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Integrated Water Use Licence Application for the Proposed Underground Mining Expansion Project of the Exxaro Dorstfontein East Coal Mine Operations`

Integrated Water and Waste Management Plan

Prepared for:
Exxaro Central Coal (Pty) Ltd

Project Number:
EXX5725-2

February 2022

Digby Wells and Associates (South Africa) (Pty) Ltd
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This document has been prepared by Digby Wells Environmental.

Report Type:	Integrated Water and Waste Management Plan
Project Name:	Integrated Water Use Licence Application for the Proposed Underground Mining Expansion Project of the Exxaro Dorstfontein East Coal Mine Operations
Project Code:	EXX5725-2

Name	Responsibility	Signature	Date
Njabulo Mzilikazi	Report Writer	[signature]	January 2022
Kelly Tucker	Project Manager	[signature]	January 2022
Mia Smith	Project Sponsor and OpsCo Reviewer	[signature]	February 2022

EXECUTIVE SUMMARY

Introduction

Digby Wells Environmental (Digby Wells) was appointed by Exxaro Coal Central (Pty) Ltd (ECC) to prepare an Integrated Water Use Licence Application (IWULA) for the proposed Underground Mining Expansion Project of the Exxaro Dorstfontein East Coal Mine (DECM) (the Project) in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). In addition, Digby Wells completed a Scoping and Environmental Impact Assessment (S&EIR) process in terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R982 of 04 December 2014, as amended) (the EIA Regulations, 2014) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

This report constitutes the Integrated Water and Waste Management Plan (IWWMP) which will be submitted to the Department of Water and Sanitation (DWS) in support of the IWULA for the Project.

This report is being made available to Interested and Affected Persons (I&APs) for a 60-day public review and commenting period.

Project Background

The DECM operates its current activities under an existing Water Use Licence (WUL) (Licence No. 06/B11B/ACIJC/9138) issued on 4 September 2019. The existing water uses authorised under this licence are described below and should be consolidated into the new licence that will be issued, should the current IWULA be approved for the new water uses described below.

Project Applicant

The details of the applicant of the IWULA are in the table below.

Name of Applicant:	Dorstfontein East Mines (Pty) Ltd
Responsible Person:	Group Sustainability Manager
Contact Person:	Mr William Seabi
Physical Address:	Farm Welstand 55 Bethal 2271
Email:	Maropeng.Seabi@overlooked.co.za

Environmental Consultant

The details of the EAP are contained in the table below.

Company Name:	Digby Wells and Associates (South Africa) (Pty) Ltd

Name of Compiler:	Njabulo Mzilikazi
Physical address:	Turnberry Office Park, Digby Wells House , 48 Grosvenor Road, Bryanston
Telephone:	011 789 9595
Email:	njabulo.mzilikazi@digbywells.com

Water Uses Under Application

It is requested that existing and authorised water uses are included in a consolidated, new IWUL which includes the new water uses in the tables below, in accordance with the provisions of the NWA.

A summary of the water uses subject to this application is presented in the table below.

Section 21 Water Use	Water Use Description
21 (c) and (i) Impeding or diverting the flow of water in a watercourse and Altering the bed, banks, course or characteristics of a water course.	• Seam 2 and 4 underground mining sections within 500 m regulated area of wetlands.
	• Surface infrastructure within 500 m of regulated wetland areas.
21.(g): disposing of waste in a manner which may detrimentally impact on a water resource.	• Sewage Treatment Plant. • Water from the Sewage Treatment Plant which will be re-used in the mining operation.
	• Using water for dust suppression.
	• Erikson dam.
21 (j) Removing, discharging or disposing of water found underground if it necessary for the efficient continuation of an activity or for the safety of people .	• Dewatering from the S4L and S2L underground mine sections.

In addition, consolidate into the new licence, existing water uses as set out in the table below.

Water Use	Water Use Description
Section 21 (a): Taking water from a water resource.	Dewatering process associated with the continuation of mining activities in the Pit 1 extension will result in water that will be used in washing plant area.
	Make up water supply for mine service requirements and the coal washing plant requirements.
	For mining within a regulated area (Wetland).

<table>
<tr><th>Water Use</th><th>Water Use Description</th></tr>
<tr><td rowspan="2">Section 21 (c): Impeding or diverting the flow; and
Section 21 (i): Altering the bed, banks course or characteristics of a watercourse.</td><td>Diversion and altering on Olifants River for conveyor structure and rail loop.
Wetlands and Olifants River crossings for conveyor structure and rail loop.</td></tr>
<tr><td>Extension of DECM Pit 1 within 500 m of wetland.</td></tr>
<tr><td rowspan="11">Section 21 (g): Disposing of waste which may impact on a water resource.</td><td>Return Water Dam (disposal of water from underground workings and mining process).</td></tr>
<tr><td>Disposal of coal slurry and discarded material from the coal mining process.</td></tr>
<tr><td>Pollution control dam.</td></tr>
<tr><td>Erickson dam 1 (Transfer of waste water).</td></tr>
<tr><td>Erickson dam 2 (Transfer of waste water).</td></tr>
<tr><td>Erickson dam 3 (Transfer of waste water).</td></tr>
<tr><td>Tank number 4 (disposal of wastewater).</td></tr>
<tr><td>Dust Suppression.</td></tr>
<tr><td>DECM Stockpile (product stockpile).</td></tr>
<tr><td>DECM East Rail Loop Stockpile (product stockpile).</td></tr>
<tr style="display:none"></tr>
<tr><td rowspan="6">Section 21 (j): Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people.</td><td>Dewatering of pit 1 opencast.</td></tr>
<tr><td>Dewatering of pit 2 opencast.</td></tr>
<tr><td>Dewatering of pit 3 opencast.</td></tr>
<tr><td>Dewatering of Block A and B underground workings.</td></tr>
<tr><td>Dewatering of Block C underground commence after six years.</td></tr>
<tr><td>Dewatering process associated with the continuation of mining activities in the Pit 1 extension will result in water that will be used in washing plant area (taking water to re-use at the washing plant).</td></tr>
</table>

Purpose of this Report

This IWWMP serves to:

- Act as a supporting document with relevant technical information to inform decision-making on the IWULA;
- Provide a clear description of the Project activities and their associated water uses to be licenced;

- Provide a summary of the established biophysical and socio-economic conditions of the Project's footprint;
- Provide an assessment of any additional potential impacts with respect to waste and water related activities;
- Serve as a guide to water and waste related measures that must be structured and progressively implemented throughout the activities to address impacts on the receiving water environment; and
- Present a plan of how the management of water and waste will be undertaken in an integrated manner and provide monitoring plans to monitor the success of such management.

Baseline Environment

The DECM is situated near the town of Kriel within the Magisterial District of Bethal, under the jurisdiction of the Emalahleni Local Council, Mpumalanga Province. The current operation lies directly north-east of the town of Ga-Nala (Kriel).

The Project Area is situated within the Eastern Highveld Grassland which is classified as an endangered vegetation type (Mucina & Rutherford, 2012) due to extensive transformation within the province as a result of mining activities.

The DECM falls within a semi-arid climate region of Southern Africa, where rainfall is sparse with high seasonal variations during wet and dry seasons. The wet (or rainy) season occurs during summer months, October to March and is characterised by short, intense convective storms. Such high rainfall contributes to significant parts of recharge into the aquifers (Braune and Xu, 2005). Dry seasons occur during wintertime (April - September) and are characterised by dry cold weather conditions.

The DECM is located within the Olifants Water Management Area (WMA 2) and occurs asymmetrically within the upper catchments of quaternary catchment B11B and B11D as revised in the 2012 water management area boundary descriptions.

The higher-lying Klein Vaalkop forms the water divide between the B11D and B11B quaternary catchments. Surface water hydrology within the Project Area is mainly associated with the upper Olifants River and locates within B11B quaternary catchment in the east. Further south, directly opposite the eye of the western Olifants River tributary is a perennial pan.

The other part of DECM is mainly associated with the upper Steenkoolspruit River. Rainfall that occurs within the B11D catchment drains towards the unnamed tributary of the Spookspruit, which flows into a westerly direction towards the Steenkoolspruit.

The Project Area consists of a total of 547.6 hectares (ha) of wetland areas. Twenty-four Hydrogeomorphic (HGM) units were identified and categorised based on terrain units. These included a pan, Hillslope Seep Wetlands (Seeps), Unchannelled Valley Bottom wetlands (UVBs) and Channelled Valley Bottom wetlands (CVBs). The Present Ecological State (PES) of each HGM unit varied from 'Moderately Modified' to 'Largely Modified' (PES C to D). The dominant land use and impacts on the HGM units were agropastoral activities, including commercial cultivation, cattle grazing, dams and infrastructure, as well as adjacent mining activities, associated infrastructure and impacts. The Ecological Importance and Sensitivity (EIS) of the Pan, UVBs Fragmented, Seep Agriculture and Seep Fragmented HGM units were regarded as 'Moderate (C)'. The CVBs, CVBs Fragmented, UVBs and Seep Unimpacted were 'High (B)'. This suggests that these systems are of ecological importance and are sensitive. The biodiversity of the systems is sensitive to modifications to the habitat and low flows.

Impact Assessment Summary

The negative and positive impacts are discussed in this IWWMP Report. Based on the impact assessment, the key negative impacts include the loss of topsoil resources, soil erosion, loss of habitat, removal of protected species and subsequent sedimentation of freshwater systems from cleared areas as a result of construction site clearance, as well as operational activities.

No wetlands will be directly impacted by the surface infrastructure; however, the surface infrastructure falls within the 100 m and 500 m Zone of Regulation of the Pan and Hillslope Seep (fragmented) (HGM units 1 and 7).

Underground mining contains the risk of surface subsidence, dewatering, decanting and contamination which might impact the water environment significantly. Mitigation and management measures have been proposed for each identified impact associated with the proposed activities.

The most crucial impacts associated with the proposed project include, but are not limited to:

- Potential for water resource contamination;
- Changes to wetland health and biodiversity; and
- Dewatering and drying out of wetlands.

The key positive impacts associated to the proposed Project include, but are not limited to:

- Social development as part of the Social and Labour Plan (SLP);
- Multiplier effects on the local and regional economy;
- Skills training; and
- Social investment in local communities.

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ACRONYMS AND ABBREVIATIONS

Abbreviation / Acronym	Description
ABA	Acid-Base Accounting
AIP	Alien Invasive Plant
AMD	Acid Mine Drainage
BID	Background Information Document
CHPP	Coal Handling and Preparation Plant
CRR	Comments and Response Report
CVB	Channelled Valley Bottom
DECM	Dorstfontein East Coal Mine
Digby Wells	Digby Wells and Associates (South Africa) (Pty) Limited, trading as Digby Wells Environmental
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECC	Exxaro Coal Central
EIA	Environmental Impact Assessment
EIA Regulations, 2014	Environmental Impact Assessment (EIA) Regulations, 2014 (GN R982 of 04 December 2014, as amended)
EIS	Ecological Importance and Sensitivity
ELM	Emalahleni Local Municipality
ELWU	Existing Lawful Water Use
ES	Ecological Services
GN	Government Notice
ha	Hectare
HGM	Hydrogeomorphic
HDSAs	Historically Disadvantaged South Africans
I&APs	Interested and Affected Parties

Abbreviation / Acronym	Description
IDP	Integrated Development Plan
IWULA	Integrated Water Used License Application
IWWMP	Integrated Water and Waste Management Plan
km	kilometres
ktpm	kilotons per month
LED	Local Economic Development
m	Metres
MAE	Mean Annual Evaporation
mamsl	Metres Above Mean Sea Level
MAP	Mean Annual Precipitation
MBSP	Mpumalanga Biodiversity Sector Plan
MPRDA	Mineral and Petroleum and Resources Development Act, 2002 (Act No. 28 of 2002)
MR	Mining Right
Mtpa	Million tonnes per annum
NAF	Non-Acid Forming
NAG	Net Acid Generation
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NGO	Non-Governmental Organisation
NNP	Net Neutralising Potential
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PCD	Pollution Control Dam
PES	Present Ecological State
PPP	Public Participation Process
RoM	Run of Mine
RQOs	Resource Quality Objectives
RWD	Return Water Dam
SANS	South African National Standards
SAWQG	South African Water Quality Guidelines

Abbreviation / Acronym	Description
S&EIR	Scoping and Environmental Impact Report
SDF	Standard Design Flood
SHEC	Safety, Health, Environmental and Community
SLP	Social and Labour Plan
SMS	Short Messaging Service
STP	Sewage Treatment Plant
UVB	Unchannelled Valley Bottom
WMA	Water Management Areas
WTP	Water Treatment Plant
WUL	Water Use Licence
WULA	Water Use Licence Application
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence

1. Introduction

Digby Wells Environmental (Digby Wells) has been appointed by Exxaro Coal Central (Pty) Ltd (ECC) to prepare an Integrated Water Use Licence Application (IWULA) for the proposed Underground Mining Expansion Project of the Exxaro Dorstfontein East Coal Mine (DECM) Operations (the Project). In addition, Digby Wells are concurrently undertaking a Scoping and Environmental Impact Assessment (S&EIR) process in terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R982 of 04 December 2014, as amended) (the EIA Regulations, 2014) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

This report constitutes the Integrated Water and Waste Management Plan (IWWMP) which will be submitted to the Department of Water and Sanitation (DWS) in support of the IWULA for the Project.

This draft version of the IWWMP is being made available to Interested and Affected Parties (I&APs) for a 60-day public review and commenting period from 11 March 2022 - 17 May 2022. The outcome of the Public Participation Process (PPP) will be recorded in Section 11 of the final IWWMP.

1.1. Background

ECC holds an approved Mining Right (MR) (Ref. No. MP 30/5/1/2/3/2/1/51 MR) for opencast and underground mining at the DECM situated in Kriel, Mpumalanga Province. The DECM was previously owned by Total Coal South Africa (Pty) Ltd (Total) and was ceded to ECC on 20 August 2015. The current proposed Project aims to extend underground mining in the approved mining area and introduce ancillary surface infrastructure to support this.

An application for Environmental Authorisation (EA) for this Project was submitted to the Mpumalanga Department of Mineral Resources and Energy (DMRE) on 13 November 2020 (Ref. No. MP 30/5/1/2/3/2/1/51 MR). The final Scoping Report (SR) was submitted to the DMRE on 26 January 2021 and was accepted on 28 May 2021. The final EIA report was submitted to the DMRE on 4 November 2021 and is awaiting approval.

1.2. Project Motivation for the Water Use Licence Application

The DECM is currently operating as an opencast and underground mine. ECC holds an existing MR for coal in the area. ECC is facing challenges regarding the continuation of open cast mining which is projected to produce substantially less run of mine (RoM) coal than what was predicted in ECC's current approved business plan.

The extension of the mining activities underground is proposed to increase the RoM coal and thus lead to greater revenue for the DECM. The Project will be able to contribute to the local economy through job creation and procurement. Increased employment will lead to increased expenditure on goods and services in the local economy. The Emalahleni Local Municipality (ELM) in which the Project lies is characterised by unemployment rates of 26.6% according to the municipality's latest Integrated Development Plan (IDP). The Project could assist in alleviating unemployment .

The Social and Labour Plan (SLP) ensures that the MR holder contributes to the socio-economic wellbeing of people in areas in which they are operating. The SLP further stipulates that ECC commits to provide opportunities and resources for employees to fully develop in the mine's job disciplines. Through external training programmes, learnerships and skills programmes, ECC will develop its employees and the surrounding community.

The mining sector is the strongest contributor to ELM's economy, accounting for almost 55% of the municipality's GDP. The area is rich in coal reserves and supplies the power stations in the area. This contributes to the energy supply of South Africa and employment. By expanding the mining operations at DECM, these benefits can be realised further into the future of the area through the extended LoM.

As such, the Project will have a number of water uses in terms of Section 21 of the NWA and requires an IWUL as follows:

- S21(c) – Impeding or diverting the flow of water in a watercourse;
- S21(g) – Disposing of waste in a manner which may detrimentally impact on a water resource;
- S21(i) – Altering the bed, banks, course or characteristics of a watercourse; and
- S21(j) – Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people.

This IWWMP provides the supporting documentation for the authorisation of these water uses as well as the consolidation of the existing Water Use Licence (WUL).

1.3. Purpose of this Report

A WULA Process is being undertaken in line with Chapter 4 of the NWA to licence water uses associated with the Project. The purpose of this IWWMP is to:

- Serve as a supporting document with relevant technical information to inform decision making on the WULA;
- Provide a clear description of the Project activities and their associated water uses to be licenced;
- Provide a summary of the established biophysical and socio-economic conditions of the Project's footprint;
- Provide an assessment of any additional potential impacts with respect to waste and water related activities;
- Serve as a guide to water and waste related measures that must be structured and progressively implemented throughout the activities to address impacts on the receiving water environment; and

- Present a plan of how the management of water and waste will be undertaken in an integrated manner and provide monitoring plans to monitor the success of such management.

1.4. Structure of this Report

The report contains the following information as shown in Table 1-1 below.

Table 1-1: Report Structure

Information	Section in the report
Administrative Information	Section 2
Conceptualisation of the Activity	Section 3
Organisational Structure of Activity	Section 4
Regulatory Water and Waste Management Framework	Section 5
Present Environmental Conditions	Section 6
Analysis and Characterisation of Activity	Section 7
Impact Assessment	Section 8
Integrated Water and Waste Management Plan	Section 9
Monitoring	Section 10
Public Participation	Section 11
Section 27 Motivation	Section 12
Conclusion	Section 13**Error! Reference source not found.**
References	Section 14

2. Administrative Information

The objective of this section of the report is to provide the relevant administrative information for the Project. This includes the applicant and WULA compiler details as well as the locality information.

2.1. Details of the Applicant

Table 2-1 contains the details of the WUL applicant.

Table 2-1: Contact Details of the Applicant

Name of Applicant:	Dorstfontein East Mine
Registration number:	1952/003176/07

Trading name (if any):	N/A
Responsible person:	Group Sustainability Manager
Contact person:	Mr William Seabi
Physical address:	Farm Welstand 55 Bethal 2271
Postal address:	Farm Welstand 55 Bethal Private Bag X5007 Kriel
Postal code:	2271
Telephone:	079 496 3304
Email:	Maropeng.Seabi@overlooked.co.za

2.2. Details of the Water Use Licence Application Compiler

Digby Wells was appointed by ECC to facilitate and complete the required IWULA process. Table 2-2 provides the details of the WULA compiler.

Table 2-2: Details of the WULA Compiler

Company Name:	Digby Wells and Associates (South Africa) (Pty) Ltd		
Name of Compiler:	Njabulo Mzilikazi		
Professional affiliation/registration:	SACNASP Cert. Sci. Nat. (120568)		
Contact person: **(if different from Compiler)**	N/A		
Physical address:	Turnberry Office Park, Digby Wells House , 48 Grosvenor Road, Bryanston		
Postal code:	2191	**Cell phone:**	076 219 1763
Telephone:	011 789 9595	**Fax:**	011 789 9495
Email:	Njabulo.Mzilikazi@digbywells.com		

2.3. Details of Landowners

Table 2-3 contains details of the farm portions directly affected by the proposed Project. These are also illustrated in the map included as Figure 2-1.

Table 2-3: Directly Affected Farms and Landowners

<table>
<tr><th>Farm</th><th>Portion Number</th><th>Owner</th></tr>
<tr><td>Bosch Krans 53 IS</td><td>12</td><td>Dorstfontein Coal Mines (Pty) Ltd</td></tr>
<tr><td rowspan="2">Dorstfontein 71 IS</td><td>2</td><td rowspan="2">Dorstfontein Coal Mines (Pty) Ltd</td></tr>
<tr><td>8</td></tr>
<tr><td rowspan="3">Fentonia 54 IS</td><td>1</td><td rowspan="3">Mr Edmund Muller</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td rowspan="5">Welstand 55 IS</td><td>4</td><td rowspan="5">Dorstfontein Coal Mines (Pty) Ltd</td></tr>
<tr><td>5</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>13</td></tr>
</table>

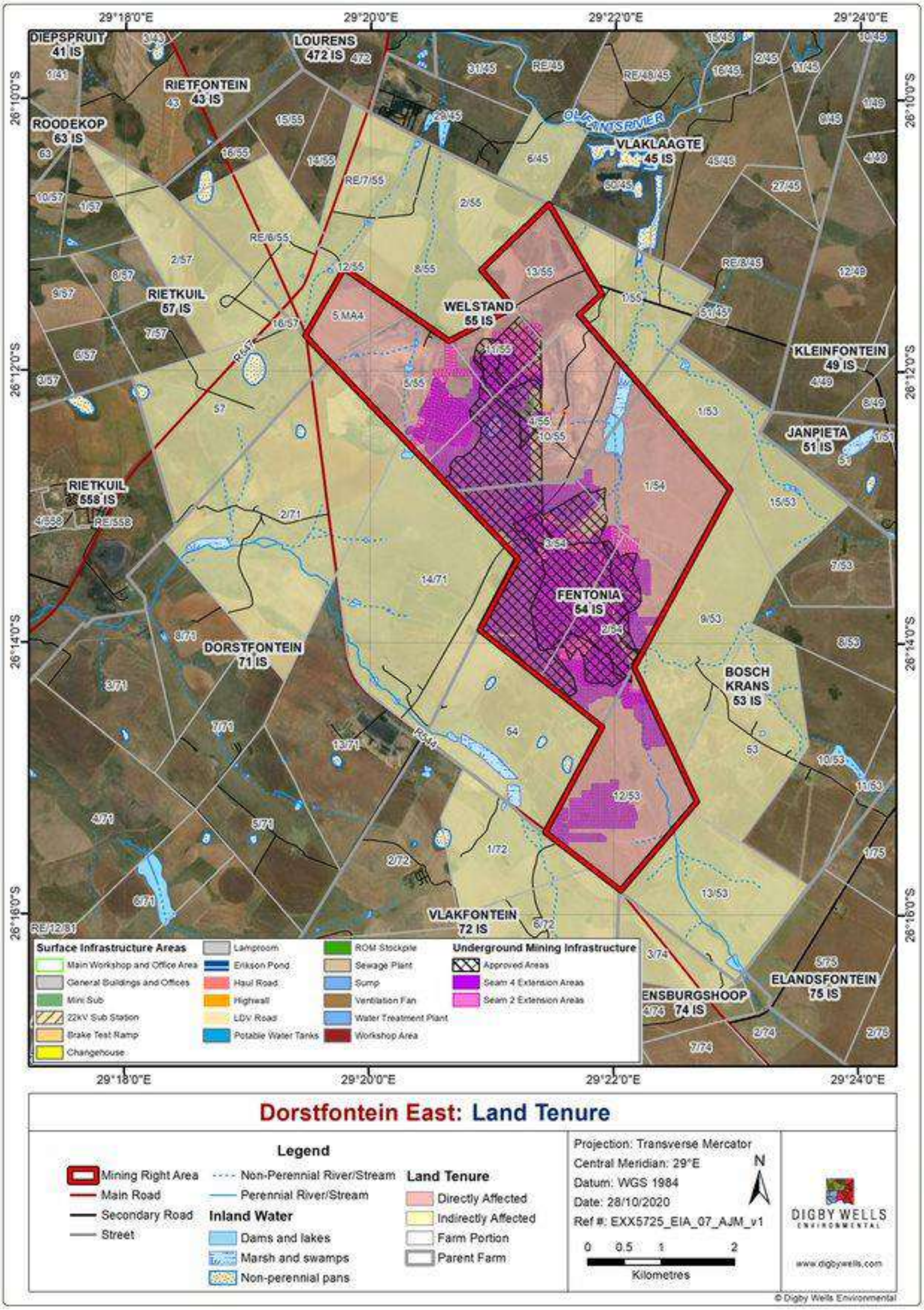


Figure 2-1: Land Tenure Map of the DECM

2.4. Regional Setting and Location of the Activity

DECM is situated near the town of Kriel within the Magisterial District of Bethal, under the jurisdiction of the Emalahleni Local Council, Mpumalanga Province. The current operation lies directly north-east of the town of Ga-Nala (Kriel). Table 2-4 represents the nearest town in relation to the Project Area. The regional and local settings of the Project are depicted in

Table 2-4: Distance and Direction of Nearest Towns from the Project Area

Town	Distance (km)	Direction
Kriel	16	NE
Thubelihle	5	E

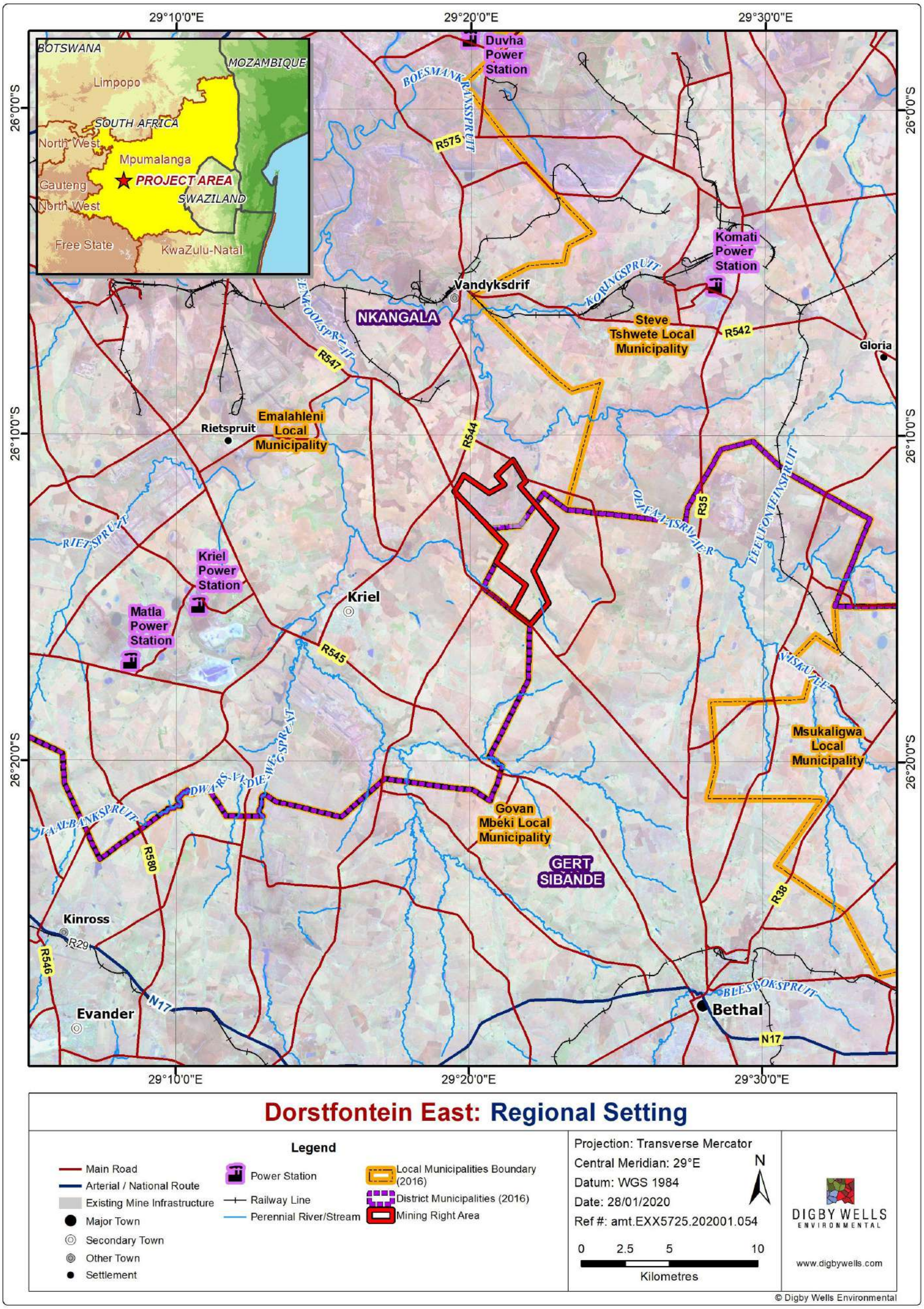


Figure 2-2: Regional Setting of Project Area

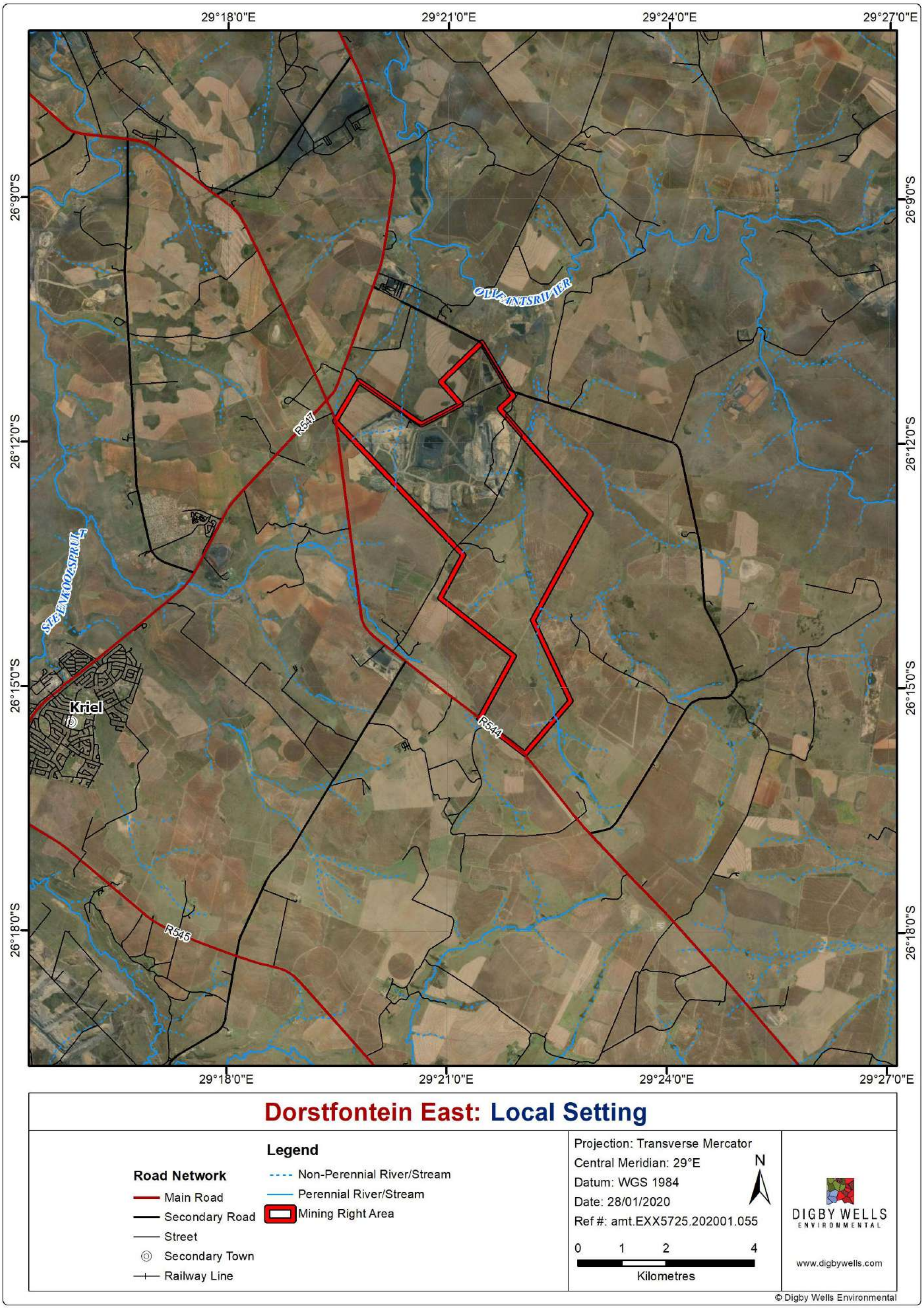


Figure 2-3: Local Setting of the Project Area

3. Conceptualisation of the Activity

DECM has approval to mine the Lower 4 Seam and the Lower 2 Seam coal, as well as mine three open pits. This section describes the existing and proposed activities at the DECM.

3.1. Current Operational Structure of the DECM Operations

The DECM holds 2 066 ha of coal rights and 1 230 ha of surface rights, which make up the DECM Operations. Current mining activities are being undertaken on the farms Dorstfontein 71 IS, Boschkrans 53 IS, Fentonia 54 IS and Welstand 55 IS. Operations at DECM comprise of the opencast and underground mining activities (the "Current Activities"), as described in the section below.

3.1.1. Opencast Mining Operations

The DECM is currently mining one opencast Pit (Pit 1). The opencast production rate has been determined at a constant rate of 3 Million tonnes per annum (Mtpa) of Run of Mine (RoM) equating to an overall coal extraction of 21 Million tons (Mt) RoM. RoM from the opencast pits is transported via conveyors to the plant. Discard is conveyed from the plant to the discard dump located between Pit 1 and underground workings.

3.1.2. Underground Mining Operations

The underground mining areas comprise a main block and a satellite block. The main block has been separated into two areas termed Block A and B and the satellite block has been termed Block C. Only the 4 Seam and 2 Seam have been considered in the underground mining areas.

The coal seams under consideration are relatively free of sandstone and/or shale partings and hence continuous mining operations have been considered in all production sections. In the area where both 4 Upper and 4 Lower Seams are to be mined simultaneously, assuming this area will be mined by underground mining methods, the 0.3 m parting between the two seams is not considered a hindrance to continuous mining methods.

3.1.3. Existing Infrastructure

The existing mine infrastructure within the DECM includes the following:

- Opencast workings (Pit 1);
- Underground workings (Block A, B and C);
- Processing plant;
- Co-disposal facility;
- Pollution Control Dams (PCDs);
- Stockpiles (topsoil and overburden);
- Haul roads;

- Stormwater control trenches;
- Dewatering infrastructure;
- Conveyors;
- Substation and powerlines;
- Bulk water supply;
- Water pipelines;
- Sewage Treatment Plant (STP);
- Water Treatment Plant
- Railway line; and
- Plant offices, change rooms, store rooms and workshops and other ancillary infrastructure.

3.2. Proposed Project Overview

The Project aims to expand the DECM's underground mining area within the existing MR Area (Ref. No. MP30/5/1/2/2/51MR). DECM was previously owned by Total Coal South Africa (Pty) Ltd (Total) and was ceded to ECC on 20 August 2015 which have approved EMPr dated August 2009 (GCS) and October 2017 (SRK Consulting). ECC is now applying to expand the underground mining areas as approved under Total. Subsequently, additional coal reserves have been identified for mining which are not covered under the existing approval. ECC is also approved to undertake underground mining of deeper coal reserves at DECM. The underground mining operations will be accessed from the existing Pit 2 opencast and Dorstfontein West operations. DECM therefore intends to further extend the LoM through the exploitation of these identified additional coal reserves between 2021 until 2034 (14 years).

A portion of the 4 Seam underground extension area situated in the southwest portion of the DECM MR boundary will also be mined. This portion will be accessed from the Dorstfontein West operations. The required infrastructure proposed (Figure 3-2) for the extension includes:

- STP;
- Water Treatment Plant (WTP);
- Potable water storage tank;
- Erikson Dam;
- A new 22 kV overhead powerline from the existing substation to a new kV substation;
- RoM stockpile conveyor at portal;
- Portal ventilation fan;
- STP and water infrastructure;
- Change house;

- Lamp room;
- Office;
- Workshop area; and
- Stone dust silo.

3.2.1. Mining

ECC considered opencast mining the extension areas versus underground mining. Digby Wells and ECC consulted with the DWS and the DMRE at the pre-application phase of the Project. These consultations allowed ECC to present the different mining options, as well as the potential environmental impacts thereof. Due to the sensitivity of the wetlands on the surface, ECC has opted to rather pursue underground mining. The impact to watercourse features as a result of underground mining have been investigated and it is recommended that all mitigation and management measures are adhered to.

In addition, a portion of Pit 3, which is approved for opencast mining, will now be included into the underground mining extension. The Pit 3 coal reserves are contained in Seam 4.

3.2.2. Processing

Existing infrastructure at the DECM will be utilised as far as possible for the transportation, stockpiling and processing of coal. No municipal infrastructure will be used.

A coal discard processing plant has been additionally proposed to treat 100 kilotons per month (ktpm) of re-mined coal discard. The plant will process discard from both the existing discard dump and the coal handling and preparation plant (CHPP). The plant will also accommodate all future DECM discard production. The product will be transported to the plant feed stockpile area by means of truck haul and from there, fed into the plant through a conveyor. A flow diagram is presented in Figure 3-1.

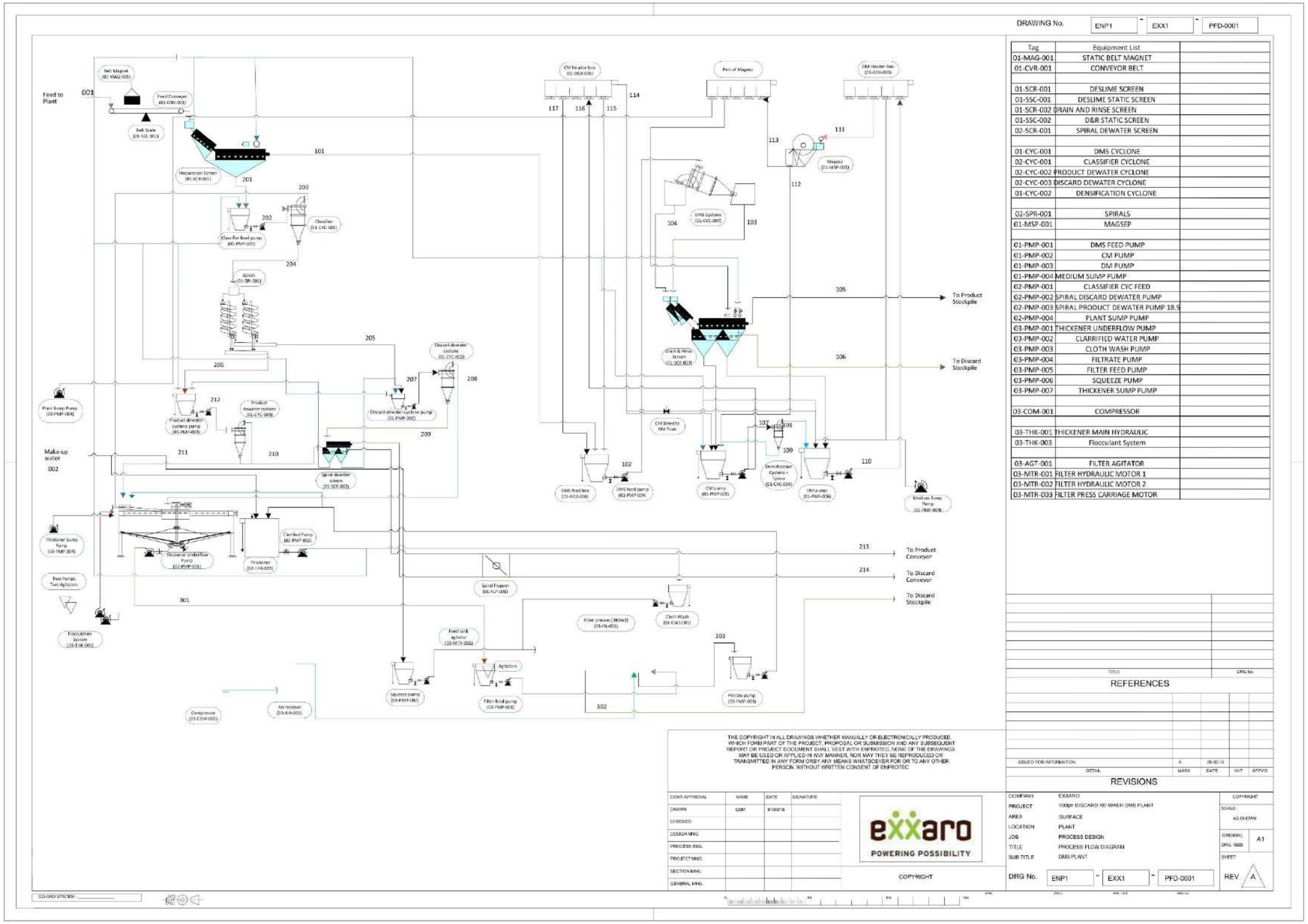


Figure 3-1: Discard Processing Facility Process Flow Diagram

Figure 3-2: Proposed Surface Infrastructure Layout

3.2.3. Services

This section explains the services required for the operation of the proposed Project. As mentioned, DECM proposes to utilise the existing infrastructure as much as possible especially considering that the proposed Project involves an expansion of mining in the approved seams.

3.2.3.1. Water Demand and Supply

The Project will require water for domestic as well as dust suppression purposes. Potable water will be sourced from the WTP which will have treated water from various dirty water containment facilities. Further detail on the demand and supply of water is contained in Section 7.2.4.

3.2.3.2. Power

A new 22 kV powerline will be constructed for power supply to the additional surface infrastructure and operation areas. This powerline will be connected from the existing substation to a new 22 kV substation.

3.2.3.3. Sanitation

DECM has an approved STP on site; however, with the extension of underground operations additional sewage capacity is required. A new STP is proposed. In addition, there are septic tanks at the existing operations requiring authorisation for use.

During the construction phase, potable latrines will be used as a means of sewage handling until such a time as permanent facilities are constructed.

3.2.3.4. Access Roads

Existing access and haul roads will be used as far as possible. The additional infrastructure required includes haul roads which will be required for the transportation of coal between different areas of infrastructure.

3.2.3.5. Contractors Camp and Laydown Area

Administrative buildings, workshops and contractor laydown areas will be constructed within the Project Area. The workshop areas will include bunded storage facilities for waste, fuel, lubricants and other hazardous substances. The bunded storage facilities will be constructed in accordance with the applicable South African National Standards (SANS) codes.

3.3. Key Water Uses and Waste Streams

3.3.1. Key Water Uses

The water volume for dust suppression amounts to 344 032 m^3/annum and this water is obtained from Erickson Dams and the Mine Plant. Most of this water is used during the dry season where high levels of dust emissions are expected since rainfall will be minimal or absent. The largest amount of water at DECM circulates within the Erickson Dams 1, 2 and 3 with an approximate value of 1 352 260 m^3/annum. The RWD/PCD and Mine Plant follow in water usage, having average volumes of 1 086 045 m^3/annum and 968 466 m^3/annum, respectively. Potable water, which is used at the mine offices, workshop and change houses totals 62 057 m^3/annum. This water, originally from Erickson Dams 1, 2 and 3, is treated at the WTP before being pumped for use at the workshop, offices and change houses. The volume of effluent treated at the sewage treatment plant is in the order of 55 851 m^3/annum.

3.3.2. Key Waste Streams

The main wastes to be generated by the Project are:

- Inter-burden (subsoil);
- Overburden (waste rock);
- General domestic waste;
- General industrial waste; and
- Hazardous waste.

4. Organisational Structure of Activities

4.1. Company Organisational Structure

The WUL applicant is Dorstfontein Coal Mines (Pty) Ltd which is a subsidiary of Exxaro Coal Central (Pty) Ltd (ECC). Figure 4-1 depicts the organisational structure.

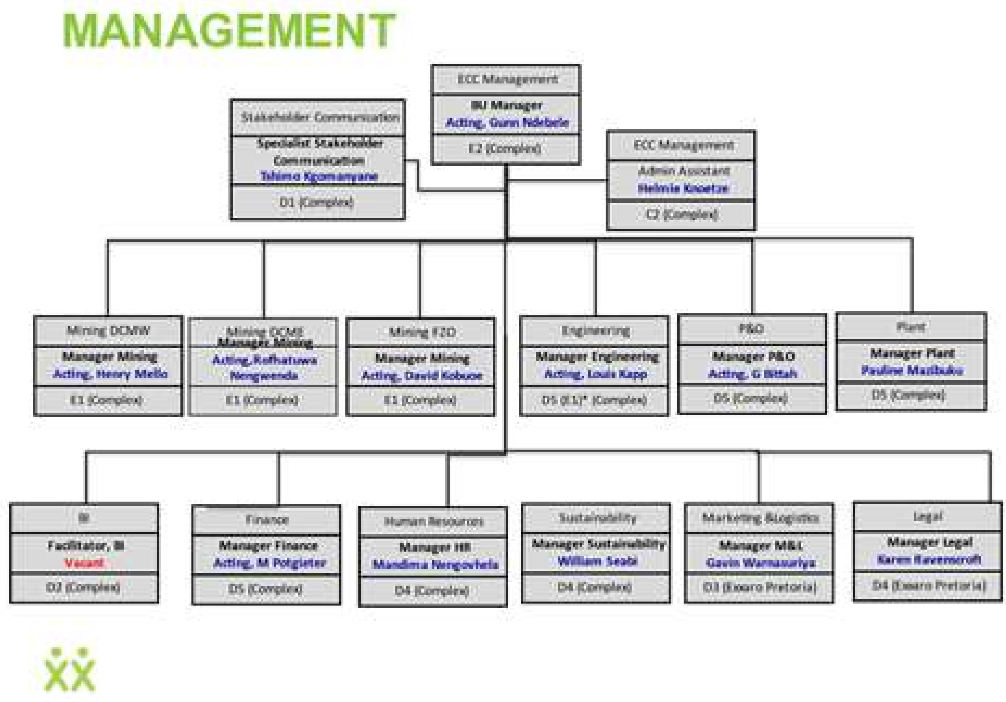


Figure 4-1: Exxaro Dorstfontein Operations Group Organisational Structure

4.2. Environmental Policies and Procedures

The Exxaro corporate Safety, Health, Environmental and Community (SHEC) Policy states the commitment to employees, the environment, communities and resources. More specifically, Exxaro's policy makes the following commitments:

- Consultation with employees, representatives and other stakeholders regarding developing, communicating and reviewing responsible and innovative policies, programmes and guidelines that safeguard the community, employees, contractors and the environment;
- Achieving high standards of environmental care;
- Ensuring proper organisational structure and resources to manage safety, health and environmental matters;
- Complying with all applicable SHEC legislation as a minimum requirement;
- Continuous hazard identification and risk assessment;
- Establishing competence and awareness through training and awareness;
- Conserving natural resources and reducing environmental burden of waste generation and emissions through re-use and recycling;
- Establishing objectives and targets and continuous improvement regarding safety, health and environmental performance and management systems;

- Reporting of incidents by all employees;
- Establishing controls to ensure policies are implemented, updated and available to all interested parties; and
- Maintaining a high level of emergency preparedness and response to manage emergencies.

4.3. Resource and Competencies

The implementation of the WUL and overall management responsibility for the implementation of the IWWMP will rest with the assigned Group Environmental Manager, overseen by the Chief Operating Officer.

The management actions that will be the responsibility of the Environmental Manager include:

- Overview of IWWMP implementation;
- Ensure that environmental monitoring, recording and reporting are conducted;
- Adapt the IWWMP where required;
- Develop and implement environmental training and awareness plans; and
- Conduct internal audits.

All employees and directors are expected to have a detailed understanding of Company policies and standards that directly relate to their job. It is every employee's responsibility to comply with the policies and standards relating to their work and to seek assistance from a manager or supervisor.

4.4. Awareness Raising, Education and Training

Section 39 of the Mineral and Petroleum and Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) requires MR holders to develop an environmental awareness plan to inform the employees of any environmental risks which may result from their work. Therefore, the objectives of the environmental awareness plan will be:

- To educate employees regarding their role in conserving the environment and the importance of conserving natural resources;
- To identify environmental training needs for employees and contractors at all levels;
- To ensure that employees whose work could cause significant environmental impact as identified by the mine are competent to perform those tasks to which they are assigned;
- To enable employees to identify environmental impacts or non-conformances of their work activities on the environment;
- To familiarise employees with emergency preparedness and response requirements;

- To be aware of the potential consequences of deviation from specified operating procedures; and
- To conduct their work and manage mining activities in an environmentally responsible manner.

