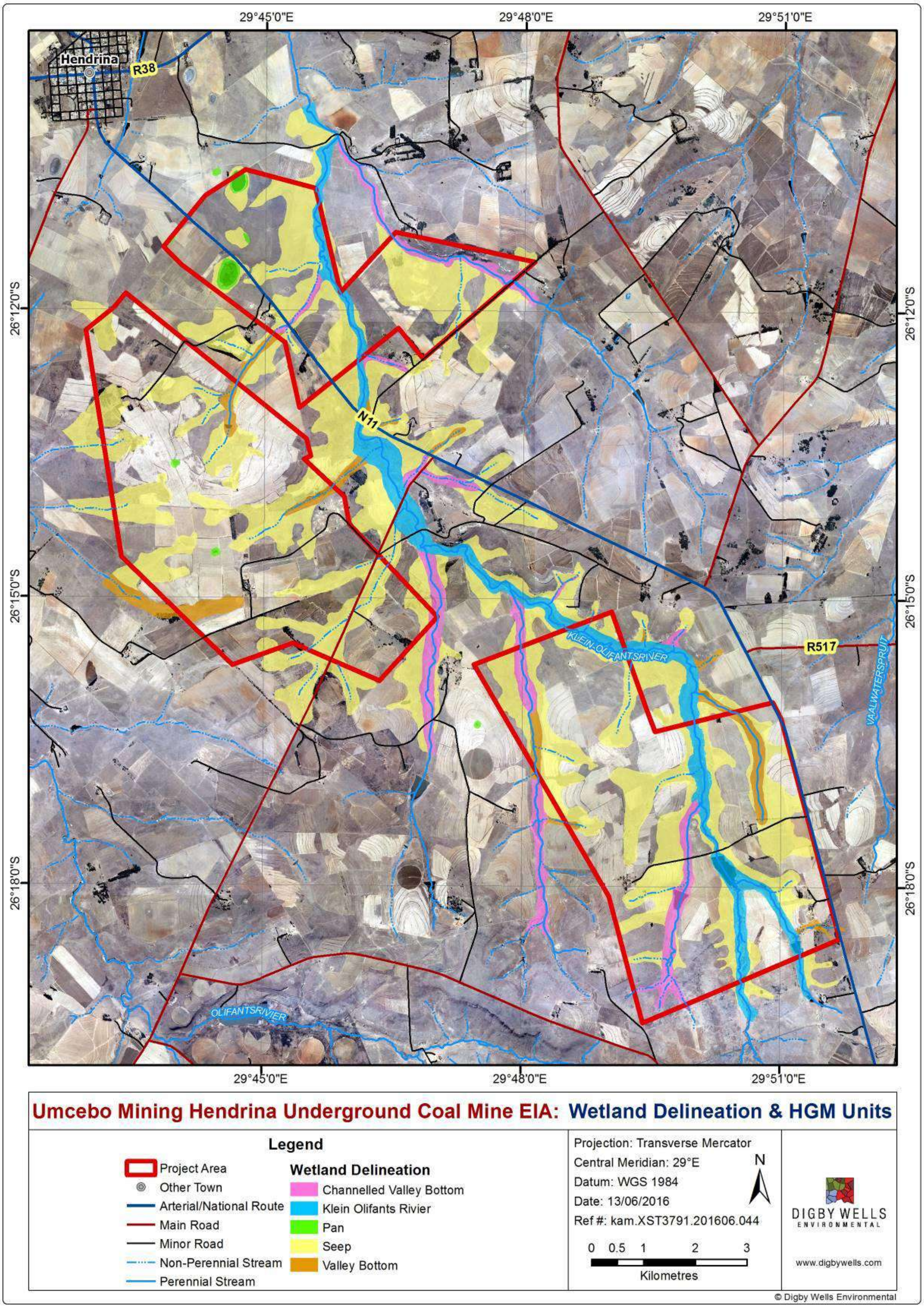


Figure 9-3: Generalised landscape slope gradient with changing flora and soil types of the project area



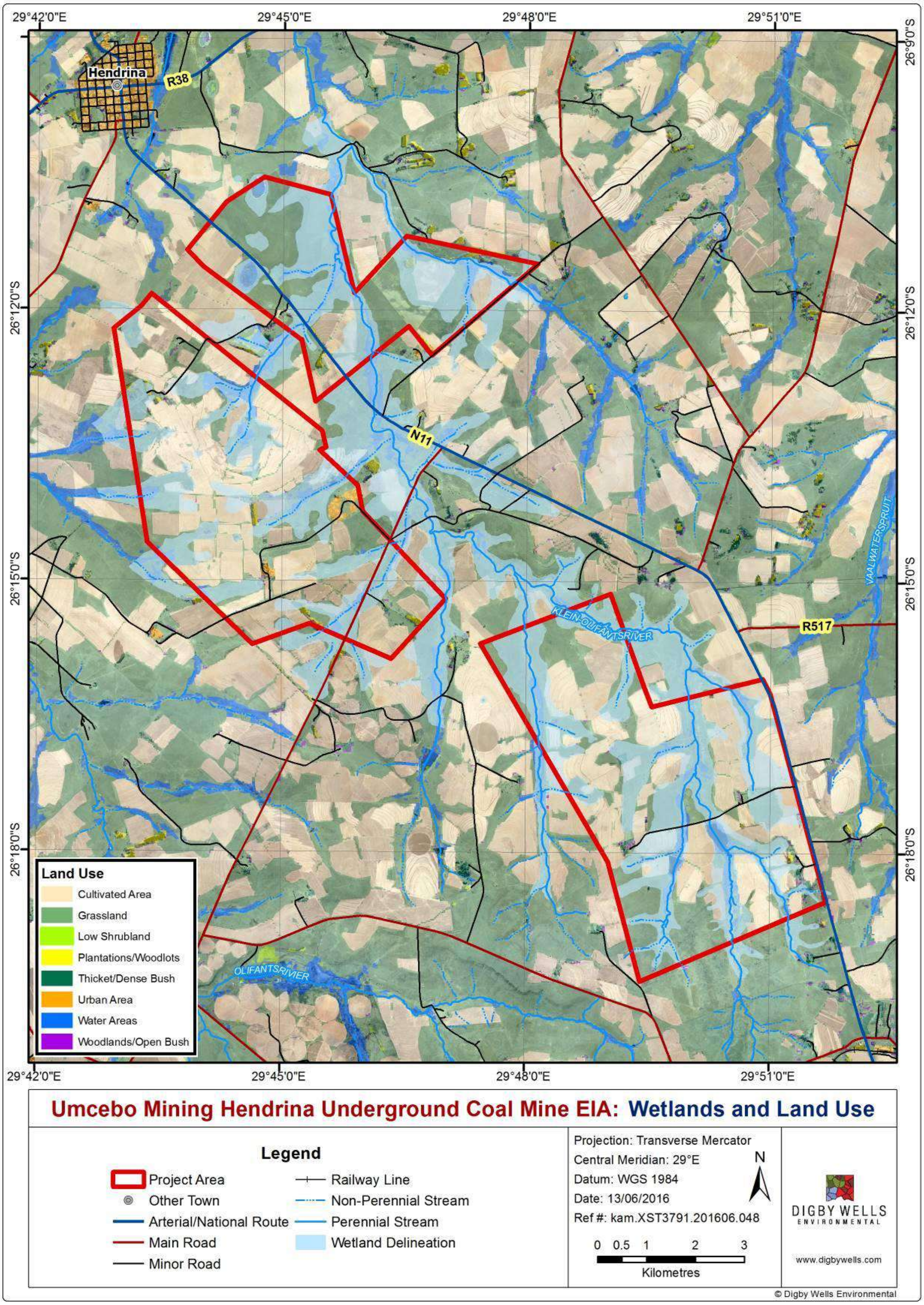
Plan 13: Wetland Delineation and HGM units

9.2 Wetland Ecological Assessment

The wetlands are important ecosystems within the project area as they characterise all three MRA's and include a variety of the wetland habitat types such as valley bottoms, hillslope seeps and depressions; i.e. HGM unit setting. The ecological functioning of these ecosystems is directly linked to their position in the landscape as well as their ecological condition. Wetlands of the Mpumalanga Province and Highveld region within the Grassland biome represent important ecosystems providing many services and goods to people (MPTA, 2014); however, this does lead often to over exploitation of these systems which compromises their ecological integrity.

The dominant land use of the area is agro-pastoral including large areas of cropland and natural grassland for grazing and grass-bailing. The wetlands of the project area are overlaid on the land use map (see Plan 14) to show the impact of the current land use practices on the wetlands and their catchment areas. This has led to negative impacts such as the removal of natural wetland vegetation of the hillslope seeps, increased sediment load reporting to the wetlands, erosion, damming of valley bottom wetlands altering the natural hydrological regime and presence and spread of alien and invasive species. Examples of these impacts recorded on site are shown in Figure 9-4 below.

Figure 9-4: Main impacts to wetlands: a) agriculture; b) alien invasive plant species such as *Cirsium vulgare* (Scottish Thistle); c) evidence of abandoned land uses and dumping as well as large stands of alien invasive trees; d) damming of valley bottoms and use of wetland by cattle; e) headcut erosion; and f) major roads bisecting the catchment areas



Plan 14: Wetlands and Land use

The wetlands of the project area are within seven locally delineated catchments (see Plan 12). Using the land use map above as well as results from the in-field studies, it is shown that these do not differ from each other from a catchment management perspective. In other words, the wetlands within all catchments are subject to similar overall land use impacts and thus the wetlands are discussed herein according to their HGM setting in the landscape of the full study area. These units are assessed using the methodology described in section 6.3 to determine their PES and EIS as well as their ecosystem services provided. The sub-sections below provide a summary of the ecological setting for each HGM unit and details their ecological scores. Please refer to the Impact Assessment section (11) for detail on the area and type of wetlands associated with the proposed mine plan and infrastructure layout.

9.2.1 Klein Olifants River

The Klein Olifants River is a channelled valley bottom major wetland and watercourse. This wetland / river flows through and drains the project area that is associated with quaternary catchment B12A, which includes six of the seven local catchments. Many parts of this river are associated with exposed bedrock along the channel and rocky cliffs are found on one side of the valley bottom in some parts. There is no woody riparian zone associated with this river, typical of rivers in the grassland biome; except for the sporadic occurrence of bushclumps of alien invasive tree species. Figure 9-7 below shows examples of the habitat found in the project area.

The surrounding land use has had significant impacts upon the natural state of the river. There are multiple barriers through this wetland including roads; as well as dams which affect the natural hydrology and water is abstracted from the river from many of the owners. Erosion of the channel is a current issue including vertical erosion and horizontal erosion causing incision and channel widening respectively. There is no agriculture present in the river; however crops occur within the buffer zone of 100m. The river is largely utilised by the livestock of the farms for drinking. The overall PES of the Klein Olifants River Channelled Valley Bottom wetland system was determined to be moderately to largely modified from the natural state; with a PES of C/D, see Table 9-2.

Despite not being in a pristine condition, the Klein Olifants River provides many goods and services at a local and regional scale and is an important freshwater wetland ecosystem in the landscape. This wetland unit has been determined to have an overall EIS of High from the summary scores and reasoning presented in Table 9-3 below on the following pages.

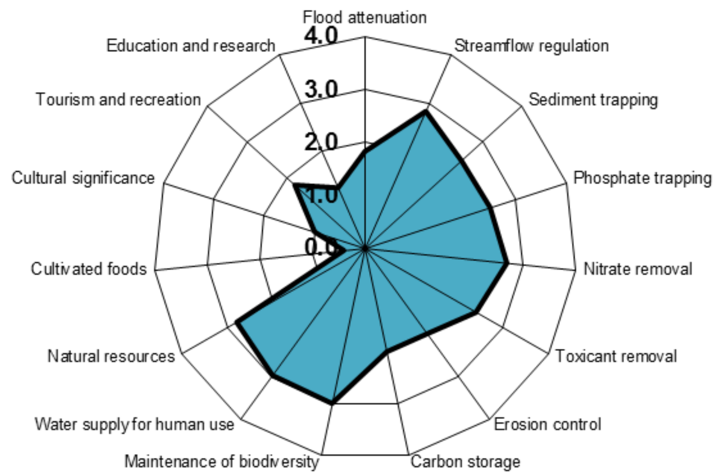
Table 9-2: Present Ecological Health Scores for the Klein Olifants River

Aspect	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final Ecological Health Score
Score	6.2 – E/D	1.0 – B	4.8 – D	4.3 – D/C

Figure 9-5: Klein Olifants River habitat in the project area

Table 9-3: Wetland Ecosystem Service results for the Klein Olifants River Channelled Valley Bottom wetland

Aspect	Overall EIS Score	EcoServices
Hydrological and Water Quality	High (2.0)	The river plays an important role in the hydrological regulating and supporting benefits in the catchment as this is a perennial river in the upper Olifants catchment and Water Management Area (WMA). Important services within this category include flood attenuation; sediment trapping; and sustaining streamflow during the dry season. Important hydrological systems are downstream as the Olifants WMA is important nationally for regulating freshwater services.

Aspect	Overall EIS Score	EcoServices
Ecological and Biodiversity	High (2.8)	The wetland can provide habitat for important species typical of the area, particularly given that the project area is found within an Important Bird Area (IBA). There is a variety of habitats associated with the river as well including meandering channels, seasonal vegetation slopes and rocky outcrops and cliffs. Maintenance of biodiversity therefore is important the river will support both terrestrial and aquatic life in the catchment.
Direct Human Benefits	Moderate (1.4)	Water supply for human is important services provided by the river use as well as provision of natural resources. The river is within the important upper Olifants catchment and WMA and thus has regional importance; but there are many local households that depend on this river for the provision of natural resources.
Summary EcoServices Radial Plot		

9.2.2 Valley Floor Wetlands

The Valley Floor wetlands within the project area are both channelled and unchannelled valley bottom systems that are connected to the Klein Olifants drainage network. These wetlands are found within all catchments and are fed by a combination of sub-surface and surface water. The systems are generally characterised by gentle slopes on either side (see Figure 9-6) and have extensive hillslope seep wetlands connected to them. The main impacts include multiple farm road crossing; many farm dams; use of wetland by cattle leading to trampling and input of nutrients; larger than natural input of sediment due to agricultural land-use; and active erosion. Thus the overall PES of the Valley Bottom wetland systems studied were determined to be moderately to largely modified from the natural state; see Table 9-4.

Table 9-4: Present Ecological Health Scores for the Valley Floor Wetlands

Aspect	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final Ecological Health Score
Score: CVB	6.3 – E/D	1.7 – B	3.3 – C	4.2 – D/C
Score: VB	5.0 – D/C	1.0 – B	4.1 – D/C	3.6 – C/D

Figure 9-6: Example photographs of habitat on site of the valley bottom wetlands: a) unchannelled and b) channelled

These wetlands are greatly utilised by the land owners for livestock grazing and drinking as well as direct water use from the dams. Through supplying these ecosystem services, the wetlands ecological condition has been somewhat degraded (as discussed above), however the wetlands are still providing important habitat for the maintenance of biodiversity. In addition the hydrological regulatory services provided by valley floor wetlands in the area are also high. These are summarised in the tables below for both the channelled and unchannelled systems.