4.5. Internal and External Communication

Management shall establish and maintain procedures for the internal communication between the various levels and functions of the organisation and receiving, documenting and responding to relevant communication from external I&APs. The organisation shall consider processes for external communication on its significant environmental aspects and record its decisions. Communication is a management responsibility. All line supervisors are responsible for effective communication within their own sections. Methods for the internal communication between the various levels and functions of the organisation and receiving, documenting and responding to relevant communication from I&APs must be established for the Project.

4.6. Employment

The Project proposes to maintain the current employees for the expansion.

5. Regulatory Water and Waste Management Framework

This section describes the key legal frameworks considered in the preparation of the WULA and IWWMP compilation.

5.1. Key Legislative Framework

The legislation applicable to the proposed project is described in this section.

5.1.1. The Constitution of the Republic of South Africa, 1996

The Constitution of the Republic of South Africa of 1996 (the Constitution) recognises the importance of the environment. Section 24 of the Constitution states that "*everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures, that –*

- *Prevent pollution and ecological degradation;*
- *Promote conservation; and*
- *Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."*

As such the Constitution encourages environmental management and the sustainable use of natural resources in the country. The interconnected nature of social, ecological and developmental change needs to be considered throughout decision-making processes.

5.1.2. National Water Act, 1996 (Act No. 36 of 1998)

The NWA provides principles for the sustainable and equitable use and protection of water resources. It is founded on the principle that the National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest and that a person can only be entitled to use water if the use is permissible under the NWA.

Section 26 of the NWA allows for the promulgation of regulations for the protection of water resources from impacts as a result of mining and related activities. The DWS has promulgated the Regulations in terms Section 26 (1) (b), (g) and (i) of the NWA to provide minimum requirements which will allow the fulfilment of the goal to protect the water resources.

Section 21 of the NWA defines a list of water uses which require a Water Use Authorisation. Water uses in terms of Section 21 include the following:

- Section 21(a) taking water from a water resource;
- Section 21(b) storing water;
- Section 21(c) impeding or diverting the flow of water in a watercourse;
- Section 21(d) engaging in a stream flow reduction activity contemplated in Section 36 of the Act;
- Section 21(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
- Section 21(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
- Section 21(g) disposing of waste in a manner which may detrimentally impact on a water resource;
- Section 21(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
- Section 21 (i) altering the bed, banks, course or characteristics of a watercourse;
- Section 21(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
- Section 21(k) using water for recreational purposes.

Water uses applicable to the DECM planned activities comprise Section 21 (c), (g), (i) and (j).

5.1.3. Regulations on Use of Water for Mining and Related Activities under the NWA

Relevant regulations contained in the Regulations on Use of Water for Mining and Related Activities Aimed at the Protection of Water Resources (GN 704 published in June 1999) (GN 704) states the following:

- Regulation 4 restricts the placement of any waste disposal facilities: No residue deposit, reservoir or dam may be located within the 1:100 year flood line, or less than a horizontal distance of 100 m from the nearest watercourse. Furthermore, person(s) may not dispose of any substance in old workings of underground or open cast excavations that may result in water pollution;
- Regulation 5 restricts the use of any material that can cause water pollution: No person(s) may use substances for the construction of a dam or impoundment if that substance will cause water pollution;
- Regulation 6 is concerned with the capacity requirements of clean and dirty water systems;
- Regulation 7 details the requirements necessary for the protection of water resources; and
- Regulation 8 provides the requirements that need to be implemented to ensure that access control is implemented at all working areas where impoundment and dams store contaminated water.

The provisions of GN 704 are applicable to the Project as the activities are related to mining activities. Therefore, these regulations are duly considered in this application.

5.1.4. National Environmental Management Act, 1998 (Act No. 107 of 1998)

The NEMA, as amended was set in place in accordance with Section 24 of the Constitution of the Republic of South Africa. Certain environmental principles under NEMA have to be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that:

"The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorising, permitting, or otherwise allowing the implementation of an activity."

The EIA Regulations, 2014 were published on 04 December 2014 and promulgated on 08 December 2014, together with the Listing Notices (GN R983 as amended, GN R984 as amended and GN R985 as amended).

Activities associated with the proposed underground mine are identified as Listed Activities in the Listing Notices (as amended) and therefore require an EA prior to being undertaken. The

EA Application was submitted to the DMRE and is currently under consideration. The EIA and EMPr are informed by the requirements of the NEMA and Regulations thereunder.

5.1.5. National Environmental Management: Waste Act, 2014 (Act No. 26 of 2014)

On 29 November 2013, a new list of waste management activities under GN R921 of 29 November 2013 were published which included activities listed under Category A, B and C. These activities include *inter alia* the following:

- Category A describes waste management activities requiring a Basic Assessment process to be carried out in accordance with the EIA Regulations, 2014 supporting an application for a waste management licence;
- Category B describes waste management activities requiring an EIA process to be conducted in accordance with the EIA Regulations, 2014 supporting a waste management licence application; and
- Category C describes waste management activities that do not require a WML but these activities will have to comply with the prescribed requirements and standards as prescribed by the Minister, which includes the Norms and Standards for Storage of Waste, 2013. These activities include the storage of general waste at a facility with a capacity to store in excess of 100 m^3 and storage of hazardous waste in excess of 80 m^3.

The Waste Classification and Management Regulations published under GN R634 of November 2013 require that all waste be classified according to SANS10234 and managed according to its classification.

The National Norms and Standards for the Assessment of Waste for Landfill Disposal were published under GN R635 on 23 August 2013 and prescribe the requirements for the assessment of waste prior to disposal to landfill in terms of Regulation 8(1)(a) of the Waste Classification and Management Regulations.

The National Norms and Standards for the Disposal of Waste to Landfill were published under GN R636 of 23 August 2013 and determine the requirements for the disposal of waste to landfill as contemplated in Regulation 8(1)(b) and (c) of the Waste Classification and Management Regulations.

The Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits from a Prospecting, Mining, Exploration or Production Operation were published in GN R632 on 24 July 2015 under section 69(1)(i) of the NEM:WA. The purpose of the Regulations is to regulate the planning and management of residue stockpiles and residue deposits from prospecting, mining, exploration or production operations.

A WML has been applied for as part of the EIA as the nature of mining activities such as the operation of the STP will constitutes a Category B 4(10) hazardous waste management activity under GN R921 of NEMWA.

5.1.6. Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)

The MPRDA sets out the requirements relating to the development of the nation's mineral and petroleum resources. It also aims to ensure the promotion of economic and social development through exploration and mining related activities. The MPRDA ensures that environmental management principles as set out in the NEMA are applied to all mining operations. The MPRDA serves as a guideline for interpretation, administration and implementation of environmental requirements and ensures that mineral resources are exploited in a sustainable manner to serve both present and future generations. The DECM has an approved MR (Ref. no. MP30/5/1/2/2/51MR) for opencast and underground mining.

An EIA process has undertaken to meet the requirements of the MPRDA read with the EIA Regulations, 2014 (as amended). Financial Provisioning and closure objectives are included in this IWWMP. Furthermore, this IWWMP is guided by the requirements of the MPRDA.

5.2. Project-Specific Regulatory Water and Waste Framework

The subsections below provide the water and waste framework applicable to the Project, including existing licences which must be consolidated as part of the licence application.

5.2.1. Existing Lawful Water Uses

An Existing Lawful Water Use (ELWU) is defined in terms of Section 32 of the NWA as a water use which has taken place lawfully two years prior to the promulgation of the NWA. This means that a permit or licence should be in place for the period between 1 October 1996 and 30 September 1998.

This is not applicable to the DECM WULA as it is for the application of new water uses and consolidation of existing authorised water uses.

5.2.2. Generally Authorised Water Uses

The NWA makes provision for General Authorisations which allow for a specific type of water use or category of water user to be generally authorised through a registration process, negating the need for a WUL.

No generally authorised water uses have been issued or are applicable to the proposed project.

5.2.3. Relevant Exemptions

5.2.3.1. *GN 704 Regulations on the Use of Water from Mining and Related Activities Aimed at Protection of Water Resources*

GN 704 published in terms of the NWA provides different regulations aimed at addressing the use of water in order to prevent pollution of water resources arising from mining and related activities with the specific focus of protecting water resources.

No GN 704 exemptions are applied for as part of this WULA.

5.2.3.2. GN R139 Regulations Regarding the Safety of Dams in terms of Section 123(1) of the NWA

There will be no dams constructed as part of the Project.

5.2.3.3. Other Exemptions

No other exemptions have been identified in relation to the WULA for the proposed DECM expansion project.

5.2.4. Existing Authorised Water Uses

The DECM operates its current activities as described in Section 3.1 under an existing WUL (Licence No. 06/B11B/ACGIJ/9138) issued on 4 September 2019. The existing water uses authorised under this licence are described in Table 5-1 and should be consolidated into the new licence that will be issued should the current WULA be approved for the new water uses described below in Section 5.2.5.

Table 5-1: Existing Water Uses at DECM (Licence No. 06/B11B/ACGIJ/9138 issued 4 September 2019)

Water Use	Description of Water Use
Section 21 (a): Taking water from a water resource.	Dewatering process associated with the continuation of mining activities in the Pit 1 extension will result in water that will be used in washing plant area.
	Make up water supply for mine service requirements and the coal washing plant requirements.
Section 21 (c): Impeding or diverting the flow; and Section 21 (i): Altering the bed, banks course or characteristics of a watercourse.	For mining within a regulated area (Wetland).
	Diversion and altering on Olifants River for conveyor structure and rail loop. Wetlands and Olifants River crossings for conveyor structure and rail loop.
	Extension of Dorstfontein East Pit 1 within 500 m of wetland.
Section 21 (g): Disposing of waste which may impact on a water resource.	Return Water Dam (disposal of water from underground workings and mining process).
	Disposal of coal slurry and discarded material from the coal mining process.
	Pollution control dam.
	Erickson dam 1 (Transfer of waste water).
	Erickson dam 2 (Transfer of waste water).

Water Use	Description of Water Use
	Erickson dam 3 (Transfer of waste water).
	Tank number 4 (disposal of wastewater).
	Dust Suppression.
	DECM Stockpile (product stockpile).
	DECM East Rail Loop Stockpile (product stockpile).
Section 21 (j): Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people.	Dewatering of pit 1 opencast.
	Dewatering of pit 2 opencast.
	Dewatering of pit 3 opencast.
	Dewatering of Block A and B underground workings.
	Dewatering of Block C underground commence after six years.
	Dewatering process associated with the continuation of mining activities in the Pit 1 extension will result in water that will be used in washing plant area (taking water to re-use at the washing plant).

5.2.5. Identification of New Water Uses

Water uses requiring a licence in accordance with Section 21 of the NWA are detailed in Table 5-2 and depicted in Figure 5 1 to Figure 5 3.

Table 5-2: New Water Uses which are Subject to this WULA

Water Use	Map Ref	Infrastructure	Description	Extent	Co-ordinates		Property	Quaternary Region
					Latitude	Longitude		
Section 21 (c) and (i)	C1	Highwall	Location of highwall within 500m of Hillslope Seep and Pan (HGM units 1 and 7).	1.65 ha	-26.204914°	29.357334°	Portion 4 of the farm Welstand 55 IS	B11B
	C2	LDV Road	Location of LDV road within 500 m of Hillslope Seep (HGM Unit 6).	0.72 ha	-26.206885°	29.358693°	Portion 4 of the farm Welstand 55 IS	B11B
	C3	WTP	Location of WTP within 500 m of the Pan (HGM Unit 7).	0.1 ha	-26.203057°	29.355492°	Portion 4 of the farm Welstand 55 IS	B11B
	C4	22 kV substation	Location of 22 kV substation within 500 m of the Pan (HGM Unit 1).	0.1 ha	-26.204876°	29.356485°	Portion 4 of the farm Welstand 55 IS	B11B
	C5	Erikson Dam	Location of Erikson dam within 500 m of the Pan (HGM Unit 1).	0.2	-26.204635°	29.356451°	Portion 4 of the farm Welstand 55 IS	B11B
	C6	Main Office and Workshop Area	Location of main office and workshop area within 500 m of the Pan (HGM Unit 1).	3 ha	-26.204340°	29.354949°	Portion 4 of the farm Welstand 55 IS	B11B
	C7	Brake Test Ramp	Location of brake test ramp area within 100 m of the Pan (HGM Unit 1).	0.55 ha	-26.204204°	29.354221°	Portion 4 of the farm Welstand 55 IS	B11B
	C8	Haul Road	Location of a haul road within 500 m of Construction of an access road through a portion of a Channel Valley Bottom Wetland (HGM Unit 2).	2.8 ha	**Point 1**		Portion 4 of the farm Welstand 55 IS	B11
					-26.205229°	29.360448°		B11B
	C9	Haul Road	Location of a haul road within 500 m of Construction of an access road through a portion of a Channel Valley Bottom Wetland (HGM Unit 2).	2.8 ha	**Point 2**		Portion 4 of the farm Welstand 55 IS	B11
					-26.207349°	29.360325°		B11B
	C10	Project Area	Location of infrastructure within 500 m of delineated wetlands and the non-perennial river (HGM Units 1-8).	3 288.53 ha (surface area)	-26.224355°	29.359324°	Portion 12 of the farm Bosch Krans 53 IS Portion 2 of the farm Dorstfontein 71 IS Portion 8 of the farm Dorstfontein 71 IS Portion 1 of the farm Fentonia 54 IS Portion 2 of the farm Fentonia 54 IS Portion 3 of the farm Fentonia 54 IS Portion 4 of the farm Welstand 55 IS Portion 5 of the farm Welstand 55 IS Portion 10 of the farm Welstand 55 IS Portion 11 of the farm Welstand 55 IS Portion 13 of the farm Welstand 55 IS	B11B
Section 21 (g)	G1	Project Area	Use of water removed from the mine void and sewage treatment plant for dust suppression (HGM Units 1-8).	3 288.53 ha (surface area)	-26.224355°	29.359324°	Portion 12 of the farm Bosch Krans 53 IS Portion 2 of the farm Dorstfontein 71 IS Portion 8 of the farm Dorstfontein 71 IS Portion 1 of the farm Fentonia 54 IS Portion 2 of the farm Fentonia 54 IS Portion 3 of the farm Fentonia 54 IS Portion 4 of the farm Welstand 55 IS Portion 5 of the farm Welstand 55 IS	B11B

Water Use	Map Ref	Infrastructure	Description	Extent	Co-ordinates		Property	Quaternary Region
					Latitude	Longitude		
							Portion 10 of the farm Welstand 55 IS Portion 11 of the farm Welstand 55 IS Portion 13 of the farm Welstand 55 IS	
	G2	Explosives Magazine Septic Tank 2 00 0L	Disposing of waste into septic tank		-26.195281°	29.349856	Portion 11 of the farm Welstand 55 IS	B11B
	G3	Training Centre Septic Tank 5 000 L	Disposing of waste into septic tank.		-26.189881	29.35665	Portion 13 of the farm Welstand 55 IS	B11B
	G4	Co-disposal Facility Office Septic Tank 3 000 L	Disposing of waste into septic tank.		-26.202858	29.349856	Portion 11 of the farm Welstand 55 IS	B11B
	G5	Opencast Mining Contractor Change House Septic Tank 5 000 L	Disposing of waste into septic tank.		-26.200894	29.354478	Portion 4 of the farm Welstand 55 IS	B11B
	G6	Opencast Mining Contractor Office Septic Tank 5000L	Disposing of waste into septic tank.		-26.201206	29.354425	Portion 4 of the farm Welstand 55 IS	B11B
	G7	Security Gate Septic Tank 3 000 L	Disposing of waste into septic tank.		-26.187306	29.360811	Portion 13 of the farm Welstand 55 IS	B11B
	G8	Railway Loadout Station Workshop Septic Tank 5 000 L	Disposing of waste into septic tank.		-26.110047	29.349417	Farm Fincham 42 IS	B11B
	G9	Weighbridge Septic Tank 3 000 L	Disposing of waste into septic tank.		-26.189025	29.359103	Portion 13 of the farm Welstand 55 IS	B11B
	G10	Sewage Treatment Plant	Operation and maintenance of STP and use of water from STP for mining operations within 500 m of delineated wetland (HGM Unit 1 - Pan).	55 851 m^3/a	-26.202866°	29.355468°	Portion 4 of the farm Welstand 55 IS	B11B
	G11	ROM stockpile	Stockpiling unprocessed coal within 500 m of delineated wetland (HGM Unit 1 - Pan).	0.1 ha	-26.204668°	29.358144°	Portion 4 of the farm Welstand 55 IS	B11B
	G12	Erickson Dam	Construction and operation of Erickson Dam for dirty water storage.	Please confirm	-26.204635°	29.356451°	Portion 4 of the farm Welstand 55 IS	B11B
Section 21 (j)	J1	Underground Mining	Dewatering of the mine void for the continuation of underground mining.	744 000 m^3/a	-26.224355°	29.359324°	Portion 12 of the farm Bosch Krans 53 IS Portion 2 of the farm Dorstfontein 71 IS Portion 8 of the farm Dorstfontein 71 IS Portion 1 of the farm Fentonia 54 IS Portion 2 of the farm Fentonia 54 IS Portion 3 of the farm Fentonia 54 IS Portion 4 of the farm Welstand 55 IS Portion 5 of the farm Welstand 55 IS	B11B

Water Use	Map Ref	Infrastructure	Description	Extent	Co-ordinates		Property	Quaternary Region
					Latitude	Longitude		
							Portion 10 of the farm Welstand 55 IS Portion 11 of the farm Welstand 55 IS Portion 13 of the farm Welstand 55 IS	

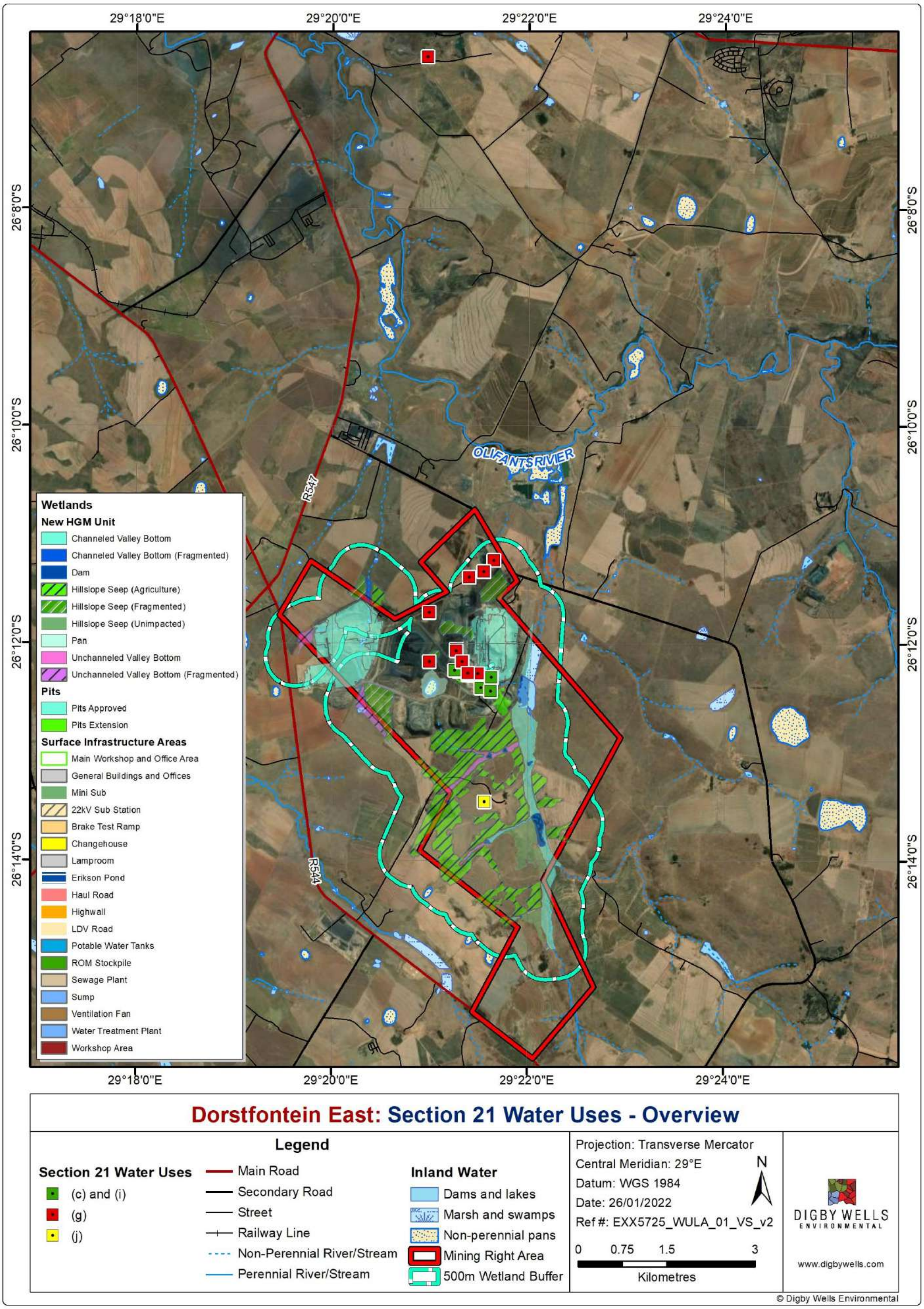


Figure 5-1: Overview of Section 21 Water Uses

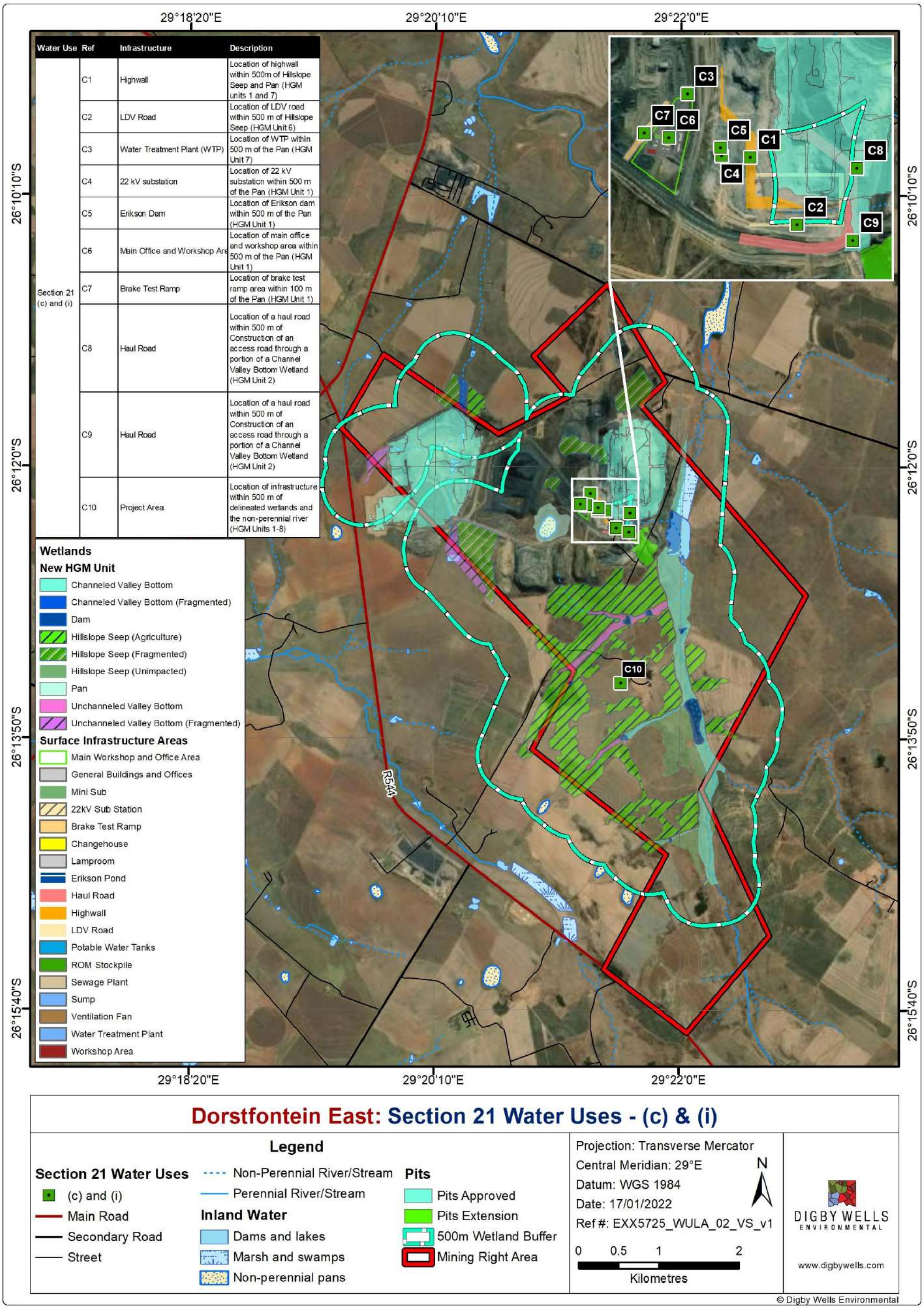


Figure 5-2: Section 21 (c) and (i) Water Uses

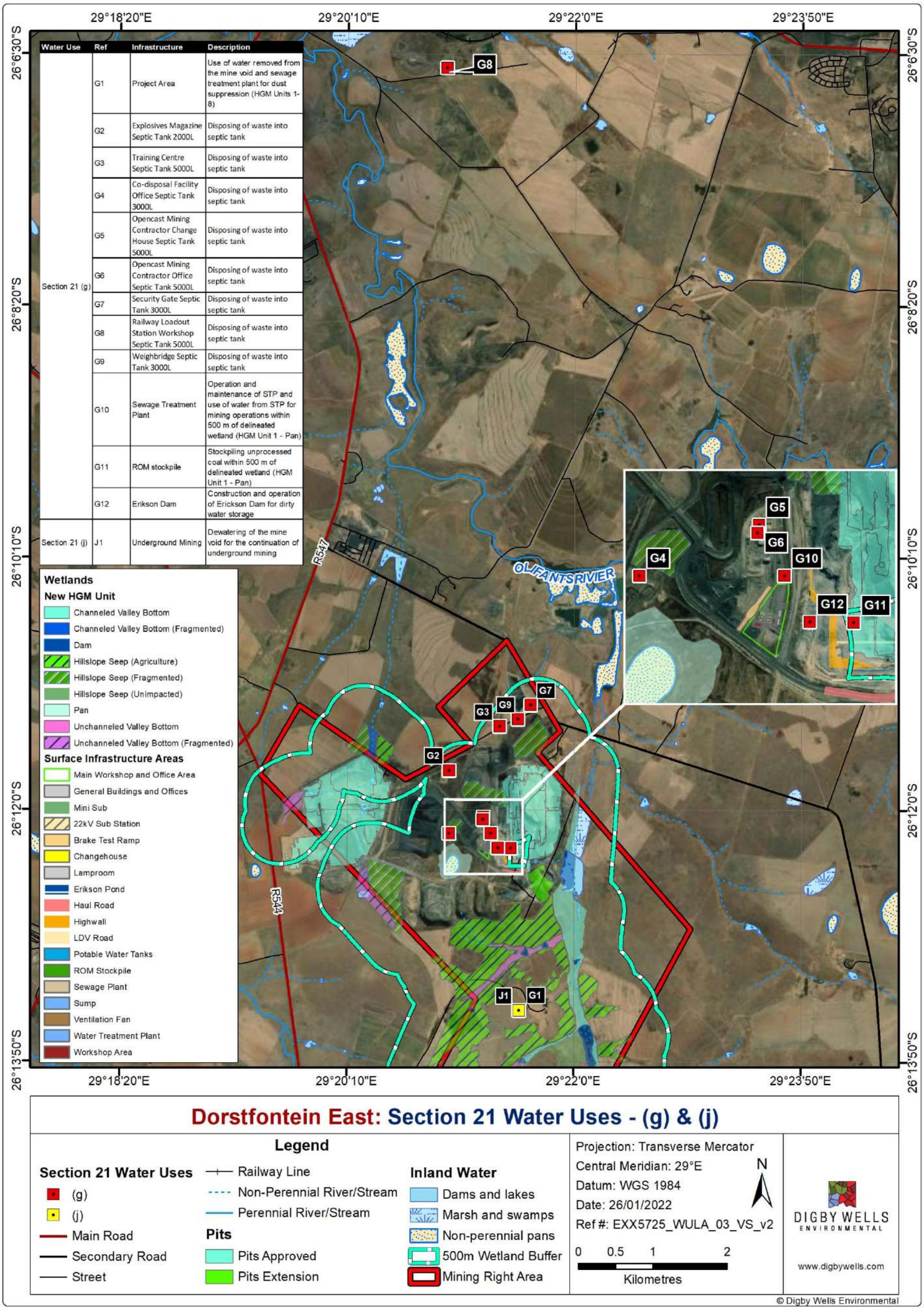


Figure 5-3: Section (g) and (j) Water Uses

5.2.6. Waste Management Activities

The operation of sewage reticulation infrastructure such as the STP and septic tanks constitutes and activity under GN R921 under NEM:WA Category B 4 (10). This has been applied for as part of the overall EIA process.

5.2.7. Other Authorisations

The DECM holds the following authorisations:

- EA for listed activities in terms of the NEMA associated with diesel storage tanks (EA Ref. No. 17/2/3 N-19) issued on 19 May 2011 by the Mpumalanga Department of Economic Development, Environment and Tourism;
- Amendment Licence in terms of Section 50 and 158 of the NWA for the Dorstfontein Coal Mine East Expansion, dated 5 June 2017;
- EA for listed activities in terms of the NEMA associated with the Pit 1 Extension and Water Transportation Pipeline Project dated 2017 (Ref. No. MP 30/5/1/2/3/2/1 (51) (EM)) issued by the Mpumalanga Department of Mineral Resources, 3 September 2017;
- EA for construction of a conveyor and railway loop (Ref. No. 17/2/2/2 NK-7) issued on 9 November 2009 by the Mpumalanga Department of Agriculture and Land Management; and
- IWUL for the water use related activities in terms of the NWA dated 4 September 2019 (Licence no. 06/B11B/ACIJ/9138).

6. Present Environmental Conditions

The following section describe the present environmental condition in the Project Area.

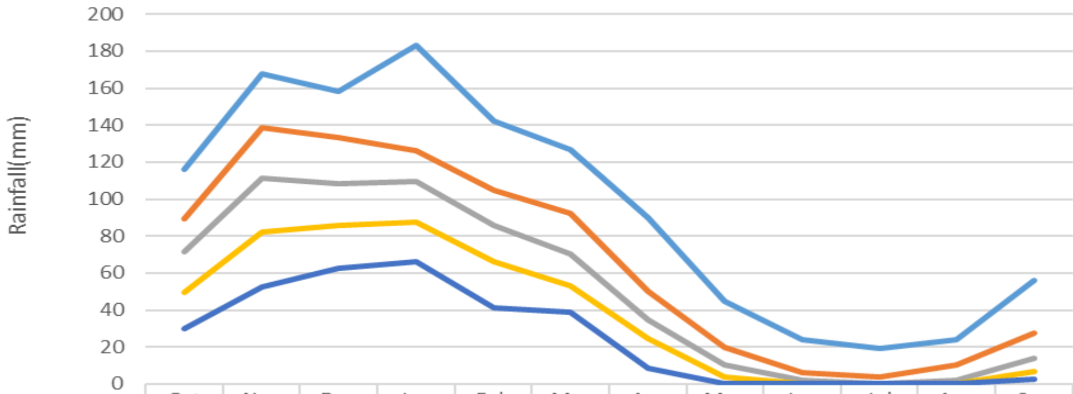
6.1. Regional Climate

DECM falls within a semi-arid climate region of Southern Africa, where rainfall is sparse with high seasonal variations during wet and dry seasons. The wet (or rainy) season occurs during summer months, October to March and is characterised by short, intense convective storms. Such high rainfall contributes to significant parts of recharge into the aquifers (Braune and Xu, 2005). Dry seasons occur during wintertime (April - September) and are characterised by dry cold weather conditions. Governing the variation in seasonal rainfall is the latitudinal movement of the Inter-Tropical Convergence Zone, which migrates to the south of the equator during summer months and back to the north of the equator in winter.

6.1.1. Rainfall

The Project site is characterised by a temperate climate with cool dry winters and warm summers. The Mean Annual Precipitation (MAP) for quaternary catchment B11B is 688 mm The average MAP for the quaternary catchment is likely to be distributed as indicated in Figure

6-1. The normal rainfall (70% of events) for the wettest month (January) will likely not exceed 126 mm, while extreme rainfall (10% of the events) will likely not exceed 183 mm. This implies that the region experiences moderate to high rainfall.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
90 Percentile	116	168	158	183	143	127	90	45	24	19	24	56
70 Percentile	89	139	133	126	105	92	50	20	6	4	11	27
50 Percentile	71	111	108	109	86	70	35	10	2	0	2	14
30 Percentile	49	82	86	88	66	53	24	4	0	0	0	7
10 Percentile	30	53	63	66	41	39	9	0	0	0	0	3

Figure 6-1: Monthly Rainfall Distribution

6.1.2. Evaporation

The Mean Annual Evaporation (MAE) for the quaternary catchments B11B is 1587 mm and 1647 mm, respectively. The region experiences higher evaporation than precipitation, giving rise to dry winters and wet summers with a negative natural water balance. The average monthly distribution of potential evaporation and rainfall for both quaternary catchments can be seen in Figure 6-2.

Generally, evaporation exceeds mean annual rainfall by a factor of two times which could mean that rainfall recharge into the aquifer could only be possible in times where rainfall is high and evaporation rates are low. This is one of the major factors resulting in dry streams and also on low moisture fluxes recharge the aquifers.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Evaporation(mm)	169	160	176	173	144	142	156	92	75	82	108	140
Rainfall(mm)	72	111	110	115	91	76	42	17	8	6	7	23

Figure 6-2: Monthly Evaporation and Rainfall

6.1.3. Temperature

Temperature variation is seasonal. Average daily temperatures of approximately 27°C are experienced during summer months while average daily temperatures of approximately 4°C are experienced during the winter season. However, daily temperatures may reach up to 36°C in summer while minimum temperatures may fall below -4°C in winter.

6.2. Geology

6.2.1. Regional Geology

DECM is located within the Witbank coalfield, which is within the Karoo Supergroup. The Karoo Supergroup within the Project Area comprises the Ecca Group as well as the Vryheid Formation. The base of the Karoo Supergroup is the Dwyka Group comprising of tillites that are fairly regularly deposited over the basin except for paleo-topographical highs. The Dwyka tillites are overlain by the Vryheid Formation of the Ecca Group which hosts the coal seams.

The Vryheid Formation consists of various sequences of stacked upward-coarsening depositional sequences of sandstone and siltstone with the various coal seams located within the alternating lithofacies. The sediments (the coal-bearing sandstones and siltstones) rest either conformably on diamictites and associated glaciogenic sediments of probable Dwyka age, or unconformably on basement rocks (GCS, 2019). The Ecca Group sediments overlie the Dwyka Group. The geology can be stratigraphically classified as indicated in Table 6-1and depicted in Figure 6-3.

Table 6-1: Stratigraphy of the Regional Geology

	Subgroup	Lithology	Formation
Karoo Supergroup	Upper Ecca	Sandstones	Volksrust
	Middle Ecca	Sandstones	Vryheid
		Shales	
		Coal	
	Lower Ecca	Shale	Pietermaritzburg

6.2.2. Local Geology

The economically important coal seams within the Witbank coalfield are the 1, 2, 4 and 5 seams with most mining occurring in the 2 and 4 seams. The thickness and distribution of the seams have been controlled by paleo-topography, pre and syndepositional events and the later destructive effects of dolerite intrusions. The DECM mining area was unaffected by major fluvial events concurrent with peat accumulation, thus modification of seam thicknesses by ancient erosion is minimal.

The structural nature of the coal seam and the overburden formation has resulted in sub outcropping occurring in the north and western areas of the reserve blocks and dipping gently in a southerly direction. This feature of the coalfield allows for relatively easy access to the seam.

The presence of the undulating dolerite sill may have a detrimental effect on the quality of the coal through devolatilisation during the emplacement of the dolerite sill. Sills and dykes are constant sources of seam disturbance where the area is associated with, not only seam destruction by burning (Hagelskamp, 1987 as in GCS, 2008) but vertical movements, as well as geotechnical problems. This results in poor roof conditions occurring in some areas.

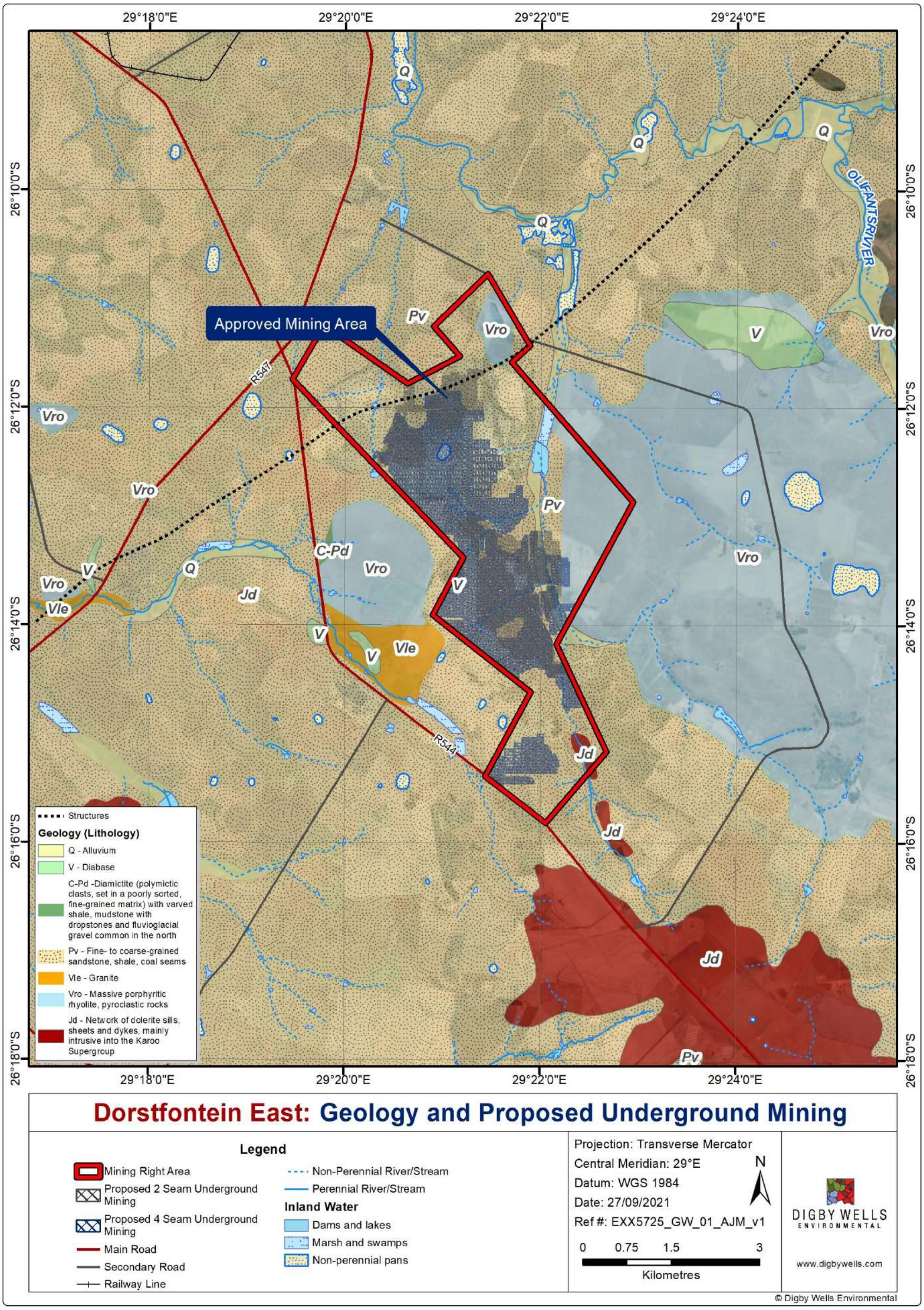


Figure 6-3: Geology of the Project Area

6.3. Topography and Drainage

6.3.1. Topography

The topographical elevation of the Project Area varies from 1515 meters above mean sea level (mamsl) and 1660 mamsl characterised with gentle slopes and low-lying areas (Figure 6-4). The topography differs approximately by 50 m in elevation between the low laying areas (an unnamed tributary of the Steenkoolspruit) and the high lying ridge areas (approximately 1660 mamsl). The high lying Klein Vaalkop forms the water divide between B11B quaternary catchment in the north-east and B11D in the south-west region. The land undulates gently. There are four valleys present in the larger reserve area, namely:

- The unnamed tributary of the Steenkoolspruit which flows in a westerly direction; and
- Three unnamed tributaries of the Olifants River, which drains in a northerly direction.

Two western Olifants tributaries overly the western limb of the reserve and the eastern tributary overly the eastern limb. The confluence of the three tributaries takes place on the farm Vlaklaagte 45 IS, just north of the mining concession area. The slopes of the valleys vary between 1:20 and 1:40. The topography between the two Olifants River tributaries is less prominent and can be characterised more as a plateau.

6.3.2. Drainage

South Africa is divided into nine Water Management Areas (WMA) (Revised National Water Resource Strategy, 2012) which are made up of quaternary catchments which relate to the drain regions of South Africa. These drainage regions are subdivided into four divisions based on the size. DECM is located within the Olifants Water Management Area (WMA 2) and occurs asymmetrically within the upper catchments of quaternary catchment B11B and B11D as revised in the 2012 water management area boundary descriptions.

The higher-lying Klein Vaalkop forms the water divide between the B11D and B11B quaternary catchments (Figure 6-5). Surface water hydrology within the Dorstfontein East Expansion Project is mainly associated with the upper Olifants River and locates within B11B quaternary catchment in the east. Further south, directly opposite the eye of the western Olifants tributary is a perennial pan.

The other part of DECM is mainly associated with the upper Steenkoolspruit River. Rainfall that occurs within the B11D catchment drains towards the unnamed tributary of the Spookspruit, which flows into a westerly direction towards the Steenkoolspruit. The confluence of the Steenkoolspruit River with the Olifants River occurs north of the mining rights area roughly a kilometre downstream from the Project Area and these two merge to form an unnamed river at quaternary catchment B11F.

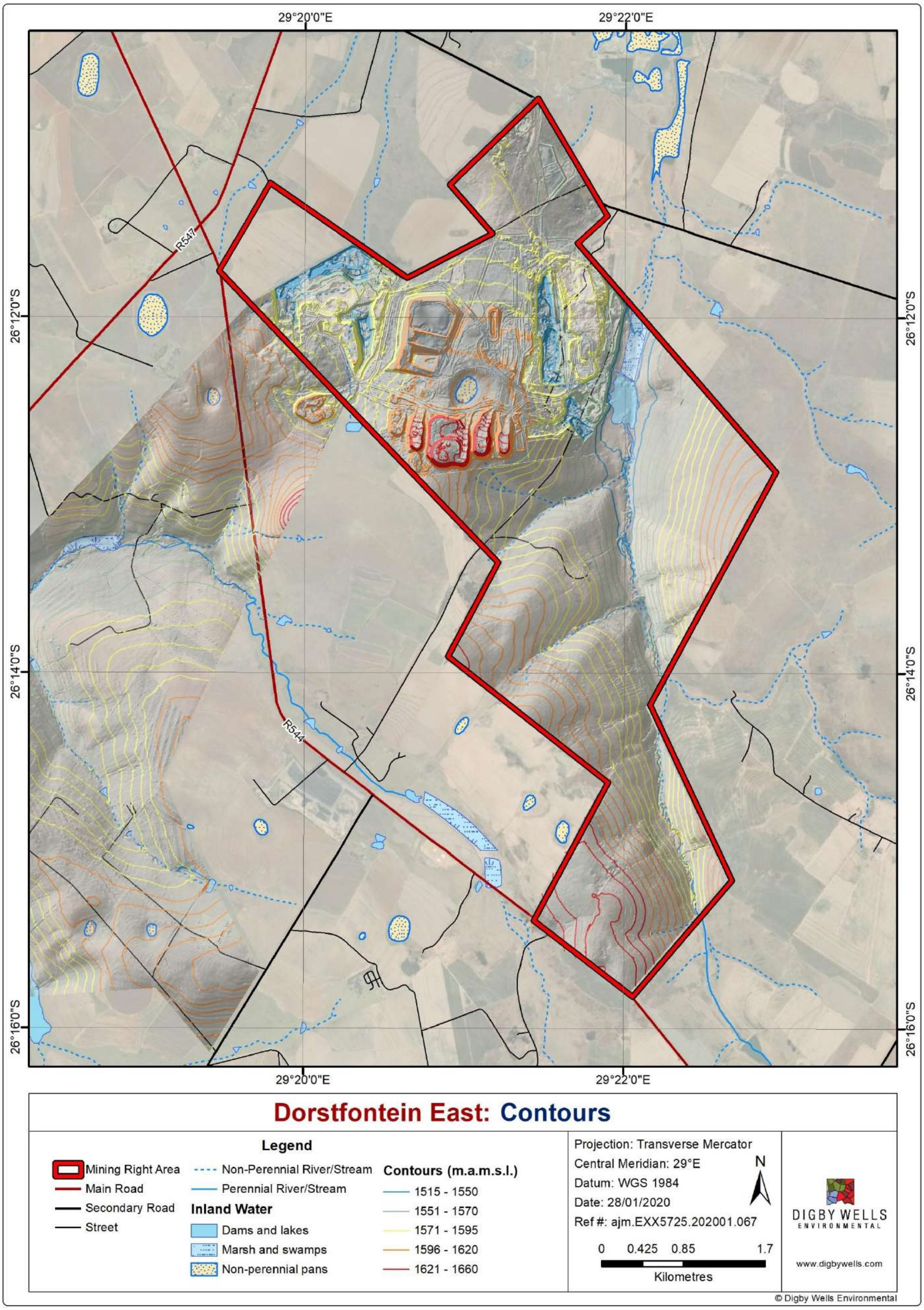


Figure 6-4: Surface Topographical Contours for the DECM

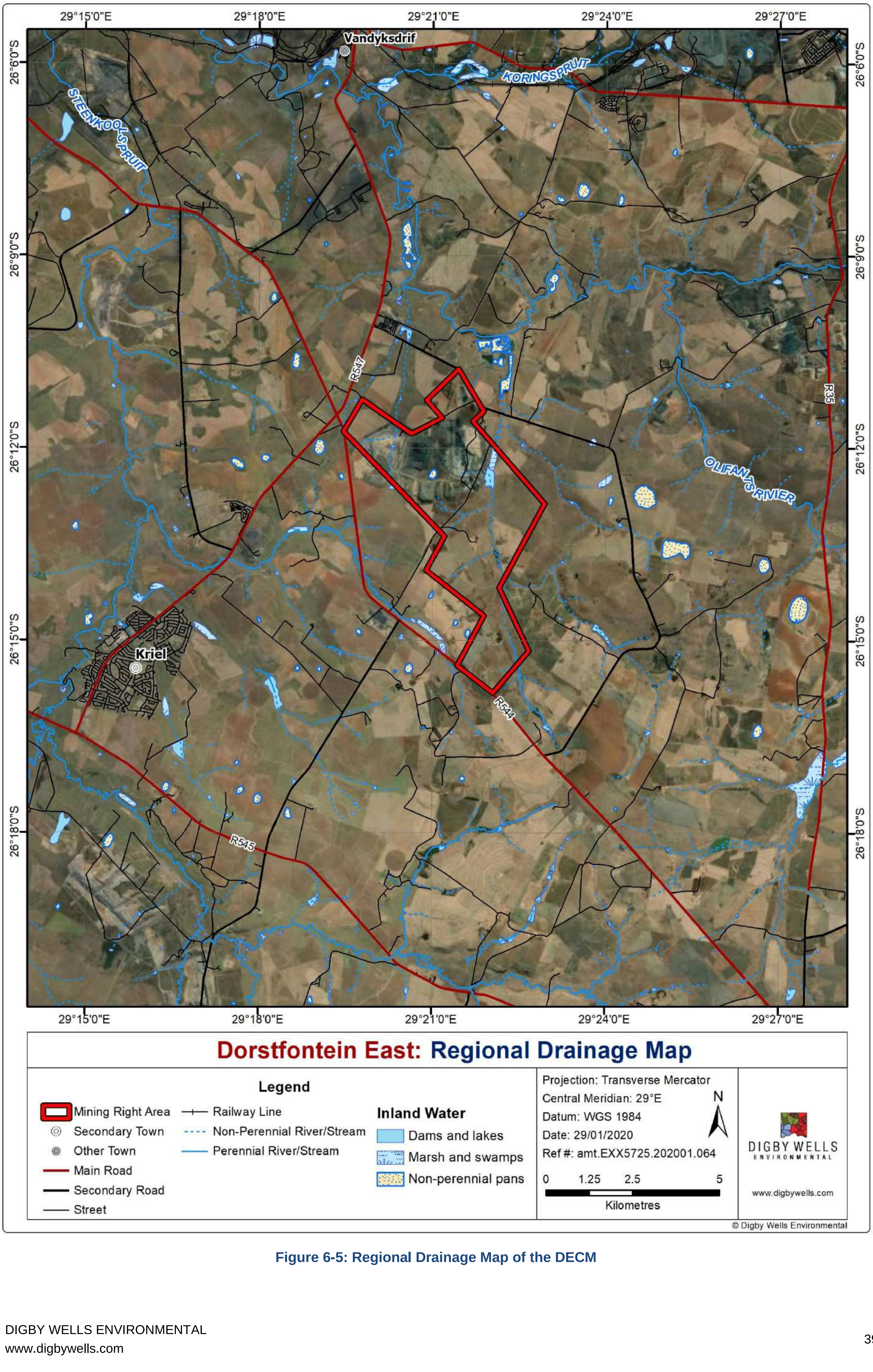


Figure 6-5: Regional Drainage Map of the DECM

6.4. Soils, Land Capability and Land Use

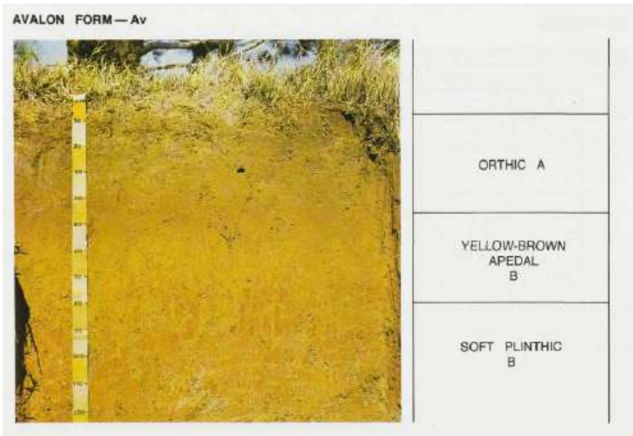
A desktop baseline environment assessment was undertaken. The results are presented in Table 6-2 and Table 6-3.

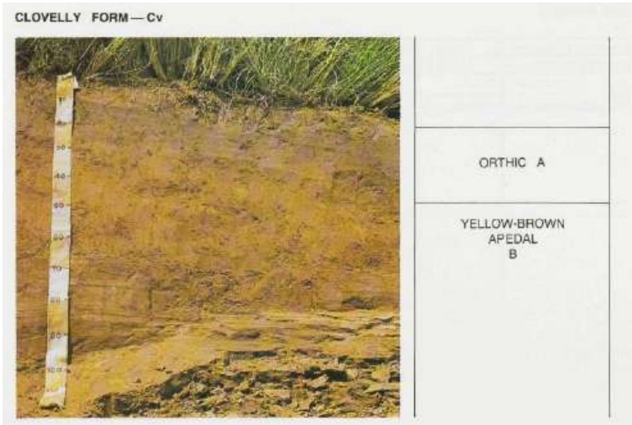
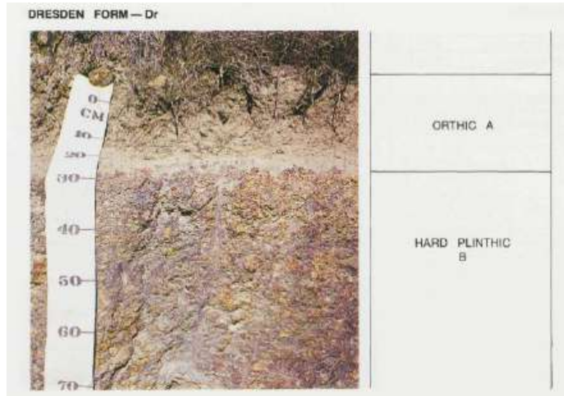
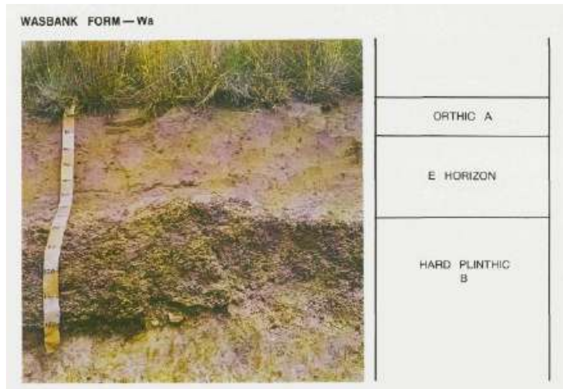
Table 6-2: Baseline Soil, Land Use and Land Capability Summary

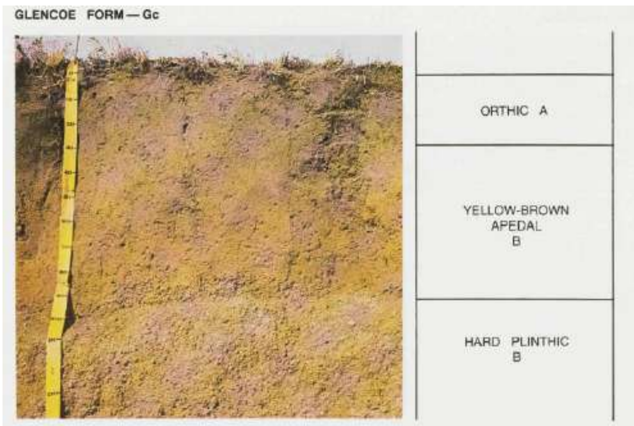
<table>
<tr><th colspan="4">Land Types and Dominant Soil Forms (Figure 6-6)</th></tr>
<tr><th>Land Type</th><th>Soil Form (see Figure 6-9)</th><th>Geology</th><th>Characteristics</th></tr>
<tr><td>Bb4
(dominant)</td><td>• Avalon
• Glencoe
• Hutton
• Kroonstad
• Longlands
• Mispah
• Sterkspruit</td><td>• Shale, sandstone, clay and conglomerate of the Ecca Group, Karoo Sequence. Dolerite, occasional felsitic lava of the Rooiberg Group, Transvaal Sequence.</td><td>• Dominated by moderately deep to deep well drained red soils on the upper slopes with soils getting shallower down slope, increasing in clay content and lower in permeability;
• The Hutton soil form usually indicates deep, fertile soils, good for agriculture, where Mispah soil forms are only slightly permeable due to the high clay content; and
• Mispah has a low potential for agriculture due to shallow bedrock and low permeability with a high erosion hazard and a shallow rooting depth.</td></tr>
<tr><td>Bb5
(north-eastern section)</td><td>• Mispah
• Hutton
• Glencoe
• Rensburg
• Wasbank
• Avalon
• Swartland
• Longlands
• Kroonstad</td><td>• Shale, sandstone, clay, conglomerate, marl and limestone of the Ecca Group. Dolerite, lava, sandstone, conglomerate, siltstone and rhyolite (Loskop Formation)</td><td>• These soils are commonly found in the lower parts of the terrain, with shallower soils, low drainage and high clay content due to the plinthic B-horizons; and
• These soils are commonly associated with wetlands.</td></tr>
<tr><td>Fa8
(eastern section)</td><td>• Mispah
• Hutton
• Clovelly
• Estcourt</td><td>• Rhyolite of the Selonsriver Formation, Rooiberg Group. Bushveld Igneous Complex</td><td>• These soils are described as sandy-loam to sandy-loam-clay soils;
• These soils are common in the upper parts of the catchment as well as in the lower foot-slope; and
• Lower in the terrain/slope the clay content is mostly higher and therefore this soil type is associated with seepage and valley bottom wetlands.</td></tr>
<tr><th colspan="3">Land Capability (Figure 6-7)</th><th>Land Use (Figure 6-8)</th></tr>
<tr><th>Class</th><th>Classification</th><th>Dominant Limitation Influencing the Physical Suitability for Agricultural Use</th><td rowspan="4">The Land Type Survey Staff information (1972 - 2006) classified the Land Use for the Project Area as:
• Mine: extraction pits, quarries, tailings and resource dumps;
• Commercial annual crops rain-fed/ dryland;
• Fallow land & old fields (grassland);
• Fallow land & old fields (bare land);
• Natural grassland;
• Open & sparse plantation forest;
• Artificial dams (including canals);
• Natural pans;
• Natural rivers; and
• Forest/Woodland.</td></tr>
<tr><td>II
(dominant)</td><td>Arable Land – Intensive Cultivation</td><td>Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.</td></tr>
<tr><td>IV
(north-eastern section)</td><td>Arable Land – Moderate Grazing</td><td>Soils have very severe limitations that restrict the choice of plants or require very careful management, or both.</td></tr>
<tr><td>VI
(eastern section)</td><td>Grazing – Moderate Grazing</td><td>Soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.</td></tr>
</table>

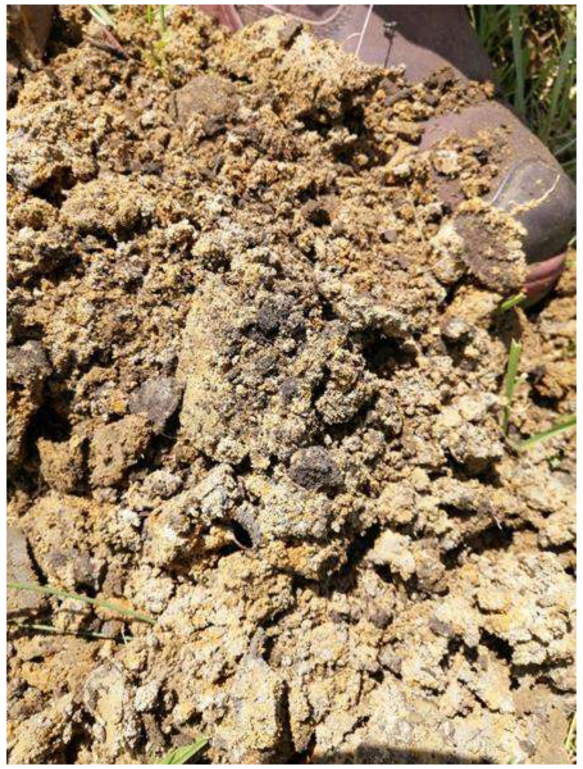
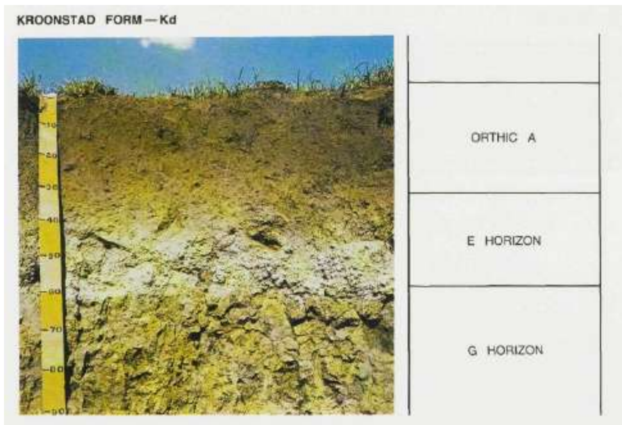
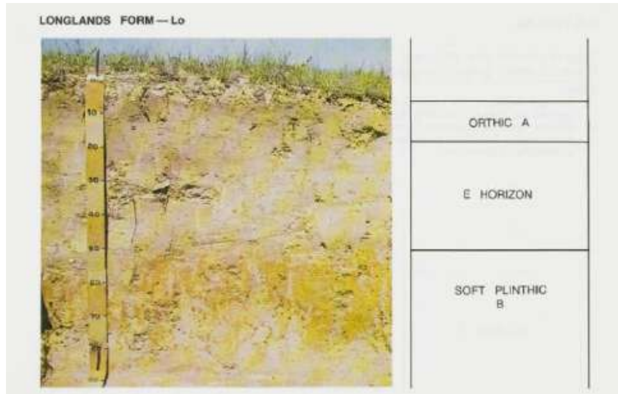
			During the site survey, the land use was confirmed to be the aforementioned, as well as: • Livestock farming; • Infrastructure (buildings, roads, powerlines, fence lines); • Dams; and • Large stands of Eucalypts Sp. and AIPs. The current Land Use of the Project Area is expected not to be largely impacted by the proposed underground mining activities.

Table 6-3: Description of Soil Forms in the Project Area

Soil Forms (Soil Classification Working Group, 1991) **(Figure 6-9)**								
	Avalon Soil Form				**Bainsvlei Soil Form**			
Soil Horizon	Orthic A-horizon	Yellow-brown Apedal B-horizon	Soft Plinthic B	 	Orthic A-horizon	Red Apedal B-horizon	Soft Plinthic B	 
Soil Horizon	A	B	B		A	B	B	
Average Depth (mm)	0 – 200 mm	200 – 600 mm	>1 200 mm		0 – 100 mm	100 – 1 000 mm	>1 000 mm	
General Characteristics	Light yellow-brown, coarse sandy, single grain, loose, many matrix pores, few roots, sandy-loam texture and and gradual smooth transition towards B1 horizon.	Reddish yellow, coarse sand single grain, loose, sandy-loam, many matrix pores, common roots, gradual smooth transition, interflow soils.	Accumulation and concretions of Fe and Mn oxides, loose crumbling structure, sandy-clay-loam, macro matrix pores, few roots.		Light brown, coarse sandy, single grain, loose, many matrix pores, high roots, sandy-loam texture, gradual smooth transition.	Red, coarse sandy loam, structureless, massive loose, many matrix pores, common roots, gradual transition.	Accumulation and concretions of Fe and Mn oxides, loose crumbling structure, light soil matrix, sandy-clay-loam, high clay content.	
Comment	Avalon soils are free draining and chemically active. Manganese and iron oxides accumulate under conditions of a fluctuating water table forming localised mottles or soft iron concretions of the soft plinthic B horizon. The Avalon soils within the Study Area were very deep, sandy soils with a light-yellow soil matrix. The soils are mainly cultivated and found in the upper slopes. Soil wetness increased with soil depth due to increasing clay content and the semi-permeable soft plinthic B2-horizon. Accumulation of iron and manganese were observed, forming mottles around 800 mm depth.				Bainsvlei soils are dark, red soils, freely draining and chemically active. Manganese and iron oxides accumulate under conditions of a fluctuating water table forming localised mottles or soft iron concretions of the soft plinthic B horizon. The Bainsvlei soils were very deep, sandy soils with a dark, red soil matrix. The soils were mainly used for cultivation and found in the upper slopes. Soil wetness increased with soil depth due to increasing clay content and the semi-permeable soft plinthic B2-horizon. Accumulation of clay, iron and manganese was observed within 800 mm depth.			
	Clovelly Soil Form				**Dresden/Wasbank Soil Form**			

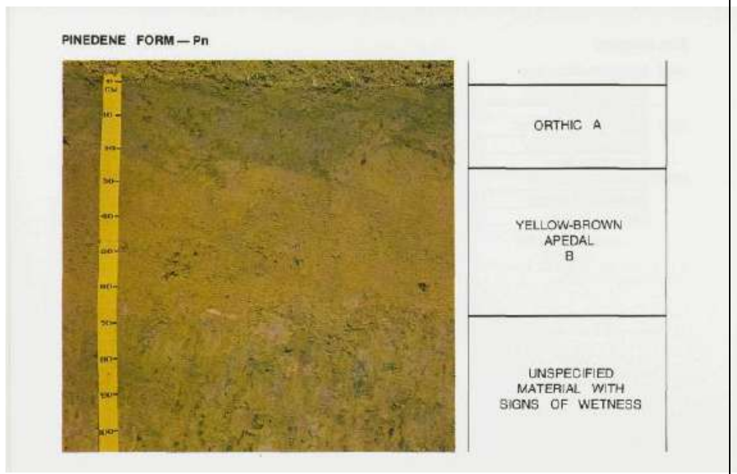
Soil Horizon	Orthic A-horizon	Yellow-brown Apedal B-horizon	Yellow-brown Apedal B-horizon	 	Orthic A-horizon	(E-horizon)	Hard Plinthic B	  
Soil Horizon	A	B	B		A	(B)	B	
Average Depth (mm)	0 – 200 mm	200 – 1 200 mm	> 1 200 mm		0 – 80 mm	(>350mm)	>80 mm	
General Characteristics	Brown, coarse sandy, single grain, loose, many matrix pores, sandy-loam, common roots, gradual smooth transition.	Reddish yellow, coarse sand single grain, loose, sandy-loam, many matrix pores, common roots, gradual smooth transition.	Reddish yellow, fine sand, single grain, loose, many matrix pores, sandy-loam-clay, few roots		Shallow, light brown topsoil with few roots, sandy-loam, few roots and abrupt transition towards B horizon. Iron and Manganese peds on the surface. Eroded.	(Light yellow to bleached (grey), coarse sandy soil, single grain, loose, many matrix pores, few roots, sandy-loam, gradual smooth transition.)	Hardened zone of accumulated iron and manganese oxides. Virtually no roots and water movement. Forms a restricted layer for hand-auger and agriculture.	
Comment	Clovelly soil forms are frequently confused with Hutton soil forms as they share the same characteristics. Clovelly soil forms have a Yellow-brown Apedal B-horizon, whereas Hutton soil has a Red-apedal B-horizon. Both these soil forms have deep, sandy, well-drained characteristics. Yellow-brown Apedal B-horizons are formed from leached Red Apedal B-horizons. Yellow- Brown Apedal B-horizons are thus usually in lower-lying areas, more leached and has higher drainage than that of the red soils and are poorer in nutrients.				**Dresden** soils typically consist of a shallow Orthic A horizon overlying a hard plinthic layer. These soils are limiting for agriculture production due to shallow soils and restricted water and air movement. The plinthic horizon consists of the accumulation of iron and manganese oxides with a strong developed structure. These horizons cannot be augured. **Wasbank** soils have the same characteristics as the Dresden soil form, however, if the E-horizon is deeper than 350 mm the soil form will be classified as a Wasbank.			

	The Clovelly Soil Forms within the Project Area were very deep, sandy soils mainly used for cattle grazing and perennial grassland. These soils are low in Soil Organic Material (SOM) and therefore not used for cultivation, but rather grassland. The Clovelly soils in the low-lying areas contained high clay content with soil depth and evidence of mottling due to a fluctuation water table indicating wetland soils.				The Dresden and Wasbank soils within the Study Area were found in the upland landscapes used for manly cattle grazing as these soils have restrictions for cultivation due to soil depth. The A-horizons are highly susceptible to erosion due to a lack of vegetation cover and stability. Large Iron and Manganese peds were observed on the surface of the soil. The soil depth of the B-horizon, in the lower-lying areas, increased, exceeding 350 mm, thus qualifying as a Wasbank soil form.			
	Glencoe Soil Form				**Hutton Soil Form**			
Soil Horizon	Orthic A-horizon	Yellow-brown Apedal B-horizon	Hard Plinthic B	 	Orthic A-horizon	Red Apedal B-horizon	Red Apedal B-horizon	 
Soil Horizon	A	B	B		A	B	B	
Average Depth (mm)	0 – 100 mm	100 – 400 mm	>400 mm		0 – 150 mm	150 – 1 200 mm	>1 200 mm	
General Characteristics	Brown, coarse sandy, single grain, loose, many matrix pores, common roots, gradual smooth transition, Fe and Mn peds on the soil surface.	Reddish-brown, coarse sand single grain, loose, many matrix pores, common roots, gradual smooth transition.	Dark red with mottles (wet), clayey fine grain, few matrix pores, few roots.		Dark reddish-brown, medium sandy loam, structureless massive, loose, many matrix pores, many roots, gradual smooth transition.	Red, coarse sandy loam, structureless, massive loose, many matrix pores, common roots, gradual transition.	Red (moist), coarse sandy loam, structureless, massive, friable, many matrix pores, few roots, gradual transition.	
Comment	These soils comprise of a Yellow-brown Apedal B-horizon overlying a Hard Plinthic layer containing an accumulation of iron- and manganese oxides. These soils together with its high clay content and restricted rooting depth prevent free drainage and lower the agricultural potential of the soils. Glencoe soil forms within the Project Area were predominantly shallow and had a restricting layer at 400 mm where the auger hit the Hard-plinthic layer. Large peds of Fe and Mn were				Hutton soil forms are usually deep, uniformly red, sandy (apedal) soils that are well-drained and have low organic carbon content and CEC due to the low clay content. These soils developed from basic parent material (example basalt) and are in an advanced state of weathering and leaching is indicative (Soil Classification Working Group, 1991).			

<table>
<tr><td></td><td colspan="4">evident on the soil surface as well as occurring through the soil profile. These areas were mainly used for grassland and cattle grazing. These shallow soils are not ideal for cultivation due to root development restrictions and low drainage potential.</td><td colspan="4">The Hutton soil forms within the Dorstfontein Project Area were deep, sandy recharge soils with a maize crop cover. The soil profile contained small Iron and Manganese peds, indicating Ferricrete underlying geology. The soils had an increased clay content with depth together with soil wetness.</td></tr>
<tr><td></td><td colspan="4">Kroonstad Soil Form</td><td colspan="4">Longlands Soil Form</td></tr>
<tr><td>Soil Horizon</td><td>Orthic A-horizon</td><td>E-horizon</td><td>G-horizon</td><td rowspan="4">

</td><td>Orthic A-horizon</td><td>E-horizon</td><td>Soft Plinthic B</td><td rowspan="4">

</td></tr>
<tr><td>Soil Horizon</td><td>A</td><td>B</td><td>B</td><td>A</td><td>B</td><td>B</td></tr>
<tr><td>Average Depth (mm)</td><td>0 – 100 mm</td><td>100 - 700 mm</td><td>>700 mm</td><td>0 – 100 mm</td><td>100 - 600 mm</td><td>>600 mm</td></tr>
<tr><td>General Characteristics</td><td>Light yellow-brown, coarse sandy, single grain, loose, many matrix pores, few roots, sandy-loam texture and gradual smooth transition towards B1 horizon.</td><td>Light yellow to bleached (grey), coarse sand single grain, loose, many matrix pores, few roots, sandy-loam, gradual smooth transition.</td><td>Light grey-brown with mottles (wet), sandy-clay-loam, macro matrix pores, few roots.</td><td>Dark brown sandy-loam topsoil with high organic material (many roots), single grain, loose, gradual smooth transition. Signs of wetness within 100 mm</td><td>Light yellow to bleached (grey), very light soil matrix, coarse sand single grain, loose, many matrix pores, many roots, sandy-loam, gradual smooth transition.</td><td>Light soil matrix with red (Fe) and black (Mn) mottles, sandy-clay-loam, high clay content.</td></tr>
<tr><td>Comment</td><td colspan="4">These soils are generally high in clay content with clear signs of mottles within the first 500 mm of the profile (indicating wetland soils). E-horizons are grey, leached, sandy soils with low structure development. They are grey and has a loose consistency. The G horizon has a higher clay content with an accumulation of iron and manganese oxides, known as mottles. These horizons are saturated for long periods, usually contain a fluctuating water table and has noticeable clay accumulation within the G-horizon.

The Kroonstad soil forms within the Dorstfontein Project Area were widespread towards the wetlands and low-lying areas. The soils matrix of these soils was highly leached, low in SOM and light in colour with clear indications of Fe and Mn mottles within the deeper horizons. The</td><td colspan="4">Longlands soils are typically characterised by eluvial horizons (E-horizons) overlying a soft plinthic B-horizon. Eluviation is defined as the down movement (leaching/washing) of suspended material, leaving the soil matrix with a light chroma. The E-horizons are typically very sandy, deep with high porosity. The leached material (consisting of clay, silt and nutrients (Fe, Mn) leached/washes down the soil profile and accumulation of colloidal material (illuviation) in the plinthic-horizon. The plinthic-horizon is high in clay, low permeability and contains high concentrations of nutrients (colloidal material).

The Longlands soils within the Study Area were deep, very sandy and well-vegetated. Signs of wetness (mottles) were observed within the first 100 mm of the soil, indicating wetland soils. The soils were mostly</td></tr>
</table>

	G-horizon contained high amounts of clay with clear signs of a fluctuating water table. The areas containing Kroonstad soil forms were mainly classified as wetlands and used for cattle grazing.			found in the low-lying areas used for cattle grazing. The soils are susceptible to erosion and should be monitored.
	Pinedene Soil Form			
Soil Horizon	Orthic A-horizon	Yellow-brown Apedal B-horizon	Unspecified material with signs of wetness	 
Soil Horizon	A	B	B	
Average Depth (mm)	0 – 100 mm	100 - 500 mm	> 1 200 mm	
General Characteristics	Light yellow-brown, coarse sandy-clay-loam, single grain, loose, many matrix pores, high root volume, sandy-loam texture and gradual smooth transition towards B-horizon.	Light brown to yellow coarse sand single grain, loose, many matrix pores, few roots, sandy-clay-loam, gradual smooth transition to unspecified material.	Light grey-brown with mottles (wet), sandy-clay-loam, macro matrix pores, few roots.	
Comment	These soils are generally fairly deep (70 – 120 centimetre (cm)) and have a loamy-sand texture with up to 8% clay content. The soils are yellow-brown with minor drainage limitations in the upper horizons, however, usually contains very high clayey underlying material, limiting free drainage. Due to these high clay sub-horizons, drainage is limited causing waterlogging and potential for wetland formation. The Pinedene soils of the Project Area were generally high in clay content with clear signs of mottles within the first 500 mm of the profile (indicating wetland soils). The soils were very wet with a high water-holding-capacity. The Yellow-brown Apedal B-horizon had clear indications of wetness with increasing clay content with depth. The soils in the B2 horizon were very wet and leached with a greyish soil matrix and red, yellow and black mottles.			

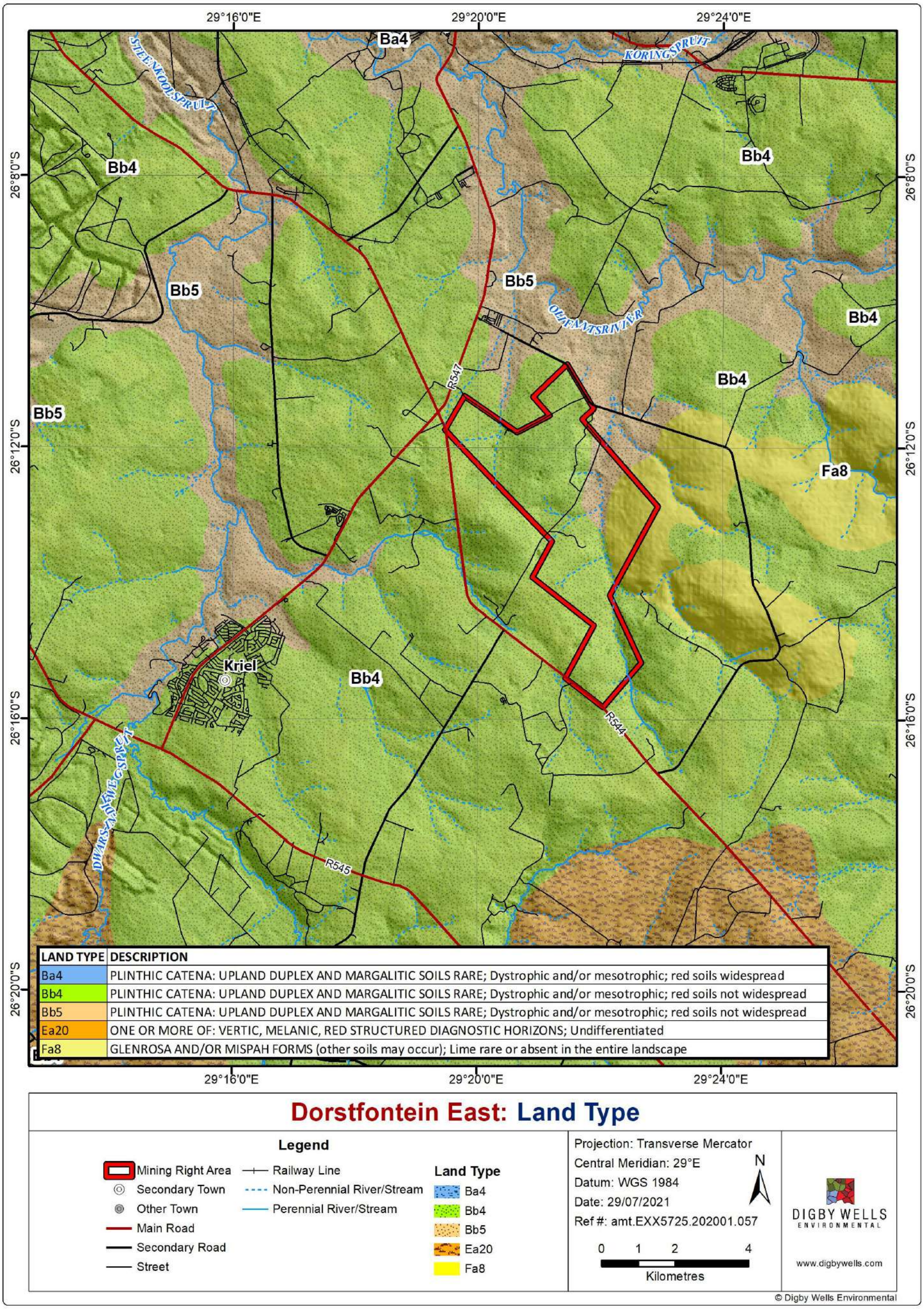


Figure 6-6: Land Types in the Project Area

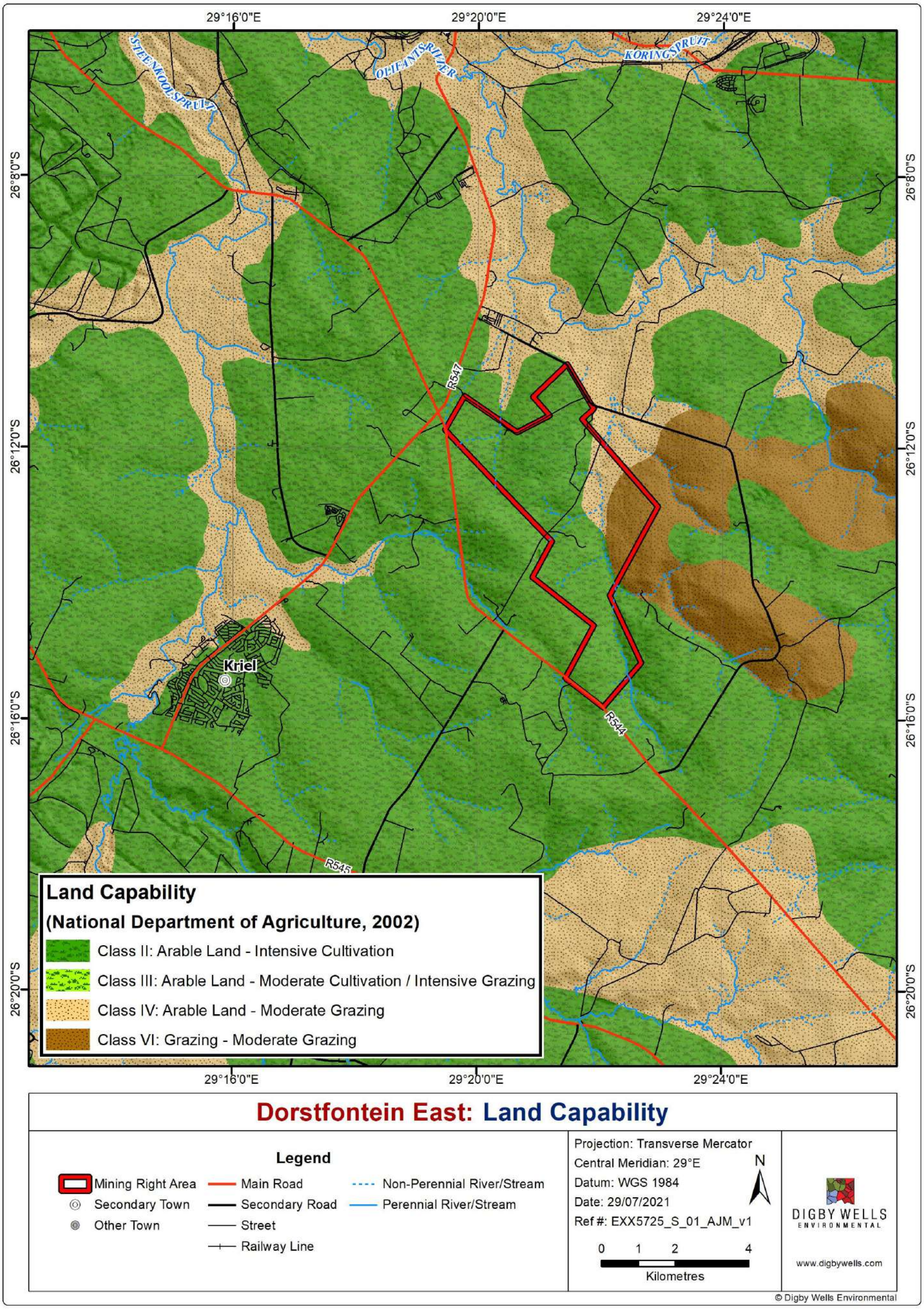


Figure 6-7: Land Capability in the Project Area

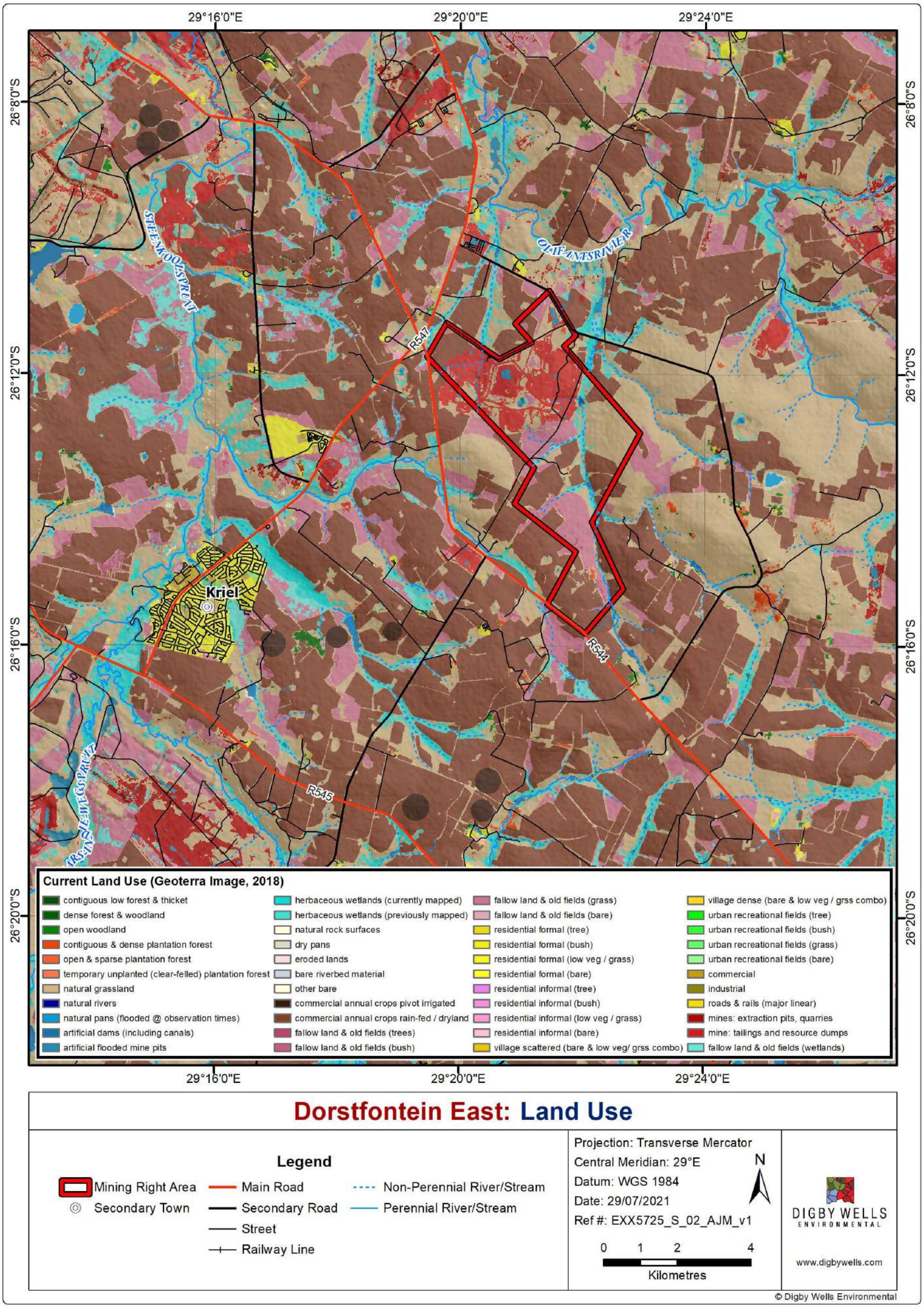


Figure 6-8: Land Uses in the Project Area

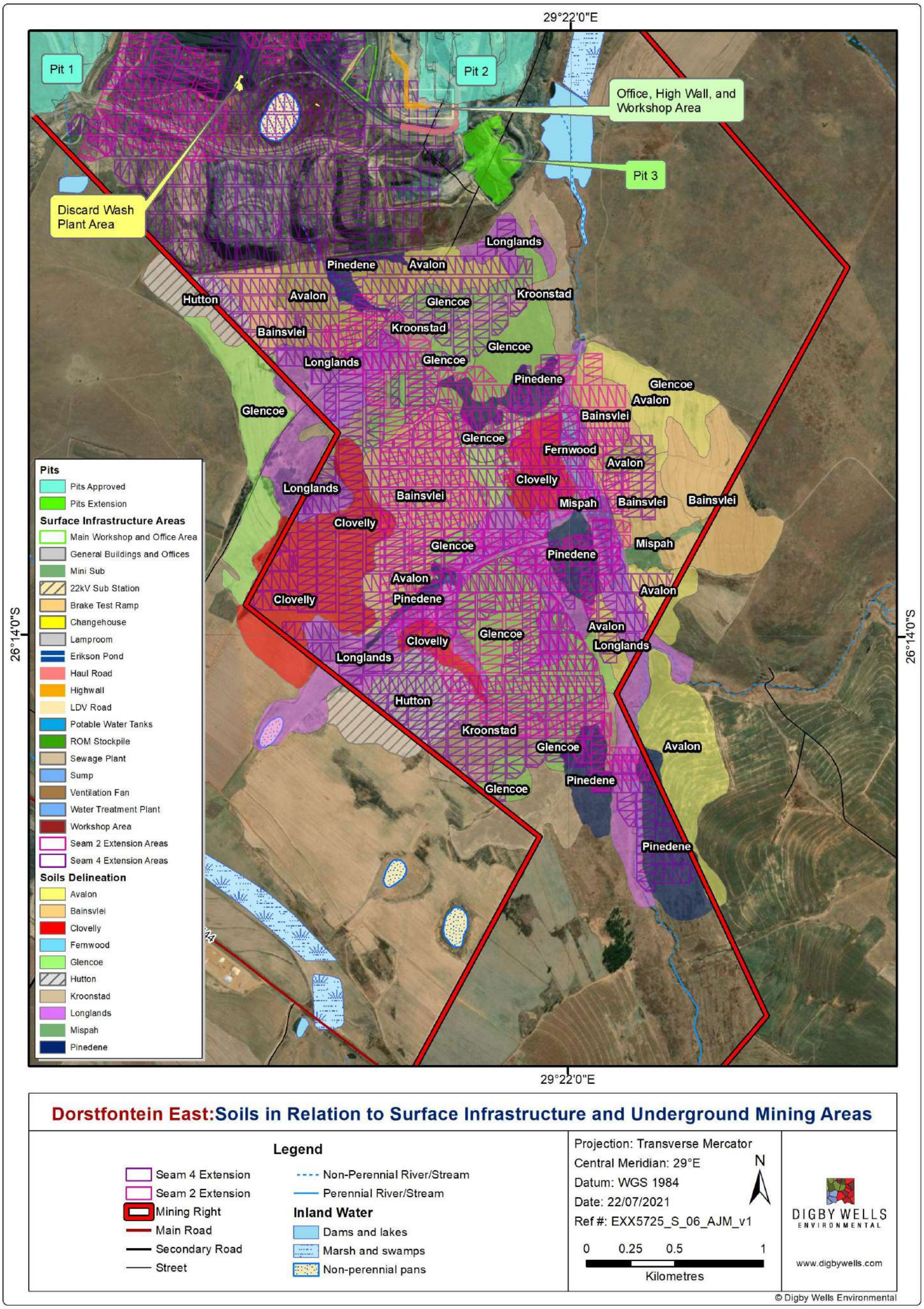


Figure 6-9: Soil Form Delineation in the Project Area

6.5. Groundwater

The groundwater system in the Mpumalanga coalfields is composed of three distinct superimposed aquifers. Hodgson *et al.* (1998) have classified the aquifer systems in the following manner:

- The upper weathered Ecca aquifer;
- The fractured Karoo aquifers within the unweathered Ecca sediments; and
- The aquifer below the Ecca sediments (the fractured pre-Karoo aquifer).

For the weathered zone, water strikes were encountered between 2-25 mbgl corresponding to the weathered aquifer. While for the fractured rock units intersected in the boreholes water strikes were observed frequently for depths between 25-57 mbgl corresponding to the fractured Karoo (Ecca) aquifer. None of the boreholes were drilled into the deeper lying fractured pre- Karoo aquifer.

6.6. Geochemistry and Waste Classification

A geochemical characterisation and waste classification at the DECM were undertaken and included in the Groundwater Impact Assessment.

A total of six discard samples were made available for testing with five samples weighing at least 1 kg and the sixth sample weighing 6 kg. The five samples were sent for static testing analyses, X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF) and Sulphur Speciation (SS%), Acid-Base Accounting (ABA), Net Acid Generation (NAG) and paste-pH analyses. The 6kg sample was sent for sub-aerial column leach testing.

The mineralogy for all the samples detected kaolinite as a dominant mineral (ranging between 46 and 71 wt. %). This is a common clay mineral formed through the breakdown of minerals like alkali-feldspar. Lizardite was also detected in trace amounts of 0.4 wt. % and this form part of the Kaolin-Serpentine group. There was also illite detected which part of a group of non-expanding clay minerals and commonly found in soils, clay-rich sedimentary rocks and low-grade metamorphic rocks. No acid-forming minerals were detected but acid neutralising minerals like dolomite (excluding Discard 4) were detected ranging between 1 and 9 wt. % and aragonite (calcite polymorph) only in Discard 4 and 5 at 2.1 and 2.4 wt. % respectively.

Paste-pH of all samples are neutral, Discard 1, Discard 3 and Discard 5 Sulphide-Sulphur (S2-S%) results show that they are above 0.3% at 0.32, 0.56 and 0.64% respectively. The above recommended 0.3% normally indicates acid-generation potential if the sulphide sulphur is above 0.3% (Soregaroli & Lawrence, 1998). Net Neutralising Potential (NNP) is positive indicating that there are more neutralising minerals than acid-forming ones. The overall results indicate that Discard 1, Discard 2, Discard 3 and Discard 5 samples are Non-Acid Forming (NAF). Discard 4 demonstrates the uncertainty of whether it has the acid-forming potential or not. This is due to acid-neutralising minerals being equivalent to the acid-forming minerals and once acid neutralising minerals are depleted acid generation potential increases and the extent of this increase leads to the unclear conclusion form the available static results for this sample.

6.7. Floodline Determination

6.7.1. Peak Flows

Catchments were delineated for river systems draining the area and two of these are relevant to the DECM surface infrastructure development site (Figure 6-10). Results from the RM3 method were used in hydraulic modelling since these were representative of the area due to site-specific runoff coefficients which were generated using an in-built RM3 module. The MIPI results helped in the selection of suitable peak flows because these were of the same order of magnitude to the RM3 method. The Standard Design Flood (SDF) results were deemed an over-estimate of peak flows for the site probably due to high regionalised runoff coefficients. Calculated peak flows are presented in Table 6-4.

Table 6-4: Calculate Peak Flows for Streams at the DECM

Catchment	RM3		SDF		MIPI	
	1:50yr	1:100yr	1:50yr	1:100yr	1:50yr	1:100yr
	(m³/s)					
CB1	60.2	81.7	150.4	190.4	71.9	90.8
CB2	168.9	229.4	329.6	417.4	162.4	205.2

6.7.2. Floodlines

The modelled 1:50-year and 1:100-year indicate that none of the proposed infrastructure falls within the floodwater way. The proposed infrastructure will be constructed within already disturbed areas and will therefore, be outside the 1:50-year and 1:100-year floodlines. See Figure 6-11.