Table 9-5: Wetland Ecosystem Service results for the Channelled Valley Bottom Wetlands

Aspect	Overall EIS Score	EcoServices
Hydrological and Water Quality	High (2.1)	The channelled wetland systems provide important hydrological regulating and supporting benefits in the catchment and report to the Klein Olifants River. Important services within this category include streamflow regulation, nutrient assimilation, and sediment trapping. The systems should be providing a greater service in erosion control however active erosion is present, causing incision and channel widening that makes the wetland compromised in this ability.

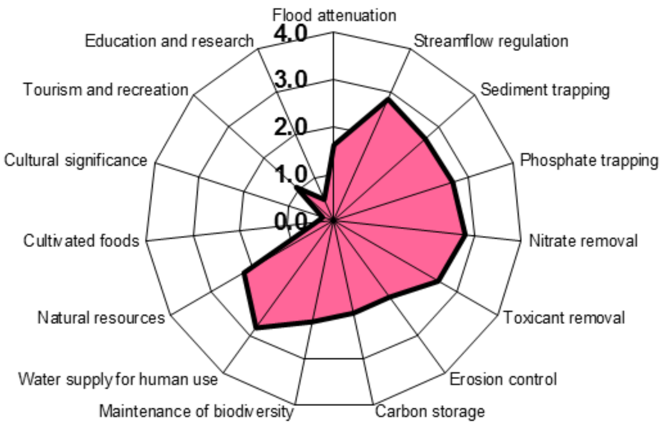
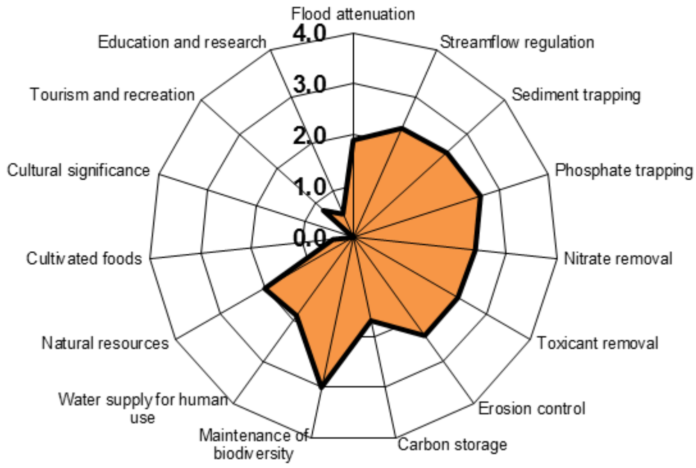
Aspect	Overall EIS Score	EcoServices
Ecological and Biodiversity	High (2.3)	The channelled wetlands provide important habitat for a variety of aquatic and terrestrial fauna and flora species and are located within a threatened grassland ecosystem and IBA. The current land use prevents the full potential of the biodiversity service from being realised.
Direct Human Benefits	Moderate (1.3)	Water supply for human use is an important service provided by these wetlands as multiple farm dams are present. Additionally, grazing livestock make great use of these wetlands for drinking water and grazing grasses.
Summary EcoServices Radial Plot		

Table 9-6: Wetland Ecosystem Service results for the Unchannelled Valley Bottom Wetlands

Aspect	Overall EIS Score	EcoServices
Hydrological and Water Quality	High (2.1)	The unchannelled wetland systems provide some hydrological regulating and supporting benefits in the catchment which report to the Klein Olifants River. Streamflow regulation, sediment trapping, nutrient assimilation and slowing down of flood waters are all important roles provided by these wetlands. These functions are strongly linked to the absence of a channel as water is spread throughout the wetland unit and thus active erosion in the area is a great risk to these wetlands.
Ecological and Biodiversity	High (2.3)	These wetlands provide natural hydromorphic grassland habitat to a variety of faunal and floral species, which represent important buffer zones and corridors between other natural areas. The use of these wetlands by livestock and general farm activities occurring within the wetland however does affect the biodiversity present.

<table>
<tr><th>Aspect</th><th>Overall EIS Score</th><th>EcoServices</th></tr>
<tr><td>Direct Human Benefits</td><td>Moderate (1.0)</td><td>These wetlands are sometimes dammed and thus water supply is a service provided; this is also due to the fact that these wetlands are hydrologically linked to the channelled systems including the river from which important water resources are derived. Grazing from livestock is the other natural resource benefit directly sourced from these wetlands.</td></tr>
<tr><td>Summary EcoServices Radial Plot</td><td colspan="2">
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9.2.3 Hillslope Seep Wetlands

The hillslope seep wetlands are extensively found throughout the project area and are connected to the watercourses that drain the catchment network; i.e. the Klein Olifants River. These wetlands are characterised by gentle slopes and hydromorphic grassland habitat. The largest impact to these wetlands is the complete removal of vegetation where croplands occur that comprise of maize, soya beans and potatoes. These wetlands are predominantly fed by groundwater and in many areas the soil layer was very shallow and found on top of hard ferricrete or sandstone. There is significant lateral movement of sub-surface water in this area and it can be seen in the presence of these wetlands.

Farm roads are plentiful through these wetlands and grazing livestock are too present and are seen as a negative impact. As a result of these activities and impacts, erosion is present in the wetlands. Thus the overall PES of the Hillslope Seep wetland systems studied were determined to be moderately to largely modified from the natural state; a score of D/C was given, see Table 9-7. Where the vegetation is left intact within these systems, the PES will be closer to a C and where there has been complete removal of habitat due to cultivation the PES will be D.

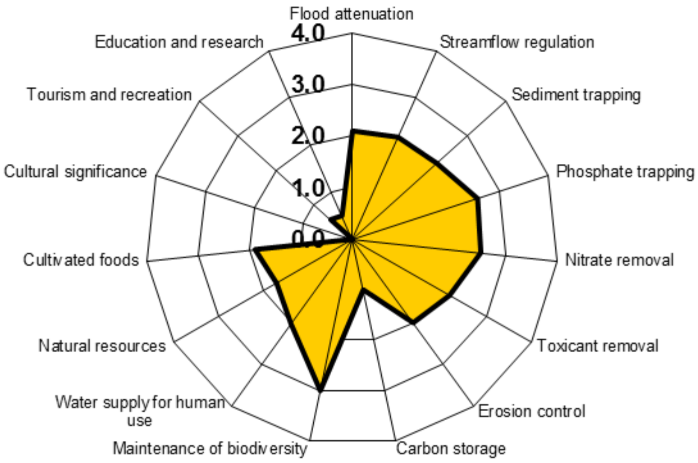
Table 9-7: Present Ecological Health Scores for the Hillslope Seep Wetlands

Aspect	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final Ecological Health Score
Score	6.0 – E/D	0.9 – A	5.1 – D	4.3 – D/C

Figure 9-7: Examples of hillslope seep setting connected to the valley bottom being characterised by: a) *Imperata cylindrica* and b) by *Agrostis lachnantha*

Table 9-8: Wetland Ecosystem Service results for the Hillslope Seep Wetlands

Aspect	Overall EIS Score	EcoServices
Hydrological and Water Quality	High (2.0)	The hillslope seep wetland systems provide important hydrological benefits in the catchment as they cover extensive areas within the landscape and are connected to the Klein Olifants River drainage network. Sustaining streamflow during the dry season is provided as these wetlands are slowly fed with sub-surface flow that moves laterally into the valley floor and river systems. Due to the diffuse nature of water movement through these systems, sediment trapping and nutrient assimilation is an important water quality enhancement benefit; particularly due to the land use impacts of the area.
Ecological and Biodiversity	Moderate (1.4)	These gentle slopes will provide habitat for important species of the area such as African Grass Owl, Marsh Owl and other terrestrial species. The regional grassland which these habitats are a part of, are endangered (see Section 8.4). These areas are important buffers and linking corridors between the remaining natural areas of the catchment.

<table>
<tr><th>Aspect</th><th>Overall EIS Score</th><th>EcoServices</th></tr>
<tr><td>Direct Human Benefits</td><td>Moderate (1.3)</td><td>The use of the wetland for grazing of livestock is an important benefit. Due to the extensive nature of these seeps and their role in supplying water to the drainage network, water supply too is seen as an important service.</td></tr>
<tr><td>Summary EcoServices Radial Plot</td><td colspan="2">
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9.2.4 Pan Wetlands

Depression / Pan Wetlands are unique habitats within the project area. These wetlands are hydrological disconnected from the stream network as they are inward draining wetlands. There are two major types of pans, where some are relatively large, in a natural state and represent significant features in the landscape, and some are small largely impacted by the agriculture of the area.

The natural pans are found within the Mooivley East MRA and contain large open areas of water surrounded by seep wetlands. These wetlands have been impacted by roads (including the N11 national road) and undergo great use by the livestock which impact water quality and can disturb the soil and trample plants. The impacted pans have been subject to complete removal of natural vegetation due to the croplands and do not contain open water. Thus the overall PES of the Natural and Impacted Pan wetland systems studied were determined to be moderately and largely modified from the natural state respectively; see Table 9-9.

Table 9-9: Present Ecological Health Scores for the Pan Wetlands

Aspect	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final Ecological Health Score
Natural Pans	4.0 – D/C	0.9 – A	3.4 – C	2.9 – C
Impacted Pans	6.5 – E	2.8 – C	7.1 – E	5.6 – D/E

Figure 9-8: Photos of the Large Natural Pan Wetlands

Figure 9-9: Examples of the Relatively Small Impacted Pans in the Project Area

Despite not being in a pristine condition, the natural pan wetlands provides habitat for a variety of faunal and floral species and are a water source for the livestock on the farm. The impacted pans play a limited role in the ecosystem as they are no longer compromised of natural floral species. These findings are summarised in the tables below.

Table 9-10: Wetland Ecosystem Service results for the Major Natural Pan Wetlands with Hillslope Seep Wetlands Connected

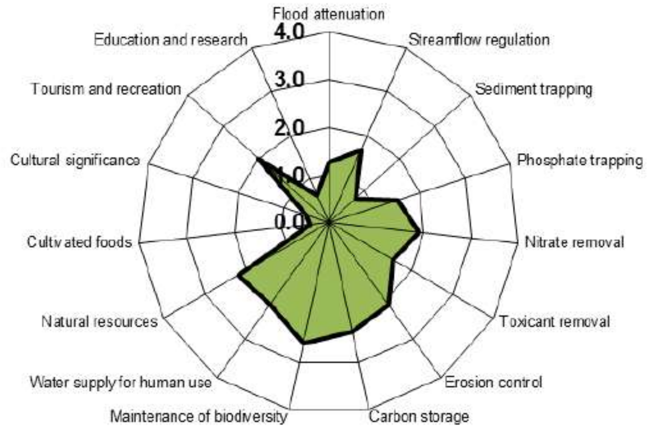
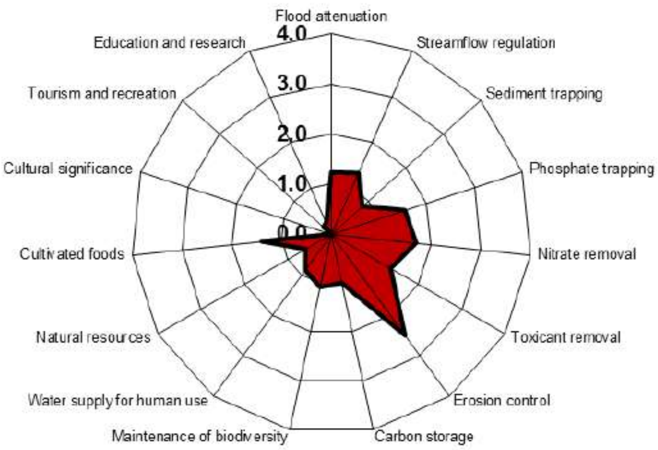
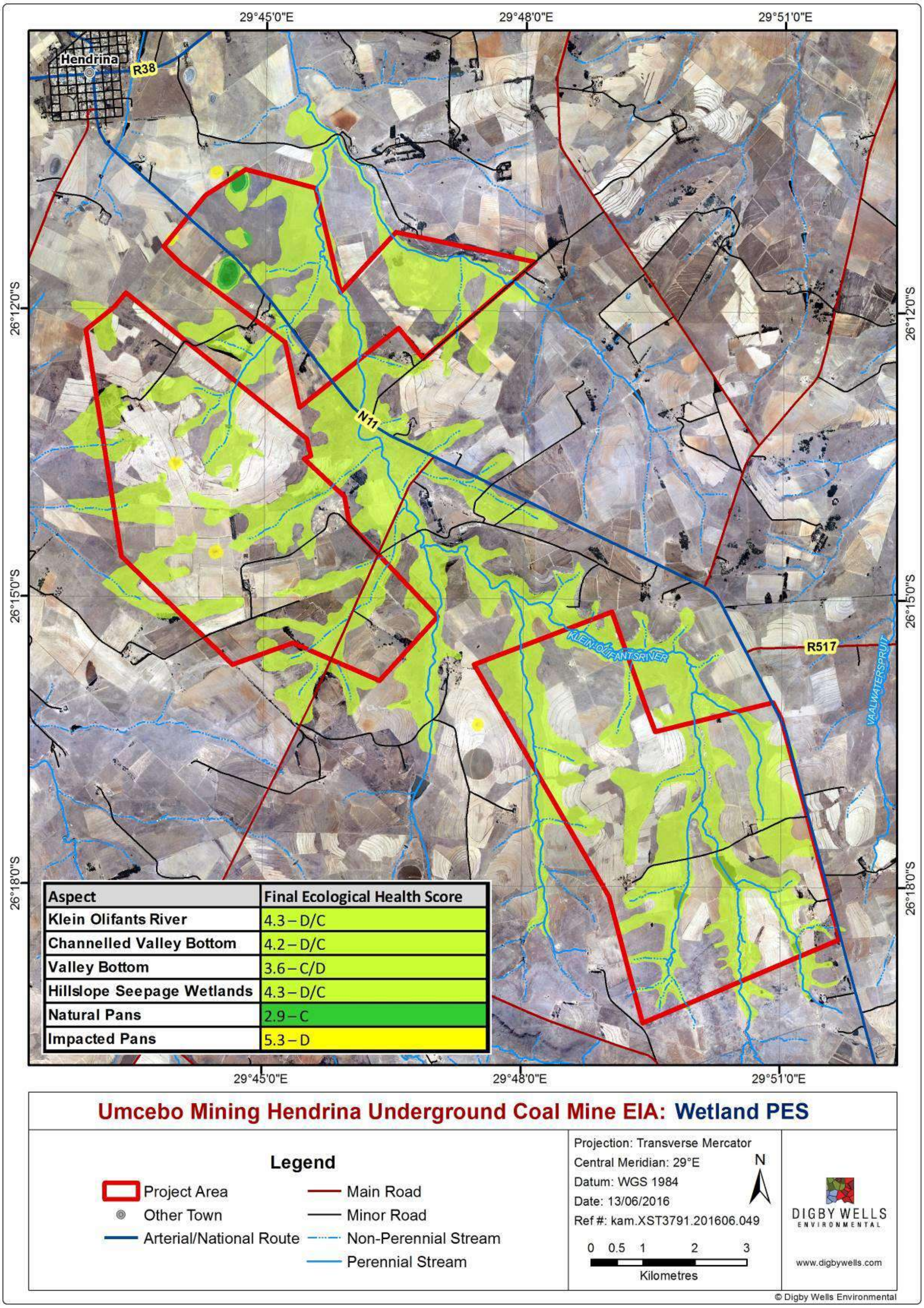
Aspect	Overall EIS Score	EcoServices
Hydrological and Water Quality	Moderate (1.0)	The pan wetland systems provide limited hydrological regulating and supporting benefits in the catchment as they are isolated in the landscape; however they do collect water that would otherwise report to the stream network and thus play a small role in streamflow regulation and flood control. Within their immediate catchment, these pans play important roles such as sediment trapping, nutrient assimilation and carbon storage.
Ecological and Biodiversity	High (2.7)	These pans provide unique habitat in the landscape for species and thus their ecological and biodiversity importance is high. This is particularly due to the project area being within an IBA and Greater Flamingos were seen in the largest pan on all field investigations, which are a Species of Special Concern. Refer to the Fauna and Flora Report (Digby Wells, 2016) for further details.
Direct Human Benefits	Low (0.9)	These pans provide limited benefits of a direct nature, being mainly small amounts of water supply for human use, livestock grazing and drinking, as well as some cultural and aesthetic benefits as these pans are unique ecosystems in the landscape.
Summary EcoServices Radial Plot		