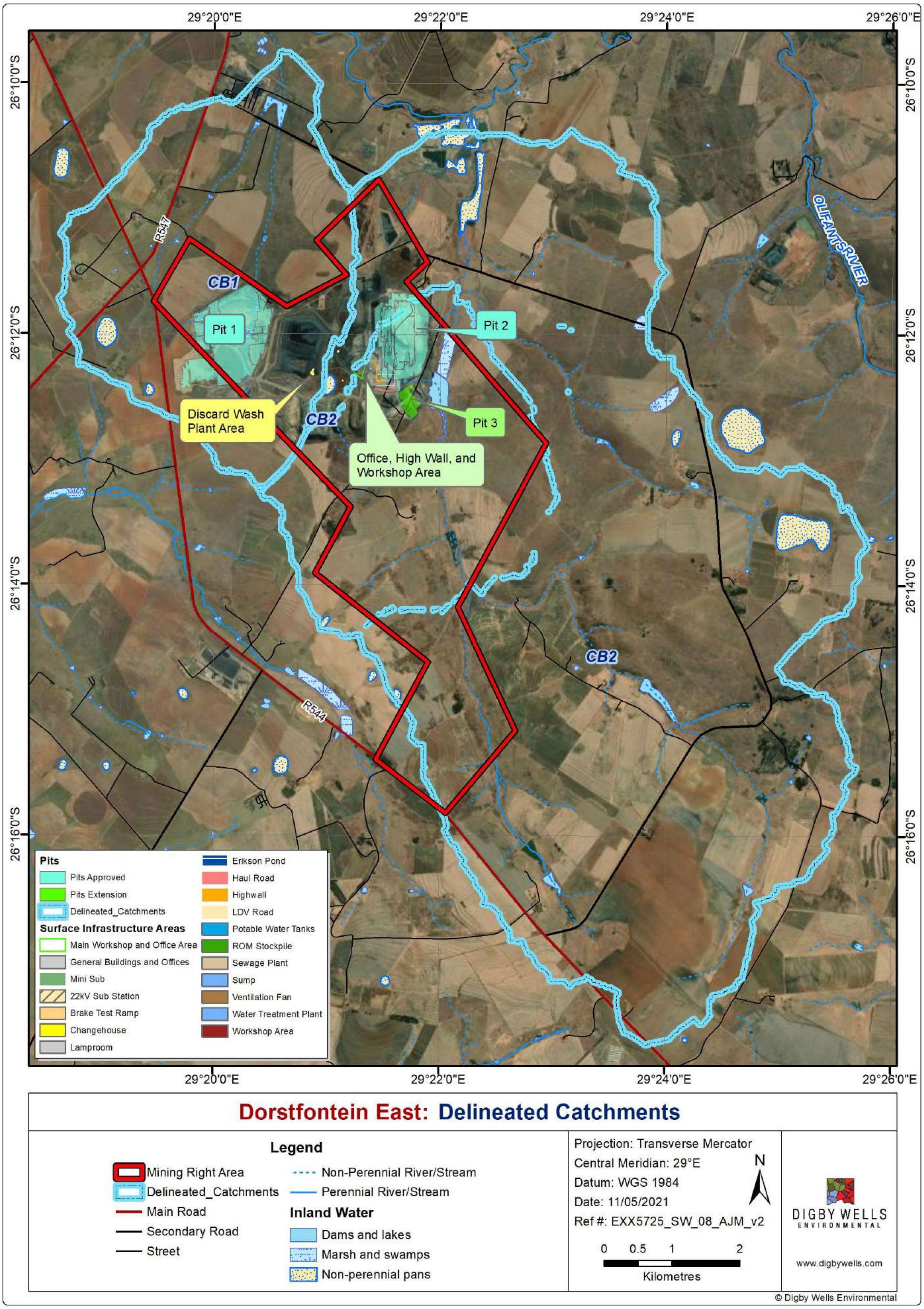


Figure 6-10: Delineated Sub-catchments in the Project Area

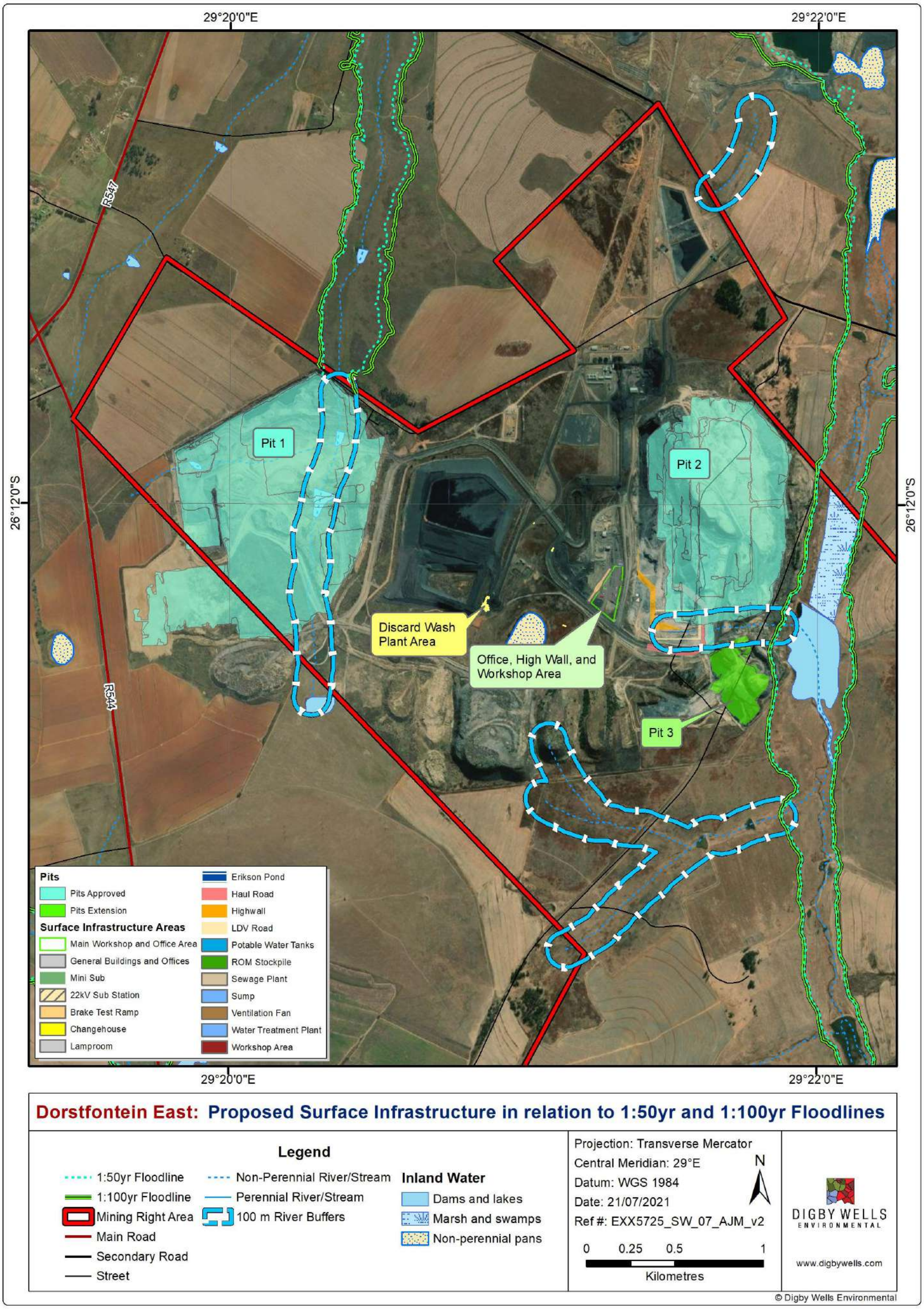


Figure 6-11: 1:50-year and 1:100-year Floodlines for Rivers in the Project Area

6.8. Water Quality

The historical water quality data for the DECM was sourced from existing Aquatico Water Quality Assessment Reports for the site (Aquatico, 2019). The limits stipulated by the DECM WUL (number: 04/B11B/ACGIJ/957) for Water Resource Protection were used to benchmark water quality for the DECM. In addition, the South African Water Quality Guidelines: Aquatic Ecosystems (DWAF, 1996) was also included for comparison purposes as the DWS' mandate also requires it to protect the health and integrity of aquatic ecosystems.

6.8.1. Existing Water Quality Monitoring at the DECM

6.8.1.1. Existing Water Quality Monitoring Points

Existing surface water monitoring localities and their descriptions at the DECM are presented in Table 6-5.

Table 6-5: Existing Surface Water Monitoring Localities at DECM

Locality	Description	Coordinates	
DCM East Surface Water			
DCM06	Upstream of Western tributary	S26.2183	E29.3676
DCM07	Downstream of Western tributary	S26.1907	E29.3688
DCM08	Pond downstream of Pit 1	S26.1939	E29.3395
ED01	Erichsen Dam 1	S26.1925	E29.3541
ED02	Erichsen Dam 2	S26.1925	E29.3543
ED03	Erichsen Dam 3	S26.1926	E29.3546
MP01	Downstream on western tributary of the Olifants River	S26.1714	E29.34
MP02	Downstream on western tributary of the Olifants River	S26.1728	E29.343
MP03	Bridge upstream of the old Transvaal Navigation Colliery	S26.1365	E29.345
MP04	Confluence of MP01 and MP02 tributaries with the Olifants River	S26.1555	E29.3436
MP05	Downstream of Transvaal Navigation Colliery	S26.1694	E29.3568
MP06	Upstream of mining activities on the Olifants River	S26.1681	E29.3746
Pan	Pan	S26.2054	E29.3504
PCD01	Pollution control dam 1	S26.1855	E29.3593
PCD02	Pollution control dam 2	S26.1861	E29.36
PCD03	Pollution control dam 3	S26.1878	E29.3597
RWDF	Return water discard facility	S29.3430	E29.3430
DCM East Sewage			
SOE	Sewage effluent (East)	S26.1932	E29.3565
DCM East Potable Water			
Potable water East	Potable water	S26.1935	E29.354
AM1	Andru Mining 1	S26.2014	E29.3545
AM2	**Andru Mining 2**	S26.1924	E29.3549
KW1	**Kwena Workshop 1**	S26.1931	E29.3550
KW2	**Kwena Workshop 2**	S26.1931	E29.3550
SLK	**SGS Lab Kitchen**	S26.1935	E29.3545
OFK	**Office Kitchen**	S26.1932	E29.3542
ECBH	Emalayinini Community Borehole	S26.1820	E29.3257
DCM East Pit Water			
MPW01	Mining Pit Water (Pit 1)	S26.2027	E29.3373
MPW03	Mining Pit Water (Pit 2)	S26.2091	E29.3614

6.8.1.2. Results from the Existing Water Quality Monitoring

Sampling localities which include DCM07, MP02 and DCM06 were dry during the sampling period to June 2019 and therefore, these could not be sampled. Average quarterly results for the analyses performed on the sampled localities are presented in Table 6-6.

Based on the calculated average for the monitoring period to June 2019, the general physical quality of the surface water in the DECM area can be described as acidic (DCM08c & MP01), neutral and alkaline (Pan), non-saline to very saline (TDS 249 mg/l to 2 378 mg/l with an overall average of 596.8 mg/l, classified as saline) and soft to very hard (total hardness of 62 mg/l to 423 mg/l with an overall average of 189 mg/l classified as moderately hard).

The average physico-chemical quality of the water from locality DCM06 could be described as neutral, non-saline and hard. The DECM WUL Water Resource limits were exceeded by the quarterly average pH value, as well as the concentrations of sodium and chloride. The limits stipulated by the South African Water Quality Guidelines (SAWQG) for Aquatic Ecosystems were exceeded by the average fluoride, aluminium and chromium concentrations during this quarter. The water quality can therefore be classified as good (Class 1) for domestic use (WRC, 1998).

The physico-chemical quality of the water from locality DCM08c in May 2019 could be described as acidic, non-saline and moderately soft. The DECM WUL Water Resource limits were exceeded by the quarterly average pH value. Both the WUL and the limits stipulated by the SAWQG for Aquatic Ecosystems were exceeded by the aluminium and manganese concentration, while the SAWQG for Aquatic Ecosystems were exceeded by the average chromium concentration during the quarterly period. The water quality can therefore be classified as marginal (Class 2) for domestic use (WRC, 1998).

At locality MP01, the water could be described as acidic, non-saline and moderately soft. The DECM WUL Water Resource limits were exceeded by the quarterly average pH value while both the WUL limits and the limits stipulated by the SAWQG for Aquatic Ecosystems were exceeded the average concentrations of aluminium and manganese and the SAWQG for Aquatic Ecosystems was exceeded by the average chromium concentration. Accordingly, the quarterly average water quality may be classified as marginal (Class 2) for domestic use (WRC, 1998).

The average concentrations of sodium recorded for localities MP03, MP04, MP05 and MP06 exceeded the limits stipulated by the water use license. The WUL limits were further exceeded by the quarterly average chloride concentrations calculated for MP03, MP04 and MP05 Pan. The average water qualities of these localities are very similar with neutral, non-saline and moderately hard to hard (MP03) physico-chemical properties. The water quality of these localities may be classified as ideal (Class 0; MP04 & MP05), good (Class 1; MP03 & MPP06) for domestic use (WRC, 1998).

The average pH value and concentrations of pH levels, TDS, sodium and chloride calculated for the Pan locality exceeded the limits stipulated by the WUL, while a high average fluoride concentration and aluminium and chromium concentrations exceeded the Aquatic Ecosystems guideline.

Table 6-6: Average Quarterly Water Quality Results for the DECM (June 2019)

VARIABLE	UNITS	DCM East WUL Water Resource Limits	SAWQG TWQGR for Aquatic Ecosystems	MONITORING LOCALITIES							
				DCM06	DCM08c	MP01	MP03	MP04	MP05	MP06	Pan
pH @ 25°C	pH	6.5/8.4	-	8.44	5.3	5.5	8	8.2	8.13	7.87	9.4
Electrical conductivity (EC) @ 25°C	mS/m	-	-	64.9	37.1	35.8	62.2	53.3	52.5	50.9	319
Total hardness	mg CaCO3/l	-	-	211	65	62	225	182	175	175	423
Total Dissolved solids @ 180°C	mg/l	-	-	441	254	249	415	357	347	331	2378
Calcium (Ca)	mg/l	-	-	24	13	13	41.7	34.3	32.3	35	22.3
Magnesium (Mg)	mg/l	-	-	37	8	7.33	29.3	23.3	23	21.3	89.3
Sodium (Na)	mg/l	21.12	-	64.4	14	14	42	38	38	35.3	690
Potassium (K)	mg/l	-	-	9.54	26	26	7.07	6.7	6.63	6.13	4.57
Total alkalinity	mg CaCO3/l	-	-	288	2.5	2.5	180	155	152	169	1400
Chloride (Cl)	mg/l	25	-	39.7	24	24.7	26	25.7	25.7	21	277
Sulphate (SO_4)	mg/l	400	-	25.5	119	105	115	87	84	71	152
Nitrate (NO_3) as N	mg/l	-	-	0.066	0.05	0.067	0.05	0.05	0.05	0.133	0.05
Ammonium (NH_4) as N	mg/l	-	-	0.274	4.5	4.23	0.133	0.083	0.083	0.117	0.233
Orthophosphate (PO_4) as P	mg/l	-	-	0.053	0.05	0.05	0.05	0.05	0.05	0.05	0.833
Fluoride (F)	mg/l	-	0.75	0.9	0.5	0.333	0.633	0.633	0.7	0.867	3.4
Aluminium (Al)	mg/l	0.18	0.005	0.034	0.2	0.508	0.05	0.05	0.05	0.05	0.154
Iron (Fe)	mg/l	-	-	0.038	0.066	0.717	0.013	0.034	0.039	0.062	0.216
Manganese (Mn)	mg/l	0.18	0.18	0.039	1.34	1.31	0.018	0.013	0.042	0.013	0.03
Chromium (Cr)	mg/l	-	0.007	0.009	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Sodium Adsorption Ratio	SAR	-	-	1.94	0.8	0.8	1.2	1.2	1.23	1.17	14.67
Bicarbonate alkalinity	mg CaCO3/l	-	-	269	5	2.5	180	155	163	181	929
Carbonate alkalinity	mg CaCO3/l	-	-	20.1	-	2.5	2.5	2.5	2.5	2.5	472
Langelier Saturation Index	LSI	-	-	0.59	-4.6	-4.37	0.33	0.33	0.27	0.15	2.23
Calcium hardness	mg CaCO3/l	-	-	60	33	32	104	86	81	87	56
Magnesium hardness	mg CaCO3/l	-	-	152	32	30	121	96	94	88	367

A general overview of constituent parameters that add up to the overall TDS concentration of the Pan monitoring locality is presented in Figure 6 11. Based on these results, the high salinity of the Pan is dominated by sodium and alkalinity. The water quality of the Pan may be classified as poor (Class 3) for domestic use (WRC, 1998).

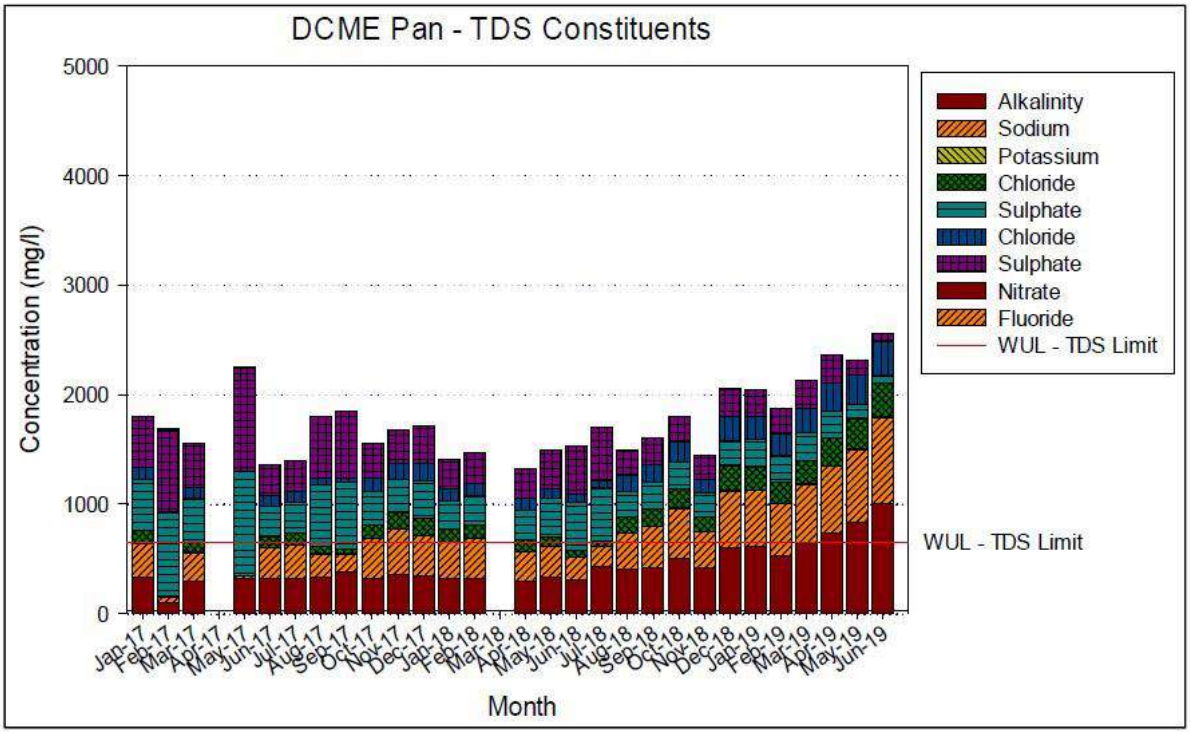


Figure 6-12: Concentration of TDS and its Constituents in the DECM Pan (January 2017 - June 2019)

6.8.2. Water Quality Upstream and Downstream of the Olifants River

Spatial assessment tables were used to compare upstream and downstream sampling localities. These tables quantify potential impacts observed from the upstream aquatic environment towards the downstream environment by highlighting any variable concentrations which can be assumed to be contributions to the total degradation (in red) or improvement (indicated in green) of downstream water quality by the mine situated between these two localities or any other potential contributor residing between them. This does not necessarily mean the contribution of any parameter exceeded the permissible concentration of that variable but is merely an indication of change in concentration.

Table 6-7 compares the average qualities recorded for localities MP03 (locality upstream of the old Transvaal Navigation Colliery) and MP05 (downstream of the old Transvaal Navigation Colliery). There were slight increases on some of the variables in a downstream direction, but on the concentration of many variables there was an improvement or no change at all.

Table 6-7: Water Quality Upstream and Downstream of the Olifants River for Locality MP03 and MP05 (April to June 2019)

VARIABLE	UNIT	DCM East WUL Water Resource Limits	Locality		CALCULATED CHANGE
			Upstream	Downstream	
			MP03	MP05	
pH @ 25°C	pH	6.5/8.4	8	8.13	0.13
Electrical conductivity (EC) @ 25°C	mS/m	-	62.2	52.5	-9.7
Total Dissolved solids @ 180°C	mg/l	650.0 mg/l	415	347	-68
Total hardness	mg CaCO3/l	-	225	175	-50
Calcium (Ca)	mg/l	-	41.7	32.3	-9.4
Magnesium (Mg)	mg/l	-	29.3	23	-6.3
Sodium (Na)	mg/l	21.12 mg/l	42	38	-4
Potassium (K)	mg/l	-	7.07	6.63	-0.44
Total alkalinity	mg CaCO3/l	-	180	152	-28
Chloride (Cl)	mg/l	25.0 mg/l	26	25.7	-0.3
Sulphate (SO_4)	mg/l	400.0 mg/l	115	84	-31
Nitrate (NO_3) as N	mg/l	-	*0.05*	*0.05*	0
Ammonium (NH_4) as N	mg/l	-	0.133	*0.083*	-0.05
Orthophosphate (PO_4) as P	mg/l	-	*0.05*	*0.05*	0
Fluoride (F)	mg/l	-	0.633	0.7	0.067
Aluminium (Al)	mg/l	0.18 mg/l	*0.05*	*0.05*	0
Iron (Fe)	mg/l	-	*0.013*	0.039	0.026
Manganese (Mn)	mg/l	0.18 mg/l	*0.018*	*0.042*	0.024
Chromium (Cr)	mg/l	-	*0.013*	*0.013*	0
Sodium Adsorption Ratio	SAR	-	1.2	1.23	0.03
Bicarbonate alkalinity	mg CaCO3/l	-	180	163	-17
Carbonate alkalinity	mg CaCO3/l	-	*2.5*	*2.5*	0
Langelier Saturation Index	LSI	-	0.33	0.27	-0.06
Calcium hardness	mg CaCO3/l	-	104	81	-23
Magnesium hardness	mg CaCO3/l	-	121	94	-27

When comparing MP06 to locality MP03 (the furthest upstream and furthest downstream localities monitored), slight increases in the average concentrations of some of the variables are observed (Table 6-8). This is not unexpected as the concentrations of dissolved substances do generally increase as they are carried downstream by the flow of the river.

Table 6-8: Water Quality Upstream and Downstream of the Olifants River for Locality MP06 and MP03 (April to June 2019)

VARIABLE	UNIT	DCM East WUL Water Resource Limits	Locality		CALCULATED CHANGE
			Upstream	Downstream	
			MP06	MP03	
pH @ 25°C	pH	6.5/8.4	7.87	8	0.13
Electrical conductivity (EC) @ 25°C	mS/m	-	50.9	62.2	11.3
Total Dissolved solids @ 180°C	mg/l	650.0 mg/l	331	415	84
Total hardness	mg CaCO3/l	-	175	225	50
Calcium (Ca)	mg/l	-	35	41.7	6.7
Magnesium (Mg)	mg/l	-	21.3	29.3	8
Sodium (Na)	mg/l	21.12 mg/l	35.3	42	6.7
Potassium (K)	mg/l	-	6.13	7.07	0.94
Total alkalinity	mg CaCO3/l	-	169	180	11
Chloride (Cl)	mg/l	25.0 mg/l	21	26	5
Sulphate (SO_4)	mg/l	400.0 mg/l	71	115	44
Nitrate (NO_3) as N	mg/l	-	*0.133*	*0.05*	-0.083
Ammonium (NH_4) as N	mg/l	-	*0.117*	0.133	0.016
Orthophosphate (PO_4) as P	mg/l	-	*0.05*	*0.05*	0
Fluoride (F)	mg/l	-	0.867	0.633	-0.234
Aluminium (Al)	mg/l	0.18 mg/l	*0.05*	*0.05*	0
Iron (Fe)	mg/l	-	0.062	*0.013*	-0.049
Manganese (Mn)	mg/l	0.18 mg/l	*0.013*	*0.018*	0.005
Chromium (Cr)	mg/l	-	*0.013*	*0.013*	0
Sodium Adsorption Ratio	SAR	-	1.17	1.2	0.03
Bicarbonate alkalinity	mg CaCO3/l	-	181	180	-1
Carbonate alkalinity	mg CaCO3/l	-	2.5	2.5	0
Langelier Saturation Index	LSI	-	0.15	0.33	0.18
Calcium hardness	mg CaCO3/l	-	87	104	17
Magnesium hardness	mg CaCO3/l	-	88	121	33

6.8.3. Additional Sampling in Adjacent Rivers

A site visit was undertaken on 5 February 2020 to assess the condition of the Project Area with respect to surface water resources and to sample streams close to the Project Area.

6.8.3.1. Sampling Points

The assessment and interpretation of surface water quality was undertaken for five points on the Olifants River and its tributaries upstream and downstream of the DECM to cover the proposed extension of the mine. The surface water quality results and coordinates of sampling points are presented in Table 6-9. The water quality was benchmarked against the DECM WUL and the Aquatic Ecosystems water quality guidelines (DWA, 1996).

6.8.3.2. Results of the Additional Water Quality Sampling Points

The following interpretations are made based on the laboratory results obtained for the five sites:

- The water quality was analysed for five sampling points namely, UPSW1, UPSW2, WPSW3, UWBSW4 and DWBSW5. As per the DECM Water Resource WUL, the concentration of pH, Cl, SO4 and Al for all the sampled sites fall within the acceptable DECM WUL limit. Sodium concentration at sites UPSW1, UPSW2 and UWBSW3 and DWBSW5 lies above the acceptable DECM WUL limits. This elevated sodium concentrations possibly come from grazing animals in the area or from mining residues;
- The TDS concentration for site DWBSW5 has exceeded the DECM WUL limit with a possible source being activities of grazing animals in the area. Fluoride at site UPSW4 lies above the acceptable SAWQG for Aquatic Ecosystem but complies at all other monitoring sites; and
- The concentrations of Zinc and Aluminium lie above the acceptable SAWQG for Aquatic Ecosystem. High natural levels of zinc in river water are usually associated with higher concentrations of other metals such as lead and cadmium which are, however, below detection levels at this mine. Possible sources of elevated Zinc can be coal mining activities in the area. Although Aluminium levels exceed the SAWQG for Aquatic Ecosystem, the parameter is within the DECM WUL standard.

Table 6-9: Surface Water Quality Results (February 2020)

Parameter (mg/L)	UPSW1	UPSW2	WPSW3	UWBSW4	DWBSW5	DCM East WUL Water Resource Limits	SAWQG TWQR for Aquatic Ecosystem
	-26.253284; 29.405361	-26.278296; 29.387332	-26.231964; 29.329921	-26.280835; 29.316266	-26.229095; 29.290761		
pH	7.5	8.1	7.6	7.4	7.6	6.5 to 8.4	NS
Electrical Conductivity	42.3	82.7	63.3	42.9	79.6	NS	NS
Total Dissolved Solids	374	546	548	402	730	650	NS
Suspended Solids	6.7	9.3	20	39	14.0	NS	NS
Total Alkalinity as CaCO3	160	452	280	160	292	NS	NS
P-Alkalinity as CaCO3	<5	<5	<5	<5	<5	NS	NS
Chloride as Cl	13	4	24	25	16	25	NS
Sulphate as SO4	35	43	48	44	154	400	NS
Fluoride as F	0.5	0.3	0.7	1.0	0.7	NS	0.75
Nitrate as N	2.8	0.2	0.2	0.2	0.2	NS	NS
Nitrite as N	<0.05	<0.05	<0.05	0.1	<0.05	NS	NS
Bromide as Br *	2.1	1.2	3.7	3.0	2.3	NS	NS
Total Phosphate as P	<0.2	<0.2	<0.2	<0.2	<0.2	NS	NS
Free & Saline Ammonia as N	0.2	0.2	0.2	0.3	0.2	NS	NS
Silver	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Aluminium	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	0.18	0.005
Arsenic	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	0.01
Gold	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Boron	0.026	0.014	0.015	0.013	0.006	NS	NS
Barium	0.100	0.085	0.075	0.108	0.098	NS	NS
Beryllium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Bismuth	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Calcium	43	80	45	30	74	NS	NS
Cadmium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	0.0004
Cerium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Cobalt	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Chromium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	0.007
Caesium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Copper	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	0.0014
Iron	0.029	< 0.025	0.100	0.553	< 0.025	NS	NS
Gallium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Mercury	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Potassium	4.8	4.2	8.0	5.3	6.1	NS	NS
Lanthanum	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Lithium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Lutetium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Magnesium	16	57	45	21	55	NS	NS
Manganese	< 0.025	< 0.025	1.13	2.25	< 0.025	0.18	0.18
Molybdenum	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Sodium	22	27	20	25	23	21.12	NS
Nickel	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Osmium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Phosphorus	< 0.010	< 0.010	< 0.010	< 0.010	0.032	NS	NS
Lead	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	0.0012

Parameter (mg/L)	UPSW1	UPSW2	WPSW3	UWBSW4	DWBSW5	DCM East WUL Water Resource Limits	SAWQG TWQR for Aquatic Ecosystem
	-26.253284; 29.405361	-26.278296; 29.387332	-26.231964; 29.329921	-26.280835; 29.316266	-26.229095; 29.290761		
Palladium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Praseodymium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Platinum	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Rubidium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Rhodium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Ruthenium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Antimony	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Scandium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Selenium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	0.002
Terbium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Tellurium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Thorium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Thulium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Uranium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Vanadium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS
Zinc	0.062	0.057	0.019	0.035	0.012	NS	0.002
Zirconium	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	NS	NS

KEY:	
Exceeds the standard	(green)
No Standard	NS

6.9. Ecology

The field investigation that was conducted in April 2021 concluded that the vegetation habitats within the Project Area include grasslands, wetlands and modified areas. A desktop baseline environmental assessment was conducted and results are discussed in Table 6-10 below. This includes wetland baselines.

Table 6-10: Ecological Baseline Summary

Bioregional Context (Darwell, Smith, Tweddle, & Skelton, 2009)		**Characteristics of the Highveld Ecoregion** (Kleynhans, Thirion, & Moolman, 2005)		**Plant Species Characteristic of the Eastern Highveld Grasslands** (Mucina & Rutherford, 2012)	
Political Region	Mpumalanga	Terrain Morphology	Plains; Low Relief; Plains; Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to high Relief Closed Hills. Mountains; Moderate and High Relief.	Graminoid Species	*Aristida aequiglumis, A. congesta, A. junciformis subsp. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. capensis, E. curvula, E. gummiflua, E. patentissima, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata* subsp. *eckloniana andropogon appendiculatus, A. schirensis, Bewsia biflora, Ctenium concinnum, Diheteropogon amplectens, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyrium sanguineum, Setaria nigrirostris, Urelytrum agropyroides.*
Level 1 Ecoregion	Highveld	Vegetation Types (Figure 6-13)	Mixed Bushveld (limited); Rocky Highveld Grassland; Dry Sandy Highveld Grassland; Dry Clay Highveld Grassland; Moist Cool Highveld Grassland; Moist Cold Highveld Grassland; North Eastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Patches Afromontane Forest (very limited).	Herb Species	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides* subsp. *latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata.*
Climate	The climate is characterised by a temperate climate with hot summers and cold, dry winters. During the summer months (December, January and February), the average daily temperature is 27°C. In winter (June, July and August), the daily average temperature is 4°C. Most (65%) of the rainfall in the area occurs during the summer, largely as thunderstorms. The rainfall averages between 700 and 750 mm per annum.			Geophytic Herb Species	*Gladiolus crassifolius, Haemanthus humilis subsp. hirsutus, Hypoxis rigidula* var. *pilosissima, Ledebouria ovatifolia.*
Freshwater Ecoregion	Southern Temperate Highveld	Altitude (mamsl.) (modifying)	1 100-2 100, 2 100-2 300 (very limited)		
Geomorphic Province	Mpumalanga Highlands	MAP (mm) (Secondary)	400 to 1 000	Succulent Herb Species	*Aloe ecklonis.*
Vegetation Type	Eastern Highveld Grassland	Coefficient of Variation (% MAP)	<20 to 35	Low Shrub Species	*Anthospermum rigidum* subsp. *pumilum, Seriphium plumosum.*
WMA	Olifants	Rainfall Seasonality	Early to late summer	Status	Vulnerable.
Sub-WMA	Upper Olifants	Mean Annual Temp. (°C)	12 to 20	**Mpumalanga Biodiversity Sector Plan (MBSP) Category (MTPA, 2014) (Figure 6-14)**	

<table>
<tr><td>Secondary Catchment</td><td>B1</td><td>Mean Daily Summer Temp. (°C): February</td><td>10 to 32</td><td colspan="2" rowspan="2">Critical Biodic=versity Area (CBA) irreplaceable;
CBA optimal;
Ecological Support Area (ESA) local corridor;
Other natural areas;
Moderately modified and old lands; and
Heavily modified areas.</td></tr>
<tr><td>Quaternary Catchment (Error! Reference source not found.)</td><td>B11B and B11D</td><td>Mean Daily Winter Temp. (°C): July</td><td>-2 to 22</td></tr>
<tr><td>Watercourse</td><td>Olifants and Steenkoolspruit Watershed</td><td>Median Annual Simulated Runoff (mm)</td><td>5 to >250</td><td colspan="2">National Freshwater Ecosystems Priority Areas (NFEPA) Wetland Classification (Nel, et al., 2011)</td></tr>
<tr><td colspan="4">Mining and Biodiversity Guideline Category, DEA (2013) (Figure 6-17)</td><td>NFEPA Wetlands (Figure 6-15)</td><td>Channelled valley bottoms, Unchanneled valley bottoms, floodplains and seeps.</td></tr>
<tr><td colspan="4">B: Highest Biodiversity Importance – Highest Risk for Mining; and
D. Moderate Biodiversity Importance – Moderate Risk for Mining.</td><td>River Freshwater Ecosystem Priority Areas (FEPA) (Figure 6-16)</td><td>Not a FEPA catchment, classified as a Sub-quaternary catchment.</td></tr>
<tr><td>Topography</td><td colspan="3">The topography is that of undulating plains and gentle slopes. It is located on the Highveld plateau and the Project Area lies between 1515 and 1660 mamsl. Drainage occurs predominantly in a northern direction of the Project Area. Valley slopes are generally flat with gradients between 1:20 and 1:40. Slopes steeper than this gradient is found near rivers in the Project Area.</td><td>Geology</td><td>The Project Area is situated in the Witbank coalfield within the Karoo Supergroup. The Karoo Supergroup within the Project Area comprises the Ecca Group as well as the Vryheid Formation. The Ecca Group is where rich coal deposits are found.
The lithology can be stratigraphically classified and includes sandstone, shale and coal.</td></tr>
</table>

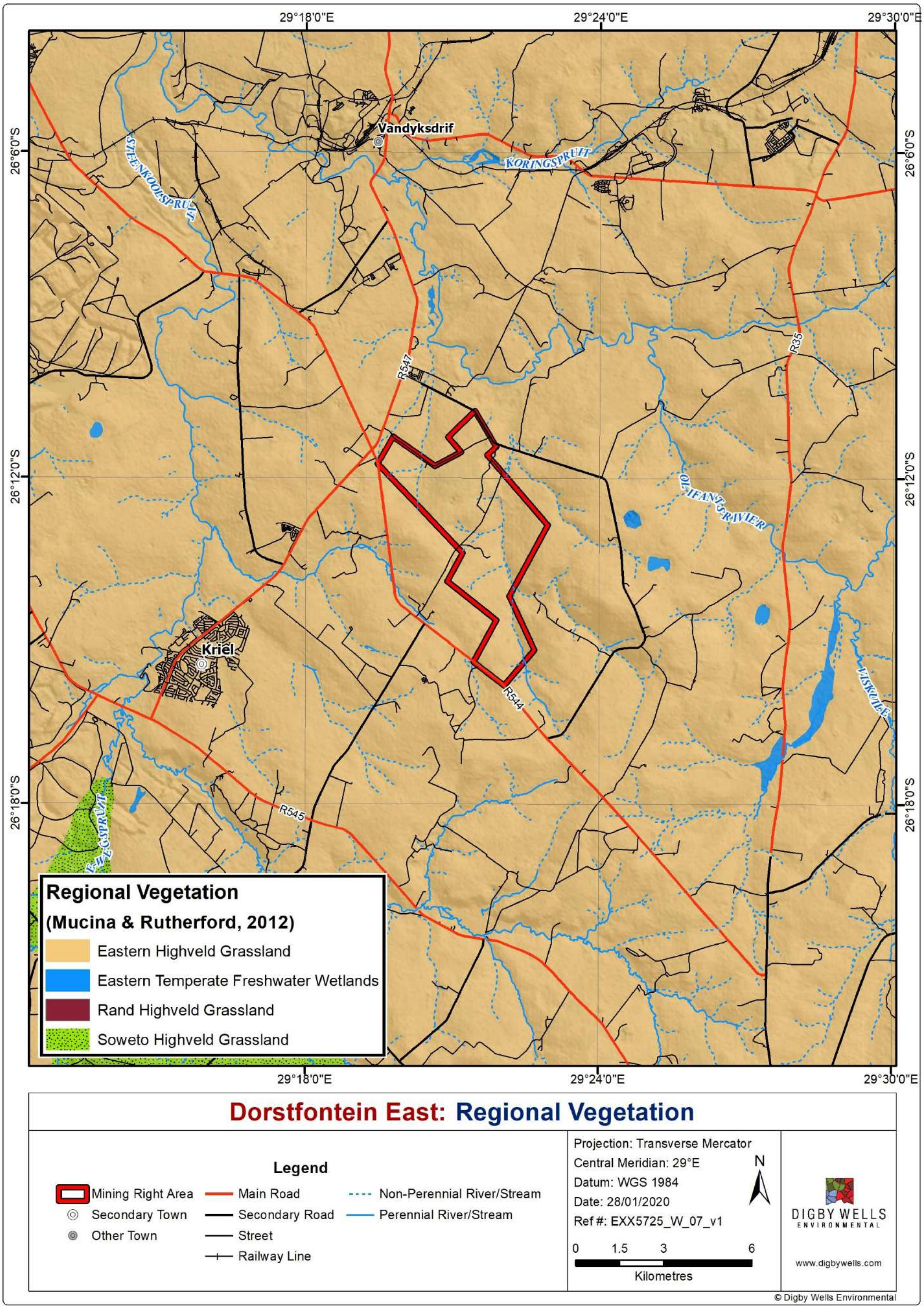


Figure 6-13: Regional Vegetation in the Project Area

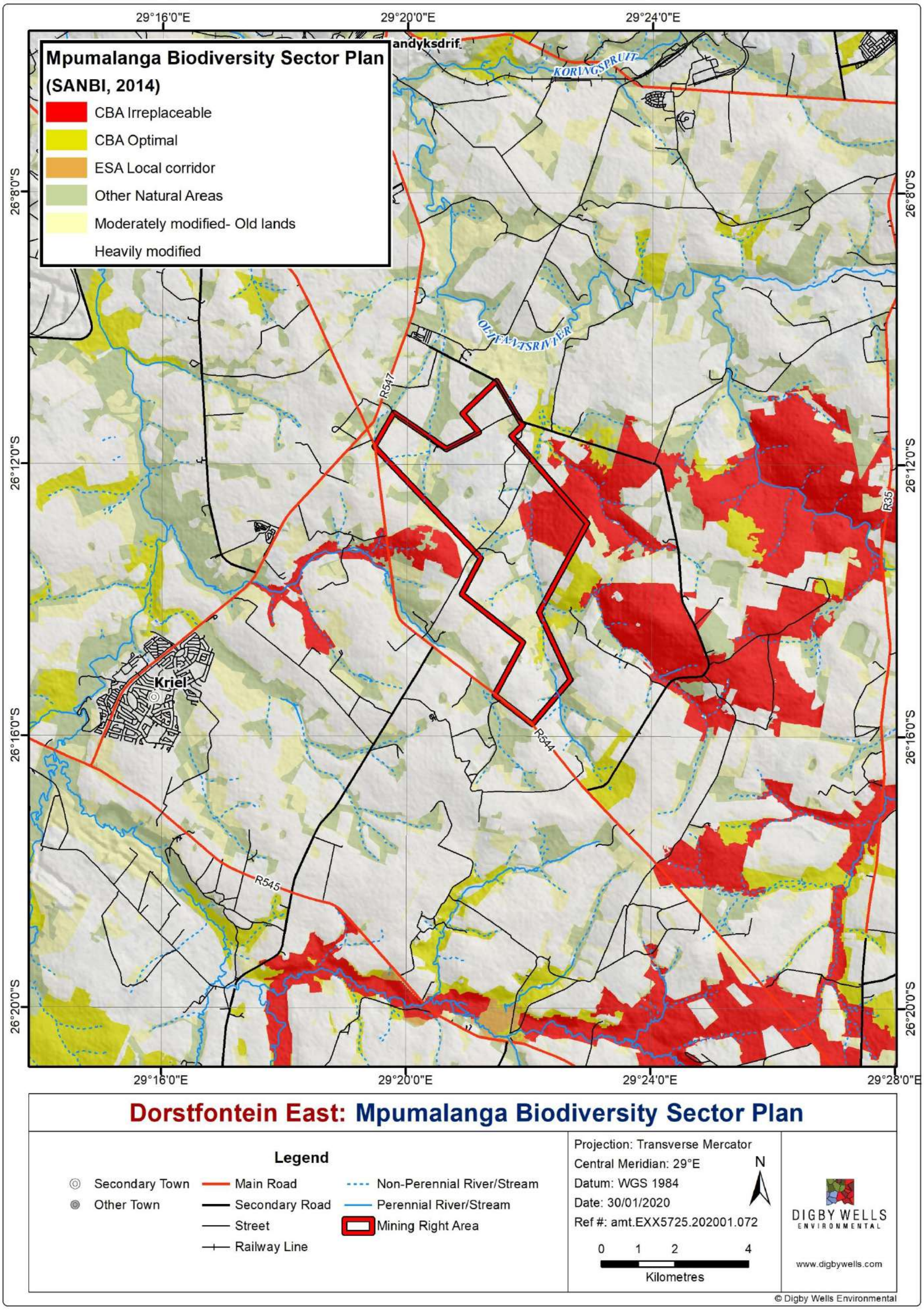


Figure 6-14: Mpumalanga Biodiversity Sector Plan

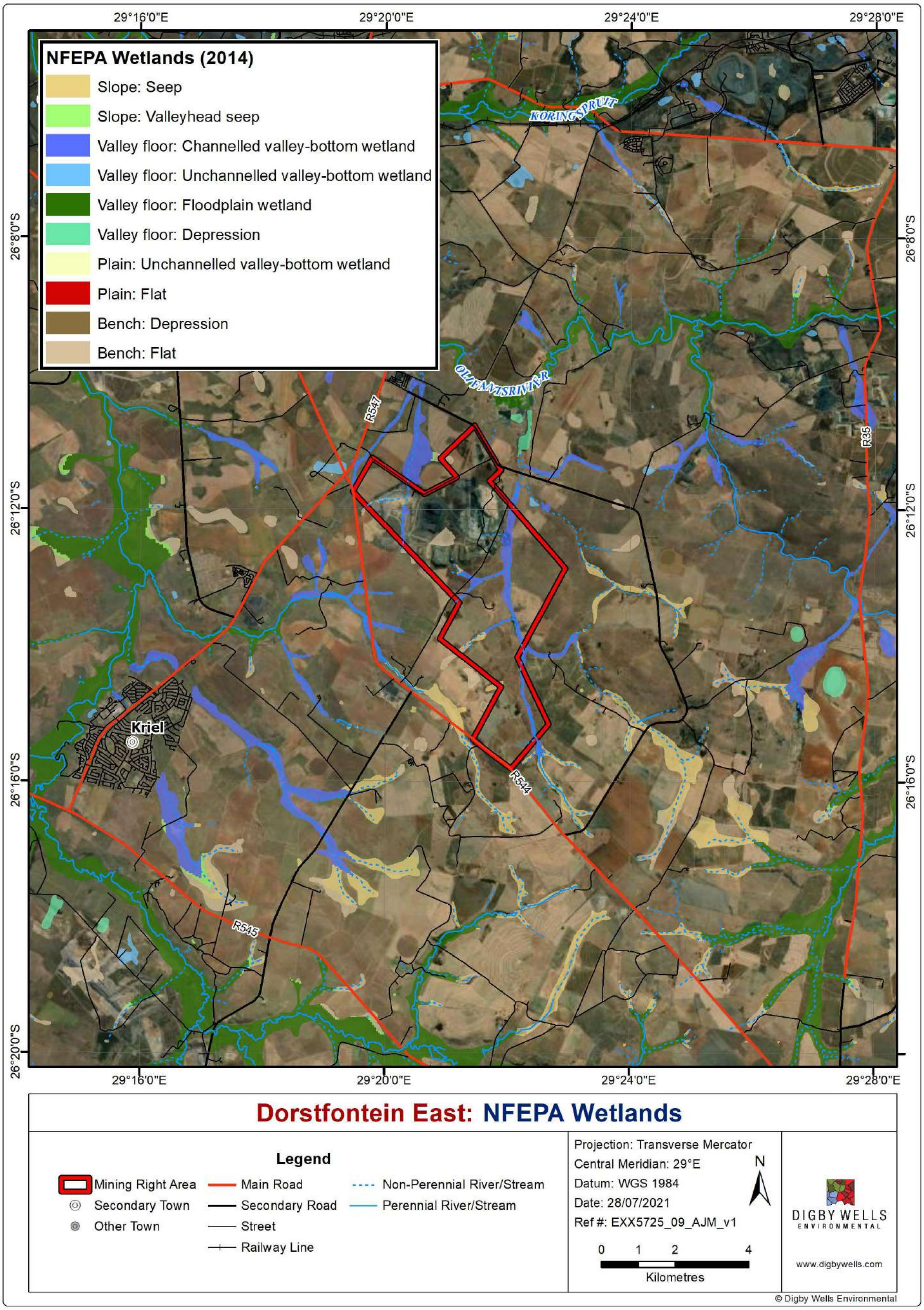


Figure 6-15: NFEPA Wetlands in the Project Area

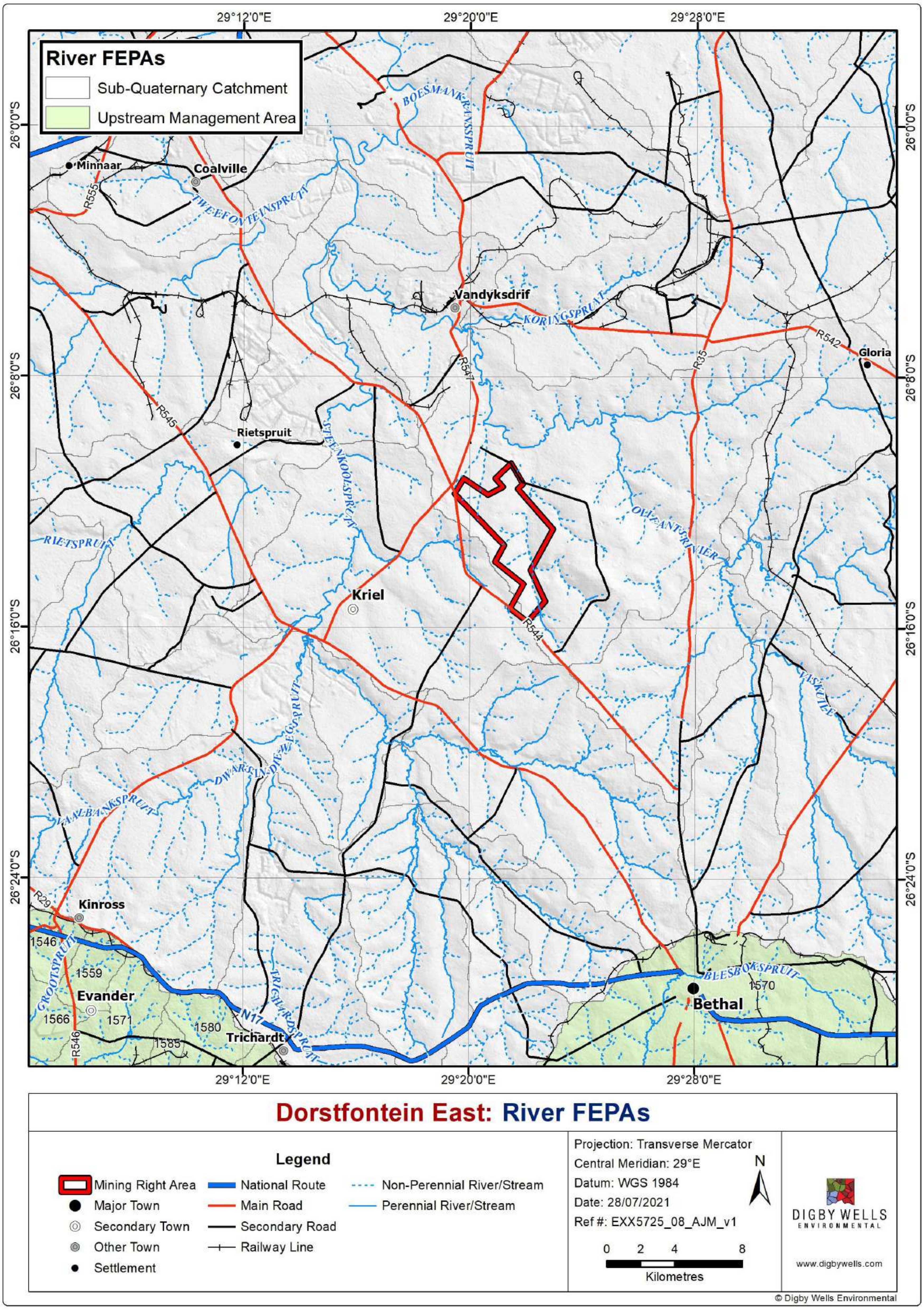


Figure 6-16: River FEPAs in the Project Area

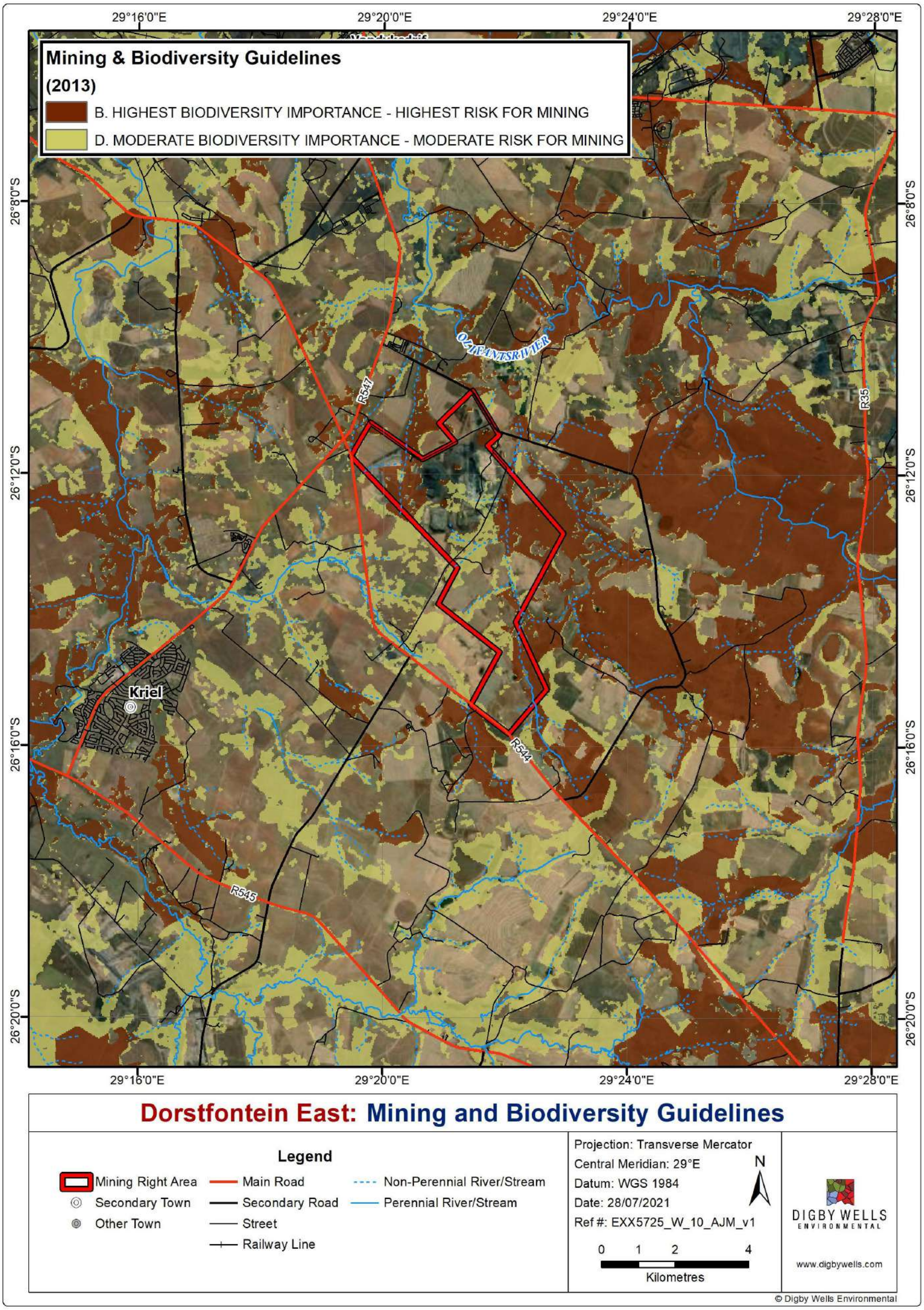


Figure 6-17: Mining and Biodiversity Guidelines for the Project Area

6.10. Wetlands

A site visit was conducted from 10 to 12 September 2019 to assess the ecological integrity, delineate the wetlands and determine their PES, Ecological Services (ES) and EIS state. This report is based on these findings and available information, to identify the potential impacts the proposed Project will have on the wetlands associated with the Project Area.

6.10.1. Wetland Delineation and Hydrogeomorphic Unit Identification

During the desktop and field assessment, 565.8 ha of wetlands were identified and delineated within the Project Area using the approved methodology by the (Department of Water Affairs and Forestry, 2005). As per the most recent proposed surface infrastructure and underground mine plan, surface infrastructure is not planned within any delineated wetlands; however, are within 100 m of a wetland (HGM 1 and 7) (Figure 9 5). Twenty-four HGM units and eight dams were identified and categorized based on terrain units. These include depressions (pans), hillslope seep wetlands (Seeps), unchannelled valley bottom wetlands (UVBs) and channelled valley bottom wetlands (UVBs). Land use activities and in-field studies have shown that some of the systems are similar from a catchment management perspective as they would be subject to similar overall land uses impacts. Therefore, it was considered practical to group the HGM units by systems that have similar land use and impacts to calculate more accurate PES and EIS scores. Eight HGM units were identified and assessed. The extent of the combined HGM units together with the total percentage of wetlands within the Project Area are indicated below (Table 6-11).

Table 6-11: Combined HGM Units

No.	Name	Acronym	Area (Ha)
1	Pan	Pan	15.9
2	Channelled Valley Bottoms	CVBs	90.9
3	Channelled Valley Bottoms (fragmented)	CVBs Fragmented	4.4
4	Unchannelled Valley Bottoms	UVBs	17.0
5	Unchannelled Valley Bottoms (fragmented)	UVBs Fragmented	19.3
6	Hillslope Seep (Agriculture)	HS Agriculture	293.6
7	Hillslope Seep (Fragmented)	HS Fragmented	66.9
8	Hillslope Seep (Unimpacted)	HS Unimpacted	39.6
Total wetlands			**547.6**
*	Artificial wetlands, dams and borrow pits	Dams	18.2
Total area			**565.8**

Artificial wetlands, dams and borrow pits are not regarded as HGM units; however, it is included in the calculations due to forming part of other HGM units and affecting the PES and EIS scores.

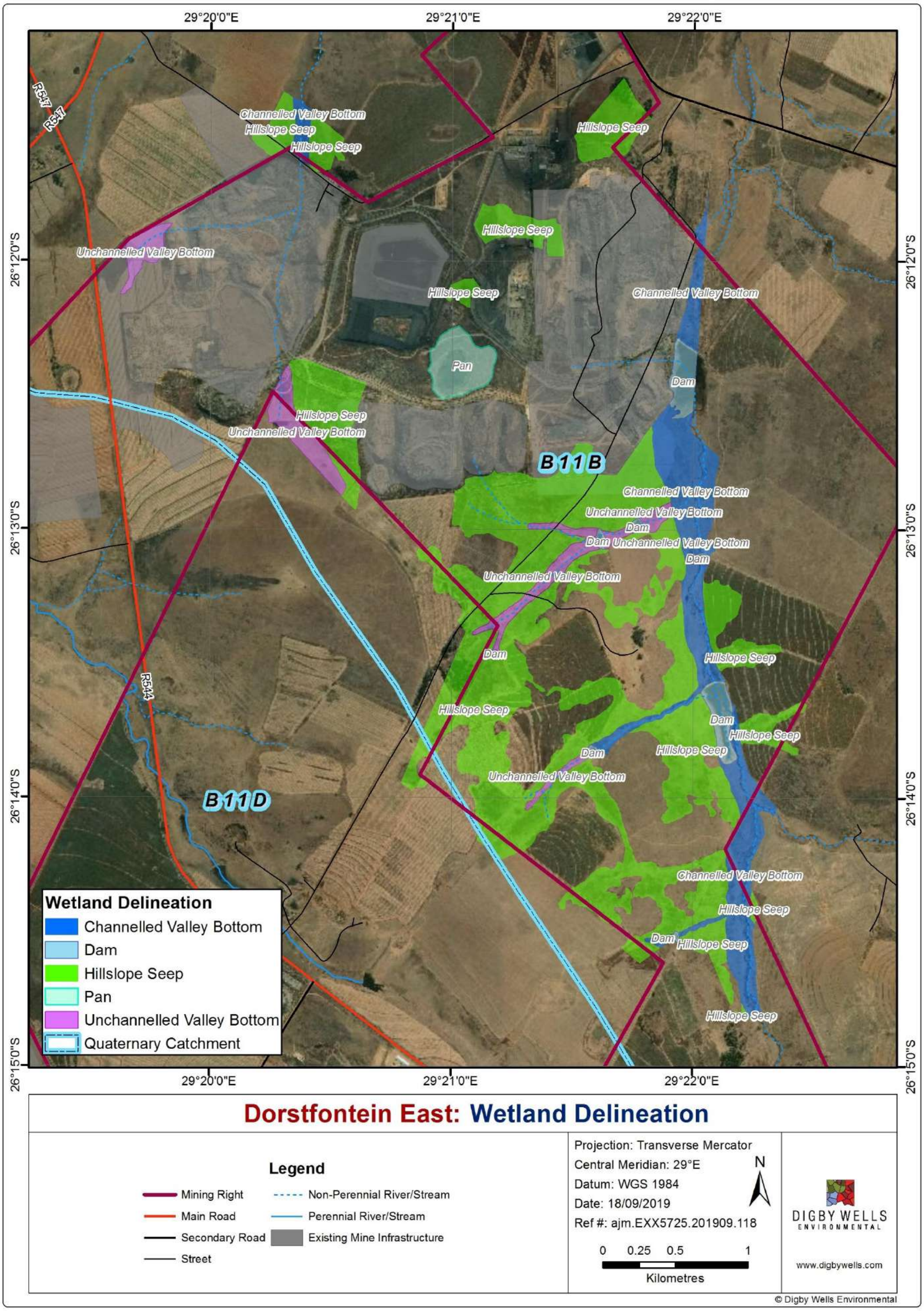


Figure 6-18: Delineation of Wetlands in the Project Area

6.10.2. Wetland Ecological Health Assessment

The PES of the HGM units were assessed in 2019. The PES of the eight HGM units were rated to have an ecological state of 'Moderately Modified' to 'Largely Modified' (Table 6-12 and Figure 6-19). According to the integrity (health) method described by Kotze *et al*. (2007):

- A category C wetland has Moderate changes to its ecosystem processes and loss of natural habitat has taken place; however, the natural habitat remains predominantly intact; and
- A category D wetland has Largely modifications to the natural ecosystem processes and loss of natural habitat and biota.

Each HGM unit, PES score and its health; hydrological, vegetation and geomorphological health are tabulated below (Table 6-12) whereas the validations for the PES values are discussed below.

Table 6-12: Present Ecological State Scores

Number	HGM Unit Group	Hydrology	Geomorphology	Vegetation	Combined PES	PES Category
1	Pan	6.0	2.0	4.1	4.3	**D**
2	CVBs	7.0	1.4	5.9	5.1	**D**
3	CVBs Fragmented	4.0	4.0	5.4	4.4	**D**
4	UVBs	2.0	0.5	6.2	2.8	**C**
5	UVBs Fragmented	3.0	0.3	7.8	3.6	**C**
6	HS Agriculture	2.0	0.6	9.0	3.6	**C**
7	HS Fragmented	4.0	1.2	7.5	4.2	D
8	HS Unimpacted	1.0	0.2	7.0	2.5	C

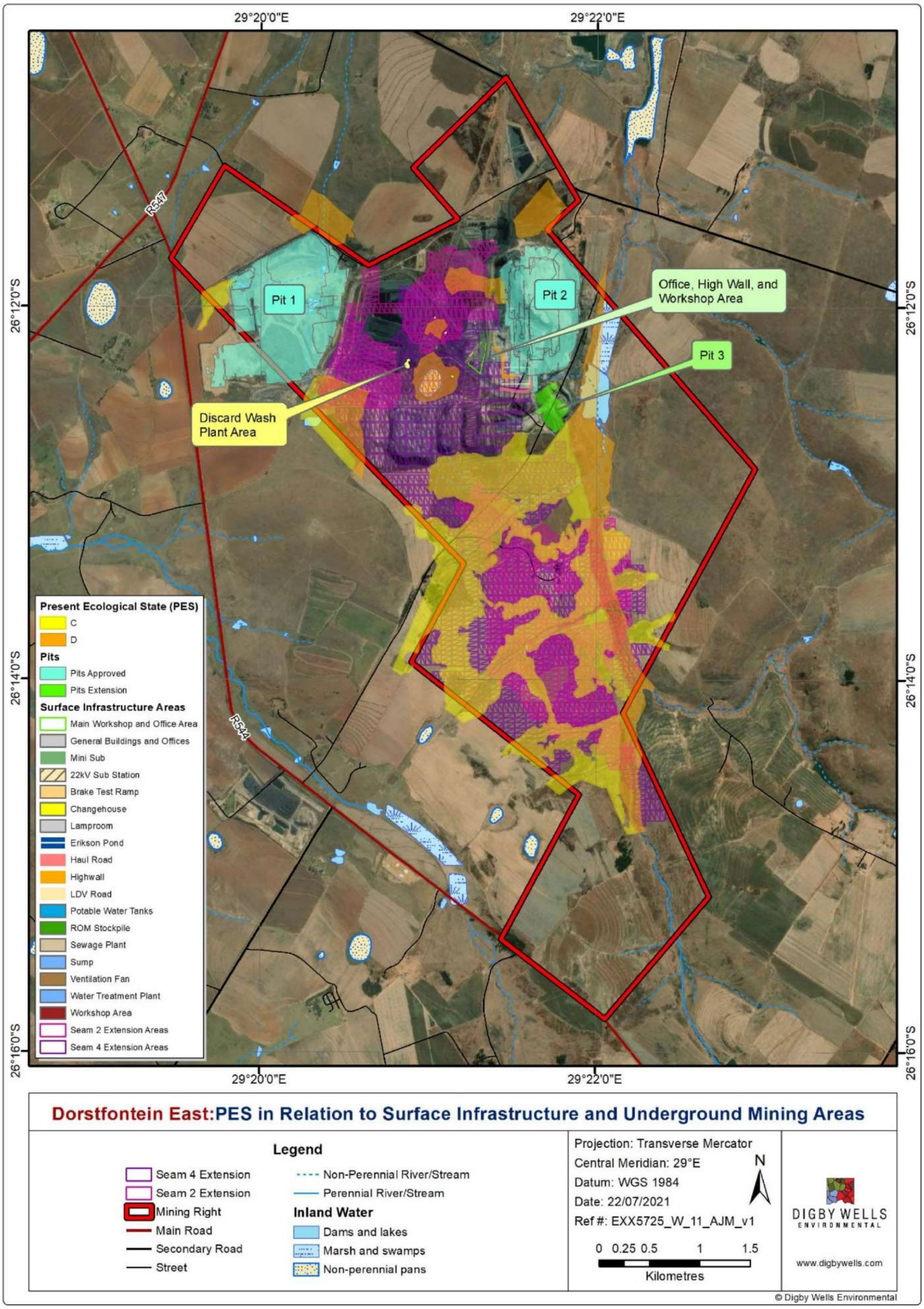


Figure 6-19: Wetland PES Scores

6.10.2.1. Validation Site Visit (2019)

A site visit was undertaken to validate the PES scores.

Pan (D) – The pan is located within the mine operational area. The entire catchment as well as the pan has been impacted by mining activities, changes to the hydrological functioning, increased AIPs and excavations and dumping was evident within the pan. Ecological functioning has been highly impacted by dominantly mining activities.

Channelled Valley Bottoms (D) – The CVBs have mainly been impacted by agropastoral activities, including cattle grazing, dams and cultivation. Large dams exist within the CVB, together with evidence of cattle trampling, erosion and compaction. This impacted the natural hydrology, ground cover and changes to the natural vegetation.

Channelled Valley Bottoms (fragmented) (D) – In addition to the aforementioned, some of the CVBs have been fragmented by linear infrastructure, including mining activities, agropastoral activities as well as roads, powerlines and fence lines. Fragmentation of wetlands impacts the natural habitat, functionality and health of a wetland. Linear infrastructure within wetlands is prone to creating erosion, channelling, drying out of wetlands and increased AIPs.

Unchannelled Valley Bottoms (C) – The UVBs within the Project Area were dominantly used for cattle grazing. There were no clear signs of channelling, erosion, or extensive cattle trampling. The vegetation was stable with little changes to water inputs to the systems. The systems were in a stable condition, well-functioning and creating habitat for various fauna and flora species.

Unchannelled Valley Bottoms (fragmented) (C) – Regardless of some of the UVBs being moderately impacted, some of the systems were fragmented by mining, agropastoral and linear infrastructure. Dams were also indicated in some of the systems. The fragmentation of the UVBs changes the natural habitat and health of the systems.

Hillslope Seep (Agriculture) (C) – The majority of the Hillslope Seep wetlands were used for agropastoral activities, including commercial cultivation and cattle grazing. The soils within Hillslope Seep wetlands (Hutton, Clovelly) are typically used for cultivation due do the decent water-holding-capacity, fertility and soil depth. However, cultivation changes the natural vegetation, hydrological functioning as well as the geomorphology by ploughing, ripping and tillage.

Hillslope Seep (Fragmented) (D) – Regardless of some Hillslope Seeps being impacted by agropastoral activities, some of the seeps have been impacted by mining activities and linear infrastructure, including roads, dams and powerlines. Some sections of the seeps have almost completely been removed by these activities or completely separated and cut off from the rest of the system.

Hillslope Seep (Unimpacted) (C) – Unimpacted Hillslope Seep wetlands were recorded within the Project Area. These wetlands were mainly used for cattle grazing; however, was well regulated and little erosion and impacts on the vegetation and geomorphology were noted.

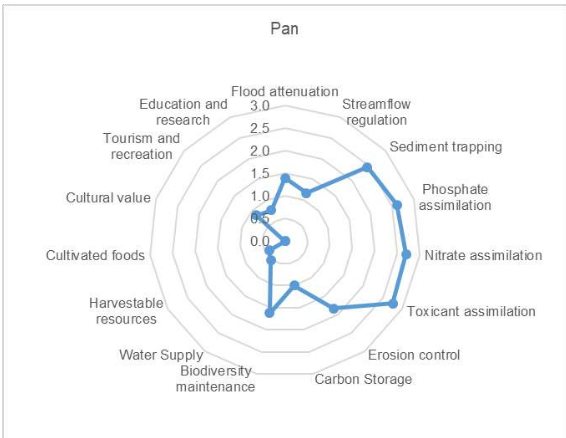
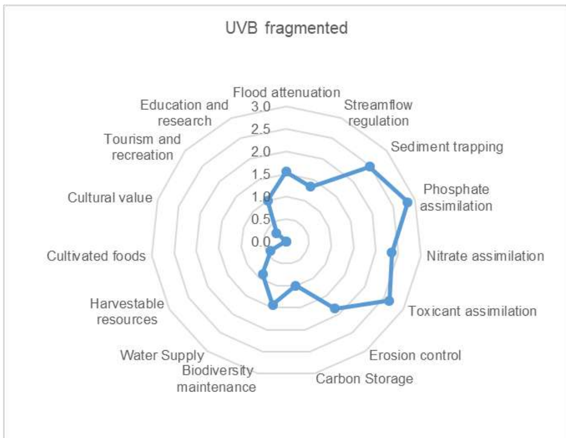
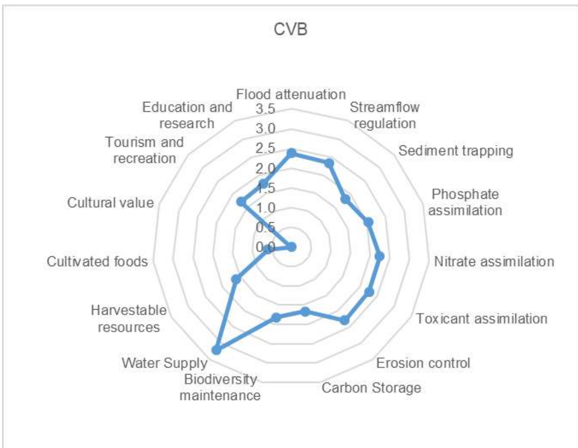
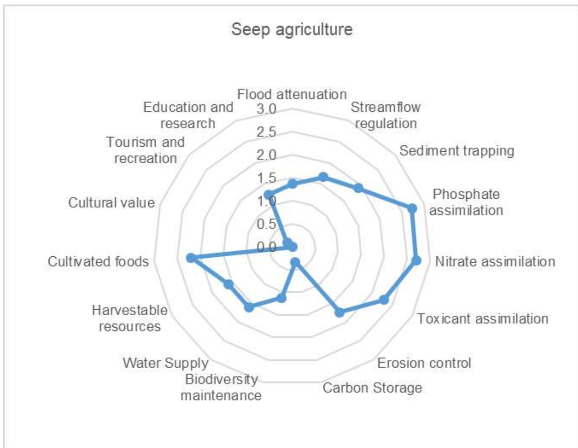
6.10.3. Wetland Ecological Services

As indicated in Table 6-13, Table 6-14 and Figure 6-20, sediment trapping, phosphate assimilation, nitrate assimilation and toxicant assimilation are the dominant ecological services provided by the HGM units. The unimpacted Hillslope Seeps and CVBs are providing biodiversity maintenance due to the fauna and flora importance. The CVBs are important for water supply, supplying all agropastoral activities in the area (i.e., dams, cattle, irrigation, domestic use).

The general ES and natural features of the wetlands were assessed in terms of functioning and the overall importance of each HGM unit was determined at a landscape level.

Table 6-13 represents radial plots showing the relative importance of each ecosystem service and lists the summary of the scores obtained.

Table 6-13: Ecoservices Radial Plots

<table>
<tr><th>Pan</th><th>Unchanneled Valley Bottoms (fragmented)</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><th>Channelled Valley Bottoms</th><th>Hillslope Seep (Agriculture)</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

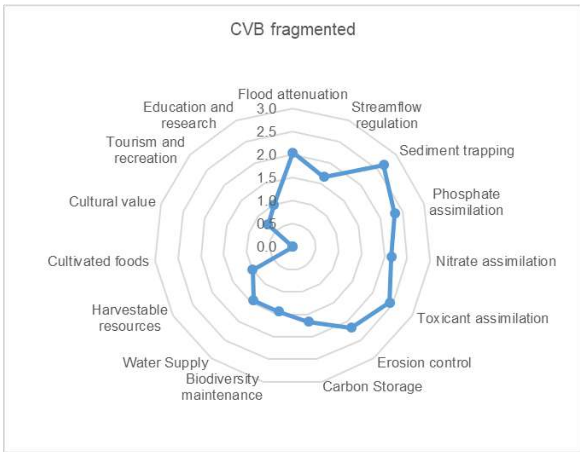
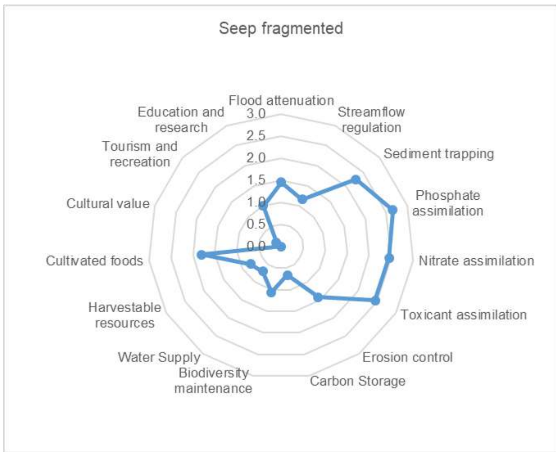
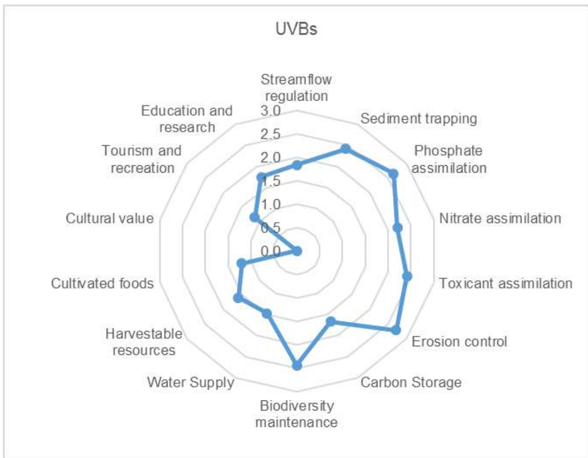
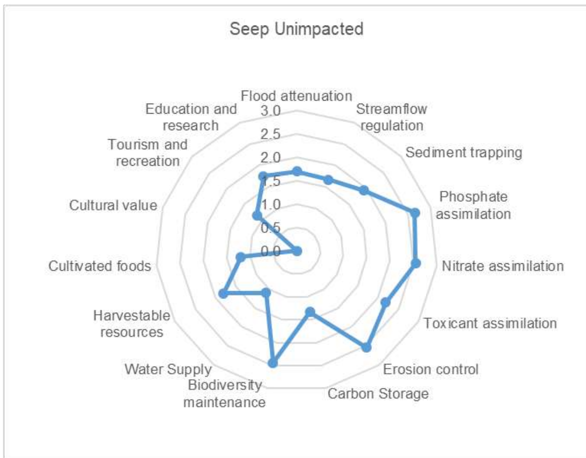
Channelled Valley Bottoms (fragmented)	Hillslope Seep (Fragmented)
	
Unchanneled Valley Bottoms	**Hillslope Seep (Unimpacted)**
	

Table 6-14: Ecological Services Scores

	1	2	3	4	5	6	7	8
Ecosystem service	**Pan**	**HS fragmented**	**UVB fragmented**	**CVB fragmented**	**HS agriculture**	**HS unimpacted**	**UVBs**	**CVB**
Flood attenuation	1.4	1.5	1.6	2.1	1.4	1.7	1.9	2.4
Streamflow regulation	1.2	1.2	1.3	1.7	1.7	1.7	1.8	2.3
Sediment trapping	2.5	2.3	2.5	2.7	1.9	1.9	2.4	1.8

	1	2	3	4	5	6	7	8
Ecosystem service	**Pan**	**HS fragmented**	**UVB fragmented**	**CVB fragmented**	**HS agriculture**	**HS unimpacted**	**UVBs**	**CVB**
Phosphate assimilation	2.6	2.7	2.8	2.3	2.7	2.7	2.6	2.0
Nitrate assimilation	2.7	2.5	2.4	2.2	2.7	2.6	2.2	2.3
Toxicant assimilation	2.8	2.5	2.6	2.4	2.3	2.2	2.4	2.3
Erosion control	1.8	1.4	1.8	2.2	1.8	2.5	2.7	2.3
Carbon Storage	1.0	0.7	1.0	1.7	0.3	1.3	1.7	1.7
Biodiversity maintenance	1.6	1.1	1.4	1.4	1.1	2.4	2.4	1.8
Water Supply	0.5	0.7	0.9	1.4	1.6	1.1	1.5	3.2
Harvestable resources	0.4	0.8	0.4	1.0	1.6	1.8	1.6	1.6
Cultivated foods	0.0	1.8	0.0	0.0	2.2	1.2	1.2	0.6
Cultural value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tourism and recreation	0.9	0.1	0.3	0.7	0.1	1.1	1.1	1.7
Education and research	0.8	1.0	1.0	1.0	1.3	1.8	1.8	1.8
SUM	**20.1**	**20.0**	**20.0**	**22.7**	**22.7**	**26.0**	**27.4**	**27.8**
Average score	**1.3**	**1.3**	**1.3**	**1.5**	**1.5**	**1.7**	**1.8**	**1.9**
	Intermediate	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**

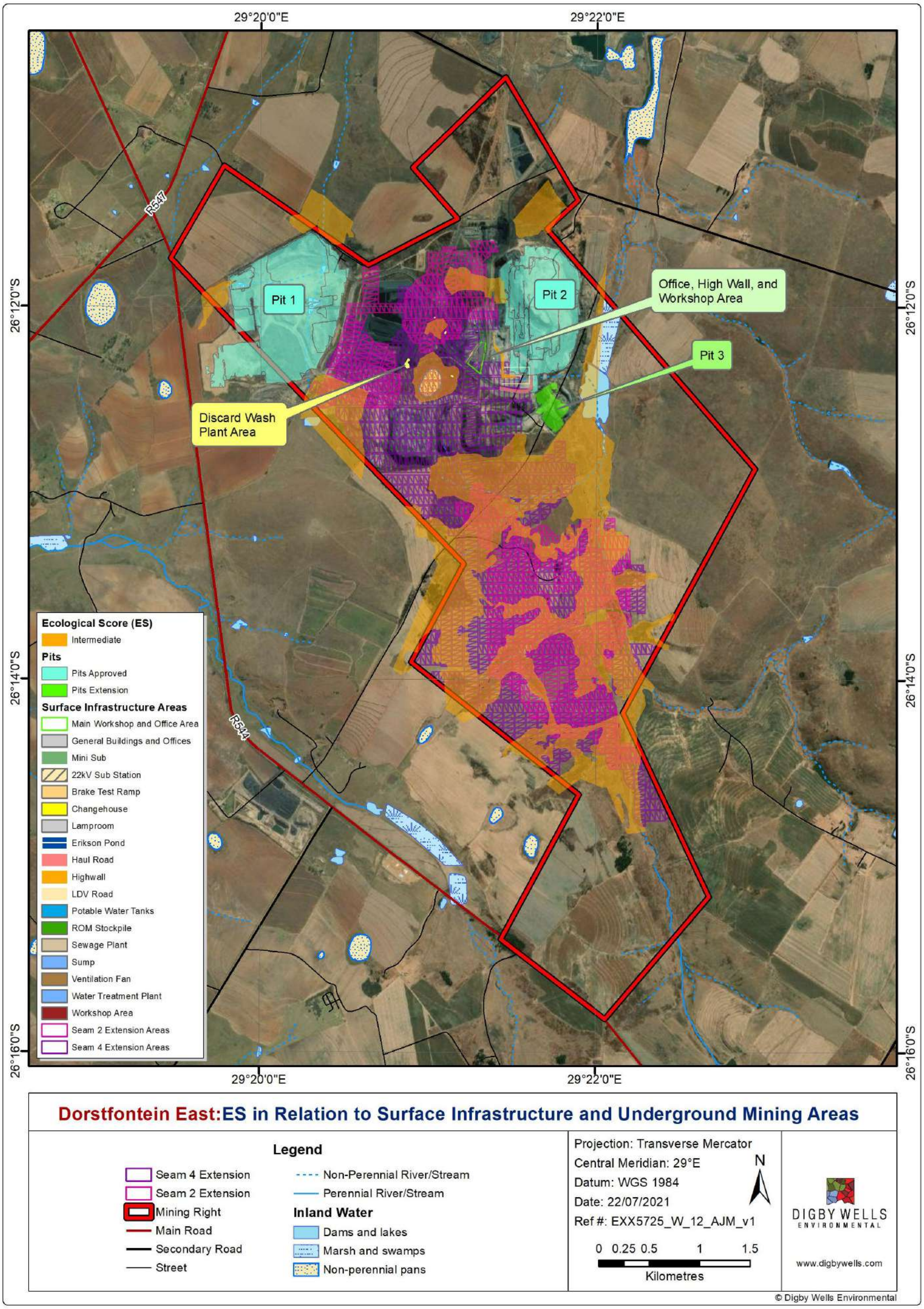


Figure 6-20: Wetland ES in the Project Area

6.10.4. Ecological Importance and Sensitivity

The EIS of a wetland is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the wetland's ability to resist disturbance and is the capability to recover from disturbance that has occurred (DWAF, 1999). Table 6-15 and Figure 6-21 indicates each HGM unit group and EIS Category.

The following was derived from the data:

- The Pan, UVBs Fragmented, HS Agriculture and HS Fragmented were regarded as 'Moderate (C)'. This specifies that the wetlands are ecologically important; however sensitive on a provincial and local scale. The integrity and biodiversity of these wetlands are sensitive to low flow and habitat modifications as a result of decades of mining, agriculture and the introduction of AIPs. These wetlands play a small role in moderating the quantity and quality of water; and
- The CVBs, CVBs Fragmented, UVBs and HS Unimpacted were considered 'High (B)'. This suggests that these systems are of ecological importance and are sensitive. The biodiversity of the systems is sensitive to modifications to the habitat and low flows. These systems play an important role in moderating the quality and quantity of water in larger systems.

The HGM units assessed play an important role in moderating the quantity and quality of water of major rivers and tributaries. However, the river system has been modified by anthropological activities, specifically mining and agropastoral activities. The outcomes are changes in the water input volumes and pattern as well as water distribution and retention patterns of water passing through the wetlands. Additionally, linear infrastructure, such as roads, power lines and fences change runoff and stormwater as well as causing fragmentation of the natural habitat. Agricultural deposits in a form of phosphates and nitrates using fertilisers or pesticides decrease the quality of water in the wetlands. Roads that have been built within the wetlands increase run-off from these hardened surfaces.

Table 6-15: Ecological Importance and Sensitivity Scores

HGM Number	HGM Unit	Ecological Importance & Sensitivity	Hydrological/ Functional Importance	Direct Human Benefits	Final EIS	EIS Category
1	Pan	1.3	1.9	0.4	1.9	**Moderate (C)**
2	CVBs	1.8	2.1	1.5	2.1	**High (B)**
3	CVBs Fragmented	1.7	2.1	0.7	2.1	**High (B)**
4	UVBs	2.3	2.2	1.2	2.3	**High (B)**
5	UVBs Fragmented	2.0	2.0	0.3	2.0	**Moderate (C)**
6	HS Agriculture	1.3	1.8	1.1	1.8	**Moderate (C)**
7	HS Fragmented	1.7	1.8	0.7	1.8	**Moderate (C)**
8	HS Unimpacted	2.3	2.1	1.2	2.3	**High (B)**

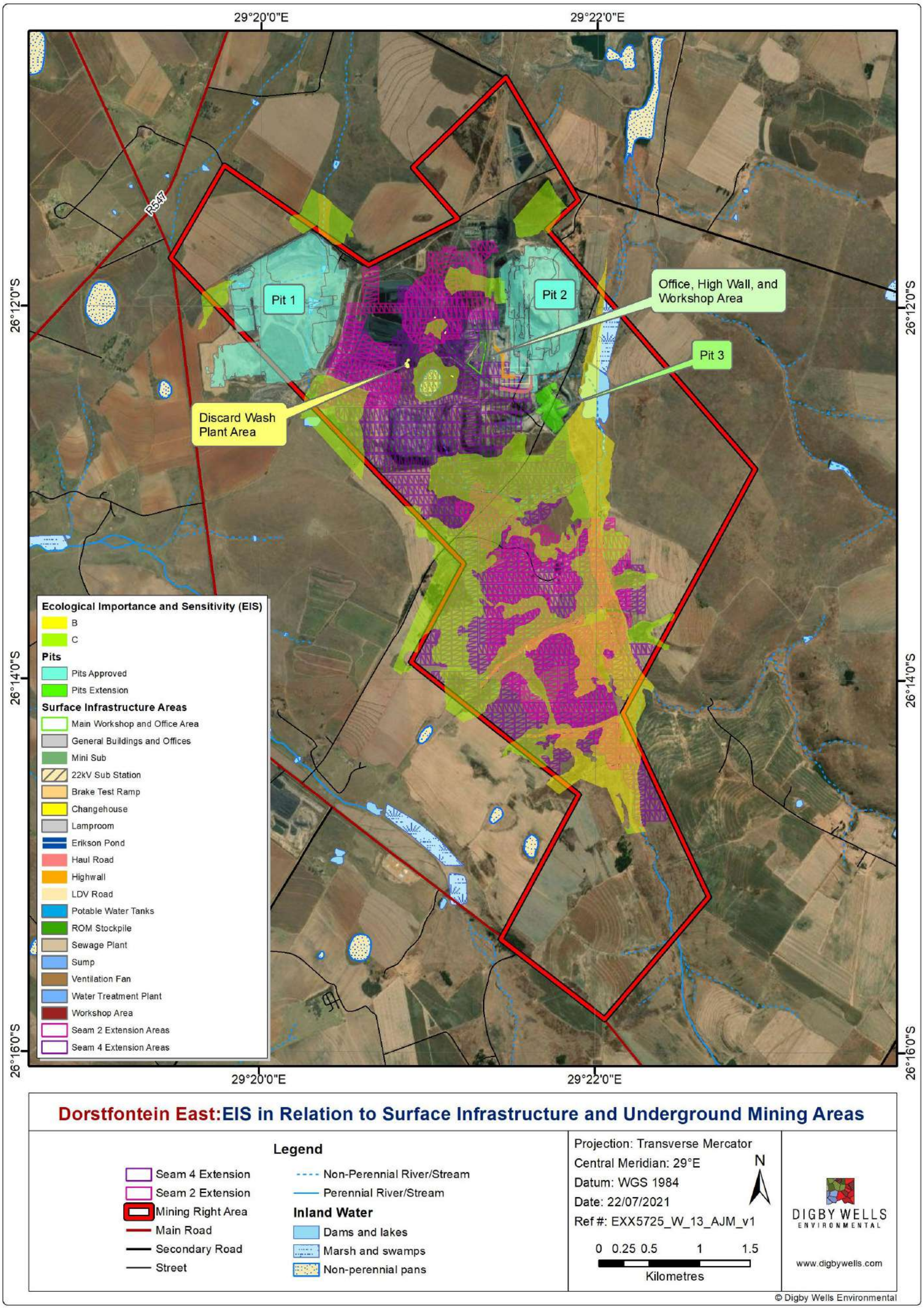


Figure 6-21: Wetland Ecological Importance and Sensitivity in the Project Area

6.11. Socio-Economic Environment

This section introduces the socio-economic baseline profile of the area and considers the existing impact that the Dorstfontein Mines (both West and East) have on the socio-economic environment.

6.11.1. Secondary Study Area

As previously indicated, the secondary study area refers to the area that is most likely to experience induced impacts brought on by the Project. Induced impacts refer to those impacts that are not directly caused by the Project but occur as an unplanned consequence of it. Typical examples of induced impacts are an increase in the local population size due to the arrival of a construction team or job seekers, which in turn leads to an increase in a demand for housing and services.

Areas that are likely to experience induced impacts are usually the closest formal human settlements as these areas already have formal housing and services available. In the case of the Project, this is likely to be Thubelihle and Kriel.

Thubelihle is directly opposite the Dorstfontein West mine and falls within ELM Ward 15 and was therefore included in the primary study area. It is more likely that job seekers would settle in Thubelihle (as opposed to Kriel) due to its proximity to the mine and the mixture of formal and informal housing in this area.

A baseline profile of Kriel was not included in the scoping report but is included here as the other formal area of human settlement consisting of formal housing and services (i.e., municipal and otherwise, e.g., shops, doctors, schools, etc.). Kriel is made up of two municipal wards, namely ELM Wards 26 and 27. A comparative and combined overview of these two Wards are presented in the following subsections to provide an overview of the town itself. It should be noted that Ward 27 also consists of vast pockets of agricultural land that could skew the population density for this portion of Kriel.

6.11.1.1. <u>Population Demographics</u>

Wards 26 and 27, have covers a combined geographical area of 380 km^2 and is collectively home to 18 111 people. Ward 26 is an urban ward whereas Ward 27 is a combination of urban and rural, which accounts for the difference in geographical areas – 5.6 km^2 (Ward 26) and 374.4 km^2 (Ward 27). The population densities in the two wards also differ significantly – 20 people per km^2 in Ward 27 against Ward 26’s 1 888 people per km^2 - the latter is characteristic of an urban setting.

Both wards have a mixture of Black African and White people as their predominant population groups, with the former in the majority at around 60% and the latter averaging at around 38% of the total population. There are slightly more males than females in both wards at an average of around 54%. Afrikaans is the language spoken by most (around 34% of the population), followed by Zulu (around 24%). Most of Ward 26’s population are native to Mpumalanga (55%), followed by significant influxes from mostly Kwazulu-Natal (10%) and Gauteng (9%).

Interestingly, less than half (47%) of the rural population in Ward 27 were born in Mpumalanga. This ward also experienced significant population influx from Gauteng and Kwazulu-Natal (10% each) and the Eastern Cape (8%). This migration pattern in these two wards is suggesting that in- and out-migration are already taking place in the area and could be as a result of the presence of coal-fired power stations and coal mines in the area (responsible for in-migration when people come to the area in search of employment) causing land use changes from, for example, agriculture to mining (responsible for out-migration when people leave the area due to job losses).

An overview of the secondary study area's education profile is provided in Figure 6-22. The overall educational level of the area appears to be low with less than half of the adult population (those aged 20 years and older) having completed Grade 12. More people in Ward 26 (46%) completed their secondary education when compared to Ward 27 (39%). Because of this, more people in Ward 26 (7.8%) have completed a tertiary education than in Ward 27 (6.6%).

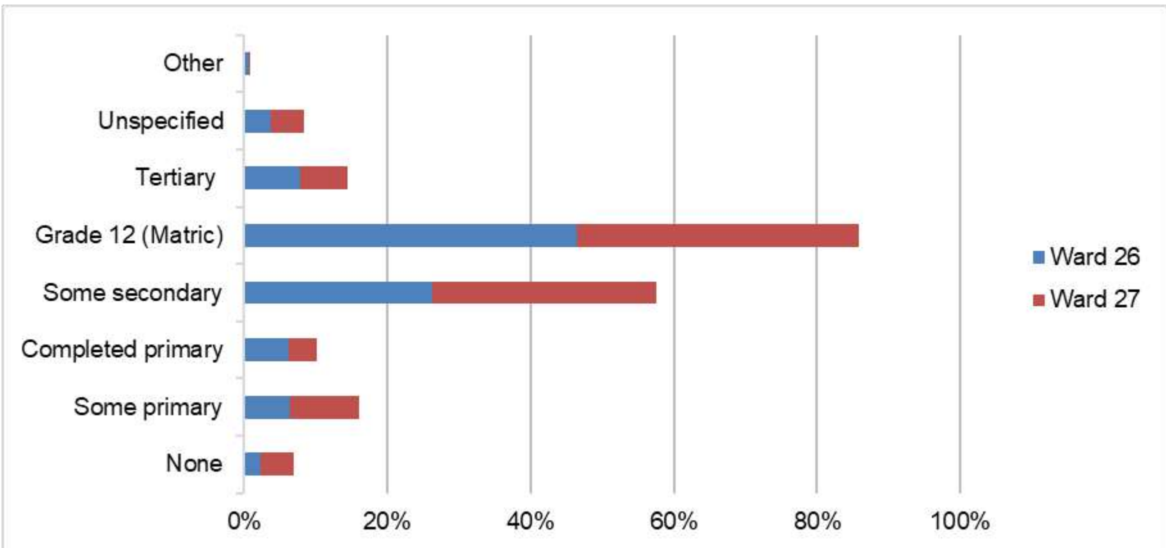


Figure 6-22: Education Profile of the Secondary Study Area

6.11.1.2. Household Characteristics

The study area consists of around 5 850 households, of which 3 350 are in Ward 26 and the remaining 2 500 in Ward 27. Most households are male headed (77% in Ward 26 and 86% in Ward 27). The types of dwellings in Ward 26 are mostly formal brick houses (79%), whereas the types of dwellings in Ward 27 are more diverse – ranging from a formal brick house (58.5%) to rooms or flatlets (13%), apartments at eight percent (8%) and other (around 19%). The total number of dwellings that are considered informal in the study area amounts to around 165 dwellings. Ward 26 have a slightly higher percentage of informal dwellings than Ward 27 (3.3% compared to 2.2%).

Most households receive their water from a regional or local service provider – 96% in Ward 26 and 80% in Ward 27. The decreased percentage in Ward 27 is likely due to the parts of the ward being occupied by agricultural land and in such instances, piped water becomes a challenge due to the distance from a main centre. Most households have access to a flush or chemical toilet (98% in Ward 26 and 88% in Ward 27). Refuse is disposed by the local authority on a regular basis for 97% of households in Ward 26 and 81% in Ward 27.

6.11.1.3. Economic Profile

When considering the total population of the secondary study area (see Figure 6-23), the employment rate is between 53% (Ward 26) and 59% (Ward 27). The unemployment rate is low for both areas at around ten percent (10%). About a third of the secondary study area's population are not economically active, i.e., they are either below the age of 15 or over the age of 65 and are therefore not actively participating in the area's economy. This segment of the population is dependent on the economically active population.

To obtain a true reflection of the employment rate in the area, only the economically active population was considered (see Figure 6-24). Amongst those aged 15-64, there are employed, unemployed individuals, as well as discouraged work-seekers (a person who is part of the economically active age group but who is not actively seeking employment and who prefers not to be working). Within this segment of the population, the employment rate is above 80% for both wards, with around 15% of the population being unemployed. Just under four percent (4%) of both wards' economically active population regard themselves as discouraged work-seekers.

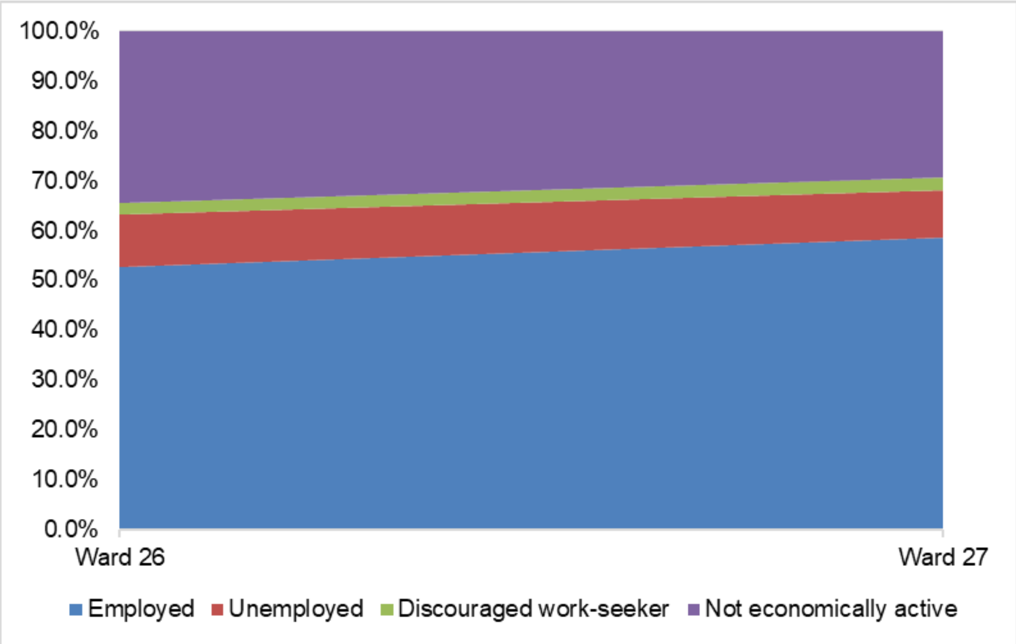


Figure 6-23: Employment Profile of the Secondary Study Area

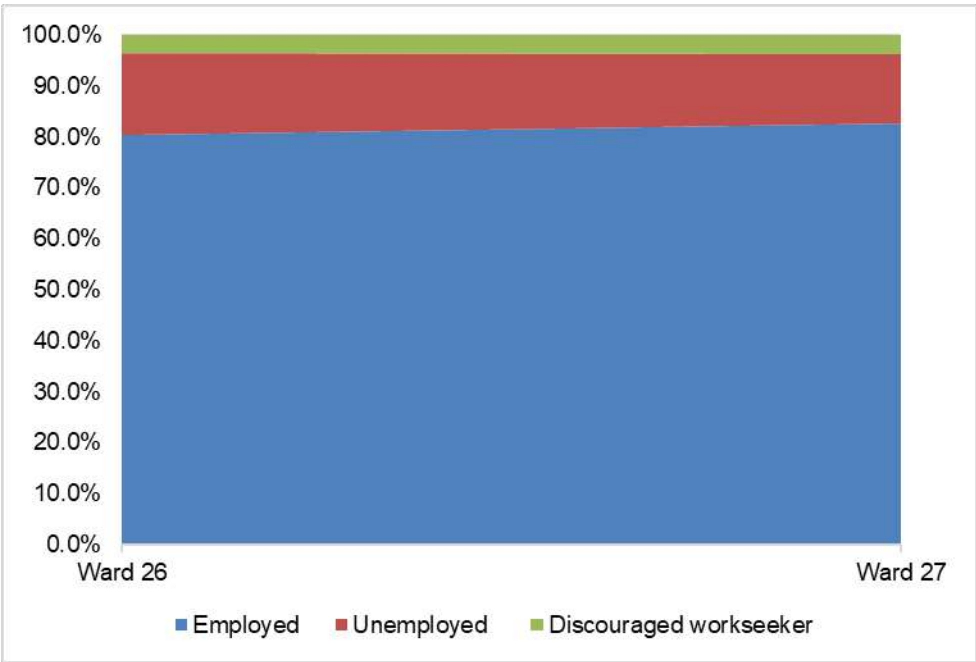


Figure 6-24: Employment Profile of the Economically Active Population

The formal sector accounts for at least 78% of the employment profile in the municipality. Ward 27 has a higher percentage of people employed in the formal sector (14.9%) compared to Ward 26 (7.2%)– this could be indicative of spin-off employment created by the mining and agricultural sector, e.g., food stalls on route to the mine.