Table 9-11: Wetland Ecosystem Service results for the small impacted Pan Wetlands

Aspect	Overall EIS Score	EcoServices
Hydrological and Water Quality	Low (0.6)	These pan wetland systems provide limited hydrological regulating and supporting benefits in the catchment as they are isolated in the landscape and are impacted by the surrounding agricultural activities. Due to their inward raining nature, they do provide some sediment trapping, nutrient assimilation and erosion control benefits, but these are greatly compromised.
Ecological and Biodiversity	Low (0.7)	These wetlands will provide habitat for some important species within the area but this will be limited as the vegetation has been largely impacted and replaced with agricultural crops, alien and invasive species and one or two permanent wetland grasses. The biodiversity potential of these systems is greatly reduced due to the land use practices.
Direct Human Benefits	Low (0.3)	These wetlands do provide some direct benefits and agricultural crops are found within the wetland edges and their buffer areas.
Summary EcoServices Radial Plot		



Plan 15: Wetland Present Ecological State (PES)

10 Sensitivity Analysis and No-Go Areas

All the information gained is summarised into understanding the sensitivities of the site and where this interacts with proposed activities. Sections 8.6 to 8.8 of the baseline information describe the desktop based plans and guidelines that highlight ecological sensitivities. The terrestrial MBSP has delineated a considerable area within and immediately around the project area as CBAs and Optimal ESAs shown as red and yellow in Plan 9 respectively. According to the guidelines from the MSBP, CBAs must be kept in a natural state with no further loss of habitat; where only low-impact, biodiversity-sensitive land-uses are appropriate.

There is surface infrastructure that will impact on some of these areas, particularly within the Hendrina South MRA. No surface infrastructure is directly placed on any NFEPA wetlands except for the conveyor that will cross a channeled valley bottom wetland between the Mooivley West and Hendrina South MRA's. The NFEPA wetland poses a significant risk to the project as no mining is to occur within a 1 km buffer area of NFEPA wetlands (Nel *et al.,* 2011). The proposed mine plan underlies NFEPA wetlands as well as their buffer and catchment areas as shown in Plan 8. Mitigation measures already employed by Umcebo to avoid wetlands during the scoping phase of the project include:

- Relocation of Mooivley East surface infrastructure out of the small seep leading to the small pan and its 100m buffer. This relocation to the north-west, however, is now within the seep wetlands leading to the larger natural pan.
- Relocation of the Hendrina South surface infrastructure to the western end of the project area to avoid crossing of a second stream. However, this infrastructure is still placed within seep wetlands and the conveyor crosses the stream to Mooivley West. This was an avoidance measure to reduce the impact from surface infrastructure on the wetlands.

According to the Mining and Biodiversity Guideline (SANBI, 2013), the project area is characterised by some areas regarded as being highest risk to mining projects, being parts of the Klein Olifants River and some natural grassland that remains in the area. The majority of the project area is regarded as being of moderate risk to mining projects, which is again mostly associated with the wetland bodies of the landscape and any remaining natural habitats. Where intensive agriculture is present, no risk level has been mapped for these areas. The proposed surface infrastructure is located within areas of moderate risk as seen on Plan 11.

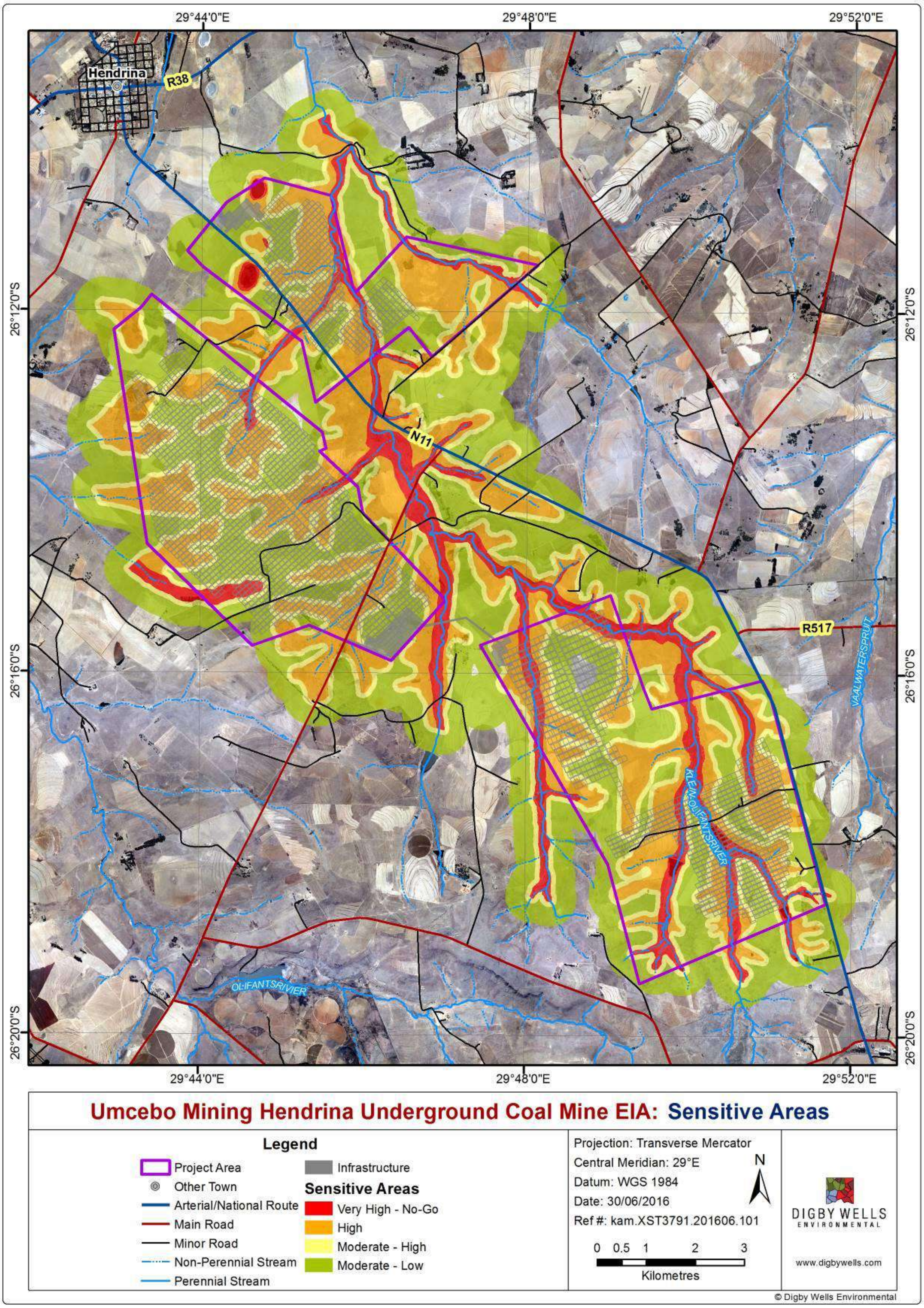
Buffer areas are important to note when discussing sensitivities of ecosystems, where a buffer is the area surrounding the wetland within which land-use activities may directly affect the ecological character of the wetland itself, and the objective for land-use within the buffer zone should be one of sustainable use through ecosystem management, consistent with the maintenance of the ecological character of the wetland (Ramsar Convention Secretariat, 2010). The proposed project is largely within 500 m of the wetland edges, which can be seen as their legislated "buffer" zone as the mining activities will have to be granted a WUL to proceed in accordance with Government Notice (GN) 1199 (of 2010) as promulgated in terms of the the NWA.

Similarly, the proposed project is within 100 m of the wetlands, which is another legislated buffer where material and activities within 100 m of a wetland and the potential to impact on a water resource should be authorised in terms of Section 40 of the NWA.. It must be noted that the DWS have recently recommended that a buffer of 200 m be placed around all wetlands that are linked to the Olifants River.

The wetland assessment allowed these sensitivities to be ground-truthed and the project wetlands were mapped according to their ecological sensitivities to the proposed project, as summarized below.

Table 10-1: Wetland Sensitivity Ratings

Sensitivity Rating	Wetland Areas identified
Very High – No Go areas	The Klein Olifants River, all channelled valley bottom systems and the natural pans.
High	The hillslope seep wetlands.
Moderate – High	The area constituting the immediate buffer area from the wetland edge to the 100 m zone surrounding all wetlands.
Moderate – Low	The 500 m buffer zone (100 m to 500 m) of all wetlands as well as the impacted pans.



Plan 16: Areas of Sensitivity – Wetlands

11 Wetland Impact Assessment

11.1 Summary of Proposed Project Interactions with Wetlands

Plan 17 below shows the underground coal resource and surface proposed infrastructure together with the final wetland delineations. The project interacts with wetlands as well as their ecological buffer areas (100 m and 500 m) and catchment zones that are described in the above sections. The table below summarise the areas of wetland impacted by the underground mining and the surface infrastructure. The Geotechnical Report (RE_GEN 01_12-16) indicates that all areas to be mined at a depth of less than 40m will have a risk of subsidence; however, the following outcomes must result from a comprehensive geotechnical investigation to reduce the overall impact:

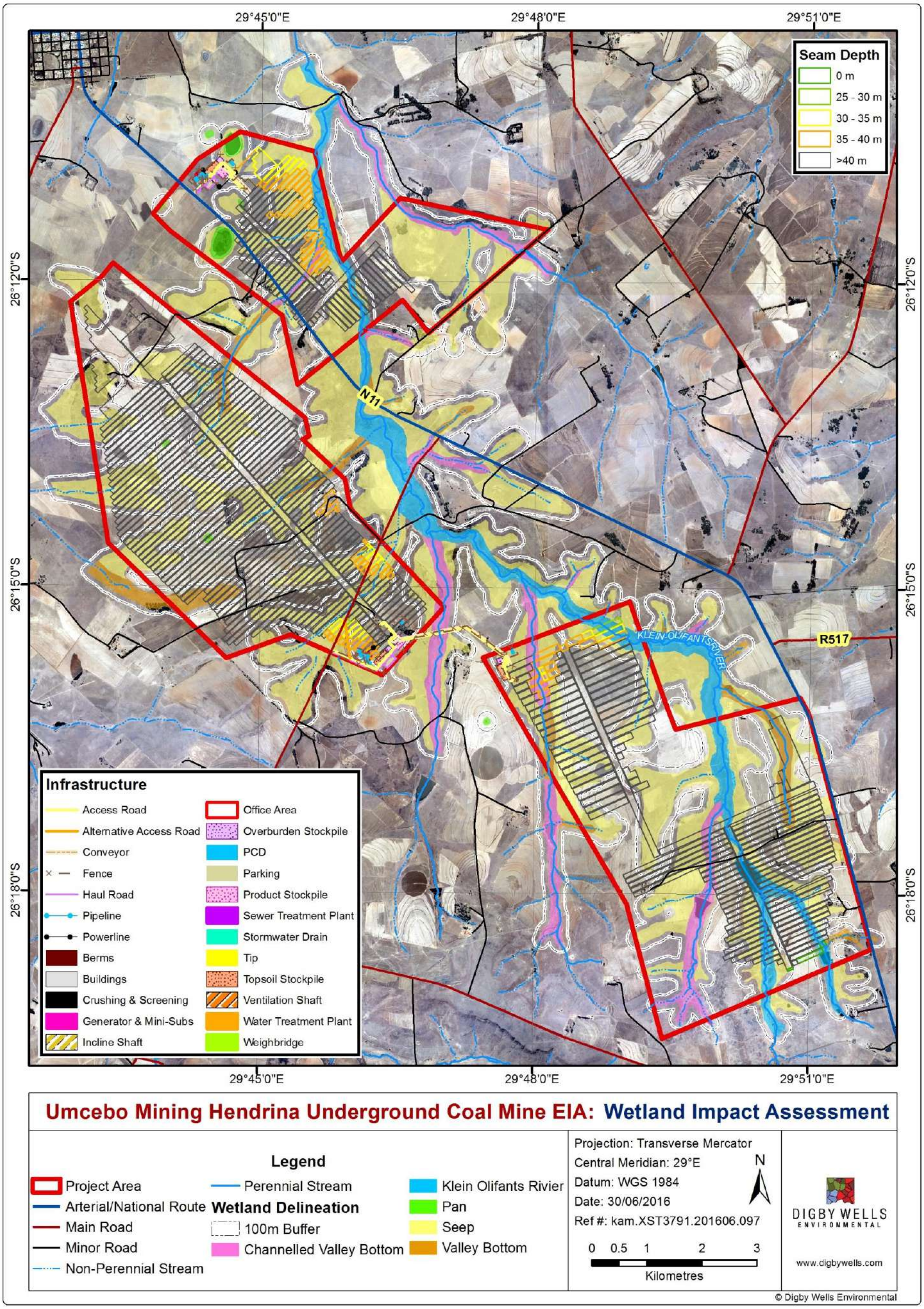
- Provide appropriate design parameters for pillar and overburden stability, in line with the actual geotechnical rockmass properties,
- Indicate any areas (undermining of the wetlands) that may fall outside of these design parameters, and
- Following the geotechnical investigation, where required a provision must be made for the rehabilitation of these areas in the event of a possible risk of subsidence / intersection collapse.

Table 11-1 shows wetlands that will be affected by surface infrastructure, as well as wetlands that fall within areas that will be mined above and below 40m.