Figure 6-25 provides an overview of the annual household income for the secondary study area. Around a quarter of the study area's population live in absolute poverty, which is defined as an annual household income of R 19 200 or less for a family of four (i.e., often these families are unable to meet their basic needs and are dependent on social grants and the goodwill of other people). Most of the population (around two thirds) fall into the lower middle- and middle-income bracket, with between 3-10% of the population in the higher middle- and high-income brackets. On average, households in Ward 26 tend to have a more stable income with most households in the middle to high income brackets.

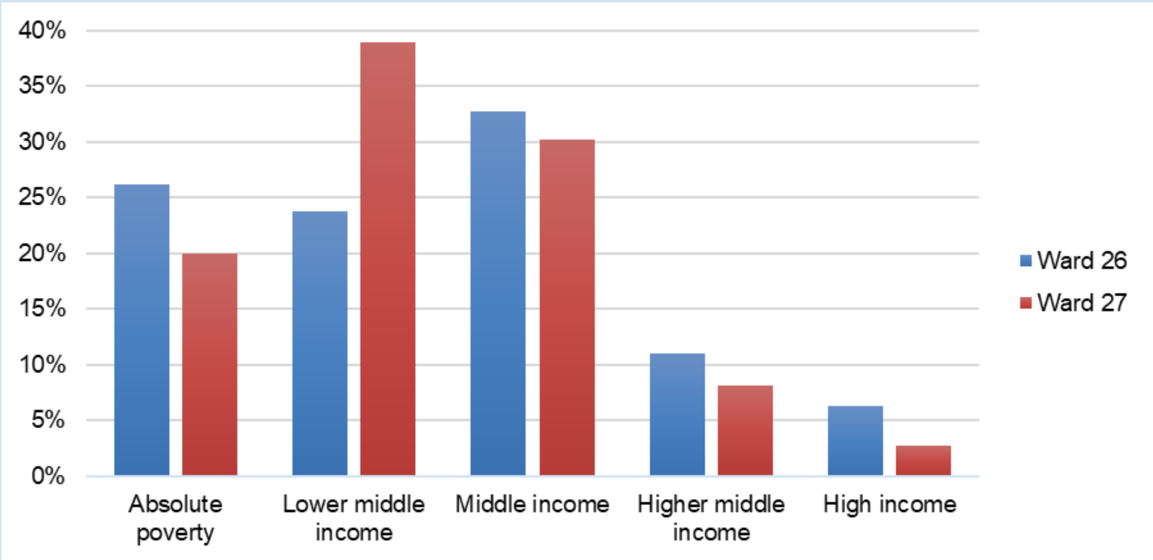


Figure 6-25: Annual Household Income in the Secondary Study Area

Considering that the study area's land use is a combination of agriculture and mining, the assumption is that the local economy would also be more diverse. The more diverse an economy, the more likely it will lead to job creation and a better balance between labour-intensive and capital-intensive industries. However, this implies that there is a need for fast growing industries to also create employment, particularly for the semi-skilled and the unskilled. Unfortunately, in practice, many fast-growing industries are of such a nature that they do not create job opportunities for unskilled labour (e.g., very few such opportunities exist within the mining sector) and therefore these industries do not contribute significantly towards a reduction in unemployment and poverty alleviation in the local area. This is one of the reasons why the MPRDA requires mines to develop an SLP to outline how they would contribute to the socio-economic development of their area of impact.

6.11.1.4. Development Needs

The development needs of Wards 26 and 27 have been identified through the IDP stakeholder engagement process and is reflected in the ELM IDP of 2020/21. These are shown in Table 6-16 below. Not all the development needs were identified only by the residents of these areas, but that some development needs were identified by the municipality itself. As such some of the development needs listed apply to the wider Kriel area and not just the ward.

Table 6-16: Development Needs in the Secondary Study Area

Area	Identified Development Needs
Ward 26 (Kriel "south")	• Streetlights and poles need to be fixed. Rusted poles cause structure to collapse leaving live wires lying on the pavement that is dangerous to people. • Storm water drains are blocked and must be cleaned and fixed. • Potholes must be fixed throughout the ward.

Area	Identified Development Needs
	• Parks and other open spaces must be cleaned and maintained. Park next to the municipal offices needs public toilet facilities. • A fire station must be constructed. The traffic department's computer system must be checked so that they are not offline so often. • The current municipal clinic is small and cramped, short-staffed and short on medicine. The site that was set aside for the new clinic in Kingfisher Street must be developed. • The ward requires public amenities such as a community hall, a youth centre, sports grounds and a play park. • Reconstruction and Development Plan (RDP) houses required.
Ward 27 (Kriel "north" and surrounding agricultural land)	• Maintenance of streetlights and high mast lights. • Fixing of potholes (Merlin, Bokmakierie, Albatross, Nagtegaal and Bosbok Streets mentioned specifically, but can assume that it would be a recurring problem throughout the ward). • Refurbishment of licence office. • Replacement of solar panels in Emaline Street. • Erection of road signs.

6.11.2. Primary Study Area

The primary study area is the area closest to the mine, which is expected to experience the most direct impacts as a result of the physical intrusion of the mine infrastructure and daily mining activities. For the purposes of this Social Impact Assessment (SIA), the primary study area is defined as the area in which the existing DECM is located, as well as the Project stie and the areas adjacent to the mining area, i.e., Govan Mbeki Local Municipality (GMLM) Ward 15 and ELM Ward 25.

This section provides a high-level discussion of these areas.

6.11.2.1. Population Demographics

Table 6-17 provides a summary of the primary study area population demographics. Ward 25 is the most populous of the two Wards with a population of 14 938 and it has a higher population density as well. Most of the population in the Wards are of economically active age groups (19 to 64 years old) with a median age of 26.5 years. Most of the population are Black African and the predominant languages isiZulu, Afrikaans and isiNdebele. The proportion of males is slightly higher than females across the wards.

Table 6-17: Population Demographics

Variable	GMLM Ward 15	ELM Ward 25	Combined
Geographical area	1 032	223	1 255

Variable	GMLM Ward 15	ELM Ward 25	Combined
Population	10 334	14 938	25 272
Population density	10 / km^2	67 / km^2	20 / km^2 (avg)
Economically active population	61%	63%	-
Largest population group	Black African (72%)	Black African (98%)	Black African
Dominant sex	Male (53%)	Male (52%)	Male
Languages	Zulu (48%) Afrikaans (23%)	Zulu (54%) Ndebele (15%)	Zulu, Afrikaans and Ndebele
Province of birth	Mpumalanga (65%)	Mpumalanga (76%)	Mpumalanga

6.11.2.2. Household Characteristics

Ward 25 has nearly double the number of households compared to that of Ward 15 with an average household size of 3.3 persons per household. Most of the households are headed by males with an average of 28% being headed by females. Research indicates that female headed households tend to face greater social and economic challenges and are vulnerable to lower household incomes and higher rates of poverty[1]. Table 6-18 provides a summary of the household characteristics.

Table 6-18: Summary of the Household Characteristics

Variable	GMLM Ward 15	ELM Ward 25	Combined
Number of households	2 871	4 868	7 739
Female headed households	25%	31%	28%
Household size (avg.)	3.6	3.1	3.3
Sex head of household	Male (76%)	Male (69%)	Male
Average household income	R 29 400 p.a. (R 2 450 p.m.)	R 29 400 p.a. (R 2 450 p.m.)	R 29 400 p.a. (R 2 450 p.m.)

6.11.2.3. Economic Profile

In both wards, the percentage of the population that has obtained a Grade 12 average 25% and lowest in ELM Ward 25 – with only 22% of the population with a matric or higher education (Table 6-19). According to the 2016 Community Survey an average of 50% of the population was employed within the formal economic sector. This may have changed due to Covid-19 and its associated loss of employment.

[1] https://www.econrsa.org/system/files/publications/working_papers/working_paper_761.pdf

Table 6-19: Summary of the Population's Education and Employment Status

Variable	GMLM Ward 15	ELM Ward 25	Combined
Education level: matric or higher	32.6%	21.7%	~ 25%
Employment rate[2]	53.4%	46.7%	~ 50%
Economic sector	Formal (74%)	Formal (78%)	Formal

6.11.2.4. Income Profiles

An average of 12% of households within the Wards did not earn an income while an average of eight percent (8%) earned an annual income of less than R10 000 per annum. This signifies that a substantial portion of households are living within the low bound and upper bound poverty line, which refers to the food poverty line plus the average amount derived from non-food items of households whose total expenditure is equal to the food poverty line (see Figure 6-26).

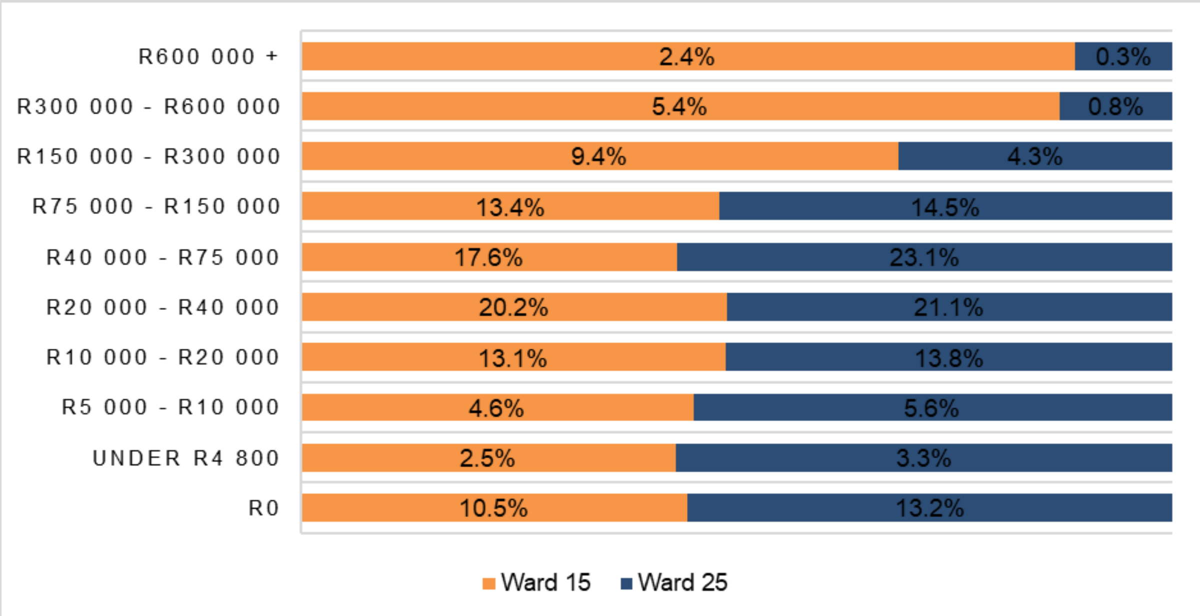


Figure 6-26: Annual Household Income

6.11.2.5. Access to Social Services and Infrastructure

Households residing in Ward 25 were reported to have better access to social services compared to those found in Ward 15. This may be attributed to the economic sectors served by the municipality within which the Ward sits such as mining and power generation. A summary of the indicators related to access to social services and infrastructure is provided in Table 6-20 below.

[2] Of the economically active population

Table 6-20: Access to Social Services

Variable	GMLM Ward 15	ELM Ward 25	Combined
Water services	Service provider (62%)	Service provider (86%)	Service provider
Toilet facilities	Flush or chemical (59.1%)	Flush or chemical (89.8%)	Flush or chemical
Refuse disposal	Local authority (50.8%)	Local authority (82.2%)	Local authority
Informal dwellings	623 (21.7%)	652 (13.4%)	1 275 (16.5%)

6.11.2.6. Development Needs

Table 6-21 below lists the development needs that were identified for the primary study area, as contained in the IDP.

Table 6-21: Development Needs in the Primary Study Area

Area	Identified Development Needs
ELM Ward 25	• Residential development stands. • RDP houses. • Road and storm water infrastructure. • Combined school. • High mast streetlights. • Formal township establishment for Ext. 6.
GMLM Ward 15	• Regular disposing of sewage through sewage trucks. • Constructing new communal toilet facilities. • Repairing of boreholes and windmills to solve water problems. • Road maintenance. • Allocation of low-cost houses. • Electrification of houses. • Employment creation. • Deploying of LED projects.

7. Analysis and Characterisation of Activity

7.1. Site Delineation and Characterisation

The Project Area covers a total surface area of 3 288.53 ha over 11 farm portions within the ELM, Mpumalanga Province. The local setting of the Project is shown and described in Section 3.

7.2. Water Management

The project aims to maximise the re-use of dirty water as process water and as such an intricate dirty water management system will be developed as discussed in subsections below.

7.2.1. Water Demand and Supply

The water balance indicates a water volume for dust suppression amounting to 344 032 m^3/annum and this water is obtained from Erickson Dams and the mine plant. Most of this water is used during the dry season where high levels of dust emissions are expected since rainfall will be minimal or absent. The largest amount of water at DECM circulates within the Erickson Dams 1, 2 and 3 with an approximate value of 1 352 260 m^3/annum. The RWD/PCD and mine plant follow in water usage, having average volumes of 1 086 045 m^3/annum and 968 466 m^3/annum, respectively. Potable water, which is used at the Mine Offices, Workshop and Change houses totals 62 057 m^3/annum. This water, originally from Erickson Dams 1, 2 and 3, is treated at the WTP before being pumped for use at the workshop, offices and change houses. The volume of effluent treated at the sewage treatment plant is in the order of 55 851 m^3/annum.

The calculated water demand, based on the potable and process water uses, for the Project is summarised in Table 7-1 below.

Table 7-1: Project Water Demand

Description	Water demand
Potable Water (Mine Offices, Workshop and Change houses)	62 057 m^3/annum
Dust Suppression	344 032 m^3/annum

7.2.2. Sewerage Management

DECM has an approved STP on site; however, with the extension of underground operations additional sewage capacity is required. The plant will be located in a “dirty water area” in the main workshop and office area and will service up to 220 people per day. The treatment plant will require 45 m^3 of water per day to process 16.2 kg of organic load. The plant is 3 m high, 2.3 m in diameter, with a storage volume of 10 m^3. The STP will discharge into the existing PCD.

7.2.3. Water Treatment

At this stage it is not anticipated that water discharge to the natural environment will be required. Therefore, no provision has been made for treating mine-affected water as part of the Project.

7.2.4. Water Balance

7.2.4.1. Inflows and Outflows

Inflows or sources of water at the DECM are presented in Table 7-2. Water outflows and or uses at the DECM are presented in Table 7-3. The water flow diagram is depicted in Figure 7-1.

Table 7-2: Water Inflows or Sources at the DECM

Process Unit	Inflow
Mine Plant	Erickson Dam 1,2 and3
Co-disposal Facility	Mine Plant
	Rainfall
Return Water Dam and PCD	Pit Dewatering
	Coal Stockpile Area (Runoff)
	Rainfall
	Tailing Storage Facility
	Sewage Treatment Plant
Sewage Treatment Plant	Offices and Change House
PCD (Railway Loadout Area)	Railway Loadout Terminal (Runoff)
Offices and Change House	Water Treatment Plant
Water Treatment Plant	Erickson Dam 1,2 and3
Erickson Dam 1,2,3	TNC Mines
	Rainfall
	RWDs
Pit 1	Rainfall/Runoff
	Groundwater inflow
Pit 2 & Dorstfontein West Operations (U/G Workings)	Rainfall
	Runoff
	Groundwater inflow
Pit 3 U/G Mining Extension (Seam 4)	Rainfall
	Runoff
	Groundwater inflow
Overburden Dump	Rainfall/Runoff

Table 7-3: Water Outflows and/or Uses at the DECM

Process Unit	Outflow
Mine Plant	Co-Disposal Facility
	Moisture in Product
	Dust Suppression
Co-disposal Facility	Evaporation
	RWD
Return Water Dam and PCD	Evaporation
	Erickson Dam 1,2 and3
Sewage Treatment Plant	RWD and PCD
PCD	Evaporation
Offices and Change House	Consumption
	Offices and Change House
Water Treatment Plant	Offices and Change House
Erickson Dam 1,2,3	Evaporation
	Mine Plant
	Dust Suppression
	Water Treatment Plant
Pit 1	Losses (Evaporation/Storage)
	Recharge/Infiltration
Pit 2 & Dorstfontein West Operations (U/G Workings)	Losses (Evaporation/Storage)
	De-watering
	Recharge/infiltration
Pit 3 U/G Mining Extension (Seam 4)	Evaporation
	De-watering
Overburden Stockpile	Losses

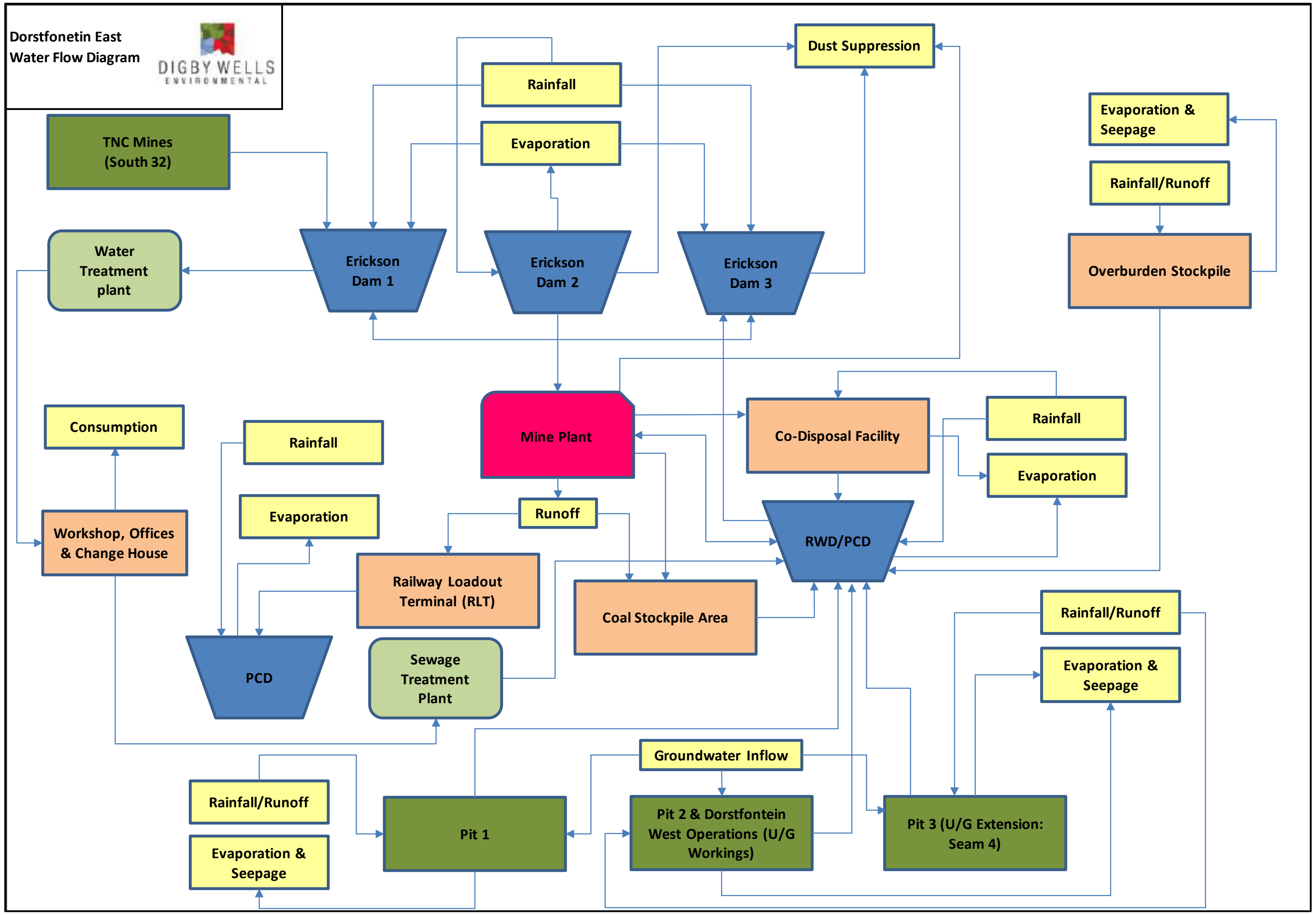


Figure 7-1: Water Flow Diagram for DECM

7.2.4.2. Calculations and Assumptions

The following assumptions and calculations were made to develop and update the water and salt balance for the DECM operations:

- The RoM is 2 156 648 tons per annum as provided by the client (Personal Communication with Mr Lorenzo Van Den Heever, 2017). This tonnage was used to calculate the amount of interstitial moisture present in the coal product based on the following two assumptions:
  - The mined product is a hard coal containing approximately 53% carbon and less moisture (World Coal Institute, 2005); and
  - Moisture in product was assumed to be 7 % of the RoM (Donahue and Rais, 2009).

7.2.4.2.1. Rainfall and Evaporation Data Used in the Water Balance

Monthly rainfall data used in the DECM water balance is presented in Table 7-4. This was derived from monthly rainfall time series records of 89 years from 1920 to 2009 (WRC, 2015). Areas of the open storage facilities were obtained from the previous DECM water balance report (GCS, 2018).

Table 7-4: Average Monthly Rainfall for Quaternaries B11B and B11D (WRC, 2015)

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall (mm)	72	111	110	115	91	76	42	17	8	6	7	23

Water stored in open storage facilities will evaporate, when available and the amount of water expected to evaporate was determined with the aid of S-Pan evaporation values for the catchment (WRC, 2015).

A mean annual precipitation of 676 mm and surface areas presented in Table 7-4 were used to calculate inflows into an open water body, such as dams.

Annual unit runoff (per square meter) which corresponds to 7% of MAP was used to calculate runoff/seepage from the Railway Loadout Terminal and Mine Plant areas that is contained in the PCDs.

A mean annual Symons Pan Evaporation (evaporation expected from an open body of water) for the area of 1 599 mm/annum distributed as indicated in Table 7-5, was applied to water facilities based on measured surface areas as presented in Table 7-6. Associated rainfall volumes falling directly on open storage facilities are also presented in Table 7-6.

Groundwater inflows were estimated to be between 800 m^3/day and 2 500 m^3/day depending on the mined area (Digby Wells, 2021) for the period between 2011 and 2018. An average dewatering volume of 1750 m^3/day was used which was split between Pit 2 and Pit 3. Dewatering for the pits is lower than computed groundwater inflows (Digby Wells, 2021).

Runoff from the overburden stockpile was assumed to be 40% of rainfall.

It is assumed that Pits 1 and 2 are being allowed to store sub-surface water in the backfilled spoils. Infiltration and recharge into the spoils were assumed to be 60% of rainfall/runoff (Hodgson & Krantz, 1998).

Losses due to seepage from Pits 1 and 2 were assumed to be 40% of water received.

Table 7-5: Average Monthly Symons Pan Evaporation for Quaternaries B11B and B11D (WRC, 2015)

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Evaporation(mm)	169	159	175	172	143	142	156	92	74	81	108	140

Table 7-6: Data Used for the DECM Water and Salt Balance

Mine Facility	Area (m^2)	Rainfall (m^3)	Evaporation (m^3)	Runoff (m^3)
Co-disposal Facility	120 776	83 335	193 121	-
RWD and PCD	75 502	52 096	117 179	-
Erickson Dam 1,2 and3	1 590	1 097	2 542	-
Coal Stockpile Area	20 979	-	-	1 028
Railway Loadout Terminal	48 777	-	-	2 390
PCD (RLT)	8 151	5 624	8 014	-
Mine Plant	85 185	-	-	4 174
Pit 1	1 792 730	-	-	87 844
Pit 2	848 965	-	-	41 599
Pit 2 surface water	10 857	7491	16828	-
Pit 3	216 960	-	-	10 631
Pit 3 surface water	12 200	-	-	-
Overburden Stockpile	592 313	-	-	245 218

7.2.4.3. Water Balance

Calculated annual and monthly water balances for the DECM are presented in Table 7-7 and Table 7-8, respectively. The water balance indicates a water volume for dust suppression amounting to 344 032 m^3/annum and this water is obtained from Erickson Dams and the mine plant. Most of this water is used during the dry season where high levels of dust emissions are expected since rainfall will be minimal or absent. The largest amount of water at DECM circulates within the Erickson Dams 1, 2 and 3 with an approximate value of 1 352 260 m^3/annum. The RWD/PCD and Mine Plant follow in water usage, having average volumes of 1 086 045 m^3/annum and 968 466 m^3/annum, respectively. Potable water, which is used at the mine offices, workshop and change houses totals 62 057 m^3/annum. This water, originally from Erickson Dams 1, 2 and 3, is treated at the WTP before being pumped for use at the workshop, offices and change houses. The volume of effluent treated at the sewage treatment plant is in the order of 55 851 m^3/annum.

Table 7-7: Annual Average Water Balance for the DECM

Annual Average Water Balance for Dorstfontein East Coal Mine					
		Water In		Water Out	Balance
Facility Name	Water Circuit/stream	Quantity (m^3/a)	Water Circuit/stream	Quantity (m^3/a)	
Erickson Dams 1, 2 & 3			To: Evaporation	2 561	
	From: Rainfall	1 075	To: Mine Plant	964 435	
	From: TNC Mines (South32)	294 365	To: Water Treatment Plant	62 057	
	From: RWD/PCD	1 056 820	To: Dust Suppression	323 206	
	Total	**1 352 259.74**		**1 352 259.74**	-
Water Treatment Plant					
	From: Erickson Dams 1,2 & 3	62 057	To: Offices; Workshop & Changehouse	62 057	
	Total	**62 057.00**		**62 057.00**	-
Mine Plant			To: Co-Disposal Facility	876 099	
	From: Erickson Dams 1,2 & 3	964 435	To: Moisture in Product (Interstitial)	67 510	
	From: Runoff	4 031	To: Dust Suppression	20 826	
			To: Coal Stockpile Area	2 015	
			To: Railway Load Terminal (RLT)	2 015	
	Total	**968 465.60**		**968 465.60**	-
Co-Disposal Facility					
	From: Rainfall	81 637	To: Evaporation	194 570	
	From: Mine Plant	876 099	To: RWD/PCD	763 166	
	Total	**957 736.36**		**957 736.36**	-
RWD/PCD	From: Rainfall	51 035			
	From: Pit Dewatering (Pits 1,2 & 3)	15 684			
	From: Co-Disposal Facility	763 166	To: Evaporation	29 225	
	From: Overburden Stockpile	130 783	To: Erickson Dams 1,2 & 3	1 056 820	
	From: Coal Stockpile Area	69 526			
	From: Sewage Treatment Plant	55 851			
	Total	**1 086 045.11**		**1 086 045.11**	-
PCD (RLT)					
	From: Rainfall	5 510	To: Evaporation	7 818	
	From: Runoff (from RLT)	2 308			
	Total	**7 817.51**		**7 817.51**	-
Coal Stockpile Area					
	From: Mine Plant	67 510			
	From: Runoff (from Plant Area)	2 015	To: RWD/PCD	69 526	
	Total	**69 525.75**		**69 525.75**	-
Workshop; Offices and Changehouse					
			To: Consumption	6 206	
	From: Water Treatment Plant	62 057	To: Sewage Treatment Plant	55 851	
	Total	**62 057.00**		**62 057.00**	
Sewage Treatment Plant					
	From: Workshop; Offices & Changehouse	55 851	To: RWD/PCD	55 851	
	Total	**55 851.30**		**55 851.30**	-
Pit 1					
	From: Rainfall/Runoff	121 178	To: Evaporation	308 483	
	From: Groundwater inflow	401 675	To: Seepage/reacharge	209 141	
			To: RWD/PCD	5 228	
	Total	**522 852.50**		**522 852.50**	-
Pit 2 Underground Workings					
	From: Rainfall/Runoff	7 339	To: Evaporation	113 305	
	From: Groundwater inflow	190 216	To: Seepage/reacharge	79 022	
			To: RWD/PCD	5 228	
	Total	**197 554.19**		**197 554.19**	-
Pit 3 U/G Extension: Seam 4					
	From: Rainfall/Runoff	9 688	To: Evaporation	29 751	
	From: Groundwater inflow	48 610	To: Seepage/reacharge	23 319	
			To: RWD/PCD	5 228	
	Total	**58 298.22**		**58 298.22**	-
Overburden Stockpile					
	From: Rainfall/Runoff	160 147	To: Evaporation	29 364	
			To: RWD/PCD	130 783	
	Total	**160 147.27**		**160 147.27**	-
Total Water Balance		**5 560 667.54**		**5 560 667.54**	

Table 7-8: Monthly Average Water Balance for the DECM

Monthly Average Water Balance for Dorstfontein East Coal Mine					
		Water In		**Water Out**	**Balance**
Facility Name	**Water Circuit/stream**	**Quantity (m^3/mon)**	**Water Circuit/stream**	**Quantity (m^3/mon)**	
Erickson Dams 1, 2 & 3			To: Evaporation	213	
	From: Rainfall	90	To: Mine Plant	80 370	
	From: TNC Mines (South32)	24 530	To: Water Treatment Plant	5 171	
	From: RWD/PCD	88 068	To: Dust Suppression	26 934	
	Total	**112 688.31**		**112 688.31**	-
Water Treatment Plant	From: Erickson Dams 1,2 & 3	5 171	To: Offices; Workshop & Changehouse	5 171	
	Total	**5 171.42**		**5 171.42**	-
Mine Plant			To: Co-Disposal Facility	73 008	
	From: Erickson Dams 1,2 & 3	80 370	To: Moisture in Product (Interstitial)	5 626	
	From: Runoff	336	To: Dust Suppression	1 735	
			To: Coal Stockpile Area	168	
			To: Railway Load Terminal (RLT)	168	
	Total	**80 705.47**		**80 705.47**	-
Co-Disposal Facility	From: Rainfall	6 803	To: Evaporation	16 214	
	From: Mine Plant	73 008	To: RWD/PCD	63 597	
	Total	**79 811.36**		**79 811.36**	-
RWD/PCD	From: Rainfall	4 253			
	From: Pit Dewatering (Pits 1,2 & 3)	1 307			
	From: Co-Disposal Facility	63 597	To: Evaporation	2 435	
	From: Overburden Stockpile	10 899	To: Erickson Dams 1,2 & 3	88 068	
	From: Coal Stockpile Area	5 794			
	From: Sewage Treatment Plant	4 654			
	Total	**90 503.76**		**90 503.76**	-
PCD (RLT)	From: Rainfall	459	To: Evaporation	651	
	From: Runoff (from RLT)	192			
	Total	**651.46**		**651.46**	-
Coal Stockpile Area	From: Mine Plant	5 626			
	From: Runoff (from Plant Area)	168	To: RWD/PCD	5 794	
	Total	**5 793.81**		**5 793.81**	-
Workshop; Offices and Changehouse			To: Consumption	517	
	From: Water Treatment Plant	5 171	To: Sewage Treatment Plant	4 654	
	Total				
Sewage Treatment Plant	From: Workshop; Offices & Changehouse	4 654	To: RWD/PCD	4 654	
	Total	**4 654.28**		**4 654.28**	-
Pit 1	From: Rainfall/Runoff	10 098	To: Evaporation	25 707	
	From: Groundwater inflow	33 473	To: Seepage/reacharge	17 428	
			To: RWD/PCD	436	
	Total	**43 571.04**		**43 571.04**	-
Pit 2 Underground Workings	From: Rainfall/Runoff	612	To: Evaporation	9 442	
	From: Groundwater inflow	15 851	To: Seepage/reacharge	6 585	
			To: RWD/PCD	436	
	Total	**16 462.85**		**16 462.85**	-
Pit 3 U/G Extension: Seam 4	From: Rainfall/Runoff	807	To: Evaporation	2 479	
	From: Groundwater inflow	4 051	To: Seepage/reacharge	1 943	
			To: RWD/PCD	436	
	Total	**4 858.18**		**4 858.18**	-
Overburden Stockpile	From: Rainfall/Runoff	13 346	To: Evaporation	2 447	
			To: RWD/PCD	10 899	
	Total	**13 345.61**		**13 345.61**	-
Total Water Balance		**458 217.54**		**458 217.54**	

7.2.4.4. Salt Balance

Annual average water flow volumes were converted to daily flow volumes and multiplied by the daily SO_4 concentration to produce daily average water and salt balance (Table 7-9). Sulphates were used in the W&SB because sulphur is recognised as one of the major impurities in coal with a concentration of up to 10% of the coal ore (Zhou, 1989). Although TDS could have been used, the effect of the abundant pollutant (sulphur) would have been masked since TDS accounts for all dissolved salts including trace-elements.

The salt balance shows that Erickson Dams and the mine plant have higher concentrations of dissolved salts amounting to 230.38 kg/m^3/day and 171.87 kg/m^3/day, respectively. These facilities should closely be monitored in case of any spills or seepages into the environment for immediate detection, mitigation and/or management. The RWD/PCD is lined and total salts in circulation amount to 12.55 kg/m^3/day. Water levels in the RWD/PCD should also be monitored to prevent the occurrence of overflows.

Table 7-9: Daily Average Water and Salt Balances for the DECM

Daily Average Water and Salt Balance for Dorstfontein East Coal Mine							
Facility Name	Water Circuit/stream	Salt In Quantity (Kg/m^3)/day	Water In Quantity (m^3/day)	Water Circuit/stream	Salt Out Quantity (m^3/day)	Water Out Quantity (kg/m^3)/da	Balance
Erickson Dams 1, 2 & 3				To: Evaporation	-	7	
	From: Rainfall	0.034	3	To: Mine Plant	170.48	2 635	
	From: TNC Mines (South32)	4.5	804	To: Water Treatment Plant	2.03	170	
	From: RWD/PCD	226	2 887	To: Dust Suppression	57.87	883	
	Total	**230.38**	**3 694.70**		**230.38**	**3 694.70**	-
Water Treatment Plant				To: Offices; Workshop & Changehouse	1.96	170	
	From: Erickson Dams 1,2 & 3	11.06	170	To: Salt residue remaining in WTP	9.10		
	Total	**11.06**	**169.55**		**11.06**	**169.55**	-
Mine Plant				To: Co-Disposal Facility	5.77	2 394	
	From: Erickson Dams 1,2 & 3	172	2 635	To: Moisture in Product (Interstitial)	14.43	184	
	From: Runoff	0.0007	11	To: Dust Suppression	4.45	57	
				To: Coal Stockpile Area	146.78	5.5	
				To: Railway Load Terminal (RLT)	0.43	5.5	
	Total	**171.87**	**2 646.08**		**171.87**	**2 646.08**	-
Co-Disposal Facility	From: Rainfall	2.6	223	To: Evaporation	-	532	
	From: Mine Plant	1.7	2 394	To: RWD/PCD	4.22	2 085	
	Total	**4.22**	**2 616.77**		**4.22**	**2 616.77**	-
RWD/PCD	From: Rainfall	1.61	139				
	From: Pit Dewatering (Pits 1,2 & 3)	2.11	43				
	From: Co-Disposal Facility	5.03	2 085	To: Evaporation	-	80	
	From: Overburden Stockpile	0.86	357	To: Erickson Dams 1,2 & 3	12.55	2 887	
	From: Coal Stockpile Area	0.46	190				
	From: Sewage Treatment Plant	2.49	153				
	Total	**12.55**	**2 967.34**		**12.55**	**2 967.34**	-
PCD (RLT)	From: Rainfall	0.174	15	To: Evaporation	-	21	
	From: Runoff (from RLT)	0.001	6.3	To: Salt residue remaining in PCD (RLT)	0.17		
	Total	**0.17**	**21.36**		**0.17**	**21.36**	-
Coal Stockpile Area	From: Mine Plant	0.13	184	To: RWD/PCD	0.13	190	
	From: Runoff (from Plant Area)	0.004	5.5				
	Total	**0.13**	**189.96**		**0.13**	**189.96**	-
Workshop; Offices and Changehouse				To: Consumption	0.20	17	
	From: Water Treatment Plant	2.0	170	To: Sewage Treatment Plant	1.80	153	
	Total	**2.00**	**169.55**		**2.00**	**169.55**	-
Sewage Treatment Plant	From: Workshop; Offices & Changehouse	2.49	153	To: RWD/PCD	2.49	153	
	Total	**2.49**	**152.60**		**2.49**	**152.60**	-
Pit 1	From: Rainfall/Runoff	16	331	To: Evaporation	-	843	
	From: Groundwater inflow	54	1 097	To: Seepage/reacharge	28.09	571	
				To: RWD/PCD	42.14	14	
	Total	**70.24**	**1 428.56**		**70.24**	**1 428.56**	-
Pit 2 Underground Workings	From: Rainfall/Runoff	0.08	20	To: Evaporation	-	310	
	From: Groundwater inflow	25.55	520	To: Seepage/reacharge	10.62	216	
				To: RWD/PCD	15.02	14	
	Total	**25.64**	**539.77**		**25.64**	**539.77**	-
Pit 3 U/G Extension: Seam 4	From: Rainfall/Runoff	0.11	26	To: Evaporation	0.00	81	
	From: Groundwater inflow	6.53	133	To: Seepage/reacharge	3.13	64	
				To: RWD/PCD	3.51	14	
	Total	**6.64**	**159.28**		**6.64**	**159.28**	-
Overburden Stockpile	From: Rainfall/Runoff	1.05	438	To: Evaporation	-	80	
				To: RWD/PCD	1.05	357	
	Total	**1.05**	**437.56**		**1.05**	**437.56**	-
Total Water & Salt Balances		**538.43**	**15 193.08**		**538.43**	**15 193.08**	

7.2.5. Stormwater Management Plan

During the site visit on 5 February 2020 an assessment of the DECM stormwater management infrastructure was conducted. Onsite assessment findings led to the conclusion that DECM has a well-established and operational stormwater management system which will adequately cover the newly proposed activities which fall within the

Storm Water Management Plan (SWMP). The runoff in the mining areas is being treated as dirty water and contained for reuse. Diversion channels are in place to divert clean water from dirty areas and join it back to the natural environment. The specific Project Area assessment observations are detailed in this section.

Identified dirty water areas include the following:

- Discard dumps;
- Coal stockpiles;
- Topsoil stockpiles;
- Waste rock dumps;
- Mine plant area;
- Railway loadout terminal;
- Workshop area;
- Mine pits; and
- Sumps.

Field investigation indicated that separation of clean and dirty catchments is in place as recommended by the GN 704 guidelines. Concrete-lined channels are used to convey dirty water from dirty areas such as discard dumps to the PCD (see Figure 7-2). Perimeter berms are in place and these are used divert clean water so that it does not mix-up with contaminated stormwater from dirty catchments. The stormwater system for the mine is generally operational and in compliance to best practice standards. For details of the existing stormwater management plan layout refer to previous reports for the site (Digby Wells, 2015; SRK Consulting, 2016). Regular maintenance of the system should be conducted so that stormwater channels will not silt-up due to sediments carried by overland flow. Berms should be checked and maintained in the event of breaching by heavy runoff events during the rainy season. Dimensions of typical existing dirty water channels at DECM are presented in Table 7-10.

Table 7-10: General Dimensions of Lined Dirty Storm Water Channels at DECM

Component	Classification	Cross-Section	Bottom Width (m)	Left Slope (m/m) (H:V)	Right Slope (m/m) (H:V)
Channel or Drain	Dirty	Trapezoidal	1	2	2

7.2.5.1. Discard Dumps

Discard dump penstock outlets discharge seepage into an open concrete channel (Figure 7-2) at the foot of the dump which passes through a silt trap before being pumped to PCDs through a pipeline.

Figure 7-2: Trapezoidal Channel Collecting Water from Discard Dump Penstock Outlets

7.2.5.2. Workshops and Plant Area

Existing trapezoidal concrete channels collect dirty storm runoff from the mine plant, workshops, RoM stockpile and convey it to the PCDs.

Several conveyor transfer points are located within the dirty areas thus any dirty water originating at these points falls within the dirty water system.

7.2.5.3. Pollution Control Dams

Three PCDs exist at the DECM site for containment of dirty water. Silt traps filter sediments from dirty water before it gets into the PCDs (Figure 7-3). The PCDs are adjoined to allow overflow from one dam to the other in cases of high rainfall events. Dirty runoff from the Railway Load-out Terminal (RLT) collects in concrete-lined drains and pumped for containment to a PCD.

Figure 7-3: Side View of PCDs at DECM

7.2.5.4. Stormwater Management Plan for the Proposed Surface Infrastructure

The proposed infrastructure which include workshop, change house, offices, ROM stockpile conveyor at portal, portal ventilation fan and stone dust silo will all be located within an area which already has existing stormwater management infrastructure in place. Their footprint should be kept within this area and should be integrated into the existing SWMP.

The areas where the proposed ventilation shaft and the new 11kV substation will be installed should be developed to minimise the extent of paved surfaces at the ground level to control runoff and reduce erosion that results from accelerated flow velocities. These areas will be treated as clean catchments which will not require any diversion stormwater infrastructure.

8. Impacts Assessment

This section aims to rate the significance of the identified potential impacts pre-mitigation and post-mitigation. The potential impacts identified in this section are informed by the environmental conditions' investigations presented in Section 6 above. The identified potential impacts are therefore a result of both the environment in which the Project activity takes place, as well as the activity itself.

Section 8.1 details the methodology employed to quantify the identified potential impacts which are subsequently presented in Section 8.2.

8.1. Impact Assessment Methodology

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

The matrix calculates the rating out of 147, whereby intensity, extent, duration and probability are each rated out of seven as indicated in Table 8-1. 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. The significance of an impact is then determined and categorised into one of eight categories (The descriptions of the significance ratings are presented in Table 8-2).

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, (i.e., there may already be some mitigation included in the engineering design). If the specialist determines the potential impact is still too high, additional mitigation measures are proposed.

Table 8-1: Impact Assessment Parameter Ratings

Rating	Intensity/ Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
7	Irreplaceable loss or damage to biological or physical resources or **highly** sensitive environments.	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..	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the Project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Serious loss and/or damage to physical or biological resources or **highly** sensitive environments, limiting ecosystem function.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the Project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.

Rating	Intensity/ Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
4	Serious loss and/or damage to physical or biological resources or **moderately** sensitive environments, limiting ecosystem function.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	Moderate loss and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function.	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.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/ Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning.	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.

Table 8-2: Significance Rating Description

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

The impact matrix abbreviations used are provided in Table 8-3.

Table 8-3: Impact Matrix Abbreviations

Abbreviation	Definition
D	Duration
E	Extent
I	Intensity
P	Probability

8.2. Results of the Impact Assessment

The potential impacts for the Project were identified and assessed according to the following aspects which are appended to this report (Table 8-4).

Table 8-4: Specialist Studies Undertaken and their Corresponding Appendix

Specialist Assessment	Appendix
Surface water	Appendix D
Wetlands	Appendix E
Aquatics	Appendix F
Hydropedology	Appendix G
Groundwater	Appendix H
Rehabilitation and Closure	Appendix I

The project phases, namely: construction; operation; decommissioning and rehabilitation; and post-closure are discussed under each aspect. Table 8-5 presents the activities associated with the Project during each phase.

Table 8-5: Activities per Project Phase

Project Phase	Project Activity
Construction Phase	• In-pit RoM stockpiling.
Operation Phase	• Blasting (only when dykes and other geological features are encountered); • In-pit RoM stockpiling; • Transportation of coal from pit for further processing; • Underground mining machinery maintenance; • Operation of water and sewer reticulation; and • Use of existing haul roads.

Project Phase	Project Activity
Closure Phase	• Demolition and removal of infrastructure – once mining activities have been concluded, infrastructure will be demolished in preparation of the final land rehabilitation; • Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation; and • Post-closure monitoring and rehabilitation.

Table 8-6 below provides the quantified impact assessment and key mitigation measures for water resources related to the activities mentioned in Table 8-5. Detailed descriptions of the identified impacts are provided in the respective specialist reports appended to this IWWMP.