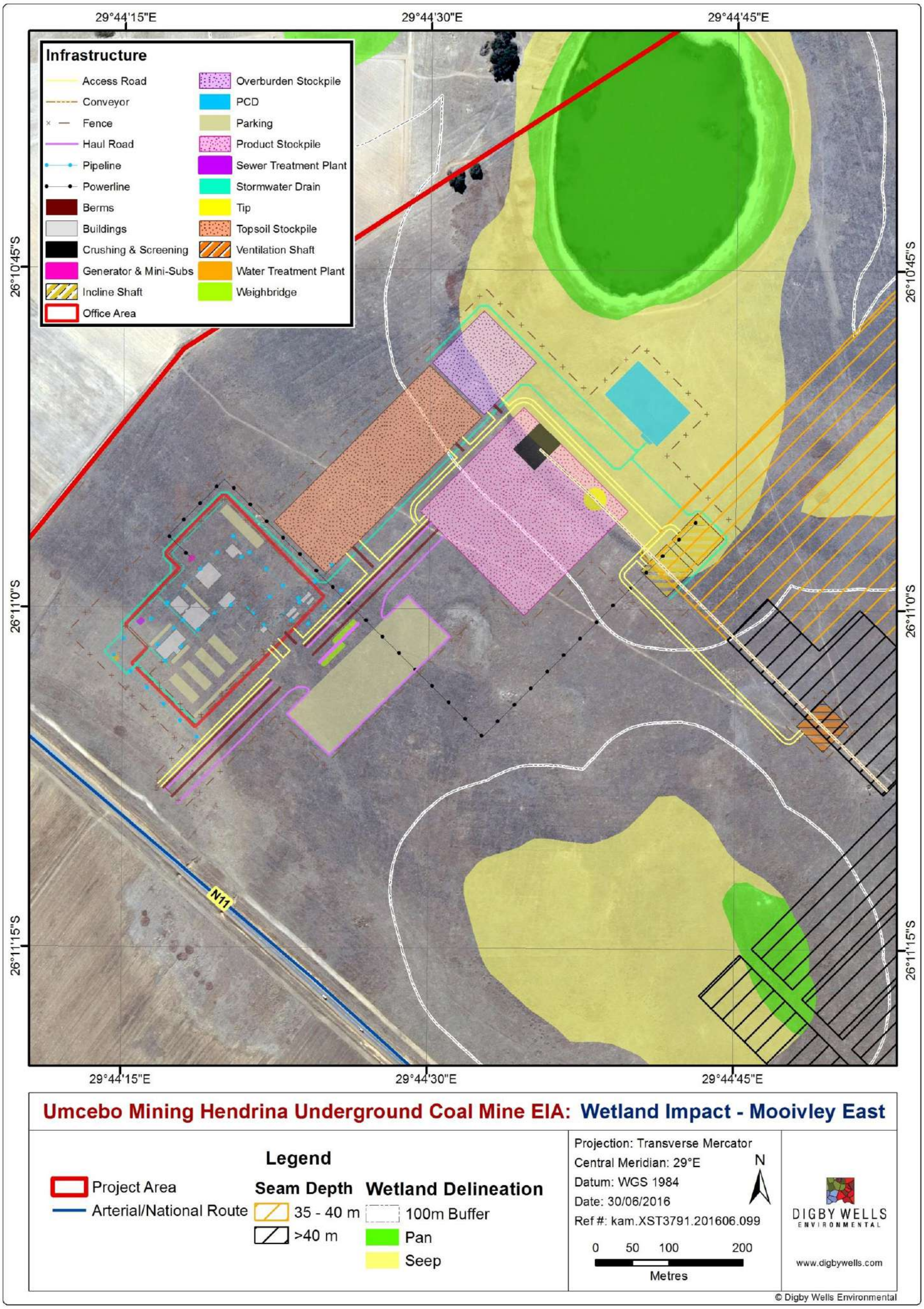
Table 11-1: Areas of Wetlands Directly Associated with the Mine Plan and Infrastructure

HGM Unit	Mooivley East	Mooivley West	Hendrina South	Total
Surface infrastructure (ha)				
Channelled Valley Bottom		1.05		1.05
Seep	5.84	3.38	8.43	17.66
			Total	**18.71**
Underground Mining (ha) below 40m				
Klein Olifants River	10.93		78.56	89.49
Channelled Valley Bottom	5.60		24.27	29.87
Valley Bottom		45.08	51.80	96.88
Seep	119.69	467.72	347.36	934.77
Pan	0.73	3.90		4.63
			Total	**1155.64**

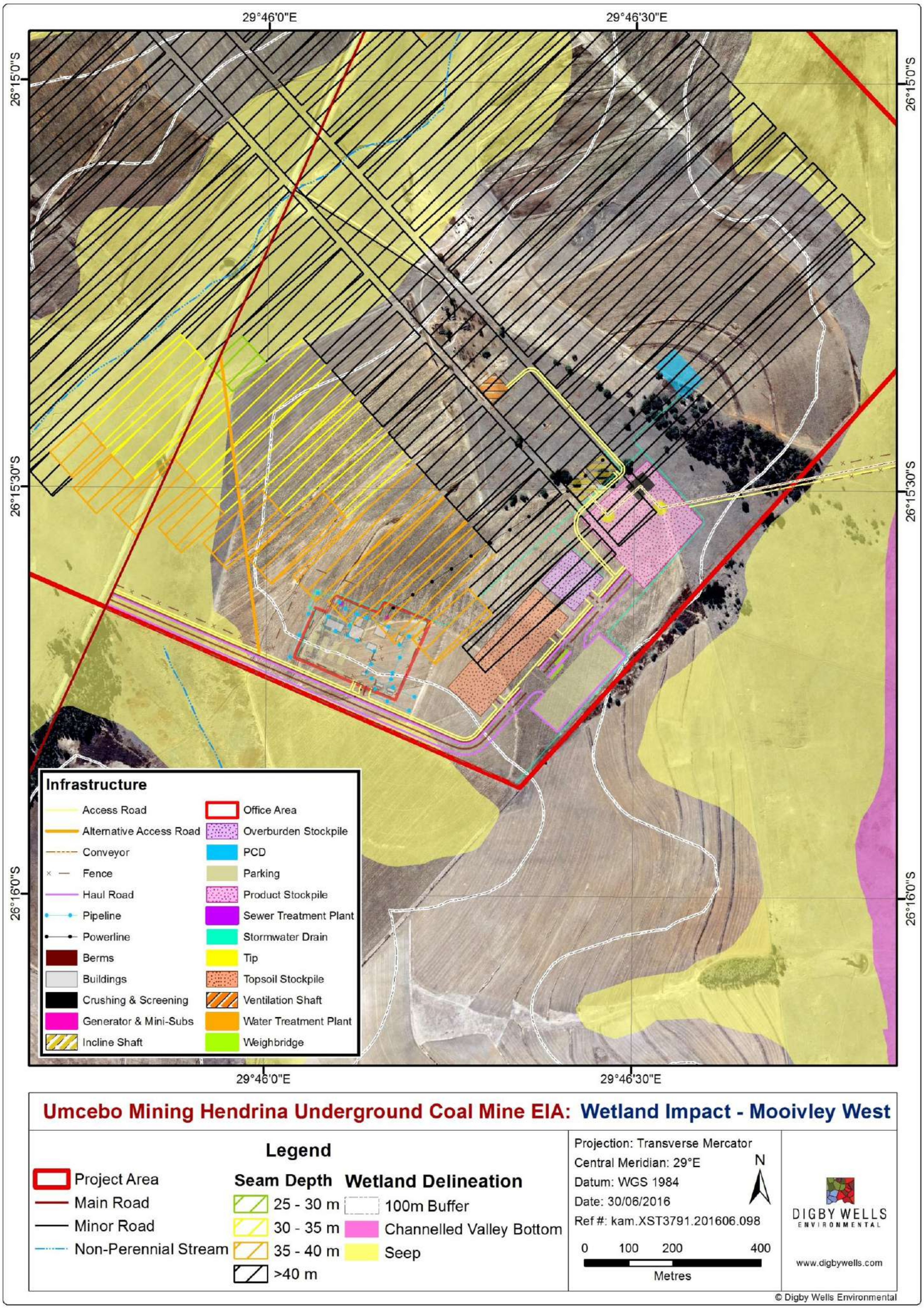
Underground Mining (ha) above 40m				
Klein Olifants River	2.51		13.34	
Channelled Valley Bottom	5.22		15.12	
Valley Bottom			0	
Seep	59.59	30.23	21.53	
Pan				
			Total	**147.54**



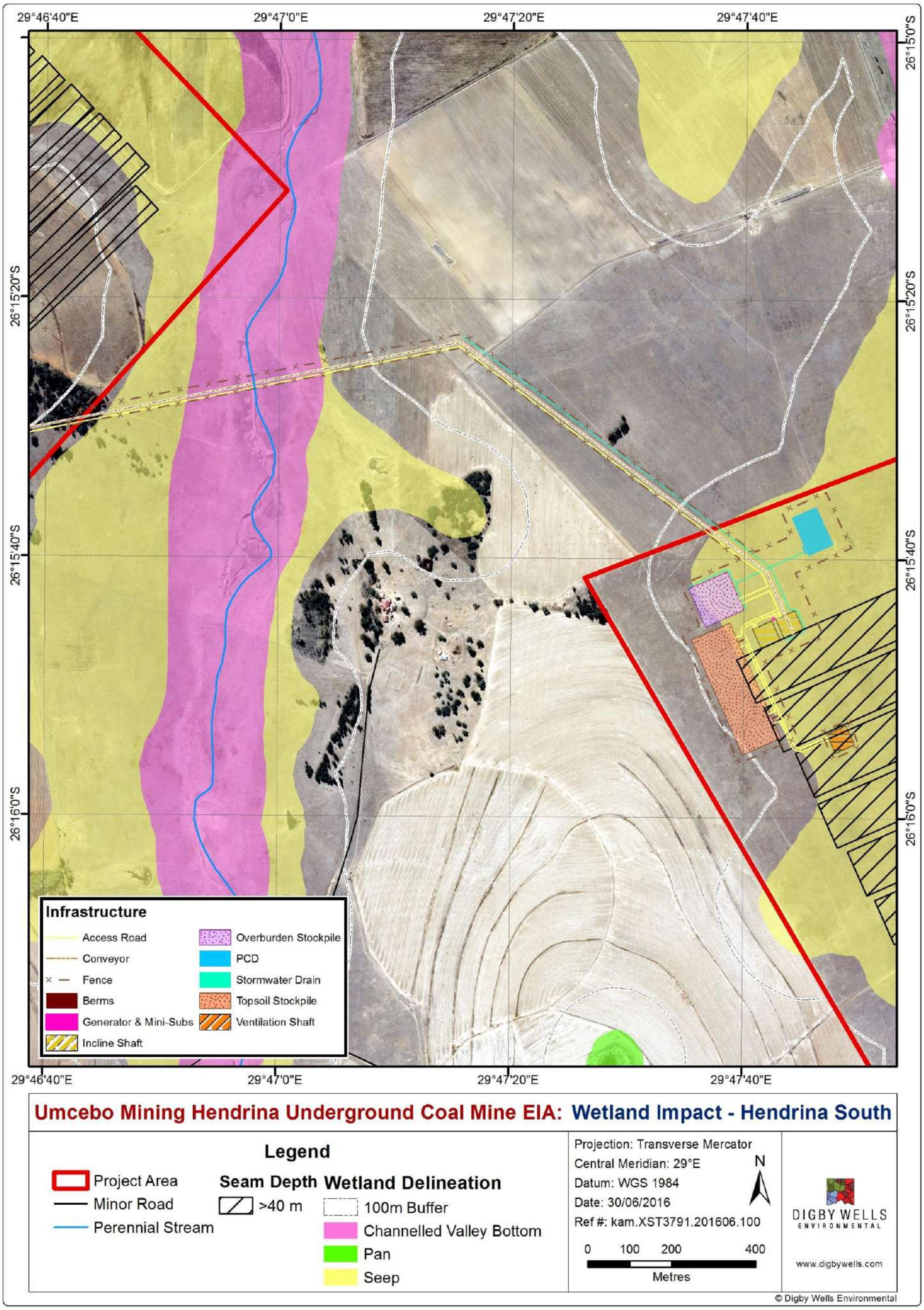
Plan 17: Wetland Impact Assessment – Proposed Mine Plan and Wetlands



Plan 18: Wetland Impact Assessment – Mooivley East infrastructure and Wetlands



Plan 19: Wetland Impact Assessment – Mooivley West infrastructure and Wetlands



Plan 20: Wetland Impact Assessment – Hendrina South infrastructure and Wetlands

11.2 Construction Phase Impacts

11.2.1 Project Activities Assessed

The construction phase activities that will have an impact on the wetlands are summarised below.

Table 11-2: Construction Phase Interactions with Wetlands

Interaction		Impact
1	Site Clearance within wetlands and their buffer areas	Removal of wetland soils and vegetation; totalling 18.7 ha.
2	Construction of general infrastructure within wetlands and their buffer areas	Development within a natural ecosystem is a negative impact to habitat integrity.
3	Construction of Overland Conveyor across an NFEPA channelled valley bottom wetland	Heavy machinery working within wetland channel and surrounds impacting upon soil, vegetation and disturbing fauna.

11.2.2 Impact Description

The construction activities will have a direct negative impact to the wetlands of the project area as wetland soils and vegetation will need to be removed for the construction of mining-related infrastructure. These activities will alter the baseline state as the wetlands are not currently affected by significant industrial or mining activities; predominantly agricultural. Not all wetlands will be impacted and not all wetlands have the same sensitivities. The greatest impacts are focussed around the large natural pan on Mooivley East where infrastructure is within the seep wetland leading to the pan (see Plan 18) and the channelled valley bottom wetland and seeps that the conveyor is crossing between Hendrina South and the Mooivley East MRA.

These impacts can be mitigated before the start of the project through avoidance and minimisation efforts in the design phase and they can be managed during the implementation phase. Avoidance of the wetlands and their 100 m buffer is the major mitigation measure as there is little mitigation for the loss of wetland soil. The natural pans are particularly sensitive receptors as they are inward draining systems and play unique roles in the landscape.

11.2.3 Management Objectives

The objectives are to prevent/minimise the loss of or further damage to natural wetland ecosystems and their buffer areas. This is important as the naturally occurring habitat and ecosystems play a major role in supporting a range of ecological processes and biodiversity in the region.

11.2.4 Management Actions and Targets

The Wetland Management Plan detailed in section 0 must be used to inform management actions. However, specific important management actions are briefly discussed below:

- The infrastructure plan must be reviewed and the footprint kept as small as possible and all wetlands must be avoided as far as possible;
- The edge of the wetlands and at least a 100 m buffer must be clearly demarcated in the field that will last for the duration of the construction phase;
- Wetland monitoring must be carried out during the construction phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible; and
- In addition, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of the ecological wetland resources affected by the proposed project:
  - Aquatic Ecology Report (Digby Wells, 2016);
  - Fauna and Flora Report (Digby Wells, 2016)
  - Groundwater Assessment Report (Digby Wells, 2016);
  - Rehabilitation Plan (Digby Wells, 2016); and
  - Surface Water Report (Digby Wells, 2016).

Where the impacts of a development cannot be avoided, reduced or mitigated, a wetland offset strategy is considered as a last resort.

11.2.5 Impact Ratings

The tables below summarise the results of the quantitative impact assessment with pre and post mitigation values. These cover the impacts listed in Table 11-2.

Table 11-3: Potential Impacts of Construction Phase Interaction 1 on Wetlands: Site Clearance Activities

Dimension	Rating	Motivation	Significance
Activity and Interaction 1: Site Clearance within wetlands and their buffer areas			
Impact Description: Loss of wetland soil and vegetation with degradation to ecological integrity and functioning. This includes a total of 18.7 ha of wetland habitat.			
Prior to Mitigation/Management			
Duration	Permanent (7)	The removal of sensitive wetland soils and intact vegetation will be a near permanent change as integrity can be lost if the minimum mitigation	-105 Moderate

Dimension	Rating	Motivation	Significance
		measures are not followed.	
Extent	Local (3)	Only small localised areas of wetland are impacted by this. 18.7 ha of total 2830.2 ha of wetlands (0.7%).	
Intensity	Serious loss of highly sensitive environment (5)	Wetlands are identified as being NFEPA wetlands or part of. Wetlands are sensitive natural ecosystems. Wetlands in the area are under a greater amount of stress leading to the remaining natural wetlands being even more important and sensitive to impacts that threaten their ecological integrity.	
Probability	Definite (7)	According to the given infrastructure layout this impact will occur.	
Nature	Negative		
Mitigation/Management Actions			
- Mitigation measures already employed by Umcebo to avoid wetlands during the scoping phase of the project include: - Relocation of Mooivley East surface infrastructure out of the small seep leading to the small pan and its 100m buffer. This relocation north-west however is now within the seep wetlands leading to the larger natural pan. Refer to Plan 18 - Relocation of the Hendrina South surface infrastructure to the western end of the project area to avoid crossing of a second stream. However, this infrastructure is still placed within seep wetlands and the conveyor is crossing the stream to Mooivley West. This was an avoidance measure that decreased the impact from surface infrastructure on the wetlands. Refer to Plan 20. - Further to this, the infrastructure should be relocated outside of the wetland areas and buffers. - With respect to Mooivley East infrastructure that is now within the seep wetlands draining into the large natural pan; redesign infrastructure placement so that all wetlands (and the 100m buffer) are avoided. - The edge of the wetlands and at least a 100m buffer must be clearly demarcated in the field that will last for the duration of the construction phase. A 100 m buffer from the edge of the wetland is recommended. - Wetland monitoring must be carried out during the construction phase by a wetland specialist to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible. Refer to Section 14.3.			
Post-Mitigation			
Duration	Project Life (5)	With no direct impacts to wetlands, the impact will last as long as the construction phase.	-66 Minor

Dimension	Rating	Motivation	Significance
Extent	Limited (2)	The local area will be impacted by the construction of all infrastructures.	
Intensity	Serious loss of sensitive environment (4)	The construction of the industrial infrastructure in close proximity to wetlands and their buffers will have some damaging impacts to natural functioning wetland ecosystems.	
Probability	Highly probable (6)	The construction of the industrial infrastructure adjacent to wetlands will have an impact	
Nature	Negative		

Table 11-4: Potential Impacts of Construction Phase Interaction 2 on Wetlands: General Construction Activities

Dimension	Rating	Motivation	Significance
Activity and Interaction 2: Construction of general infrastructure within wetlands and their buffer areas			
Impact Description: Industrial activity within a natural ecosystem is a negative impact to habitat integrity. This is realised through habitat fragmentation, spreading of alien and invasive species, increased incidence of erosion, potential water quality deterioration and disturbance to avifanua and other fauna utilising the wetlands.			
Prior to Mitigation/Management			
Duration	Project Life (5)	The impacts caused during the construction will have a long lasting effect if not mitigated. Impacts must be managed proactively.	-70 Minor
Extent	Municipal (4)	The impact could spread beyond the local development boundaries due to the ability of degraded water quality or alien invasive species to travel significant distances; especially downstream. Habitat fragmentation is also a municipal scale impact.	
Intensity	Serious damage to or loss of sensitive environments (5)	These impacts are serious threats to sensitive habitats such as wetlands; especially in an area with high level of cumulative habitat loss and water quality deterioration.	
Probability	Likely (5)	These impacts are common of mining and industrial construction sites and project and thus have at least a 65% chance of occurring with some small mitigation measures assumed.	

Dimension	Rating	Motivation	Significance
Nature	Negative		
Mitigation/Management Actions			
- The infrastructure plan must be reviewed and the footprint kept as small as possible and wetlands must be avoided as far as possible; i.e. move all infrastructures out of wetlands and the 100m buffer; particularly with respect to Mooivley East infrastructure that is within the seep wetlands draining into the natural pan. - The edge of the wetlands and at least a 100 m buffer must be clearly demarcated in the field that will last for the duration of the construction phase. A 100 m buffer from the edge of the wetland is recommended. - Refer to the Surface Water Report (Digby Wells, 2016) for details on a Storm Water Management Plan that is to be carried out. This must be in operation during the construction phase and wetlands must be highlighted as sensitive receptors. - Refer to the Fauna and Flora Report (Digby Wells, 2016) for mitigation measures relating to habitat impacts as well as faunal species disturbances. For example, minimal bright lights should be left on at night time and they should be facing outwards of the site; and an alien and invasive plant species management programme must be in place from the construction phase. - Wetland monitoring must be carried out during the construction phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible.			
Post-Mitigation			
Duration	Medium term (3)	The potential impacts caused during the construction will remain a threat throughout the project life but the managed impact will have a medium term impact in the ecosystem.	-32 Negligible
Extent	Local area (3)	Managing and mitigation measures will prevent the impacts from spreading beyond the local development site.	
Intensity	Minor (2)	With fully functional management, monitoring and mitigation plans, the impact to the ecosystem functioning will be minimal.	
Probability	Probable (4)	Despite all intentions to prevent impacts, it is probable that impacts will still be realised due to the nature of the activity and the proximity to sensitive wetland receptors. These impacts must be managed accordingly.	
Nature	Negative		

Table 11-5: Potential Impacts of Construction Phase Interaction 3 on Wetlands: Construction of Conveyor

Dimension	Rating	Motivation	Significance
Activity and Interaction 2: Construction of Overland Conveyor across and NFEPA channelled valley bottom wetland			
Impact Description: Activities with the wetland channel and the surrounds will impact negatively upon sensitive wetland soils as well as the vegetation. This will lead to direct disturbance of fauna during construction and could also lead to the spreading of alien and invasive species and increased incidence of erosion.			
Prior to Mitigation/Management			
Duration	Project Life (5)	The impacts caused during the construction could have a long lasting effect if not mitigated and designed with proactive management.	-84 Moderate
Extent	Municipal (4)	The impact could spread downstream beyond the local development boundaries. It is important to note the ability of polluted water or alien invasive species to travel significant distances. Water pollution and habitat fragmentation is a municipal scale impact.	
Intensity	Serious damage to or loss of sensitive environments (5)	These impacts are serious threats to sensitive habitats such as wetlands; especially in an area with high level of cumulative habitat loss and water quality deterioration.	
Probability	Almost Certain (6)	These impacts are very common with industrial stream crossings and thus have an 80% chance of occurring with some small mitigation measures assumed.	
Nature	Negative		
Mitigation/Management Actions			
▪ The edge of the wetlands and at least a 100 m buffer must be clearly demarcated in the field that will last for the duration of the construction phase. This area must receive particular attention and a careful construction approach to minimize all impacts. ▪ Wetland monitoring must be carried out to ensure no unnecessary impact to wetlands is realised. If an impact is realised and recorded during monitoring, a remedial action must put in place as soon as possible and reported upon. ▪ Refer to the Surface Water Report (Digby Wells, 2016) for details on a Storm Water Management Plan that is to be carried out. This must be in operation during construction phase and wetlands must be highlighted as sensitive receptors. ▪ Refer to the Fauna and Flora Report (Digby Wells, 2016) for mitigation measures relating to			

Dimension	Rating	Motivation	Significance
habitat impacts as well as faunal species disturbances. For example, an alien and invasive plant species management programme must be in place from the construction phase. ▪ Construction must be done in the dry season as far as practical possible. ▪ The conveyor should be placed on plinths above the ground so as to allow movement safely underneath for faunal species utilising the wetland and to prevent hydrological alterations to the stream channel. ▪ The conveyor must be designed to catch any coal fallout from the conveyor belt to prevent pollution of the stream and should be covered where it crosses the stream. ▪ Rehabilitation of the conveyor system must be carried out, monitored and reported upon. ▪ A WUL will be required and all mitigation measures stipulated therein must be carried out.			
Post-Mitigation			
Duration	Long term (4)	The impact will still have long term presence but it could be reversed with rehabilitation and management interventions.	-50 Minor
Extent	Limited (2)	Impact will now be limited to the immediate conveyor footprint	
Intensity	Serious damage or loss of sensitive environment (4)	Some small areas within the conveyor footprint or servitude will still be damaged or lost but these will be minor.	
Probability	Likely (5)	The residual impacts to the stream crossings are still likely to occur and thus have at least a 65% chance of occurring.	
Nature	Negative		

11.3 Operational Phase Impacts

11.3.1 Project Activities Assessed

The operational phase activities that will have an impact on the wetlands are summarised below.

Table 11-6: Operational Phase Interactions with Wetlands

Interaction		Impact
1	Underground Blasting and Mining	Undermining of wetlands leading to hydrological and geomorphic changes to the functioning of the ecosystem; particularly related to groundwater impacts.

Interaction		Impact
2	Hauling, Conveying and Stockpiling of Coal	The movement of coal over the channelled valley bottom that is highlighted as an NFEPA wetland and is a tributary to the Klein Olifants has a significant threat to water quality and coal fines that will be transported from the conveyor into the surrounding environment. Stockpiling of coal represents a pollution source into the surrounding natural environment.

11.3.2 Impact Description

Mining of coal within and around wetland ecosystems represents significant negative impacts to these ecosystems that function from a combination of surface and groundwater inputs. The undermining will occur from a depth of 32 m in some areas to deeper than 100 m in the deeper sections. The resource is at the shallow closer to the Klein Olifants River and associated Channelled Valley Bottom systems according to the Geological Report (Figure 11-1; Shanduka Coal, 2012), The shallower mining activities will have greater negative impacts as this has a stronger link to the wetland systems and the surface is at great risker from surface destabilisation, leading to subsidence if mitigation measures are not carried out. Groundwater is a significant water source in the area and this is seen in the extensive hillslope seep wetlands.

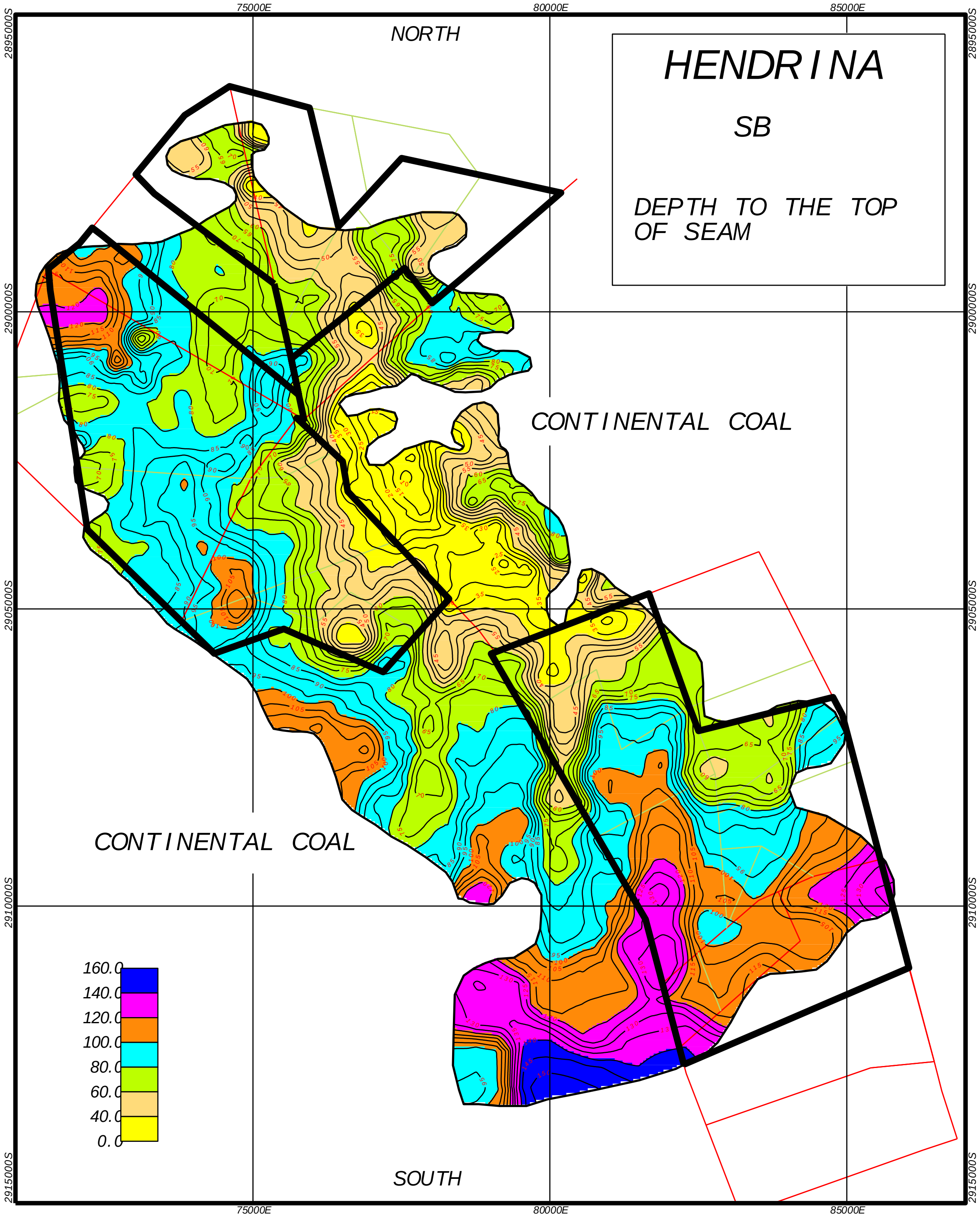


Figure 11-1: Depth to top coal seam from surface (Shanduka Coal, 2012)

The handling and storage of the coal will have some impacts to the wetlands. This is particularly with respect to the conveyor that crosses the NFEPA channelled valley bottom wetland as movement of coal through the environment will likely result in deposition of some coal fines that will negatively impact the water quality. Furthermore, the maintenance of this conveyor will require activities within the wetlands to continue through operational phase. Stockpiling of the coal may also negatively impact the surrounding environment and the risk of seepage must be managed (refer to Section 13).

11.3.3 Management Objectives

To prevent/minimise the loss of or further damage to natural wetland ecosystems and their buffer areas. This is important as the naturally occurring habitat and ecosystems play a major role in supporting a range of ecological processes and biodiversity in the region.