Table 8-6: Impact Assessment Associated with the Construction, Operation and Closure Phases

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Construction	Access road construction, movement of vehicles and heavy machinery.	Soil, Land Use and Land Capability	• Compaction of soil; • Increased runoff potential; and • Increased erosion and consequently sedimentation potential.	5	3	4	5	Moderate (negative) - 60	• Keep site clearing to a minimal • While soils are being stockpiled, the soils should be revegetated to limit erosion and loss of organic material; • Establishment of effective vegetation around constructed infrastructure for adequate soil protection from wind and water erosion; • If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place at regular intervals or after high rainfall events; and • Runoff must be controlled and managed by the use of proper stormwater management measures.	4	2	2	4	Negligible (negative) - 32
Construction	Site clearing and preparation by the removal of vegetation and topsoil, leading to the exposure of soils for site establishment.	Soil, Land Use and Land Capability	• Compaction of soil; • Increased runoff potential; • Increased wind and water erosion and consequently sedimentation potential; • Removal of vegetation and basal cover resulting in loss of topsoil, organic material and increased erosion potential; and • Compaction, ponding and changing the natural landscape of the area.	5	4	5	6	Moderate (negative) -84	• Keep site clearing to a minimal • While soils are being stockpiled, the soils should be revegetated to limit erosion and loss of organic material; • Establishment of effective vegetation around constructed infrastructure for adequate soil protection from wind and water erosion; • If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place at regular intervals or after high rainfall events; and • Runoff must be controlled and managed by the use of proper stormwater management measures.	4	2	2	4	Negligible (negative) - 32
Construction	Construction of surface infrastructure.	Soil, Land Use and Land Capability	• Increased vehicle movement in the area, increasing soil compaction and runoff potential; • Increased hardened surfaces resulting in increased hydrological functioning; • Diggings, removal and shifting of soil;	5	4	5	6	Moderate (negative) - 84	• Increased vehicle movement in the area, increasing soil compaction and runoff potential; • Increased hardened surfaces resulting in increased hydrological functioning; • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the soils; and • Increased dust, erosion and sedimentation	4	2	2	4	Negligible (negative) - 32

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
			• Potential spillage of sewage wastewater and hydrocarbons such as oils, fuels and grease, thus contamination of the soils; and • Increased dust, erosion and sedimentation.											
Construction	Waste management activities, including: • In-pit RoM Stockpiling; • Handling of hydrocarbon chemicals; • Hauling and transportation of waste material; • Transportation of product coal; and • Disposal of waste material	Soil, Land Use and Land Capability	• Soil contamination from hydrocarbon waste (i.e., lubricants, oils explosives and fuels); • Soil contamination from sewage and wastewater; and • Soil compaction resulting from the movement of heavy machinery within the Project Area.	5	3	3	6	Minor (negative) - 66	• Runoff must be controlled and managed by the use of proper stormwater management measures; • Vehicles should regularly be surveyed and checked that oils spills and other contaminants are not exposed to the soils; • Re-fuelling must take place on bunded impervious surfaces to prevent seepage of hydrocarbons into the soil; • All vehicles and machines must be parked within hard park areas and must be checked daily for fluid leaks; and • Fuel, grease and oil spills should be remediated using a commercially available emergency clean up kits. However, for major spills (>5 L), if soils are contaminated, they must be stripped and disposed of at a licensed waste disposal site.	4	2	1	4	Negligible (negative) - 29
Construction	Access road construction.	Wetlands	• Erosion and sedimentation; and • Soil compaction and or disturbance.	5	2	5	5	Minor (negative) -60	• At areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing; • Environmental Practitioner and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; and • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction.	4	1	3	4	Minor (negative) - 32
Construction	Site clearing, including the removal of	Wetlands	No wetlands will directly be impacted, however secondary impacts might occur	5	2	2	3	Negligible	• Environmental Practitioner and botanist to be present during vegetation clearing to prevent	3	1	1	2	Negligible (negative) - 10)

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
	vegetation and disturbance of soils.		as activities are proposed within 100 m and 500 m of wetlands. Secondary impacts include: • Erosion and sedimentation; • Loss of fauna and flora (biodiversity); and • Increased AIPs.					(negative) - 27	unnecessary clearing of extensive areas not part of the direct footprint area; • Monitor and rehabilitate cleared and impacted areas where necessary; • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas; and • Limit vegetation removal and construction activities to the infrastructure footprint area only, where removed or damaged vegetation areas should be revegetated as soon as possible with a suitable mix of plant species as determined by a qualified botanist.					
Construction	Construction of mine related surface infrastructure.	Wetlands	• Increased hardened surface, runoff and onset of erosion and sedimentation; • Decreased wetland habitat, functionality and integrity; and • Soil, water and wetland contamination.	6	3	6	4	Minor (negative) - 60	• Wherever possible, surface infrastructure and vehicle movement should be placed outside wetlands and the 100 m Zone of Regulation to prevent impacts such as increased hardened surfaces, runoff, contamination, erosion and sedimentation; • All areas of increased ecological sensitivity should be designated as "No-Go" areas and be off-limits to all unauthorised vehicles and personnel; • Limit vegetation removal and construction activities to the infrastructure footprint area only, where removed or damaged vegetation areas should be revegetated as soon as possible with a suitable mix of plant species as determined by a qualified botanist; • All spills must be cleaned up immediately to prevent contaminants to enter the wetlands; and • Monitor rehabilitated areas to ensure successful re-establishment of vegetation and assess/prevent AIPs proliferation as well as monitor erosion, canalisation and changes to the systems.	5	2	4	3	Negligible (negative) - 33
Construction	Waste management activities.	Wetlands	• Contamination from Hydrocarbon waste (lubricants, oils explosives and fuels);	7	3	7	5	Moderate (negative) – 85	• A SWMP should already be implemented. This should consider all wetlands and other watercourses associated with the new	6	2	6	4	Minor (negative) - 56

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
			• Contamination from sewage and wastewater; and • Changes to wetland health and biodiversity.						developments/infrastructure which should divert stormwater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible; • The SWMP should convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • The SWMP should convey contaminated water away from wetlands and freshwater systems; • Freshwater resource monitoring must be carried out during the construction phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; • Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; • Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; and • All spills should be immediately cleaned up and treated accordingly.					
Construction	Site clearance and construction of proposed infrastructure.	Aquatics	• Land and vegetation manipulation/clearing in proximity to the watercourses.	5	3	4	5	Minor (negative) – 60	• General mitigation actions provided in the wetlands and surface water studies conducted by Digby Wells should be used to guide the effective management of aquatic resources potentially affected by the proposed Project. However, more specific management actions for the Construction Phase are listed below: • Limit vegetation removal to the infrastructure footprint area only. Where removed or damaged, vegetation areas (riparian or aquatic related) should be revegetated as soon as possible;	5	2	2	3	Negligible (negative) – 27

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
									• Bare land surfaces downstream of construction activities must be vegetated to limit erosion from the expected increase in surface runoff from infrastructure; • Environmentally friendly barrier systems, such as silt nets or, in severe cases, use trenches downstream from construction sites to limit erosion and possibly trap contaminated runoff from construction; • Storm water must be diverted from construction activities and managed in such a manner to disperse runoff and prevent the concentration of storm water flow; • Water used at construction sites should be utilised in such a manner that it is kept on site and not allowed to run freely into nearby watercourses (i.e., use of a PCD); • Construction chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; • All vehicles must be frequently inspected for leaks; • No material may be dumped or stockpiled within any rivers, drainage lines in the vicinity of the proposed project; • All waste must be removed and transported to appropriate waste facilities; and • High rainfall periods (usually November to March) should be avoided during construction to possibly avoid increased surface runoff in attempt to limit erosion and the entering of external material (i.e., contaminants and/or dissolved solids) into associated aquatic systems.					
Construction	Site preparation including vegetation clearance and	Hydropedology	• Siltation and sedimentation of water resources leading to deteriorated water quality.	5	4	3	6	Minor (negative) - 72	• Buffer zones need to be delineated and established as specified in the Wetlands	2	2	2	3	Negligible (negative) - 18

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
	excavations, leading to exposure of soils.								report (Digby Wells , 2020) to prevent the destruction of wetlands within DECM;					
Construction	Handling of hydrocarbons and other chemicals; Loading, hauling and transportation of product coal.	Hydropedology	• Contamination of water resources leading to deterioration of water quality.	6	5	3	5	Minor (negative) - 70	• Developments near undisturbed wetlands need to be avoided as much as possible; • Rehabilitate the land to the most suitable post-mining land use; • The discard dump should be lined with an impermeable layer to prevent groundwater contamination; • Clearing of vegetation must be limited to the development footprint and the use of any existing access roads must be prioritised to minimise creation of new ones; • Dust suppression on the haul roads and other cleared areas must be undertaken on regular basis to prevent or limit dust generation; • Hydrocarbon and hazardous waste storage facilities must be appropriately bunded to ensure that leakages can be contained. Spill kits should be in place and construction workers should be trained in the use of spill kits, to contain and immediately clean up any leakages or spills; • Vehicles should regularly be maintained as per the developed maintenance program. This should also be inspected daily before use to ensure there are no leakages underneath; and • Drip trays must be used to capture any oil leakages. Servicing of vehicles and machinery should be undertaken at designated hard park areas. Any used oil should be disposed of by accredited contractors.	5	2	2	2	Negligible (negative) - 18
Construction	Site preparation and excavations. Stockpiling of spoils and discard.	Surface water	• Sedimentation and siltation of nearby watercourses most likely leading to deteriorated water quality.	5	2	3	4	Minor (negative) - 40	• The following mitigation measures are recommended during the construction activities: • Site preparation for the construction of infrastructure should be confined to the existing development footprint area to minimise disturbance of soils and the	2	2	3	2	Negligible (negative) - 14
Construction	Washing off, of oils, fuels and other hydrocarbon spills	Surface water	• Surface water contamination and deterioration of water quality.	5	4	2	5	Minor (negative) - 55		2	2	2	2	Negligible (negative) - 12

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
	during the construction of facilities such as offices, ablutions, storerooms, workshops, storage dams, process plant, roads, pipelines, power lines and conveyors.								probability of sedimentation and siltation of the nearby watercourses. • Ensure that additional proposed infrastructure should be within the existing storm water management plan as proposed, to ensure continued control of any dirty runoff on site. • Construction should be undertaken during the dry winter period to reduce sedimentation in nearby watercourses since there will be minimal to no occurrence of rainfall ; and • All storage areas (fuels, paints, oils) used at the construction camp should be appropriately bunded and spill kits should be in place and construction workers trained in the use of spill kits, to contain and immediately clean up any potential leakages or spills.					
Construction	Temporary employment creation.	Socio-economic	• Temporary economic injection through income, mostly on an individual or household level.	3	2	1	4	Negligible (positive) 24	• Advertise any local employment opportunities in local community papers and at venues frequented by community members (e.g., community hall, municipal offices, etc.). • Develop and maintain a database of job seekers who apply for any job advertised through the above-mentioned measures. • Do not employ at the gate. Employment at the gate of day labourers will stimulate an influx of job seekers and crowds gathering at the work site; and • Ensure that local communities are aware of and have easy access to the mine's grievance mechanism so that they can register complaints around employment practices. This will also allow the mine with opportunities to address any legitimate complaints.	3	3	2	5	Minor (positive) 40
Construction	Project-induced in-migration.	Socio-economic	• A temporary increase in certain segments of the population can place additional strain on housing and services.	2	3	2	4	Negligible (negative) - 28	• Discourage in-migration from other areas by focusing employment opportunities at the local community and widely publicising this intent and refrain from employing day labourers at the gate. Maintain a job seeker register and only employ people who are registered on this	1	2	0	2	Negligible (negative) - 6

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
									database and who have been verified as being from the local area; and • Engage with local communities to understand their concerns, raise awareness of risks and opportunities and identify solutions to issues related to in-migration.					
Operational	Blasting (only when dikes and other geological features are encountered).	Soil, Land Use and Land Capability	• Movement of the soil strata; and • Potential subsistence, causing ponding and undulating topographies	5	3	4	5	Moderate (negative) - 60	• Do not blast in sensitive areas (wetland areas) where there is a possibility of ponding and subsidence; and • Limit the use of blasting.	4	2	2	4	Negligible (negative) - 32
Operational	Underground mining machinery maintenance.	Soil, Land Use and Land Capability	• Soil Contamination; and • Soil compaction.	5	3	3	6	Minor (negative) - 66	• Soil pollution monitoring should be conducted at selected locations on the Project site to detect any extreme levels of pollutants; and • Any spillage effluent should be cleaned up immediately and the removed contaminated soils should be disposed of at accredited disposal sites.	4	2	1	4	Negligible (negative) - 28
Operational	Use of existing haul roads and vehicle movement.	Soil, Land Use and Land Capability	• Compaction of soil; • Increased runoff potential; • Head cut erosion and channel forming from the roads (culverts); and • Increased erosion and consequently sedimentation potential.	5	4	4	5	Moderate (negative) - 65	• Make use of existing roads to encourage minimal impacts/footprint to the Project Area; • Keep to designated areas for vehicle movement to prevent further compaction and potential erosion; and • Maintain road culverts and monitor soil erosion and sedimentation.	4	2	2	4	Negligible (negative) - 32
Operational	In-pit RsM Stockpiling.	Soil, Land Use and Land Capability	• Soil Contamination from ROM stockpiles, leaching, erosion, sedimentation of contaminants; • Loss of vegetation and habitat due to high contaminates in soils; and • Erosion and sedimentation from RoM stockpiling areas.	5	3	3	6	Moderate (negative) - 66	• Runoff must be controlled and managed by the use of proper stormwater management measures; • Stockpiles should be engineered to prevent excessive runoff and erosion; • Construct a trench around the stockpiles to prevent runoff, contaminants and sediments to enter the natural systems; and • RoM-stockpiles not to be constructed in high land capability areas and wetland areas.	4	2	3	4	Minor (negative) - 36

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Operational	Operation of water and sewer reticulation. Waste management activities.	Soil, Land Use and Land Capability	• Soil contamination from Hydrocarbon waste/spills (lubricants, oil, explosives and fuels); and • Soil contamination from sewage and wastewater	5	3	3	6	Moderate (negative) - 66	• Soil pollution monitoring should be conducted at selected locations on the Project site to detect any extreme levels of pollutants; and • Any spillages of sewage effluent from the treatment plant or ablution facilities should be cleaned up immediately and the removed contaminated soils should be disposed of at accredited disposal sites.	4	2	2	4	Negligible (negative) - 32
Operational	Operation of the coal discard processing plant.	Soil, Land Use and Land Capability	• Contamination of soil; • Increased runoff; and • Increased erosion and consequently sedimentation potential.	5	4	4	6	Moderate (negative) - 78	• Soil pollution monitoring should be conducted at selected locations on the Project site to detect any extreme levels of pollutants; • Discard from the coal wash plant must be contained and treated before released into the environment; and • Any spillages from the coal wash plant should be cleaned up immediately and the removed contaminated soils should be disposed of at accredited disposal sites.	4	2	3	4	Minor (negative) - 36
Operational	Blasting (only when dikes and other geological features are encountered).	Wetlands	• Movement of the strata causing potential subsistence, resulting in ponding and undulating topographies; and • Dewatering and drying out of wetlands.	7	3	7	7	Major (negative) - 119	• Freshwater resource monitoring must be carried out during the operational and decommissioning phases by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; • Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material and sedimentation into wetland areas; and • If it is unavoidable that any of the wetlands be affected, the disturbance must be minimised and suitably rehabilitated.	6	3	6	6	Moderate (negative) - 90
Operational	Underground mining machinery maintenance.	Wetlands	• Contamination and deterioration of soil and water quality and quantity; and • Loss or changes to natural wetland PES, ES and EIS.	6	3	6	5	Moderate (negative) – 75	• Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil; • All spills must be cleaned up immediately to prevent contaminants to enter the wetlands;					Minor (negative) – 48

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
									• Channelled water should not be dispersed in a concentrated manner. Baffles should be incorporated into artificial drainage lines/channels around the surface infrastructure to decrease the kinetic energy of water as it flows into the natural environment; • A SWMP should already be implemented. This should consider wetlands associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible; • No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads and within the operational footprint; and • All vehicles must be regularly inspected for leaks.					
Operational	Use of existing haul roads and vehicle movement.	Wetlands	• Head cut erosion and channel forming from the roads (culverts); and • Increased erosion and consequently sedimentation potential into wetlands; • Loss of vegetation and habitat; and • Wetland fragmentation.	6	3	5	5	Minor (negative) - 70	• The edge of the wetlands and a 100m buffer or 1:100 flood line buffer should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the operational phase; • All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel; • If it is unavoidable that any of the wetland areas present will be affected, the disturbance must be minimised and suitably rehabilitated; • If spill occur, it must be cleaned up immediately and remediated; • No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines; • Culverts, roads and river crossings must be maintained, cleared and monitored; and • No vehicles or heavy machinery may be allowed to drive indiscriminately within any	5	2	3	4	Minor (negative) - 40

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
									wetland areas or their buffer areas. All vehicles must remain on demarcated roads and within the operational footprint.					
Operational	In-pit RoM Stockpiling.	Wetlands	• Potential runoff from topsoil and subsoil stockpiles causing sedimentation into the wetlands; and • Erosion and sedimentation of contaminants into the wetland areas.	6	3	5	4	Minor (negative) - 56	• The edge of the wetland and a 100 m buffer or 1:100 flood line buffer should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the operational phase; • All areas of increased ecological sensitivity should be designated as "No-Go" areas; • No material is to be stockpiled or dumped within any wetlands, 100 m buffer or 500 m buffer zones of the wetlands, nor in rivers, tributaries or drainage lines; • A SWMP should already be implemented. This should consider all wetlands and other watercourses associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; and • Ensure Soil Management and AIPs Plans are implemented and maintained to minimise erosion and sedimentation.	4	2	4	3	Negligible (negative) - 30
Operational	Operation of water and sewer reticulation. Waste management activities.	Wetlands	• Contamination from Hydrocarbon waste/spills (lubricants, oil, explosives and fuels); • Contamination from sewage and wastewater; and	6	3	6	5	Moderate (negative) - 75	• A SWMP should already be implemented. This should consider all wetlands and other watercourses associated with the new developments/infrastructure which should divert stormwater and wastewater away from the surface infrastructure and back into natural watercourses to maintain catchment	5	2	4	4	Minor (negative) - 44

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
			• Changes to wetland integrity and biodiversity.						yield as far as possible. The SWMP should also convey contaminated water to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Clean water must be separated from contaminated/dirty water. Clean water must be put back into the freshwater systems, whereas contaminated water must first be treated; • Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; and • Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; • Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; • All spills should be immediately cleaned up and treated accordingly.					
Operational	Operation of the coal discard processing plant.	Wetlands	• Contamination of soil, water and wetlands; • Loss of wetland health and biodiversity; and • Loss of wetland functionality.	6	3	7	6	Moderate (negative) -96	• Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; • Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; and • Spillage from the coal processing plant must be cleaned up immediately to prevent pollutants entering the freshwater systems.	5	3	5	5	Minor (negative) -65

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Operational	Uncontrolled runoff of stormwater or process water from or through the surface infrastructure.	Aquatics	• Water quality and habitat deterioration of watercourses receiving unnatural/contaminated runoff.	5	3	5	5	Minor (negative) – 65	• The following management actions are recommended to guide the effective management of stormwater and water generated on site: • Runoff from dirty areas should be directed to the storm water management infrastructure (drains and PCDs) and should not be allowed to flow into the nearby watercourses, unless DWS discharge authorisation and compliance with relevant discharge standards as stipulated in the NWA is obtained; • Channelled water should not be dispersed in a concentrated manner. Baffles should be incorporated into artificial drainage lines/channels around the surface infrastructure to decrease the kinetic energy of water as it flows into the natural environment; • Bare surfaces downstream from the developments where silt traps are not an option should be vegetated in order to attempt to limit erosion and runoff that might be carrying contaminants; • Careful monitoring of the areas where dust suppression is proposed should be undertaken regularly. Areas concentrating water runoff should be addressed and not allowed to flow freely into associated watercourses; and • Monitoring of the associated water courses should be done by an aquatic specialist in order to determine potential impacts where after new mitigation actions should be implemented as per the specialist's recommendations.	5	1	-1	3	Negligible (negative) – 21
Operational	Runoff from the dirty water areas or catchments (coal stockpile areas, mine processing plant, workshops etc.).	Hydropedology	• Surface water contamination and deterioration of water quality on the natural water resources.	3	5	4	5	Moderate (negative) - 60	• The following mitigation measures are recommended: • The management of general and other forms of waste must ensure collection and disposal into clearly marked skip bins that can be	2	2	2	2	Negligible (negative) - 12

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Operational	Hydrocarbons and chemicals spillages and leakages from equipment, moving haulage trucks and machinery.	Hydropedology	• Water contamination by hydrocarbon waste and deterioration of water quality through runoff and potential groundwater contamination where leaks and spillages occur within recharge soils.	5	4	3	6	Minor (negative) – 72	collected by approved contractors for disposal to appropriate disposal sites; • The overall housekeeping and storm water system management (including the maintenance of berms, de-silting of dams and conveyance channels and clean-up of leaks) must be maintained throughout the LoM; • The hydrocarbon and chemical storage areas and facilities must be located on hard-standing area (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This will prevent mobilisation of leaked hazardous substances; • Training of mine personnel and contractors in proper hydrocarbon and chemical waste handling procedures is recommended; and • Vehicles must only be serviced within designated service bays.	5	2	2	2	Negligible (negative) – 18
Operational	Hydrocarbon and chemical spillages and leakages from equipment, moving vehicles and machinery during mining, processing, loading and hauling of the product coal.	Surface water	• Surface water contamination by hydrocarbon waste and deterioration of surface water quality	5	4	3	4	Minor (negative) – 48	• The mitigation measures described below are currently being undertaken on the existing DCM operations and these should continue to ensure as low impacts on water resources as practically possible. • Ensure that runoff from dirty areas is being directed to the existing storm water management infrastructure and should not be allowed to flow into the watercourses, unless DWS discharge authorisation has been granted upon compliance with relevant effluent discharge standards as stipulated in the National Water Act (NWA); • Water quality monitoring should continue downstream and upstream of the mine site and within all surface water circuits at the mine to detect any contamination arising from operational activities; • The hydrocarbon and chemical storage areas should continue to be located on hard-standing areas (paved or concrete surface that is impermeable), roofed and bunded in	5	2	2	3	Negligible (negative) – 27
Operational	Runoff from contaminated areas such as Waste Rock Dumps, STP and discard processing plant may pollute nearby surface water resources.	Surface water	• Surface water contamination by runoff from dirty areas and deterioration of surface water quality.	6	4	4	5	Minor (negative) - 70		4	2	2	4	Negligible (negative) - 32

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
									accordance with SANS1200 specifications. This helps to prevent mobilisation of leaked hazardous substances; • Mine workers should be trained in the use of spill kits to contain and immediately clean up any leakages or spills and inductions should be conducted for new employees; • Servicing of vehicles and machinery should continue being conducted at designated, appropriately paved areas. All used oils should be disposed of by accredited vendors from the mine site; and • Disposal of general and other forms of waste should continue to be done into clearly marked skip bins which are collected by approved contractors for final disposal to appropriate disposal sites.					
Operational	Active mine dewatering will be required to ensure dry working conditions in the open pits and underground mining areas. The dewatering will cause ground levels to be drawn down in the vicinity of the mining area.	Groundwater	• Mine dewatering causing lowering of groundwater levels	6	2	3	6	Minor (negative) – 66	• Mining should progress as swiftly as possible to reduce the period of active dewatering; • The mining area extent should be kept to a minimum; • Dewatering of the open pits and underground voids should stop should as soon as the mining activities cease; and • Groundwater levels surrounding the pits and voids should be monitored on a regular basis throughout the LoM to verify the extent of the cone of drawdown.	5	2	3	6	Minor (negative) - 60
Operational	Mine dewatering causing a decrease in groundwater reserves.	Groundwater	• Due to active mine dewatering required to ensure dry working conditions in the open pits and underground voids, certain groundwater volumes will be extracted from the open pits and underground mining areas, limiting the groundwater resource.	6	2	3	4	Minor (negative) - 44	• Mining should progress as swiftly as possible to reduce the period of active dewatering; • The mining area extent should be kept to a minimum; • Dewatering of the open pits and underground voids should stop should as soon as the mining activities cease; and • Dewatering volumes should be monitored frequently throughout the LoM to note deviations from the predicted inflows as soon as possible.	5	2	3	4	Negligible (negative) - 40

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Operational	Acid Mine Drainage (AMD) formation in pits, underground voids and co-disposal facility; other surface sources that could cause groundwater contamination.	Groundwater	• Due to AMD formation in the mining areas and co-disposal facility, or any seepage from infrastructures, the groundwater quality could be impacted upon.	6	2	2	3	Negligible (negative) -30	• Groundwater abstraction should continue for the LoM to maintain a cone of drawdown; • Monitoring of groundwater quality in the area surrounding the mining areas should continue throughout the LoM; • Groundwater levels surrounding the mining areas should be monitored on a regular basis throughout the LoM to verify the extent of the cone of drawdown; • Dispose of coal discard slurry at the co-disposal facility only; • Pollution control dams and/or RoM coal stockpile areas should be lined and clean water needs to be diverted away from these infrastructures; and • Contamination from workshops, sewage treatment plant, wash bay or waste collection areas should be contained as much as possible by proper construction of hardstanding and bunded areas.	5	2	2	2	Negligible (negative) - 18
Operational	Long term employment creation.	Socio-economic	• Extended employment periods at the mine through the extension of the LoM.	4	3	2	4	Minor (positive) 36	• Revise the DECM's Employment Policy where necessary with the objective of increasing local employment and transferring operational positions from migrant workers to people from within the study areas; • In the event of new positions being created or vacant posts being filled, local labour should be prioritised in the recruitment process as part of the DECM's employment policy or as part of a contractor management plan with the objective of recruiting 100% of any new or additional unskilled labour from local communities; • Develop a database of goods and services that could potentially be outsourced to the local community; • Implement a contractor management plan (including direct service providers) in place to ensure that the local employment and procurement targets of the operation is met.	4	4	3	5	Minor (positive) 55

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
									The targets should be aligned to the Mining Charter 2018; and • Ensure that the grievance mechanism is widely known and accessible to allow communities the opportunity to register complaints and have these addressed in a timeous manner.					
Operational	Project-induced in-migration	Socio-economic	• An increase in certain segments of the population can place additional strain on housing and services.	4	3	3	4	Minor (negative) -40	• Discourage in-migration from other areas by focusing employment opportunities at the local community and widely publicising this intent; • Communicate the mine's intent of utilising the existing workforce at the mine expansion rather than employing additional people; • Any new job opportunities should be offered only to those job seekers who have registered on the mine's database during the construction phase; and • Engage with local communities to understand their concerns, raise awareness of risks and opportunities and identify solutions to issues related to in-migration.	3	3	2	3	Negligible – (negative) -24
Operational	Skills training	Socio-economic	• As per the requirements of the SLP, the workforce and some of the local community will be upskilled in line with the mine's skills development plan.	5	3	2	7	Minor (positive) 70	• Revise current SLP for the next five-year cycle between 2022-2027 and include additional skills training programmes to ensure required skills are in place to support redeployment of workforce; • Identify skills deficiencies against requirements, performance management, succession planning, career structuring and operational equity plan and include appropriate training programmes in the new SLP cycle. Ensure that these aligned to the core skills areas of the mine and hard to fill vacancies; and • Give preference to students for local communities for bursaries and internships. Advertise these in the local media.	5	3	3	7	Moderate (positive) 77
Operational	Social investment in local communities.	Socio-economic	• The mine is currently implementing mine community development projects and will continue to do so	5	5	3	4	Minor (positive) 52	• Revise and update SLP for next five-year cycle to include updated mine community development projects;	5	5	4	5	Minor (positive) 70)

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
			under this project that extends the LoM and the mine's SLP commitments.						• Ensure mine community development projects are in line with identified projects in the IDP and decided on in consultation with relevant stakeholders (municipality, communities, etc.); • Develop an updated mine community plan as part of an updated SLP for the Projectthe Project in consultation with relevant local stakeholders; • Ensure that the current allocation as per DECM's Mine Works Programme for the updated SLP is in line with the targets of the Mining Charter 2018; and • Monitor and manage the social contribution of multinational suppliers (in-house as well as suppliers to the contractors and direct service providers).					
Operational	Multiplier effects on the local and regional economy.	Socio-economic	• Through the expansion of the DEMC, direct and multiplier effects will continue for a further 14 years.	5	4	2	4	Minor (positive) 44	• Implement enhancement measures linked to employment creation and opportunities associated with the supply chain; • Implement SLP related interventions; • Compliance with SLP commitments to make maximum use of local Small, Medium and Micro Enterprises (SMMEs) and Broad-based Black Economic Empowerment (BBBEE) companies; and • Implement grievance procedure.	5	5	6	6	Moderate (positive) 96
Operational	Continuation in nuisance factors.	Socio-economic	• The extended LoM implies an extension and intensification of certain nuisance factors such as blasting, resulting in continued noise and dust pollution and other issues.	5	3	3	5	Minor (negative) - 55	• Implement mitigation measures as per the Noise and Air Quality Impact Assessment specialist studies. • Alert surrounding communities if activities are going to take place that will increase dust and noise levels and proposed additional mitigation measures that will be implemented during this time. • Communicate the mine's grievance mechanism and how to access the system through the local media. Ensure that users know how to access the system and address grievances timeously.	5	2	2	5	Minor (negative) - 45

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Operational	Continued competition over water resources	Socio-economic	• Water is a scarce resource and the expansion of the mine could further impact on this limited resource.	5	5	5	4	Minor (negative) -60	• Implement mitigation measures under the EMPr to prevent contamination of shared water resources; and • Communicate the mine's grievance management system to local communities and respond timeously to any grievances related to water resources.	5	3	3	3	Negligible (negative) -33
Operational	Community health, safety and security.	Socio-economic	• Continuation and expansion of mining activities will lead to a possible increase and continuation of impacts associated with community health, safety and security.	6	2	5	5	Minor (negative) -65	• In partnership with government authorities the Project to support improvements to existing health services to handle the increase in population numbers and changes to the existing health profile of the area. This may include facilities, quality of medical personnel, diagnostic capacity and treatment, etc; • Develop and implement an Emergency Prevention, Preparedness and Response Plan; • Design and implement measures to minimise the risk of hazardous substances entering the environment, including development of an Emergency Prevention, Preparedness and Response Plan for accidents involving release of hazardous substances to the environment. This will include: ○ Installation of oil water separators and grease traps as appropriate at fixed refuelling facilities, workshops, parking areas, fuel storage and containment areas; ○ Use of drip trays and other temporary measures to prevent entry of hazardous substances into the environment during fuelling or servicing of vehicles and equipment on site; ○ Provision of spill kits and training of staff in their use; ○ Secure storage and labelling of hazardous substances in line with the manufacturer's recommendations and measures	6	2	-2	3	Negligible – (negative) -30

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
									to prevent contact with untrained personnel, birds, animals; and ○ Secondary containment using impervious, chemically resistant material and designed to prevent contact between incompatible materials in the event of a release. • To mitigate the risk of increased transmission of communicable diseases: ○ Develop information, education and communication campaigns around diseases and health practices including communicable diseases such as HIV/AIDS, TB and Covid- 19; and ○ Regularly review and update as necessary its existing communicable diseases management strategy. • To mitigate the potential for diseases associated with access to water and sanitation facilities: ○ Survey all households in the primary study area to record the location, extent and quality of water sources the size of the population reliant on water and its usage patterns, particularly regarding seasonality and differences in water use or access by vulnerable populations, including women; and ○ Develop a programme in consultation with local communities to improve access to decent quality potable water and determine preferred water infrastructure; • To mitigate community safety from road traffic: ○ Develop a Traffic Management Plan covering vehicle safety, driver					

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
									and passenger behaviour, use of drugs and alcohol, hours of operation, rest periods and accident reporting and investigations; ○ Strictly enforce drug and alcohol policies in relation to Project drivers and undertake regular and random testing of drivers and in response to suspicious behaviour; ○ Require Project drivers to be trained in defensive driving and provided regular refresher courses; ○ Propose road bypasses where there is a significant risk to public safety from road accidents; ○ Establish preparedness and response capabilities to deal with any road traffic or other accidents that may occur including multiple casualty events; and ○ In partnership with local authorities and the police, educate communities on road traffic laws and road safety.					
Closure	Rehabilitation – rehabilitation mainly consists of spreading and landscaping of the preserved subsoil and topsoil, profiling of the land and re-vegetation.	Soil, Land Use and Land Capability	• Compaction of soil; • Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology; and • The proliferation of AIPs, changing the soil biodiversity and potential.	3	3	4	5	Minor (negative) - 50	• Continue with Concurrent Rehabilitation and implement land rehabilitation measures; • Address compacted areas by deep ripping to loosen the soil and revegetate the area as soon as possible; • Re-vegetate exposed soil areas to promote organic carbon and soil health; • Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs; • Only designated access routes are to be used to reduce any unnecessary compaction; and • The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions.	4	2	2	4	Negligible (negative) - 32

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Closure	Demolition of infrastructure and rehabilitation of affected areas.	Soil, Land Use and Land Capability	• Disturbance of soils and subsequent erosion by wind and water; • Increased vehicle movement in the area, increasing soil compaction and runoff potential; • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the soils; • Unexpected changes in the depth and the nature of the soil; and • Ponding of water and creation of drainage channels.	6	3	4	5	Minor (negative) - 65	• Continue with Concurrent Rehabilitation and implement land rehabilitation measures; • Address compacted areas by deep ripping to loosen the soil and revegetate the area as soon as possible; • Inventory of hazardous waste materials stored on-site should be compiled and arrange complete removal; • Monitor decant of AMD and implement management measures which include in-situ passive treatment or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses; • Seal the shaft by placing concrete plugs as well as implement a monitoring plan to ensure no decant; • Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs; • Only designated access routes are to be used to reduce any unnecessary compaction; and • The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions.	2	2	2	4	Negligible (negative) - 24
Closure	Post-closure monitoring and rehabilitation.	Soil, Land Use and Land Capability	• Minimal negative impacts on the environment; • AIPs Monitoring Plan; and • Soil compaction and increased runoff potential due to vehicle movement during rehabilitation programs.	5	4	2	5	Minor (negative) - 55	• The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions; • Continue with Concurrent Rehabilitation and implement land rehabilitation measures; and • Rehabilitation and Monitoring Plan.	6	4	3	7	Moderate (Positive) 91
Closure	Rehabilitation – rehabilitation mainly consists of spreading and landscaping of the preserved subsoil and topsoil, profiling of the land and re-vegetation.	Wetlands	• Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology of the wetlands; and • The proliferation of AIPs.	5	3	5	6	Minor (negative) - 78	• Decommissioning should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands; • Stormwater must be diverted from decommissioning activities;	4	2	3	4	Minor (negative) - 36)

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
			• Exposure of soils and subsequent compaction, erosion and sedimentation into the wetlands; • Deterioration of water quality; and • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of wetlands.						• Stored mine-affected water should be treated before decommissioning of any mine-related water retention areas, such as PCDs and wastewater facilities; • Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material and sedimentation into wetland areas; • Implement and maintain a Wetland and AIPs Plan for the duration of the decommissioning phase and into closure; • No material should be dumped/stockpiled within any wetlands or watercourses; • No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads; and • Monitor the decant of AMD and implement management measures which include for example an abstraction borehole placed down gradient of the decant point and in-situ passive treatment or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses (refer to Groundwater Impact Assessment.					
Closure	Post-closure monitoring and rehabilitation.	Wetlands	• Onset of erosion and sedimentation; and • AIPs proliferation.	3	2	3	4	Negligible (negative) -32	• An AIPs Management Plan must be in place during the decommissioning phase. In this regard, special mention is made of *A. mearnsii, Eucalyptus grandis and Pinus patula* which is the dominant alien invasive tree species observed adjacent to the HGM units at the time of the assessment; • No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads; • All vehicles must be regularly inspected for leaks;	2	1	2	2	Negligible (negative) -10
Closure	Post-mining decants into wetlands and streams	Wetlands	• Water, soil and wetland contamination; • Decreased PES, ES and EIS; and • Loss of habitat integrity and ecosystem services such as toxicant removal and water for human use.	7	4	6	7	Major (negative) – 119		6	4	5	7	Moderate (negative) – 105

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
									• Re-fuelling must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into the topsoil; • All spills should be immediately cleaned up and treated accordingly; • Appropriate sanitary facilities must be provided for the duration of the decommissioning phase and all waste must be removed to an appropriate waste facility; and • Wetland monitoring must be carried out during the decommissioning phase into mine closure to ensure no unnecessary impact to wetlands takes place.					
Closure	Seepage and runoff of contaminated water entering aquatic ecosystems.	Aquatics	• Water quality deterioration of watercourses in contact with contaminated water resulting in AMD.	7	5	6	6	Minor (negative) – 108	• The goal of mitigation should be to prevent and or limit the seepage and runoff of contaminated water into associated aquatic ecosystems. The following measures may be utilised in attempt to reduce the Post Closure impacts: • Best practice rehabilitation should be utilised to trap and contain the deep sediments that contain the acid forming rock responsible for acid water formation. • If decant occurs post-closure, passive treatment with lime or other alkaline compounds can be applied to neutralise AMD at the decant points. • Aquatic biomonitoring is also recommended to monitor any changes in the aquatic ecosystems and to provide solutions for identified, additional/unforeseen impacts for at least three years after rehabilitation.	3	1	1	3	Negligible (negative) – 15
Closure	Demolition of mine infrastructure (PCDs, workshops, haul roads, processing plant etc.) Disturbance of soils and erosion by overland flow.	Hydropedology	• Sedimentation and siltation of nearby watercourses and deterioration of water quality.	5	4	3	7	Moderate (negative) - 84	• The following mitigation measures are recommended: • Restore the topography to pre-mining conditions as much as is practically possible by backfilling, removing stockpiles and restore the slope gradient and angle of the site;	5	2	2	2	Negligible (negative) - 18

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Closure	Rehabilitation of disturbed sites close to pre-mining conditions.	Hydropedology	• Restoration of pre-mining streamflow regime in nearby watercourses.	7	5	3	6	Moderate (positive) 90	• Immediate revegetation of cleared areas; • Where practical, closure activities should be prioritized during dry months of the year (May to September); • Movement of demolition machinery and vehicles should be restricted to designated access roads to minimise the extent of soil disturbance; • Use of accredited contractors for removal or demolition of infrastructure during closure is recommended; this will reduce the risk of waste generation and accidental spillages; • Ensure that the infrastructure (pipelines, fuel storage areas, pumps) are first emptied of all residual material before closure; • Surface inspection should be continuously undertaken to allow runoff to drain onto the natural streams until vegetation has fully established on the site; • If decant occurs post-closure, passive treatment with lime or other alkaline compounds can be applied to neutralise AMD at the decant points; • If decant occurs, the decant needs to be captured, contained and treated to acceptable or prescribed water quality standards prior to discharge into the natural water resources; • Avoid ground destabilisation of areas regarded as important for wetland recharge; and • Removal of pillars post closure should be done in a manner to minimise the risk of subsidence.	No mitigation possible.				
Closure	Potential risk of subsidence.	Hydropedology	• The mined-out areas may be prone to subsidence.	7	5	4	6	Moderate (negative) - 96		6	2	2	4	Minor (negative) - 40
Closure	Disturbance of soils during removal of infrastructure at closure	Surface water	• In-stream water quality and quantity deterioration from sedimentation and siltation.	6	4	2	5	Minor (negative) - 60	• The following mitigation measures are recommended: • Disturbance of soils during infrastructure demolition should be restricted to relevant footprint areas;	2	2	2	4	Negligible (negative) - 24
Closure	Spillages of hydrocarbons (oils, fuels and grease) by	Surface water	• Surface water contamination due to hydrocarbon waste spillages.	7	5	4	6	Moderate (negative) -96		6	2	2	4	Minor (negative) - 40

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
	vehicles and machinery used during demolition and transportation of material from decommissioned infrastructure								• Movement of machinery and vehicles during infrastructure demolition should be restricted to designated access roads to minimise the extent of soil disturbance; • Use of accredited contractors for removal or demolition of infrastructure during closure is recommended; this will reduce the risk of waste generation and accidental spillages					
Closure	Reaction of sulphide compounds in extracted coal residues with water and oxygen, causing Acid Mine Drainage (AMD) and decant to low-lying areas.	Surface water	• Contamination of soil and water resources from potential decant of AMD and movement of contamination plumes due to the re-watering of the backfilled pit.	7	5	4	6	Moderate (negative) – 96	• Re-profiling and revegetation of disturbed landscapes post-closure should be conducted to facilitate free drainage as much as practically possible to support post-mining land use; and • If decant occurs post-closure, passive treatment with lime or other alkaline compounds can be applied to neutralise AMD at the decant points. • Should passive treatment fall short, active or electrolytic water treatment (e.g., Reverse Osmosis) should be considered.	6	2	2	4	Minor (negative) – 40
Closure	Mine Dewatering and residual effect on rebounding groundwater levels.	Groundwater	• Due to the dewatering activities during the operational phase, groundwater levels surrounding the mining areas will be subdued at the start of the Post Closure Phase, after it will gradually recover towards pre-mining levels.	6	2	3	6	Minor (negative) – 66	• Dewatering should cease as soon as possible after mining activities are completed to allow for groundwater level recovery; • Groundwater level recovery should be frequently monitored to identify deviations from the predicted recovery rate Groundwater quality should be frequently sampled to establish if a contaminant plume will migrate ; and • Clean water and runoff should be diverted where possible towards the open pit voids to flood areas as fast as possible after mining has stopped.	5	2	3	6	Minor (negative) - 60

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Closure	AMD formation in open pits, underground voids and co-disposal facility.	Groundwater	• Due to AMD taking place within the backfilled open pits and in co-disposal facility, groundwater contamination with elevated sulphate and low pH could occur.	7	2	6	6	Moderate (negative) - 90	• Dewatering of the pits should cease as soon as possible after mining activities are completed to allow for groundwater level recovery; • Rehabilitation of the pits and co-disposal facility to reduce infiltration of rainwater into the dump to reduce seepage generation; • Clean water and runoff should be diverted where possible towards the rehabilitated pits as fast as possible after mining has stopped; • Groundwater quality should be frequently sampled to establish if a contaminant plume will migrate; and • If a contaminant plume is detected from Pit 1 or Pit 2, groundwater may need to be abstracted and treated before release into the environment.	7	2	4	6	Minor (negative) - 78
Closure	Mine decant causing contamination of groundwater.	Groundwater	• If groundwater levels within the open pits recover to elevations higher than surface elevations, this water may then flow from the pit areas and cause groundwater contamination down gradient of the mine.	7	2	6	5	Moderate (negative) - 75	• The post-closure sealing of inter-connections between the mining areas at DECM, especially between the underground mine voids and the opencast pits; • Installation of groundwater abstraction boreholes at decant points, or formation of a pit lake, to reduce water level and prevent decant flow and treatment of the abstracted water; • Rehabilitation of the pits and co-disposal facility to reduce infiltration of rainwater into the dump to reduce seepage generation; and • Groundwater level recovery in the rehabilitated open pits should be frequently monitored to create stage curves and predict the final water recovery level.	6	2	3	5	Minor (negative) - 55
Closure	Post-closure monitoring and rehabilitation.	Socio-economic	• Economic contraction.	5	4	6	6	Moderate (negative) -90	• Develop and implement an integrated Mine Closure Plan. • Proactively assess and manage the social and economic impacts on individuals, regions and economies where retrenchment and/or closure of the Project are certain.	3	4	-3	6	Minor (negative) -60

Phase	Project Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
Post Closure	Seepage and runoff of contaminated water entering aquatic ecosystems.	Aquatics	• Water quality deterioration of watercourses in contact with contaminated water resulting in AMD.	7	5	6	6	Minor (negative) – 108	• The goal of mitigation should be to prevent and or limit the seepage and runoff of contaminated water into associated aquatic ecosystems. The following measures may be utilised in attempt to reduce the Post Closure impacts: • Best practice rehabilitation should be utilised to trap and contain the deep sediments that contain the acid forming rock responsible for acid water formation; • Financial provision is made annually for a Reverse Osmosis Water Treatment Plant post-closure to prevent AMD water from decanting to release the treated water into the clean environment • Aquatic biomonitoring is also recommended to monitor any changes in the aquatic ecosystems and to provide solutions for identified, additional/unforeseen impacts for at least three years after rehabilitation.	3	1	-1	3	Negligible (negative) – 15

8.2.1. Construction Phase Impacts and Mitigation

The surface infrastructure proposed will be constructed on already disturbed land while the underground mining will extend in the existing underground mining operations.

The subsections that follow describe the identified potential impacts to water resources as a result of these activities.

8.2.1.1. *Surface Water*

The following potential impacts to surface water have been identified for the construction phase:

- Disturbance of soils during land clearance can lead to sedimentation and possible siltation of nearby watercourses; and
- The use of oils, fuels and other hydrocarbons from earthmoving equipment during construction of surface infrastructure may lead to surface water contamination. This impact will lead to the deterioration of water quality, affecting aquatic life and downstream water users.

The quantification of these impacts pre- and post- mitigation is provided in Table 8-7 and Table 8-8.

Table 8-7: Sedimentation and Siltation of Nearby Watercourses

Activity: Site preparation and excavations. Stockpiling of spoils and discard.			
Impact: Sedimentation and possible siltation of nearby watercourses due to construction of additional infrastructure			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will likely occur for the duration of the Project	Minor (negative) -40
Intensity	2	This will have minor to medium-term impacts resulting in a reduction in water quality for immediate downstream users and the aquatic life	
Spatial scale	3	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	4	Without appropriate mitigation, it is probable that this impact will occur	
Mitigation/ Management Measures			

• Site preparation for the construction of infrastructure should be confined to the existing development footprint area to minimise disturbance of soils and the probability of sedimentation and siltation of the nearby watercourses; • Ensure that additional proposed infrastructure should be within the existing storm water management plan as proposed, to ensure continued control of any dirty runoff on site; and • Construction should be undertaken during the dry winter period, where possible, to reduce sedimentation in nearby watercourses since there will be minimal to no occurrence of rainfall.			
Post-mitigation			
Duration	2	The impact will likely only occur during the construction phase	Negligible (negative) -14
Intensity	2	Should the impact occur, it will have minor medium-term impacts resulting in a reduction in water quality for downstream users and the aquatic life	
Spatial scale	3	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	2	If mitigation measures are correctly implemented, it will be rare/improbable for this impact to occur.	

Table 8-8: Surface Water Contamination

Activity: Use of oils, fuels and other hydrocarbons			
Impact: Surface water contamination from hydrocarbon materials including oils and fuels during construction			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will mainly occur during the construction phase but may occur throughout the LOM	Minor (negative) -55
Intensity	4	This will moderately impact the water quality and the ecosystem functionality for downstream users	
Spatial scale	2	Limited to the site and its immediate surroundings	
Probability	5	Likely: The impact may occur	
Mitigation/ Management Measures			

Activity: Use of oils, fuels and other hydrocarbons			
Impact: Surface water contamination from hydrocarbon materials including oils and fuels during construction			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
• Site preparation for the construction of infrastructure should be confined to the existing development footprint area to minimise disturbance of soils and the probability of sedimentation and siltation of the nearby watercourses; • Ensure that additional proposed infrastructure should be within the existing storm water management plan as proposed, to ensure continued control of any dirty runoff on site; • Construction should be undertaken during the dry winter period, where possible, to reduce sedimentation in nearby watercourses since there will be minimal to no occurrence of rainfall and • All storage areas (fuels, paints, oils) used at the construction camp should be appropriately bunded and spill kits should be in place and construction workers trained in the use of spill kits, to contain and immediately clean up any potential leakages or spills.			
Post-mitigation			
Duration	2	The impact will likely only occur during the construction phase	Negligible (negative) -12
Intensity	2	Minor effects on biological or physical environment	
Spatial scale	2	Limited to the site and its immediate surroundings	
Probability	2	With the existing measures already in place. It will be rare/improbable for this impact to occur.	

8.2.1.2. Wetlands

The following potential impacts to wetlands have been identified:

- Fragmentation of wetlands and wetland habitat;
- Soil compaction and or disturbance;
- Loss of fauna and flora (biodiversity);
- Increased erosion and sedimentation;
- Quantity and quality changes to the hydrological functioning;
- Destruction or complete removal of wetland habitat;
- Increased AIPs;
- Fragmentation of wetlands and wetland habitat;

- Fragmentation of wetlands and wetland habitat;
- Partial or complete loss of wetland ecosystems;
- Increased erosion and sedimentation;
- Contamination from Hydrocarbon waste (lubricants, oils explosives and fuels);
- Contamination from sewage and wastewater; and
- Changes to wetland health and biodiversity.

The quantification of these impacts pre- and post- mitigation is provided in Table 8-9 to Table 8-12.

Table 8-9: Erosion, Sedimentation and Soil Compaction and/or Disturbance

Activity: Access road construction, movement of vehicles and heavy machinery.			
Impact: Erosion, sedimentation and soil compaction and/or disturbance during access road construction.			
Pre- Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The construction activities will result in the installation of permanent infrastructure, however, will be located outside wetlands. Secondary impacts might still arise, such as erosion and sedimentation from hardened surface.	Minor (negative) -60
Extent	2	Proposed infrastructure are located outside wetlands, however, impacts might occur in wetlands adjacent of the infrastructure	
Intensity	5	Erosion and sedimentation could lead to loss of biodiversity and wetland functionality.	
Probability	5	It is likely that impacts from the construction of the infrastructure might occur	
Nature	Negative		
Mitigation measures			
• At areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing; • Environmental Practitioner and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; and • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction.			

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	When mitigated and recommendations are implemented, impacts should last long-term	Minor (negative) -32
Extent	1	Proposed infrastructure are located outside wetlands and when recommendations are followed, impacts should only be in very limited areas.	
Intensity	3	When mitigation and recommendations are followed, impacts should be moderate to low	
Probability	4	It is still probably that impacts might occur from the construction of the infrastructure.	
Nature	Negative		

Table 8-10: Erosion, Loss of Biodiversity and Increased AIPs

Activity: Site clearing and preparation by the removal of vegetation and topsoil, leading to the exposure of soils for site establishment.			
Impact: No wetlands will directly be impacted, however secondary impacts might occur as activities are proposed within 100 m and 500 m of wetlands. Secondary impacts include: • Erosion and sedimentation; • Loss of fauna and flora (biodiversity); and • Increased AIPs.			
Pre- Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	Impacts could occur through the life of mine if not mitigated and monitored.	Negligible (negative) -27
Extent	2	Impacts to the wetlands will be limited to the areas directly adjacent of the proposed infrastructure.	
Intensity	2	Impacts will be minor as the proposed infrastructure are at least 100 m away from the wetlands as well as the wetlands are already heavily impacted.	
Probability	3	Impacts to the wetlands due to the activities are unlikely.	
Nature	Negative		

Mitigation measures			
• Environmental Practitioner and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; • Monitor and rehabilitate cleared and impacted areas where necessary; • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas; and • Limit vegetation removal and construction activities to the infrastructure footprint area only, where removed or damaged vegetation areas should be revegetated as soon as possible with a suitable mix of plant species as determined by a qualified botanist.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	3	When recommendations are followed, impacts should only be medium-term (1-5 years).	Negligible (negative) -10
Extent	1	Impacts to the wetlands will be limited to the areas directly adjacent of the proposed infrastructure, if any.	
Intensity	1	Impacts will be minimal due to construction and site clearing when mitigation recommendations are followed.	
Probability	2	It is rare that impacts to the wetlands will occur due to site clearing more than 100 m from the closest wetland.	
Nature	Negative		

Table 8-11: Soil, Water and Wetland Degradation

Activity: Construction of surface infrastructure			
Impact: • Increased hardened surface, runoff and onset of erosion and sedimentation; • Decreased wetland habitat, functionality and integrity; and • Soil, water and wetland contamination.			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	Impacts due to the construction of the infrastructure might have impacts to the adjacent wetlands beyond the Project life.	Minor (negative) -60
Extent	3	Impacts will be on site and the immediate surrounding area.	