11.3.4 Management Actions and Targets

The Wetland Management Plan detailed in Section 0 must be used to inform management actions. However, specific important management actions for the operational phase of the proposed project are briefly discussed below:

- A comprehensive geotechnical investigation should be undertaken for the following:
  - Provide appropriate design parameters for pillar and overburden stability, in line with the actual geotechnical rockmass properties,
  - Indicate any areas (undermining of the wetlands) that may fall outside of these design parameters, and
  - Following the geotechnical investigation, where required a provision must be made for the rehabilitation of these areas in the event of a possible risk of subsidence / intersection collapse.
- The impacted footprint kept as small as possible and thus areas outside of the designated surface infrastructure areas must be regarded as no go; especially with respect to all wetlands, which must be avoided;
- The edge of the wetlands and a 100 m buffer must be demarcated where they are in close proximity to the infrastructure areas and at risk of being impacted from undesirable activities.
- Wetland monitoring must be carried out to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible;
- In addition, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of the ecological wetland resources affected by the proposed project:
  - Aquatic Ecology Report (Digby Wells, 2016);

- Fauna and Flora Report (Digby Wells, 2016)
- Groundwater Assessment Report (Digby Wells, 2016);
- Rehabilitation Plan (Digby Wells, 2016); and
- Surface Water Report (Digby Wells, 2016).

11.3.5 Impact Ratings

Table 11-7: Potential Impacts of Operational Phase Interaction 1 on Wetlands: Underground Mining

Dimension	Rating	Motivation	Significance
Activity and Interaction 1: Underground Blasting and Mining			
Impact Description: Undermining of wetlands leading to hydrological and geomorphic changes to the functioning of the ecosystem; particularly related to groundwater impacts. Depth of mine ranges above 40m.			
Prior to Mitigation/Management			
Duration	Permanent (7)	Undermining of sensitive wetlands may have an irreversible impact to the functioning of these ecosystems. The mining will also be a permanent change to the wetland setting and groundwater functioning as mine dewatering will result in the lowering of the water table; estimated at 1m (Groundwater Report, Digby Wells, 2016). This is particularly the case for the top seam (seam SB) and where shallower coal resources are found. Most of the seam is above 100m and much of the top seam is above 60m (Figure 11-1).	-90 Moderate
Extent	Limited (2)	The Klein Olifants River and the associated wetlands are within an important catchment and further impacts to this area may have municipal level significance. Total area at risk is147.54ha	
Intensity	Irreplaceable loss of highly sensitive environments (6)	These rivers and wetlands are important for the ecological services they provide to society; particularly due to the high level of cumulative loss of wetland functioning in the area. Undermining of these wetlands may lead to the loss of some of these areas and this is seen as an irreplaceable loss of these highly sensitive systems.	

Dimension	Rating	Motivation	Significance
Probability	Highly Probable (6)	If the possibility of subsidence is reduced to a negligible risk through the use of appropriate safety factors, the probability is considerably reduced.	
Nature	Negative		
Mitigation/Management Actions			
▪ Avoid all undermining of channelled valley bottom wetlands and the Klein Olifants River; especially if shallower than 100m below ground – see areas deemed as no-go according to the sensitivity analysis: Section 10. ▪ The highest safety factor must possible must be used for areas of shallow mining (35 to 100m at least) and high safety factors must also be used where undermining of hillslope wetlands is realised. ▪ Underground dykes and sills must be carefully managed as this can lead to dewatering of wetlands if undesired aquifers are punctured.			
Post-Mitigation			
Duration	Permanent (7)	Although mitigation measures may lessen the impact somewhat, the mining will be a permanent change to the wetland setting and groundwater functioning.	-42 Minor
Extent	Local (3)	The impacts may be managed to be contained within the development area and not to have negative impacts of a municipal scale.	
Intensity	Serious damage to sensitive environments (4)	Even with mitigation, the residual impact will still have serious damaging effects on the natural functioning of the sensitive wetland ecosystems.	
Probability	Unlikely (3)	Undermining of these wetlands is very likely to lead to the impacts described.	
Nature	Negative		

Table 11-8: Potential Impacts of Operational Phase Interaction 2 on Wetlands: Coal Handling, Transport and Stockpiling

Dimension	Rating	Motivation	Significance
Activity and Interaction 2: Hauling, Conveying and Stockpiling of Coal			
Impact 1 Description: The movement of coal over the channelled valley bottom that is highlighted as an NFEPA wetland (and is a tributary to the Klein Olifants River) will negatively impact water quality as coal fines that will very likely be transported from the conveyor into the surrounding environment. Negative impacts from maintenance of the conveyor servitude may also be incurred.			
Prior to Mitigation/Management			
Duration	Beyond Project Life (6)	Carbonaceous material will cause pollution of the water that may reside for a time longer than the operation of the conveyor. Additionally, if erosion occurs from the increased vehicular activity around this area, the impact will last longer the operation of the conveyor.	
Extent	Municipal (4)	The Klein Olifants River and the associated wetlands are within an important catchment and further impacts to this area may have municipal level significance.	-84 Moderate
Intensity	Serious damage to sensitive environments (4)	These wetlands are sensitive receptors and this represents a moderate impact to the ecological functioning.	
Probability	Highly Probable (6)	Transporting coal on the conveyor across the wetlands is very likely to lead to the impacts described.	
Nature	Negative		
Mitigation/Management Actions			
▪ The conveyor must be designed in such a way so as to minimise the windblown coal fines and any potential coal fallout and should be covered. If possible, the conveyor is to be fully closed over the wetlands and within the 100m buffer area. ▪ The conveyor servitude must also have a well-designed stream crossing and this should be maintained. The wetlands outside of this must be demarcated as no-go areas. ▪ The conveyor must be monitored and maintained to best operating standards and per the design criteria that capture mitigation measures. This should be done in the dry season. ▪ The wetland must be monitored on a regular basis to ensure no residual impact to the wetland and river is realised; and if so that remediation measures are followed. It is recommended that at least 100m on either side fo the conveyor is assessed for any sign of ecological decline and pollution such as coal fine deposition and runoff, die back of vegetation, increased erosion and more.			

Dimension	Rating	Motivation	Significance
Post-Mitigation			
Duration	Project Life (5)	The conveyor and the potential impacts will be present for the operational life of the project.	-40 Minor
Extent	Limited (2)	The mitigation measures can ensure any impacts will be limited to the site and its immediate surroundings.	
Intensity	Moderate damage to sensitive environments (3)	These wetlands are sensitive receptors and the activities associated with the conveyor will still represent a moderate impact to the ecological functioning.	
Probability	Probable (4)	Transporting coal on the conveyor across the wetlands is still likely to lead to the impacts described.	
Nature	Negative		

11.4 Closure and Rehabilitation Phase

11.4.1 Project Activities Assessed

Table 11-9: Rehabilitation Phase Interactions with Wetlands

Interaction		Impact
1	Removal of infrastructure and surface rehabilitation.	Similarly to the construction phase, the removal of the infrastructure will lead to potential negative impacts on the integrity of the natural wetland systems.
2	Underground mine closure and rehabilitation	Post-mining decant of groundwater will have negative impacts on the wetlands as this water is likely to be of a poor water quality.

11.4.2 Impact Description

This phase will require the removal of the infrastructure and the rehabilitation of the site to an acceptable and sustainable landscape that will be non-polluting in perpetuity. Similarly to the construction phase, this will require large scale activities within and around the wetland of the site and may have negative impacts if not managed. It is particularly important to remediate highly polluted sites such as the PCD, screening and crushing plant and product stockpile areas.

The post-mining landscape will have groundwater impacts due to decant being realised at some point as the mine voids fill up naturally with water once dewatering stops. Given the altered underground conditions, the water quality is likely compromised and even acid mine drainage (AMD) is likely. This represents one of the largest negative impacts to the wetlands and water resources of the local area and catchment.

11.4.3 Management Objectives

Wetlands are especially sensitive ecological systems that provide important good and services to the benefit of society. The objectives of management actions are to prevent/minimise the loss of or further damage to natural wetland ecosystems and their buffer areas. This is important as the naturally occurring habitat and ecosystems play a major role in supporting a range of ecological processes and biodiversity in the region. The rehabilitation phase is important for managing and remediating negative impacts.

11.4.4 Management Actions and Targets

The Wetland Management Plan detailed in Section 0 must be used to inform management actions. However, specific important management actions are briefly discussed below:

- The edge of the wetlands and a 100 m buffer must be clearly demarcated in the field that will last for the duration of the decommissioning and rehabilitation phase. The rehabilitation footprint kept as small as possible and all non-impacted wetlands must be avoided;
- Wetland monitoring must be carried out during rehabilitation to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible;
- In addition, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of the ecological wetland resources affected by the proposed project:
  - Aquatic Ecology Report (Digby Wells, 2016);
  - Fauna and Flora Report (Digby Wells, 2016)
  - Groundwater Assessment Report (Digby Wells, 2016);
  - Rehabilitation Plan (Digby Wells, 2016); and
  - Surface Water Report (Digby Wells, 2016e).

11.4.5 Impact Ratings

Table 11-10: Potential Impacts of Rehabilitation Phase Interaction 1 on Wetlands: Removal of infrastructure and surface rehabilitation

Dimension	Rating	Motivation	Significance
Activity and Interaction 1: Removal of infrastructure and surface rehabilitation.			
Impact Description: Similarly to the construction phase, the removal of the infrastructure will lead to potential negative impacts on the integrity of the natural wetland systems.			
Prior to Mitigation/Management			
Duration	Long term (4)	The impacts caused during the rehabilitation activities will have a long lasting effect if not mitigated.	-65 Minor
Extent	Municipal (4)	The impact could spread beyond the local development boundaries due to the ability of degraded water quality or alien invasive species to travel significant distances; especially downstream.	
Intensity	Serious damage to or loss of sensitive environments (5)	These impacts are serious threats to sensitive habitats such as wetlands; especially in an area with high level of cumulative habitat loss and water quality deterioration.	
Probability	Likely (5)	These impacts are common of mining and industrial construction sites and project and thus have at least a 65% chance of occurring with some small mitigation measures assumed.	
Nature	Negative		
Mitigation/Management Actions			
▪ The edge of the wetlands and at least a 100 m buffer must be clearly demarcated in the field that will last for the duration of the rehabilitation phase. ▪ The rehabilitation footprint kept as small as possible and non-impacted wetlands must be avoided. ▪ Careful attention must be given to handling wetland soils, if any. ▪ Wetland monitoring must be carried out during the rehabilitation phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible.			
Post-Mitigation			
Duration	Medium term (3)	Impacts will last as long as rehabilitation activities are ongoing.	-36 Minor

Dimension	Rating	Motivation	Significance
Extent	Local (3)	Mitigation will allow impacts to be within the local site.	
Intensity	Moderate damage to sensitive environments (3)	Rehabilitation activities may still have a moderate effect on the wetlands on the project area. These wetlands are sensitive environments and must be managed with caution.	
Probability	Probable (4)	Negative impacts to the wetlands during rehabilitation could occur given the nature of the task.	
Nature	Negative		

Table 11-11: Potential Impacts of Rehabilitation Phase Interaction 2 on Wetlands: Underground mine closure and rehabilitation

Dimension	Rating	Motivation	Significance
Activity and Interaction 2: Underground mine closure and rehabilitation			
Impact 1 Description: Post-mining decant of groundwater will have negative impacts on the wetlands as this water is likely to be of a poor water quality.			
Prior to Mitigation/Management			
Duration	Permanent (7)	Decant of polluted underground water into the catchment will have negative impacts beyond the project life and will be irreversible if no managed or mitigated against.	-114 Major
Extent	Regional (5)	The Klein Olifants River and the associated wetlands are within an important catchment and impacts to this area will have a regional level significance.	
Intensity	Irreplaceable damage to highly sensitive environments (7)	These wetlands are sensitive receptors and this represents serious impacts to these systems that could lead to irreplaceable damage to and loss of ecological functioning.	
Probability	Highly Probable (6)	It is very likely to lead to the impacts described.	
Nature	Negative		
Mitigation/Management Actions			

Dimension	Rating	Motivation	Significance
▪ Groundwater and wetlands must be monitored post-mining for potential decant. ▪ Long-term water treatment options will need to be investigated by Umcebo to prevent polluted decant water from entering the catchment.			
Post-Mitigation			
Duration	Permanent (7)	It is likely that the issue of polluted underground water will be a permanent catchment impact to manage.	-90 Moderate
Extent	Local (3)	If adequate water treatment is carried out before discharge then the impact can be managed at the local site.	
Intensity	Serious damage to highly sensitive environments (5)	These wetlands are sensitive receptors and altered water quality represents serious impacts to these systems that must be managed.	
Probability	Highly Probable (6)	It is very likely to lead to the impacts described.	
Nature	Negative		

12 Cumulative Impacts

Some of the major contributing factors to the decline of wetlands in South Africa include mining, industrial and agricultural activities as well as poor treatment of waste water from industry and mining (Oberholster *et al.*, 2011). Coal mining causes destruction of wetlands via direct impacts such as removal of habitat, alteration of flow and contamination of water, but also indirectly through the drawdown of groundwater resources during the dewatering process (van Der Walt, 2011).

Dewatering has cumulative impacts on wetlands, which are complex, interlinked systems in the Highveld. Underground mining, particularly in Mpumalanga due to bord and pillar methods, has frequently resulted in unplanned surface collapse (Ochieng *et al.* 2010). This collapse has been the cause of ground and surface water contamination due to acidification and salinisation of nearby aquifers. Blodget and Kuipers (2002) elaborates that subsidence can cause fissures or pits which may result in loss of large volumes of ground or surface water if connected to the stream network. This is specifically applicable to the shallow coal mining proposed in places (32 m). The proposed project is likely to continue to contribute to these cumulative impacts to wetland resources in the Mpumalanga Province region.

13 Unplanned Events and Low Risks

The planned activities will have known impacts as discussed above; however, unplanned events may happen on any project that may have potential impacts which will need mitigation and management. Table 13-1 below is a summary of the findings from a wetlands perspective. Please note not all potential unplanned events may be captured herein and this must therefore be managed by Umcebo throughout all phases.

Table 13-1: Unplanned Events, Low Risks and their Management Measures

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbon Spill into wetland habitat	Contamination of wetland soil and water resources associated with the wetland.	A spill response kit must be available at all times. The incident must be reported on and if necessary a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations. Areas of high risk must be managed with particular care and impact must be kept to the smallest area possible; for example areas where planned inspection of vehicles is carried out.
Uncontrolled erosion	Sedimentation of wetland ecosystems leading to compromised functionality.	Erosion control measures must be put in place and if necessary a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
PCD overflow	The water resources of the catchment are stressed and any pollution will negatively impact the functioning of the wetlands and rivers. This could negatively impact fauna and flora that are found within the wetlands.	Spill protection berms must be in place to manage such an event and protect the water resources. The overflow must be stopped as soon as possible and the impacted area remediated. If necessary a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations. Monitoring of the impact to wetlands and success of the remediation actions must be carried as often as needed.
Airborne coal dust settling in wetlands	Carbonaceous material will cause pollution of the wetlands as well as potential sedimentation. This will compromise the ecosystem functioning of the wetland.	Wetland monitoring must be done throughout the life of the project to ensure that this impact is not reaching a critical level. All areas of coal handling and stockpiling must be seen as high risk areas and monitored. Dust suppression will need to be improved and the wetland rehabilitated as far as possible. If necessary a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Illegal activities within wetlands from staff or other parties; such as dumping, squatting; burning of rubbish; washing of clothes and more.	Wetlands are sensitive ecosystems and undesirable human activity within these wetlands may cause significant negative impacts to their functioning. These impacts may interrupt the biodiversity related to the wetland or result in pollution of the water in the wetland.	The edge of the wetlands and a 100 m buffer must be demarcated where they are in close proximity to the infrastructure areas and at risk of being impacted from illegal activities. This is imperative for the natural pans near to the infrastructure on Mooivley East MRA. The impact must be identified, investigated and removed as soon as possible. Mine staff must be educated if they identified as the source of the impact. Wetland monitoring must be done throughout the life of the project to ensure that this impact is not reaching a critical level. If necessary a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Failure in the functioning of the clean-dirty water separation and storm water management plan leading to uncontrolled spilling of polluted material (including oils, coal fines etc.) from the infrastructure areas (sucas the coal stockpiles) .	The water resources of the catchment are stressed and any pollution will negatively impact the functioning of the wetlands and rivers. This could negatively impact fauna and flora that are found within the wetlands.	The spilling of the contaminant must be stopped immediately and the impacted area remediated. Spill protection berms must be in place as well. If necessary a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Subsidence of undermined areas, particularly where coal resource was shallow (above 100	This will have a major negative impact to the wetland such as altered hydrological functioning, compromised geomorphic structure and potential loss of the ecosystem.	A wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.

14 Environmental Management Plan

The objective of an Environmental Management Plan (EMP) is to present mitigation measures that (a) manage undue or reasonably avoidable adverse impacts associated with the development and (b) to enhance potential positives.

14.1 Project Activities with Potentially Significant Impacts

The following is a summary of the identified significant impacts to wetlands that will require mitigation measures for the project to go ahead.

Table 14-1: Potentially Significant Project Impacts

Activity		Impact
Construction Phase		
1	Site Clearance within wetlands and their buffer areas	Removal of wetland soils and vegetation; totalling 18.7 ha.
2	Construction of general infrastructure within wetlands and their buffer areas	Industrial activity within a natural ecosystem is a negative impact to habitat integrity.
3	Construction of Overland Conveyor across and NFEPA channelled valley bottom wetland	Heavy machinery working with wetland channel and surrounds impacting upon soil, vegetation disturbing fauna.
Operational Phase		
1	Underground Blasting and Mining	Undermining of wetlands leading to hydrological and geomorphic changes to the functioning of the ecosystem; particularly related to groundwater impacts.
2	Hauling, Conveying and Stockpiling of Coal	The movement of coal over the channelled valley bottom that is highlighted as an NFEPA wetland and is a tributary to the Klein Olifants has a significant threat to water quality and coal fines that will be transported from the conveyor into the surrounding environment.
Rehabilitation Phase		
1	Removal of infrastructure and surface rehabilitation.	Similarly to the construction phase, the removal of the infrastructure will lead to potential negative impacts on the integrity of the natural wetland systems.
2	Underground mine closure and rehabilitation	Post-mining decant of groundwater will have negative impacts on the wetlands as this water is likely to be of a poor water quality.

14.2 Summary of Mitigation and Management

Table 14-2 provide a summary of the proposed project activities, environmental aspects and impacts on the receiving environment. Information on the frequency of mitigation, relevant legal requirements, recommended management plans, timing of implementation, and roles / responsibilities of persons implementing the EMP. All of the mitigation measures have been previously listed in the impact assessment tables as well.

Table 14-2: Mitigation and Management Plan

Activities	Potential Impact	Size and scale of disturbance	Phase	Mitigation Type/Measures	Compliance with standards/Standard to be achieved	Time period for Implementation
Site Clearance within wetlands and their buffer areas	Removal of wetland soils and vegetation; totalling 18.7 ha.	18.7 ha.	Construction	▪ With respect to Mooivley East infrastructure that is now within the seep wetlands draining into the large natural pan; redesign infrastructure placement so that all wetlands (and the 100m buffer) are avoided. ▪ The edge of the wetlands and at least a 100 m buffer must be clearly demarcated in the field that will last for the duration of the construction phase. ▪ Wetland monitoring must be carried out during the construction phase by a wetland specialist to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible. Refer to Section 14.3. ▪ Where wetlands cannot be avoided, a wetland offset strategy should be implemented.	The NWA Section 21 (c), (g) and (i) of the NWA Section 24 of the Constitution NEM:BA NEMA Department of Water and Forestry (DWAF) guidelines for the delineation of wetlands (2005); Mining and Biodiversity Guideline (DEA *et al.*, 2013); MTPB, 2014);	Design and construction phase
Construction of general infrastructure within wetlands and their buffer areas	Industrial activity within a natural ecosystem is a negative impact to habitat integrity.		Construction	▪ The infrastructure plan must be reviewed and the footprint kept as small as possible and wetlands must be avoided as far as possible; i.e. move all infrastructures out of wetlands and the 100m buffer; particularly with respect to Mooivley East infrastructure that is within the seep wetlands draining into the natural pan. ▪ The edge of the wetlands and at least a 100m buffer must be clearly demarcated in the field that will last for the duration of the construction phase. ▪ Refer to the Surface Water Report (Digby Wells, 2016) for details on a Storm Water Management Plan that is to be carried out. This must be in operation during construction phase and wetlands must be highlighted as sensitive receptors. ▪ Refer to the Fauna and Flora Report (Digby Wells, 2016) for mitigation measures relating to habitat impacts as well as faunal species disturbances. For example, minimal bright lights should be left on at night time and they should be facing outwards of the site; and an alien and invasive plant species management programme must be in place from the construction phase. ▪ Wetland monitoring must be carried out during the construction phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible.		Design and construction phase

Activities	Potential Impact	Size and scale of disturbance	Phase	Mitigation Type/Measures	Compliance with standards/Standard to be achieved	Time period for Implementation
Construction of Overland Conveyor across and NFEPA channelled valley bottom wetland	Heavy machinery working with wetland channel and surrounds impacting upon soil, vegetation disturbing fauna.		Operational	▪ The edge of the wetlands and at least a 100m buffer must be clearly demarcated in the field that will last for the duration of the construction phase.. This area must receive particular attention and a careful construction approach to minimize all impacts. ▪ Wetland monitoring must be carried out to ensure no unnecessary impact to wetlands is realised and that contractors are following instructions. If an impact is realised and recorded during monitoring, a remedial action must put in place as soon as possible and reported upon. ▪ Refer to the Surface Water Report (Digby Wells, 2016) for details on a Storm Water Management Plan that is to be carried out. This must be in operation during construction phase and wetlands must be highlighted as sensitive receptors. ▪ Refer to the Fauna and Flora Report (Digby Wells, 2016) for mitigation measures relating to habitat impacts as well as faunal species disturbances. For example, an alien and invasive plant species management programme must be in place from the construction phase. ▪ Construction must be done in the dry season. ▪ The conveyor should be placed on plinths above the ground so as to allow movement safely underneath for faunal species utilising the wetland and to prevent hydrological alterations to the stream channel ▪ The conveyor must be covered to prevent coal fallout from the conveyor belt from polluting the stream. ▪ Rehabilitation of the foundations of the conveyor system must be carried out, monitored and reported upon. ▪ A WUL will be required and all mitigation measures stipulated therein must be carried out.		Design and construction phase
Underground Blasting and Mining	Undermining of wetlands leading to hydrological and geomorphic changes to the functioning of the ecosystem; particularly related to groundwater impacts.	900 ha	Operational	▪ Avoid all undermining of channelled valley bottom wetlands and the Klein Olifants River if possible – see areas deemed as no-go according to the sensitivity analysis: Section 10. ▪ The highest safety factor possible (towards a factor of 2) must be used for areas of shallow mining. This is mostly associated with the top seam where many wetlands are known to occur. The safety factors must be determined by the relevant engineers in a comprehensive geotechnical assessment. ▪ Underground dykes and sills must be carefully managed as this can lead to dewatering of wetlands if undesired aquifers are punctured.		Design and operational phase

Activities	Potential Impact	Size and scale of disturbance	Phase	Mitigation Type/Measures	Compliance with standards/Standard to be achieved	Time period for Implementation
Hauling, Conveying and Stockpiling of Coal	The movement of coal over the channelled valley bottom that is highlighted as an NFEPA wetland and is a tributary to the Klein Olifants has a significant threat to water quality and coal fines that will be transported from the conveyor into the surrounding environment. Stockpiling of coal also represents risks to the environment that much be managed.		Operational	▪ The conveyor must be designed in such a way so as to minimize the windblown coal fines and any potential coal fallout. ▪ The conveyor servitude must also have a well-designed stream crossing to allow maintenance vehicles to cross with minimal impact. The wetlands outside of this must be demarcated as no-go areas. ▪ The conveyor must be monitored and maintained to best operating standards. This should be done in the dry season. ▪ The wetland must be monitored on a regular basis to ensure no residual impact to the wetland and river is realised; and if so that remediation measures are followed. ▪ Runoff from areas of coal handling and stockpiling are to be managed according to the SWMP (Surface Water report; Digby Wells, 2016).		Design and operational phase
Removal of infrastructure and surface rehabilitation.	Similarly to the construction phase, the removal of the infrastructure will lead to potential negative impacts on the integrity of the natural wetland systems.		Rehabilitation	▪ The edge of the wetlands and at least a 100m buffer must be clearly demarcated in the field that will last for the duration of the rehabilitation phase. The rehabilitation footprint kept as small as possible and non-impacted wetlands must be avoided. ▪ Careful attention must be given to handling wetland soils, if any. ▪ Wetland monitoring must be carried out during the construction phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible.		Rehabilitation phase
Underground mine closure and rehabilitation	Post-mining decant of groundwater will have negative impacts on the wetlands as this water is likely to be of a poor water quality.		Rehabilitation	▪ Groundwater and wetlands must be monitored post-mining for potential decant. ▪ Long-term water treatment options will need to be investigated by Umcebo to prevent polluted decant water from entering the catchment.		

14.3 Monitoring Plan

Monitoring of the wetlands and mining activities is important to detect any predicted or unforeseen impacts to these sensitive systems and to understand the impact so that a remedial action can be carried out. Mining is an important activity for the economic growth of South Africa but has the potential to have impacts far beyond the boundaries of the project area and longer than the life of mine. It is important to manage impacts to the environment and protect the ecosystem services that it provides; and this is particularly important with regards to wetlands and water resources. The below table summarises the recommended monitoring plan for the project.

Table 14-3: Monitoring Plan

Activities	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time periods for implementing impact management actions
All activities	General - All impacts and threats to wetlands predicted or not.	Wetlands should be monitored through all phases of the project. The wetlands should be demarcated in the field that are at particular risk of impacts and these area must be monitored regularly. Signs of ecological impact must be assessed including deposition of coal fines, die back of vegetation, increased erosion, decreased water quality and other indicators identified by a wetland specialist. The natural wetlands of high and very high sensitivity should be monitored on a regular basis to detect if the mining activities are having any residual or unforeseen impact on the functioning of these important systems. The natural pans and the Klein Olifants channelled valley bottom wetland are the most important here. The functional aspects of the wetland should be assessed such as floral diversity, water quality, use of wetland by faunal species (notably Flamingos), erosion and more. Monitoring for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. must be done and remediated where needed.	The environmental officer of the mine should monitor the wetlands at all times as part of managing the site and the surrounding area. Independent wetland specialist should carry out monitoring on a regular basis during all phases of the mining project and provide recommended remedial actions where required.	Internal monitoring should be done as often as possible according to the management practices of the mine. Recommended timing is at least once a quarter. External independent wetland specialist monitoring should be done regularly and when needed, i.e. after an incident.
Site Clearance within wetlands and their buffer areas	Removal of wetland soils and vegetation; totalling 18.7 ha.	Wetland monitoring should: Ensure that the wetlands are demarcated in the field and that no impact is extended beyond the infrastructure area; monitor for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. and remediate; ensure proper handling and storage of wetland soils.		Construction activities should be monitored monthly by a wetland specialist.
Construction of general infrastructure within wetlands and their buffer areas	Industrial activity within a natural ecosystem is a negative impact to habitat integrity.			
Construction of Overland Conveyor across and NFEPA channelled valley bottom wetland	Heavy machinery working with wetland channel and surrounds impacting upon soil, vegetation disturbing fauna.	Monitoring of the construction over this channelled valley bottom must ensure that all activities are done according to the detailed design and are implemented with the least possible impacts to the wetlands. Monitoring for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. and remediate; ensure proper handling and storage of wetland soils. It is recommended that 100m on either side of the conveyor be demarcated and monitored.		
Underground Blasting and Mining	Undermining of wetlands leading to hydrological and geomorphic changes to the functioning of the ecosystem; particularly related to groundwater impacts.	As mining progresses, wetlands should be monitored for evidence of loss of functionality due to groundwater changes. Monitoring for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. must be done and remediated where needed.		Undermined wetlands should be monitored annually

Activities	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time periods for implementing impact management actions
Hauling, Conveying and Stockpiling of Coal	The movement of coal over the channelled valley bottom that is highlighted as an NFEPA wetland and is a tributary to the Klein Olifants has a significant threat to water quality and coal fines that will be transported from the conveyor into the surrounding environment. Stockpiling of coal also represents risks to the environment that much be managed.	Monitoring of the operation of the conveyor over a sensitive wetland is important to ensure all impacts are remediated as soon as possible; thus preventing and long term residual impacts to the system that compromises the ability of the wetland to function. Runoff from areas of coal handling and stockpiling are to be managed according to the SWMP (Surface Water report; Digby Wells, 2016).		The conveyor and stockpiles must be monitored internally with the maintenance regime. Specialist monitoring can be undertaken annually to ensure no residual impact is being experienced.
Removal of infrastructure and surface rehabilitation.	Similarly to the construction phase, the removal of the infrastructure will lead to potential negative impacts on the integrity of the natural wetland systems.	Wetland monitoring should: Ensure that the wetlands are demarcated in the field and that no impact is extended beyond the infrastructure area; monitor for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. and remediate; ensure proper handling and storage of wetland soils.		Rehabilitation activities should be monitored monthly by a wetland specialist.

15 Consultation Undertaken

No consultation has been undertaken for completion of the wetland study.

15.1 Comments and Responses

Results from the draft EIA comment period will be incorporated into the finalised report.

16 Conclusion and Recommendations

The project area is characterised by large areas of wetlands totalling 2,830.2 ha, which is 42 % of the MRA's. The proposed project will have significant negative impacts of the wetlands and these must be mitigated as far as possible. The most sensitive wetlands of the study area are the natural pans and the channelled valley bottom wetlands, including the Klein Olifants River. These wetlands have been designated as potential no-go areas and it is recommended that these highly sensitive wetlands are avoided by all mining activities. Where any wetlands are to be being undermined, it is recommended that the best possible safety factor is used (towards a factor of 2)where the mining is above 100m. This will need to be determined in later stages of the project design.

If the mining project is to go ahead, the mine will need to make provision for long term water quality impacts and remediation of this. This is particularly related to potential decant of acidic underground water post-mining. It can be concluded that the project will have a residual negative impact to the wetlands and their catchment areas. Umcebo will need to take this into consideration and manage the residual impact with adequate rehabilitation actions and if need be with an offsetting strategy to ensure not nett loss of wetland functionality is realised. The monitoring plans throughout the life of the mine must also inform Umcebo on the impacts to the wetlands and the remedial actions required.

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Appendix A: CV's of Specialists

DIGBY WELLS
ENVIRONMENTAL

Ms. Caroline Wallington

Wetland and Rehabilitation Consultant

Biophysical Department

Digby Wells Environmental

1 Education

- 2016 – 2017: currently doing part-time MSc Environmental Science (University of the Witwatersrand)
- 2012: BSc Honours in Botany (University of Cape Town, UCT)
- 2009 – 2011: BSc Ecology and Environmental & Geographical Sciences (UCT)
- 2003 – 2007: Parktown High School for Girls, Parkview, JHB, South Africa

1.1 Short Course Training

- Wetlands Management: Introduction and Delineation Short Course – Held in Pretoria, Gauteng; conducted through the University of the Free State, UFS (2013);
- Land Rehabilitation Society of Southern Africa (LaRSSA) pre-conference training workshops:
  - Rehabilitation Norms and Standards – conducted at the Second Annual LaRSSA Conference at Glenburn Lodge, Gauteng, on the 9th of September 2014;
  - Can Rehabilitation contribute significantly to Biodiversity Conservation - conducted at the Third Annual LaRSSA Conference at Glenburn Lodge, Gauteng, on the 8th September 2015
- Constructed Wetlands Masterclass – Held at the Hackle Brooke Conference Centre, Johannesburg, on the 19th & 20th of February 2015;
- French Beginners Module A – conducted through the Wits Language School from the 16th May to 18th July 2015;
- Wetland Rehabilitation Short Learning Program - conducted through the University of the Free State, UFS; held in Chrissiesmeer, Mpumalanga on 17th to 19th November 2015

2 Language Skills

- English – Primary Language

- Afrikaans – Intermediate Level
- French – Basic Level

3 Employment

- January 2015 – Present: Digby Wells Environmental – Wetland and Rehabilitation Consultant
- November 2013 – December 2014: Digby Wells Environmental – Junior Rehabilitation and Wetland Consultant
- July – October 2013: Digby Wells Environmental – Biophysical Intern
- March - May 2013: Wilderness Safaris, North Island, Seychelles – Assistant Environmental Officer
- June & July 2011: Digby Wells Environmental – Student Environmental Science Assistant
- February & March 2008: Anglo Coal South Africa – Student Environmental Assistant

4 Experience

Caroline is currently in the role of Wetland and Rehabilitation consultant in the Biophysical Department of the Johannesburg Offices of Digby Wells Environmental. She has been employed in this position since January 2015, following on from the junior position from November 2013. The majority of her projects are focussed around wetland ecology, with rehabilitation and floral assessments also forming part of her work. Project management and administration also forms a part of her job.

Caroline is competent in wetland assessment methodology and has experience in the Limpopo, Gauteng, Free State and Mpumalanga Provinces of South Africa as well as in African countries outside South Africa including Malawi and the Democratic Republic of Congo (DRC).

Information pertaining to the technical expertise of project involvement of Caroline include the following:

- Wetland Assessments;
  - Delineations;
  - WET-Management Series assessments;
  - Impact Assessments; and
  - Mitigation and Management Plans
- Biodiversity and Land Management Plans;
- Biodiversity Baseline Assessments for Flora;

- Rehabilitation Strategies;
- Environmental Impact Assessments and Environmental Management Plans

4.1 Project History

The following project list is indicative of Caroline's experience, providing insight into the various projects, roles and locations she has worked in.

Year	Client	Project	Role	Location
2015	Pamish Investments	Environmental Impact Assessment for the Magnetite Open Pit Project	Wetland Specialist	West Rand, Gauteng Province, South Africa
2015	Oakleaf Investment Holdings (Pty) Ltd	Environmental Impact Assessment for the Proposed Oakleaf Opencast Coal Mine	Wetland Specialist	Bronkhorstspruit, Gauteng, South Africa
2015	AECOM South Africa (Pty) Ltd	Eastern Basin AMD Short Term Intervention EIA	Wetland Specialist	Springs, South Africa
	Anglo Operations (Pty) Ltd	New Vaal Colliery Biodiversity Action Plan (BAP)	Technical Specialist and Project Manager	Free State, South Africa
	Anglo Operations (Pty) Ltd	Landau Colliery Rehabilitation Survey	Rehabilitation Specialist	Mpumalanga, South Africa
	Ergo Mining (Pty) Ltd	Soweto Cluster Mine Dumps Reclamation	Project Administrator	Soweto, South Africa
	Geo Soil & Water	Vlakvarkfontein Wetland Delineation	Wetland Specialist and Project Manager	Mpumalanga, South Africa
	Ledjadja Coal (Pty) Ltd	Boikarabelo Biodiversity and Land Management Plan (BLMP)	Specialist and Project Manager	Limpopo, South Africa
	Msobo Coal (Pty) Ltd	Consbrey and Harwar Environmental and Social Impact Assessment	Wetland Assistant	Mpumalanga, South Africa
	Corridor Crescent Investments (Pty) Ltd	Twfelaar Desktop Wetland Delineation	Wetland Specialist and Project Manager	Mpumalanga, South Africa
	Northern Coal (Pty) Ltd	Jaglust Wetland Assessment	Wetland Specialist and Project Manager	Mpumalanga, South Africa

Year	Client	Project	Role	Location
	Penumbra Mining (Pty) Ltd	Penumbra Wetland Monitoring	Wetland Specialist and Project Manager	Mpumalanga, South Africa
	Platreef Resources (Pty) Ltd	Platreef Environmental and Social Impact Assessment	Aquatics assistant	Limpopo, South Africa
	Randgold Resources (Pty) Ltd	Kibali ESIA and EMP update	Wetlands specialist	Kibali, DRC
	Resource Generation (Pty) Ltd	Wetland Delineation and Health Assessment	Wetland Specialist and Project Manager	Limpopo, South Africa
	Sappi South Africa (Pty) Ltd	Ngodwana Wetland Delineation and Health Assessment	Wetland Specialist and Project Manager	Mpumalanga, South Africa
	Sasol Mining (Pty) Ltd	Mooikraal Wetland Delineation and Health Assessment	Wetland Specialist and Project Manager	Free State, South Africa
	Sasol Mining (Pty) Ltd	Mooikraal 3km Pipeline Basic Assessment	Wetland Specialist, Fauna and Flora assistant and Project Manager	Free State, South Africa
	Sasol Mining (Pty) Ltd	Sasol Sigma 10ML Pipeline Basic Assessment	Project Manager	Free State, South Africa
	Vedanta	Vedanta IPP EIA	Rehabilitation Specialist	Limpopo, South Africa
	Anglo Operations (Pty) Ltd	Dalyshope Environmental and Social Impact Assessment	Rehabilitation Specialist	Limpopo, South Africa
	Boikarabelo Coal Mine, Resource Generation	Boikarabelo Wetland Assessment	Wetland Specialist	Limpopo, South Africa
	HCI Coal (Pty) Ltd	Palesa Coal Mine Rehabilitation Plan	Rehabilitation Specialist	Mpumalanga, South Africa
	HCI Coal (Pty) Ltd	Mbali Coal Mine Rehabilitation Plan	Rehabilitation Specialist	Mpumalanga, South Africa
	Eskom Holdings SOC	Eskom Kruispunt-Sublime Power	Wetland Specialist and	Mpumalanga,

Year	Client	Project	Role	Location
	Ltd	Line Wetland Assessment	Project Manager	South Africa
	Eskom Holdings SOC Ltd	Eskom Kudu-Dorstfontein Power Line Wetland Assessment	Wetland Specialist and Project Manager	Mpumalanga, South Africa
	Eskom Holdings SOC Ltd	Eskom Kudu-Dorstfontein Power Line WULA	Project Manager	Mpumalanga, South Africa
	Fountain Capital: Oakleaf Investment Holdings (Pty) Ltd	Oakleaf EIA and WULA	Wetland Specialist	Gauteng, South Africa
	Ixia Coal (Pty) Ltd	Ixia Imvula Environmental Authorisation	Wetland Specialist	Mpumalanga, South Africa

5 Professional Registration

None at this point.

6 Publications

None at this point.

Ms. Crystal Rowe

Flora and Wetlands Ecologist

Biophysical

Digby Wells Environmental

1 Education

- 2008-2010: BSc Botany and Geology (Nelson Mandela Metropolitan University- (NMMU))
- 2011 BSc Honours in Botany (NMMU)

1.1 Short Courses

- 2012: Tools for Wetland Assessment - Rhodes University
- 2015: Constructed Wetlands – Melrose Training

2 Language Skills

- English (1st language); and
- Afrikaans (2nd language).

3 Employment

- June 2013 – *Present*: Digby Wells Environmental – Flora & Fauna Ecologist
- November 2011- June 2013: Natural Scientific Services (NSS) – Junior Ecologist

4 Experience

Crystal has completed numerous flora and wetland ecology assessments throughout Africa, for the following assessments:

- Wetland delineations and Health Assessments
- Biodiversity Baseline Assessments for Flora and Fauna
- Impact Assessments
- Aquatic Flora Assessments

5 Project Experience

Crystal Rowe specialises in flora and wetland ecology. She achieved a BSc in Botany and Geology and a BSc Hons in Botany at Nelson Mandela Metropolitan University (NMMU). Key experience includes ecological impact assessments, baseline vegetation assessments, estuarine ecological state assessments and wetland health assessments. Project experience includes various countries such as: the DRC, Ethiopia, the Ivory Coast, Mali, Mozambique, Sierra Leone and extensively within South Africa. Crystal is competent in plant identification and is experienced in IFC compliant assessments. She is also certified to complete wetland Ecosystem Services and is a registered professional natural scientist in South Africa (reg. no.: 400090/15). Some of Crystal's project experience is listed below:

Year	Client	Project	Responsibility	Location
2012	ERM for London Mining	Marampa Mine Sierra Leone Barge Route	Mangrove and estuarine flora assessment	Sierra Leone
2012	ERM for Allana Potash	Allana Potash Mine ESIA	Flora Assessment, assistant fauna assessment	Danakil Depression, Ethiopia
2012	ERM for Anadarko Petroleum	Anadarko Petroleum offshore LNG project	Aquatic Baseline (involvement in floral component) Assessment	Northern Mozambique, Palma
2012	Sedibelo Platinium Mines (Pty) Ltd	Sedibelo West Platinum Mining Project	Flora Assessment (assistant)	North-west Province
2012	Eskom Holdings SOC Ltd	Lethabo Powerstation	Biodiversity Assessment	Free State Province
2012	Eskom Holdings SOC Ltd	Matimba Powerstation	Biodiversity Assessment	Free State Province
2013	Dube Tradepoort	Dube Tradeport Wetland Assessment	Wetland Assessment	Durban, KZN, South Africa
2013	Anglo Coal (Pty) Ltd	Kleinkopje Biodiversity Action Plan	Wetland and flora studies Compilation of Biodiversity Action Plan	Mpumalanga Province, South Africa
2014	Randgold Resources	GIS training for the BAP for Gounkoto and Loulo Gold	Biodiversity Action Plan	Mali

		Mines		
2014	Randgold Resources	Flora and Fauna Assessments for Kibali Gold Mine ESIA	Flora and wetland assessments	Orientale Province, Democratic Republic of Congo
2014	Randgold Resources	Biodiversity Action Plan for Tongon Gold Mine	Flora assessment	Ivory Coast
2014	Sasol Mining (Pty) Ltd	Sigma Ash Back-filling Project	Wetland Assessment	Free State Province, South Africa
2014	Sasol Mining (Pty) Ltd	Mooikraal flora, fauna and wetland assessment	Mooikraal flora, fauna and wetland assessment	Free State Province, South Africa
2014	Exxaro Coal (Pty) Ltd	Grootegeluk Wetland Offset Strategy	Wetland Offset Strategy	Limpopo Province, South Africa
2014	Anglo Operations	Dalyshope Environmental Impacts Assessment	Flora and Wetlands Assessment	Limpopo Province, South Africa
2015	Northern Coal	Jagtlust Wetland Offset Strategy	Wetland Offset Strategy	Carolina, Mpumalanga Province, South Africa
2015	Aureus Mining Inc.	New Liberty Constructed Wetland	Constructed wetland design	Liberia
2015	Universal Coal (Pty) Ltd	Roodekop Wetland Offset Strategy	Wetland Offset Strategy	Mpumalanga Province, South Africa
2015	Anglo Coal (Pty) Ltd	Goedehoop Mine Wetland Assessment	Wetland Assessment	Mpumalanga Province, South Africa
2015	Exxaro Coal (Pty) Ltd	Matla Brine Ponds and Water Treatment	Wetland Offset Strategy	Mpumalanga Province, South Africa

		Plant		
2015	Eskom Holdings Soc Ltd	Kriel Powerstation IWULA	Wetland Assessment	Mpumalanga Province, South Africa
2015/2016	Exxaro Coal (Pty) Ltd	Matla River Diversion biomonitoring	Wetland and flora monitoring	Mpumalanga Province, South Africa
2015	Exxaro Coal (Pty) Ltd	Schoornoord Coal Mine EIA	Wetland Assessment	Mpumalanga Province, South Africa
2016	Fountain Capital	Oakleaf Coal Mine EIA	Flora and Fauna Assessment Wetland Assessment	Gauteng Province, South Africa
2016	Natural Habitats	Makpele Palm Oil Plantation	Flora, wetland and High Conservation Value Assessment	Makpele Chiefdom, Sierra Leone
2016	Anglo Coal (Pty) Ltd	Isibonelo Wetland Offset Strategy	Wetland Offset Strategy	Mpumalanga Province, South Africa
2016	Randgold Resources	Loulo Gold Mine Constructed Wetland – *in process*	Design of constructed wetland to treat mine effluent	Mali
2016	Glencore	Hendrina Environmental Impact Assessment	Flora and wetland assessment	Mpumalanga Province, South Africa
2016	Sun City International	Sun City Wetland Assessment	Wetland Assessment	Northern Province, South Africa
2016	Harmony Gold	Harmony Gold Biodiversity Action Plan	Flora and wetland studies Compilation of Biodiversity Action Plan	
2016	International mining and infrastructure corporation PLC	Ntem Iron Ore Project	Review of specialist flora and fauna assessments	Cameroon (no site visits involved)

6 Professional Registration

- South African Council for Natural Scientific Professions: Professional Natural Scientist – Botanical Science. Registration number: 400090/15

7 Publications

Adams J.B., Grobler A., Rowe C., Riddin T. Bornman T.G. and Ayres D. 2012. Plant traits and spread of the invasive salt marsh grass, *Spartina alterniflora* Loisel., in the Great Brak Estuary, South Africa. African Journal of Marine Science. Volume 34, Issue 3: 312-322.