Intensity	6	Impacts, such as soil and water contamination could be irreplaceable and cause permanent impacts to the wetlands.	
Probability	4	There is a possibility that impact might occur due to construction of the infrastructure	
Nature	Negative		
Mitigation measures			

- Wherever possible, surface infrastructure and vehicle movement should be placed outside wetlands and the 100 m Zone of Regulation to prevent impacts such as increased hardened surfaces, runoff, contamination, erosion and sedimentation;
- All areas of increased ecological sensitivity should be designated as "No-Go" areas and be off-limits to all unauthorised vehicles and personnel;
- Limit vegetation removal and construction activities to the infrastructure footprint area only, where removed or damaged vegetation areas should be revegetated as soon as possible with a suitable mix of plant species as determined by a qualified botanist;
- All spills must be cleaned up immediately to prevent contaminants to enter the wetlands; and
- Monitor rehabilitated areas to ensure successful re-establishment of vegetation and assess/prevent AIPs proliferation as well as monitor erosion, canalisation and changes to the systems.

Post-Mitigation

Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	Impacts due to the construction of the infrastructure might have impacts to the adjacent wetlands beyond the Project life	Negligible (negative) -33
Extent	2	Impacts should be in a limited area only when recommendations are implemented and followed.	
Intensity	4	Impacts might still be serious even after mitigation, such as contamination of soil, water and wetlands.	
Probability	3	It is unlikely that impacts will occur from the construction of the infrastructure to the wetlands.	
Nature	Negative		

Table 8-12: Contamination of Wetlands from Hydrocarbons and Waste

Activity: Waste management activities			
Impact Description: • Contamination from Hydrocarbon waste (lubricants, oils explosives and fuels); • Contamination from sewage and wastewater; and • Changes to wetland health and biodiversity.			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	7	Soil, water and wetland contamination could be permanent	Moderate (negative) – 85
Extent	3	Impacts will be local and the immediate area as the wetlands that could be affected is not connected to the rest of the downstream systems.	
Intensity	7	Contamination could lead to an irreplaceable loss of wetland PES, ES and EIS	
Probability	5	There is a possibility that impacts might occur from the waste management.	
Nature	Negative		
Mitigation measures			
• A SWMP should already be implemented. This should consider all wetlands and other watercourses associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible; • The SWMP should convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • The SWMP should convey contaminated water away from wetlands and freshwater systems; • Freshwater resource monitoring must be carried out during the construction phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; • Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; • Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; and • All spills should be immediately cleaned up and treated accordingly.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**

Duration	6	Impacts could last beyond the Project life even after mitigation	Minor (negative) -56
Extent	2	Impacts should only occur where spills have occurred	
Intensity x type of impact	6	Contamination could lead to an irreplaceable loss of wetland PES, ES and EIS	
Probability	4	There is a possibility that impacts might occur from the waste management.	
Nature	Negative		

8.2.1.3. Aquatics

The following impacts are anticipated in terms of the aquatic environment:

- Increased surface runoff and erosion; and
- Water and habitat quality deterioration.

The quantification of these impacts pre- and post-mitigation is depicted in Table 8-13

Table 8-13: Water Habitat and Quality Deterioration

Activity: Site clearance and construction of proposed infrastructure			
Impact Description: Water and habitat quality deterioration associated with vegetation manipulation/clearing			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	Once vegetation is cleared for infrastructure, no revegetation will occur until project closure.	Minor (negative) – 60
Extent	3	Based on the proximity of the proposed infrastructure to the Olifants River Tributary (~500 m) and largely disconnected nature of the watercourse, the extent of runoff is expected to be localised to within the tributaries directly affected and the receiving Olifants River.	
Intensity x type of impact	4	Effects to biological or physical resources expected to occur within immediate proximity and potentially impact on downstream reaches.	

Probability	5	Due to the dry nature of the area, the impact is likely to be significant during high-flow season only. However, direct modifications to the watercourses during the dry periods will have a negative impact	
Nature	Negative		
Mitigation/Management Measures			

- Limit vegetation removal to the infrastructure footprint area only. Where removed or damaged, vegetation areas (riparian or aquatic related) should be revegetated as soon as possible;
- Bare land surfaces downstream of construction activities must be vegetated, where practically possible, to limit erosion from the expected increase in surface runoff from infrastructure;
- Environmentally friendly barrier systems, such as silt nets or, in severe cases, use trenches downstream from construction sites to limit erosion and possibly trap contaminated runoff from construction;
- Storm water must be diverted from construction activities and managed in such a manner to disperse runoff and prevent the concentration of storm water flow;
- Water used at construction sites should be utilised in such a manner that it is kept on site and not allowed to run freely into nearby watercourses (i.e. use of a PCD);
- Construction chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions;
- All vehicles must be frequently inspected for leaks;
- No material may be dumped or stockpiled within any rivers, drainage lines in the vicinity of the proposed project;
- All waste must be removed and transported to appropriate waste facilities; and
- High rainfall periods (usually November to March) should be avoided during construction to possibly avoid increased surface runoff in attempt to limit erosion and the entering of external material (i.e. contaminants and/or dissolved solids) into associated aquatic systems.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	5	Once vegetation is cleared for infrastructure, no revegetation will occur until the closure phase of the Project or removal of the infrastructure.	Negligible (negative) – 27
Extent	2	Following mitigation actions and if high rainfall periods are avoided for construction, impacts will be limited to immediate surroundings.	

Intensity x type of impact	2	If mitigation measures are all incorporated for the Construction Phase, the intensity of the impact should be low.	
Probability	3	The likelihood of the impact occurring at the surrounding watercourses is reduced by the mitigation actions and should only result in extreme cases or unexpected rainfall events.	
Nature	Negative		

8.2.1.4. Hydropedology

The following potential impacts on the hydropedological environment have been identified:

- Wetland fragmentation;
- Soil compaction;
- Water resource siltation and sedimentation;
- Water quality deterioration; and
- Water resource contamination.

The quantification of these impacts pre- and post- mitigation is presented in Table 8-14.

Table 8-14: Water Quality Deterioration

Dimension	Rating	Motivation	Significance
Activity: Site preparation including vegetation clearance and excavations, leading to exposure of soils.			
Impact: Siltation and sedimentation of water resources leading to deteriorated water quality.			
Duration	5	The impact will likely occur during construction	Minor (negative) -72
Intensity	4	Serious to medium term environmental effects	
Spatial scale	3	Impact has the potential to extend across the site and to nearby water resources.	
Probability	6	Almost certain that the impact will occur	
Mitigation/Management Measures			

• Buffer zones need to be delineated and established as specified in the Wetlands report (Digby Wells , 2020) to prevent the destruction of wetlands within DECM; • Developments near undisturbed wetlands need to be avoided as much as possible; • Rehabilitate the land to the most suitable post-mining land use; • Clearing of vegetation must be limited to the development footprint and the use of any existing access roads must be prioritised to minimise creation of new ones; • Dust suppression on the haul roads and other cleared areas must be undertaken on regular basis to prevent or limit dust generation; • Hydrocarbon and hazardous waste storage facilities must be appropriately bunded to ensure that leakages can be contained. Spill kits should be in place and construction workers should be trained in the use of spill kits, to contain and immediately clean up any leakages or spills; • Vehicles should regularly be maintained as per the developed maintenance program. This should also be inspected daily before use to ensure there are no leakages underneath; and • Drip trays must be used to capture any oil leakages. Servicing of vehicles and machinery should be undertaken at designated hard park areas. Any used oil should be disposed of by accredited contractors.			
Post-mitigation			
Duration	2	The impact will only likely occur in the short term given implementation of recommended mitigation measures	Negligible (negative) -18
Intensity	2	Minor effects on biological or physical environment are expected if silt traps and soil stabilisation procedures are followed	
Spatial scale	2	With proper management, the impact will be localized to the immediate downstream of the site	
Probability	3	There is a possibility that the impact will occur	

8.2.1.5. Groundwater

No impacts to groundwater are anticipated during the construction phase of the Project.

8.2.2. Operational Phase Impacts and Mitigation

8.2.2.1. Surface Water

The following impacts to surface water have been identified for the operational phase:

- Surface water contamination by hydrocarbon waste and deterioration of surface water quality; and
- Surface water contamination by runoff from dirty areas and deterioration of surface water quality.

These have been quantified in Table 8-15 and Table 8-16.

Table 8-15: Water Contamination from Hydrocarbons and Chemicals

Activity: Use of equipment, moving vehicles and machinery during mining, processing, loading and hauling of the product coal			
Impact: Water Contamination from hydrocarbon and chemical spillages and leakages			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will only likely occur during the entire life of the Project	Minor (negative) -48
Intensity	4	This will moderately impact the water quality and the ecosystem functionality for downstream users.	
Spatial scale	3	The impacts will be localised but may extend to downstream environments	
Probability	4	Without appropriate mitigation, it is probable that this impact will occur.	
Mitigation Measures			
• Ensure that runoff from dirty areas is being directed to the existing storm water management infrastructure and should not be allowed to flow into the watercourses, unless DWS discharge authorisation has been granted upon compliance with relevant effluent discharge standards as stipulated in the NWA; • Water quality monitoring should continue downstream and upstream of the mine site and within all surface water circuits at the mine to detect any contamination arising from operational activities; • The hydrocarbon and chemical storage areas should continue to be located on hard-standing areas (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This helps to prevent mobilisation of leaked hazardous substances; • Mine workers should be trained in the use of spill kits to contain and immediately clean up any leakages or spills and inductions should be conducted for new employees. • Servicing of vehicles and machinery should continue being conducted at designated, appropriately paved areas. All used oils should be disposed of by accredited vendors from the mine site; and • Disposal of general and other forms of waste should continue to be done into clearly marked skip bins which are collected by approved contractors for final disposal to appropriate disposal sites.			
Post-mitigation			
Duration	5	The impact will only likely occur for the LoM	Negligible (negative) -27

Intensity	2	With proper management of hydrocarbon and chemicals on site the impact will rarely be of significance and water quality in nearby watercourses will be maintained for optimal functionality of ecosystems and downstream	
Spatial scale	2	With proper management, the impact will be localised to relevant operational areas within the mine's footprint.	
Probability	3	With the implementation of recommended mitigation measures the impact's probability of occurrence will be very low.	

Table 8-16: Water Contamination

Activity: Operation of WRDs, STP and discard processing plant			
Impact: Water Contamination from runoff from dirty water areas			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will remain for some time after the life of the mining project.	Minor (negative) -70
Intensity	4	Moderate environmental impairment of ecosystem function that may take several years to rehabilitate	
Spatial scale	4	The impacts will be localised to the nearby watercourses but may extend to the downstream water users	
Probability	5	The impact will occur	
Mitigation/ Management Measures			

Activity: Operation of WRDs, STP and discard processing plant			
• Ensure that runoff from dirty areas is being directed to the existing storm water management infrastructure and should not be allowed to flow into the watercourses, unless DWS discharge authorisation has been granted upon compliance with relevant effluent discharge standards as stipulated in the NWA; • Water quality monitoring should continue downstream and upstream of the mine site and within all surface water circuits at the mine to detect any contamination arising from operational activities; • The hydrocarbon and chemical storage areas should continue to be located on hard-standing areas (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This helps to prevent mobilisation of leaked hazardous substances; • Mine workers should be trained in the use of spill kits to contain and immediately clean up any leakages or spills and inductions should be conducted for new employees; • Servicing of vehicles and machinery should continue being conducted at designated, appropriately paved areas. All used oils should be disposed of by accredited vendors from the mine site; and • Disposal of general and other forms of waste should continue to be done into clearly marked skip bins which are collected by approved contractors for final disposal to appropriate disposal sites.			
Post-mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact will only likely persist in the absence of proper monitoring and maintenance of storm water management plan infrastructure on site.	Negligible (negative) -32
Intensity	2	Proper and continued implementation of storm water management plan and water quality monitoring will lower the intensity of the impact.	
Spatial scale	2	The impacts will be localised to incident areas due to effective stormwater control and water quality monitoring.	
Probability	4	The impact will probably occur	

8.2.2.2. Wetlands

The following potential impacts to wetlands have been identified for the operational phase:

- Movement of the strata causing potential subsistence, resulting in ponding and undulating topographies;
- Dewatering and drying out of wetlands;
- Contamination and deterioration of water quality and quantity;

- Loss or changes to the natural wetland integrity and biodiversity;
- Head cut erosion and channel forming from the roads (culverts); and
- Increased erosion and consequently sedimentation potential into wetlands;
- Loss of vegetation and habitat;
- Wetland fragmentation;
- Potential runoff from stockpiles causing contamination into the wetlands;
- Erosion and sedimentation of contaminants into the wetland areas;
- Contamination from Hydrocarbon waste/spills (lubricants, oil, explosives and fuels);
- Contamination from sewage and wastewater;
- Changes to wetland integrity and biodiversity;
- Contamination of soil, water and wetlands;
- Loss of wetland health and biodiversity; and
- Loss of wetland functionality.

These impacts have been quantified pre- and post-mitigation in Table 8-17 to Table 8-22.

Table 8-17: Strata Movement and Wetland Dewatering and Drying Out

Activity: Blasting (only when dikes and other geological features are encountered)			
Impact Description: • Movement of the strata causing potential subsistence, resulting in ponding and undulating topographies; and • Dewatering and drying out of wetlands.			
Pre Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	7	Impacts from blasting could be permanent to the wetlands	Major (negative) -119
Extent	3	The impact from the blasting could have impacts to the wetlands in the Project Area and immediate surrounding areas	
Intensity	7	Impacts could lead to irreplaceable impacts to the wetlands and their PES, ES and EIS.	
Probability	7	These impacts are highly probable.	
Nature	Negative		
Mitigation measures			

• Freshwater resource monitoring must be carried out during the operational and decommissioning phases by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; • Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material and sedimentation into wetland areas; and • If it is unavoidable that any of the wetlands be affected, the disturbance must be minimised and suitably rehabilitated.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	Impacts from blasting could last beyond project life even when managed and mitigated.	Moderate (negative) -90
Extent	3	The impact from the blasting could still extent to the local area even after mitigation and management	
Intensity	6	Impacts could still lead to irreplaceable impacts to the wetlands and their PES, ES and EIS.	
Probability	6	It is highly probably that impacts from blasting will occur to wetlands of the entire Project Areas even after mitigation and recommendations are followed.	
Nature	Negative		

Table 8-18: Water Quality and Quantity and Wetland Biodiversity and Integrity Impacts

Activity: Underground mining machinery maintenance			
Impact Description: • Contamination and deterioration of soil and water quality and quantity; and • Loss or changes to natural wetland PES, ES and EIS.			
Pre Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	Impacts to wetlands due to contamination could last beyond project life.	Moderate (negative) – 75
Extent	3	Impacts could extent to the local and surrounding areas, impacting downstream and adjacent wetlands	

Intensity	6	Soil and water contamination could lead to irreplaceable losses to the wetlands	
Probability	5	It is likely that impacts might occur from vehicle maintenance	
Nature	Negative		
Mitigation measures			
• Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil; • All spills must be cleaned up immediately to prevent contaminants to enter the wetlands; • Channelled water should not be dispersed in a concentrated manner. Baffles should be incorporated into artificial drainage lines/channels around the surface infrastructure to decrease the kinetic energy of water as it flows into the natural environment; • A SWMP should already be implemented. This should consider wetlands associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible; • No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads and within the operational footprint; and • All vehicles must be regularly inspected for leaks.			
Post-Mitigation			
Duration	5	Impacts to wetlands might still be during the Project life even after mitigation and recommendations are followed	Minor (negative) – 48
Extent	2	Impacts could only be in limited areas after recommendations and mitigation is followed	
Intensity	5	Contamination could still be serious even after remediation/mitigation	
Probability	4	There is still a possibility that impacts might occur even after mitigation	
Nature	Negative		

Table 8-19: Erosion, Sedimentation and Habitat Fragmentation and Loss

Activity: Use of existing haul roads and vehicle movement
Impact Description: • Head cut erosion and channel forming from the roads (culverts);

- Increased erosion and consequently sedimentation into wetlands;
- Loss of vegetation and habitat; and
- Contamination.

Pre Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	6	The potential impacts caused during the operational phase will cease after the operational life, however, could last beyond the Project life.	Minor (negative) -70
Extent	3	Impacts could extend to the immediate area and surroundings	
Intensity	5	Impacts could be serious and lead to change in wetland PES, ES and EIS	
Probability	5	It is likely that impact might occur from using haul roads	
Nature	Negative		

Mitigation measures

- The edge of the wetlands and a 100m buffer or 1:100 flood line buffer should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the operational phase;
- All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel;
- If it is unavoidable that any of the wetland areas present will be affected, the disturbance must be minimised and suitably rehabilitated;
- If spill occur, it must be cleaned up immediately and remediated;
- No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines;
- Culverts, roads and river crossings must be maintained, cleared and monitored; and
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads and within the operational footprint.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	5	The potential impacts caused during the operational phase will cease after the operational life, however, could last beyond the Project life.	Minor (negative) -40
Extent	2	Impacts could be restricted to limited areas of managed and mitigated	

Intensity	3	Impacts could still be moderate even after recommendation are followed	
Probability	4	It is unlikely that impact will occur from using haul roads	
Nature	Negative		

Table 8-20: Contamination of Wetlands

Activity: In-pit ROM Stockpiling			
Impact Description: • Potential runoff from stockpiles causing contamination into the wetlands; and • Erosion and sedimentation of contaminants into the wetland areas.			
Pre Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The potential impacts could lead to impacts beyond project life	Minor (negative) -56
Extent	3	The impact could spread beyond the local development boundaries	
Intensity	5	These impacts are serious threats to important and sensitive freshwater resource habitats	
Probability	4	These impacts are probable and could occur	
Nature	Negative		
Mitigation measures			
• The edge of the wetland and a 100m buffer or 1:100 flood line buffer should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the operational phase; • All areas of increased ecological sensitivity should be designated as "No-Go" areas; • No material is to be stockpiled or dumped within any wetlands, 100 m buffer or 500 m buffer zones of the wetlands, nor in rivers, tributaries or drainage lines; • A SWMP should already be implemented. This should consider all wetlands and other watercourses associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses;			

• Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; and • Ensure Soil Management and AIPs Management Plans are implemented and maintained to minimise erosion and sedimentation.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	Impacts could still have long-term effects, even after mitigation	Negligible (negative) -30
Extent	2	Impacts can be limited to a small extent when mitigated and manged	
Intensity	4	Impacts can still be serious, even after mitigation and recommendations are followed	
Probability	3	It is unlikely that impacts will occur to the wetlands if recommendation are followed	
Nature	Negative		

Table 8-21: Wetland Health, Functionality and Biodiversity Impacted by Waste Management Activities

Activity: Operation of water and sewer reticulation. Waste management activities			
Impact Description: • Contamination from Hydrocarbon waste/spills (lubricants, oil, explosives and fuels); • Contamination from sewage and wastewater; and • Changes to wetland integrity and biodiversity due to contamination, erosion, sedimentation, siltation and increased water supply to systems.			
Pre Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	Impacts could last beyond project life and affect wetlands for a long time	Moderate (negative) -75
Extent	3	Impacts to the wetlands could be local and the immediate surrounding areas	
Intensity	6	Contamination of wetlands could lead to irreplaceable impacts to the PES, ES and EIS	

Probability	5	There are not wetlands in the immediate surroundings, however there it is still likely that impacts will occur	
Nature	Negative		
Mitigation measures			
• A SWMP should already be implemented. This should consider all wetlands and other watercourses associated with the new developments/infrastructure which should divert stormwater and wastewater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey contaminated water to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Clean water must be separated from contaminated/dirty water. Clean water must be put back into the freshwater systems, whereas contaminated water must first be treated; • Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; and • Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; • Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; and • All spills should be immediately cleaned up and treated accordingly.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	When mitigation recommendations are followed, impacts should only last for the duration of the Project	Minor (negative) -44
Extent	2	Impacts should only occur in limited areas when mitigated and recommendations are followed	
Intensity	4	Impacts can still be serious to the wetlands even after mitigation	
Probability	4	There is still a probability that impacts to the wetlands will occur even after mitigations and recommendations	
Nature	Negative		

Table 8-22: Wetland Health, Integrity and Biodiversity Impacted by Coal Discard Processing Plant

Activity: Operation of the coal discard processing plant			
Impact Description: • Contamination of soil, water and wetlands; • Loss of wetland health and biodiversity; and • Decreased wetland PES, ES and EIS.			
Pre Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impacts could lead to impacts beyond the Project life to wetlands and their functionality	Moderate (negative) -96
Extent	3	Impacts of spillage and contamination of the wetlands could be at a local level	
Intensity	7	Contamination may lead to irreplaceable loss of wetlands and wetland functionality	
Probability	6	These impacts are highly probable.	
Nature	Negative		
Mitigation measures			
• Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; • Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; and • Spillage from the coal processing plant must be cleaned up immediately to prevent pollutants entering the freshwater systems.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	Impacts will occur during the life of the Projectthe Project, even when mitigation and management recommendations are followed	Minor (negative) -65
Extent	3	Impacts will still have an impact to the local extent	
Intensity	5	Contamination and other impacts will still cause a serious loss to wetlands even after mitigation and management recommendations are followed	

Activity: Operation of the coal discard processing plant			
Probability	5	It is still likely that impacts will occur, even after mitigation	
Nature	Negative		

8.2.2.3. Aquatics

The potential impact to the aquatic environment has been identified as water quality and habitat deterioration associated with runoff, seepage and leaks from the operational areas of the Project.

This has been quantified pre- and post-mitigation in Table 8-23.

Table 8-23: Water Quality and Habitat Deterioration

Activity: Uncontrolled runoff of stormwater or process water from or through the surface infrastructure			
Impact Description: Water quality and habitat deterioration of watercourses receiving unnatural/contaminated runoff			
Dimension	**Rating**	**Motivation**	**Significance**
Pre Mitigation/Management			
Duration	5	It is predicted that contaminant input will continue throughout the life of the Project whenever rainfall events occur.	Minor (negative) – 65
Extent	3	Based on the proximity of the proposed infrastructure to watercourses and largely disconnected nature of the watercourses, the extent of runoff is expected to be localised to within the respective catchment.	
Intensity	5	Runoff, seepage and or leakage into watercourses is expected to impact functioning of the aquatic ecosystems.	
Probability	5	The impact is likely to occur throughout the life of the Project but limited due to periodic rainfall events.	
Nature	Negative		
Mitigation/ Management Measures			

- Runoff from dirty areas should be directed to the storm water management infrastructure (drains and PCDs) and should not be allowed to flow into the nearby watercourses, unless DWS discharge authorisation and compliance with relevant discharge standards as stipulated in the NWA is obtained;
- Channelled water should not be dispersed in a concentrated manner. Baffles should be incorporated into artificial drainage lines/channels around the surface infrastructure to decrease the kinetic energy of water as it flows into the natural environment;
- Bare surfaces downstream from the developments where silt traps are not an option should be vegetated in order to attempt to limit erosion and runoff that might be carrying contaminants;
- Careful monitoring of the areas where dust suppression is proposed should be undertaken regularly. Areas concentrating water runoff should be addressed and not allowed to flow freely into associated watercourses; and
- Monitoring of the associated water courses should be done by an aquatic specialist in order to determine potential impacts where after new mitigation actions should be implemented as per the specialist's recommendations.

Post-Mitigation			
Duration	5	Runoff will continue throughout the Project life.	Negligible (negative) – 21
Extent	1	Runoff will most likely be largely restricted and captured after mitigation.	
Intensity	1	If mitigation measures are all incorporated for the Project, the intensity of the impact should decrease. However, contaminants are more difficult to manage compared to solid particles and may enter associated aquatic systems resulting in water quality deterioration.	
Probability	3	The likelihood of the impact occurring is reduced by the mitigation actions and should only result in extreme rainfall events or if mitigation structures aren't maintained.	
Nature	Negative		

8.2.2.4. Hydropedology

The following potential impacts to hydropedology have been identified for the operational phase:

- Surface water contamination by runoff from dirty water areas; and
- Surface water contamination from hydrocarbon and chemical spillages and leakages.

Table 8-24 and Table 8-25 quantify these impacts and their mitigation measures.

Table 8-24: Surface Water Contamination

Activity: Operation of dirty water areas i.e. coal stockpile areas, mine processing plant, workshops, etc.			
Impact: Surface water contamination by runoff from dirty water areas			
Dimension	**Rating**	**Motivation**	Significance
Pre Mitigation			
Duration	3	The impact will remain for a medium to short term	Moderate (negative) - 60
Intensity	5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	
Spatial scale	4	The impacts will likely extend to watercourses in the whole municipal area affecting downstream water users	
Probability	5	The impact may occur if no measures are put in place	
Mitigation/ Management Measures			
• The management of general and other forms of waste must ensure collection and disposal into clearly marked skip bins that can be collected by approved contractors for disposal to appropriate disposal sites; • The overall housekeeping and storm water system management (including the maintenance of berms, de-silting of dams and conveyance channels and clean-up of leaks) must be maintained throughout the LoM; • The hydrocarbon and chemical storage areas and facilities must be located on hard-standing area (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This will prevent mobilisation of leaked hazardous substances; • Training of mine personnel and contractors in proper hydrocarbon and chemical waste handling procedures is recommended; and • Vehicles must only be serviced within designated service bays.			
Post-mitigation			

Duration	2	The impact will not last long post mitigation	Negligible (negative) - 12
Intensity	2	Proper and continued implementation of storm water management plan and water quality monitoring will lower the intensity of the contaminated runoff impact on proximal water resources	
Spatial scale	2	Limited spatial extent if mitigation measures are adequately implemented	
Probability	2	The possibility of the impact occurring is very low if mitigation measures are adequately implemented	

Table 8-25: Surface Water Contamination from Chemical Spillages

Activity: Use of hydrocarbons and chemicals leading to spillages and leakages from equipment, moving haulage trucks and machinery			
Impact: Surface water Contamination from hydrocarbon and chemical spillages and leakages			
Pre-mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will likely occur for the duration of the operational phase	Minor (negative) -72
Intensity	4	Moderate impacts to water quality and ecosystem functionality are expected	
Spatial scale	3	The impact may extend across the site and to nearby settlements if contaminants are washed into proximal watercourses	
Probability	6	It is most likely that the impact will occur	
Mitigation/ Management Measures			
• The management of general and other forms of waste must ensure collection and disposal into clearly marked skip bins that can be collected by approved contractors for disposal to appropriate disposal sites; • The overall housekeeping and storm water system management (including the maintenance of berms, de-silting of dams and conveyance channels and clean-up of leaks) must be maintained throughout the LoM; • The hydrocarbon and chemical storage areas and facilities must be located on hard-standing area (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This will prevent mobilisation of leaked hazardous substances;			

• Training of mine personnel and contractors in proper hydrocarbon and chemical waste handling procedures is recommended; and • Vehicles must only be serviced within designated service bays.			
Post-mitigation			
Duration	5	The impact will likely occur for the life of the Project	Negligible (negative) -18
Intensity	2	With proper management of hydrocarbon and chemicals on site the impact intensity will be low	
Spatial scale	2	With proper management, the impact will be localised to incident sites, where contaminants will quickly be cleaned up	
Probability	2	The possibility of the impact occurring is very low if mitigation measures re adequately implemented	

8.2.2.5. Groundwater

The following groundwater-related impacts have been identified:

- Groundwater level drawdown;
- Aquifer yield; and
- Groundwater quality.

These have been quantified below.

Table 8-26: Groundwater Drawdown Impact

Dimension	Rating	Motivation	Significance
Activity and Interaction: Mine dewatering causing lowering of groundwater levels			
Impact Description: Active mine dewatering will be required to ensure dry working conditions in the open pits and underground mining areas. The dewatering will cause ground levels to be drawn down in the vicinity of the mining area.			
Pre Mitigation/Management			
Duration	6	Expected for LoM	Minor (negative) -66
Extent	2	Limited to opencast and underground mining areas and surroundings.	
Intensity	3	Moderate, short-term effects but not affecting ecosystem function.	

Probability	6	It is likely that this impact will occur	
Nature	Negative		
Mitigation/Management Actions			
• Mining should progress as swiftly as possible to reduce the period of active dewatering; • The mining area extent should be kept to a minimum; • Dewatering of the open pits and underground voids should stop as soon as the mining activities cease; and • Groundwater levels surrounding the pits and voids should be monitored on a regular basis throughout the LoM to verify the extent of the cone of drawdown.			
Post-Mitigation			
Duration	5	Expected for LoM	Minor (negative) -60
Extent	2	Limited to opencast and underground mining areas and surroundings.	
Intensity	3	Moderate, short-term effects but not affecting ecosystem function.	
Probability	6	It is likely that this impact will occur	
Nature	Negative		

Table 8-27: Groundwater Abstraction

Dimension	**Rating**	**Motivation**	Significance
Activity and Interaction: Mine dewatering causing a decrease in groundwater reserves			
Impact Description: Due to active mine dewatering required to ensure dry working conditions in the open pits and underground voids, certain groundwater volumes will be extracted from the open pits and underground mining areas, limiting the groundwater resource.			
Prior to Mitigation/Management			
Duration	6	Expected for LoM and a short period post-closure	Minor (negative) -44
Extent	2	Limited to Pit 1, Pit 2, proposed underground mining areas and surroundings	

Intensity	3	Moderate, short-term effects but not affecting ecosystem function.	
Probability	4	It is probable that this impact will occur	
Nature	Negative		
Mitigation/Management Actions			
• Mining should progress as swiftly as possible to reduce the period of active dewatering; • The mining area extent should be kept to a minimum; • Dewatering of the open pits and underground voids should stop should as soon as the mining activities cease; and • Dewatering volumes should be monitored frequently throughout the LoM to note deviations from the predicted inflows as soon as possible.			
Post-Mitigation			
Duration	5	Expected for LoM	Negligible (negative) -40
Extent	2	Limited to Pit 1, Pit 2, proposed underground mining areas and surroundings	
Intensity	3	Moderate, short-term effects but not affecting ecosystem function.	
Probability	4	It is probable that this impact will occur	
Nature	Negative		

Table 8-28: Groundwater Quality

Dimension	Rating	Motivation	Significance
Activity and Interaction: AMD formation in pits, underground voids and co-disposal facility; other surface sources that could cause groundwater contamination			
Impact Description: Due to AMD formation in the mining areas and co-disposal facility, or any seepage from infrastructures, the groundwater quality could be impacted upon.			
Prior to Mitigation/Management			
Duration	6	Expected for LoM and post-closure	Negligible (negative) -30
Extent	2	Limited to opencast and underground mining areas and surroundings	
Intensity	2	Negligible effects due to drawdown cone preventing contaminants from spreading	

Dimension	Rating	Motivation	Significance
Probability	3	Based on model results this impact is probable	
Nature	Negative		
Mitigation/Management Actions			
• Groundwater abstraction should continue for the LoM to maintain a cone of drawdown; • Monitoring of groundwater quality in the area surrounding the mining areas should continue throughout the LoM; • Groundwater levels surrounding the mining areas should be monitored on a regular basis throughout the LoM to verify the extent of the cone of drawdown; • Dispose of coal discard slurry at the co-disposal facility only; • Pollution control dams and/or ROM coal stockpile areas should be lined, where applicable and clean water needs to be diverted away from these infrastructures; and • Contamination from workshops, sewage treatment plant, wash bay or waste collection areas should be contained as much as possible by proper construction of hardstanding and bunded areas.			
Post-Mitigation			
Duration	5	Expected for LoM	Negligible (negative) -18
Extent	2	Limited to opencast and underground mining areas and surroundings	
Intensity	2	Negligible effects due to drawdown cone preventing contaminants from spreading	
Probability	2	Based on model results this impact is probable	
Nature	Negative		

8.2.3. Decommissioning and Post-Closure Impacts and Mitigation

Activities during the decommissioning and rehabilitation phase comprise the removal of the Project infrastructure and rehabilitation of disturbed footprints. A Rehabilitation and Closure Plan (RCP) has been developed for the Project and attached as Appendix I. Generally, rehabilitation will include ripping, shaping and revegetating of the disturbed surfaces.

The subsections below detail the identified potential impacts which could be realised to water resources as a result of these activities.

8.2.3.1. Surface Water

The following potential impacts to surface water have been identified for the decommissioning and rehabilitation phase:

- In-stream water quality and quantity deterioration;
- Surface water contamination; and
- Surface water pollution.

The quantification of these impacts pre- and post-mitigation is provided in Table 8-29 and Table 8-30.

Table 8-29: In-stream Water Quality and Quantity Deterioration

Activity: Removal of infrastructure at decommissioning			
Impact: In-stream water quality and quantity deterioration from sedimentation and siltation			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will likely occur during the demolition of infrastructure and may extend beyond closure if not mitigated	Minor (negative) -60
Intensity	4	This will moderately impact the water quality and the ecosystem functionality for downstream users.	
Spatial scale	2	The impacts will be localised to the nearby watercourses from where the silt is being generated to downstream reaches.	
Probability	5	This impact will likely occur.	
Mitigation/ Management Measures			

• Disturbance of soils during infrastructure demolition should be restricted to relevant footprint areas; • Movement of machinery and vehicles during infrastructure demolition should be restricted to designated access roads to minimise the extent of soil disturbance; • Use of accredited contractors for removal or demolition of infrastructure during decommissioning is recommended; this will reduce the risk of waste generation and accidental spillages; • Re-profiling and revegetation of disturbed landscapes post-closure should be conducted to facilitate free drainage as much as practically possible to support post-mining land use; and • If decant occurs post-closure, a Reverse Osmosis Water Treatment Plant should be used to treat the AMD decant to DWS compliance levels before the treated water is released into the natural environment. Financial provision is made annually for a Reverse Osmosis Water Treatment Plant for use post-closure to treat AMD decant (Lorenzo van de Heaver 2021, pers. comm).			
Post-mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	2	The impact will likely occur during the decommissioning phase if mitigated.	Negligible (negative) -24
Intensity	2	Should the impact occur it will have a minor effect resulting in reduction of water quality for the downstream users.	
Spatial scale	2	With proper management, the impact will be localised to nearby watercourses from where the silt is being generated downstream	
Probability	4	With the implementation of recommended mitigation measures the impact's probability of occurrence will be very low.	

Table 8-30: Surface Water Contamination from AMD

Activity: Reaction of sulphide compounds in extracted coal residues with water and oxygen			
Impact: Water contamination from Acid Mine Drainage decant into surface water resources			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	7	The impact will remain beyond the life of the Project.	96-Moderate (negative)
Intensity	5	High significant impact on the environment. Irreparable damage to highly valued species, habitat or ecosystem.	

Spatial scale	4	The impacts will be localised to the immediate surroundings of the mine site.	
Probability	6	It is most likely that the impact will occur.	
Mitigation Measures			
- Disturbance of soils during infrastructure demolition should be restricted to relevant footprint areas; - Movement of machinery and vehicles during infrastructure demolition should be restricted to designated access roads to minimise the extent of soil disturbance; - Use of accredited contractors for removal or demolition of infrastructure during decommissioning is recommended; this will reduce the risk of waste generation and accidental spillages; - Re-profiling and revegetation of disturbed landscapes post-closure should be conducted to facilitate free drainage as much as practically possible to support post-mining land use; and - If decant occurs post-closure, a Reverse Osmosis Water Treatment Plant should be used to treat the AMD decant to DWS compliance levels before the treated water is released into the natural environment. Financial provision is made annually for a Reverse Osmosis Water Treatment Plant for use post-closure to treat AMD decant (Lorenzo van de Heaver 2021, pers. comm).			
Post-mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will occur beyond the Life of Mine	40-Minor (negative)
Intensity	2	With mitigation the AMD impact will have low to moderate intensity	
Spatial scale	2	Limited to the site and its immediate surroundings.	
Probability	4	It is probable that the impact will occur.	

8.2.3.2. Wetlands

The following potential impacts to wetlands have been identified for the decommissioning and rehabilitation phase:

- Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology of the wetlands;
- The proliferation of AIPs;
- Exposure of soils and subsequent compaction, erosion and sedimentation into the wetlands;
- Deterioration of water quality;

- Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of wetlands;
- Minimal negative impacts on the environment;
- Wetland and AIPs Monitoring Plan;
- Water and soil contamination; and
- Loss of habitat integrity and ecosystem services such as toxicant removal and water for human use.

The quantification of these impacts pre- and post-mitigation is provided in Table 8-31 to Table 8-33.

Table 8-31: Reduced Ecological Integrity during Closure

Activity: Rehabilitation and demolition of infrastructure and rehabilitation of affected areas.			
Impact Description: • Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology of the wetlands; • Erosion and sedimentation; • Contamination; and • The proliferation of AIPs.			
Pre Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impacts caused during the decommissioning activities will have a long-lasting effect if not mitigated.	Minor negative (-78)
Extent	3	The impacts could spread beyond the local development boundaries	
Intensity	5	Impacts due to decommissioning could be serious to the wetlands PES, EIS and ES	
Probability	6	It is highly possible that impacts will occur due to decommissioning	
Nature	Negative		
Mitigation measures			
• Decommissioning should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands; • Stormwater must be diverted from decommissioning activities; • Stored mine-affected water should be treated before decommissioning of any mine-related water retention areas, such as PCDs and wastewater facilities;			

- Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material and sedimentation into wetland areas;
- Implement and maintain a Wetland and AIPs Management Plan for the duration of the decommissioning phase and into closure;
- No material should be dumped/stockpiled within any wetlands or watercourses;
- No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads; and
- Monitor the decant of AMD and implement management measures which include for example an abstraction borehole placed down gradient of the decant point and reverse osmosis or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses (refer to Groundwater Impact Assessment, (Digby Wells, 2021).

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impacts will still be long term even after mitigation and recommendations are followed	Minor negative (-36)
Extent	2	Impacts should be limited to small areas after mitigation and management	
Intensity x type of impact	3	Impacts will still have moderate losses to the wetlands even after mitigation and management recommendations	
Probability	4	Even after mitigation and management, it is still probable that impacts will occur	
Nature	Negative		

Table 8-32: Reduced Ecological Integrity Post-closure

Activity: Post-closure monitoring and rehabilitation.			
Impact Description: • Onset of erosion and sedimentation; and • AIPs proliferation.			
Pre Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	3	Impacts will have a medium-term duration effects to the wetlands	Negligible (negative) -32
Extent	2	Impacts to the wetlands will be limited to specific areas	

Intensity	3	Impacts will have moderate loss to the wetlands and its PES, EIS and ES	
Probability	4	There is a probability that impacts will occur due to decommissioning and monitoring	
Nature	Negative		
Mitigation measures			
- An AIPs Management Plan must be in place during the decommissioning phase. In this regard, special mention is made of *A. mearnsii, Eucalyptus grandis and Pinus patula* which is the dominant alien invasive tree species observed adjacent to the HGM units at the time of the assessment; - No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads; - All vehicles must be regularly inspected for leaks; - Re-fuelling must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into the topsoil; - All spills should be immediately cleaned up and treated accordingly; - Appropriate sanitary facilities must be provided for the duration of the decommissioning phase and all waste must be removed to an appropriate waste facility; and - Wetland monitoring must be carried out during the decommissioning phase into mine closure to ensure no unnecessary impact to wetlands takes place.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	2	Impacts to the wetlands will only be for the short term	Negligible (negative) -10
Extent	1	Impacts will be very limited	
Intensity	2	Impacts will have minor losses to the wetlands and their PES, EIS and ES	
Probability	2	It is rare that impacts will occur from monitoring	
Nature	Negative		

Table 8-33: Water, Soil and Wetland Contamination due to Mine Decant

Activity: Post-mining decants into wetlands and streams			
Impact Description: • Water, soil and wetland contamination; • Decreased PES, ES and EIS; and • Loss of habitat integrity and ecosystem services such as toxicant removal and water for human use.			
Pre Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	7	Water quality will continue to deteriorate for several years and the habitat/biodiversity will be permanently transformed.	Major (negative) – 119
Extent	4	The extent of the impact will affect the entire downstream reach of the watercourse.	
Intensity	6	Contamination from decant can have irreplaceable losses to the wetlands and the PES, ES and EIS	
Probability	7	The likelihood is assumed as definite until proven otherwise.	
Nature	Negative		
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	Water quality will continue to deteriorate for several years and the habitat will be permanently transformed.	Moderate (negative) – 105
Extent	4	The extent of the impact will affect the local area only when mitigated and managed.	
Intensity	5	Impacts to the wetlands and downstream freshwater systems can be serious even after mitigation and management	
Probability	7	The likelihood is assumed as definite until proven otherwise. Impacts will occur even after mitigation and management	
Nature	Negative		

8.2.3.3. Aquatics

Water quality deterioration as a result of seepage leading to AMD is a potential impact during the post-closure and rehabilitation phase.

This impact has been quantified pre- and post-mitigation in Table 8-34.

Table 8-34: Water Quality and Habitat Deterioration from AMD

Activity: Uncontrolled runoff of stormwater or process water from or through the surface infrastructure			
Impact Description: Water quality and habitat deterioration of watercourses receiving unnatural/contaminated runoff			
Pre Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	It is predicted that contaminant input will continue throughout the life of the Project whenever rainfall events occur.	Minor (negative) – 65
Extent	3	Based on the proximity of the proposed infrastructure to watercourses and largely disconnected nature of the watercourses, the extent of runoff is expected to be localised to within the respective catchment.	
Intensity x type of impact	5	Runoff, seepage and or leakage into watercourses is expected to impact functioning of the aquatic ecosystems.	
Probability	5	The impact is likely to occur throughout the life of the Project but limited due to periodic rainfall events.	
Nature	Negative		
Mitigation/ Management Measures			

- Runoff from dirty areas should be directed to the storm water management infrastructure (drains and PCDs) and should not be allowed to flow into the nearby watercourses, unless DWS discharge authorisation and compliance with relevant discharge standards as stipulated in the NWA is obtained;
- Channelled water should not be dispersed in a concentrated manner. Baffles should be incorporated into artificial drainage lines/channels around the surface infrastructure to decrease the kinetic energy of water as it flows into the natural environment;
- Bare surfaces downstream from the developments where silt traps are not an option should be vegetated in order to attempt to limit erosion and runoff that might be carrying contaminants;
- Careful monitoring of the areas where dust suppression is proposed should be undertaken regularly. Areas concentrating water runoff should be addressed and not allowed to flow freely into associated watercourses; and
- Monitoring of the associated water courses should be done by an aquatic specialist in order to determine potential impacts where after new mitigation actions should be implemented as per the specialist’s recommendations.

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	Runoff will continue throughout the Project life.	Negligible (negative) – 21
Extent	1	Runoff will most likely be largely restricted and captured after mitigation.	
Intensity x type of impact	1	If mitigation measures are all incorporated for the Project, the intensity of the impact should decrease. However, contaminants are more difficult to manage compared to solid particles and may enter associated aquatic systems resulting in water quality deterioration.	
Probability	3	The likelihood of the impact occurring is reduced by the mitigation actions and should only result in extreme rainfall events or if mitigation structures aren’t maintained.	
Nature	Negative		

8.2.3.4. Hydropedology

The following potential impacts to hydropedology have been identified for the decommissioning and rehabilitation phase:

- Sedimentation and siltation of nearby watercourses and deterioration of water quality;
- Restoration of pre-mining streamflow regime in nearby watercourses; and
- The mined-out areas may be prone to subsidence.

The quantification of these impacts pre- and post-mitigation is provided Table 8-35 to Table 8-37.

Table 8-35: Water Quality Deterioration

Activity: Demolition of mine infrastructure			
Impact: Deterioration of water quality of receiving waterbodies caused by hydrocarbon waste and other contaminants			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will likely occur throughout the decommissioning phase.	Moderate (negative) -84
Intensity	4	Moderate impacts to water quality and ecosystem functionality are expected.	
Spatial scale	3	The impact may extend across the site and to nearby settlements if contaminants are washed into proximal watercourses.	
Probability	7	It is most likely that the impact will occur.	
Mitigation/ Management Measures			

- Restore the topography to pre-mining conditions as much as is practically possible by backfilling, removing stockpiles and restore the slope gradient and angle of the site;
- Immediate revegetation of cleared areas;
- Where practical, decommissioning activities should be prioritized during dry months of the year (May to September);
- Movement of demolition machinery and vehicles should be restricted to designated access roads to minimise the extent of soil disturbance;
- Use of accredited contractors for removal or demolition of infrastructure during decommissioning is recommended; this will reduce the risk of waste generation and accidental spillages;
- Ensure that the infrastructure (pipelines, fuel storage areas, pumps) are first emptied of all residual material before decommissioning;
- Surface inspection should be continuously undertaken to allow runoff to drain onto the natural streams until vegetation has fully established on the site;
- If decant occurs post-closure, passive treatment with lime or other alkaline compounds can be applied to neutralise AMD at the decant points;
- If decant occurs, the decant needs to be captured, contained and treated to acceptable or prescribed water quality standards prior to discharge into the natural water resources; and
- Mined-out areas may be prone to subsidence, therefore, recommendations provided in the geotechnical report should be adhered to and adequately managed (ECC, 2021). It is essential that the ground is stabilized through the proposed bord and pillar mining method to stabilise the land and conserve the hydropedological recharge mechanisms as much as is practically possible.

Post Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will likely occur during the decommissioning phase.	Negligible (negative) -18
Intensity	2	With proper management of hydrocarbon and chemicals on site the impact intensity will be low.	
Spatial scale	2	With proper management, the impact will be localised to incident sites, where contaminants will quickly be cleaned up.	
Probability	2	The possibility of the impact occurring is very low if mitigation measures re adequately implemented.	

Table 8-36: Restoration of Pre-mining Streamflow Regime

Dimension	Rating	Motivation	Significance
Impact: Restoration of pre-mining streamflow regime in nearby watercourses			
Duration	7	Permanent benefits are anticipated once closure and recharge has been undertaken.	Moderate (positive) 90
Intensity	5	On-going and widespread benefits to local communities are anticipated over time.	
Spatial scale	3	The extent of the benefits will extend across the site and to nearby settlements.	
Probability	6	The impact is highly probable.	

Table 8-37: Risk of Subsidence

Activity: Residual mined-out areas			
Impact: Potential risk of subsidence			
Pre Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	7	The impact will remain beyond the life of the Project.	Moderate (negative) 96
Intensity	5	High significant impact on the environment. Irreparable damage to highly valued species, habitat or ecosystem.	
Spatial scale	4	The impacts will be localised to the immediate surroundings of the mine site.	
Probability	6	It is most likely that the impact will occur.	
Mitigation/ Management Measures			
Mined-out areas may be prone to subsidence, therefore, recommendations provided in the geotechnical report should be adhered to and adequately managed (ECC, 2021). It is essential that the ground is stabilized through the proposed bord and pillar mining method to stabilise the land and conserve the hydropedological recharge mechanisms as much as is practically possible.			
Post-mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will occur beyond the Life of Mine	Minor (negative) 40

Intensity	2	With proposed mitigation measures, the impact will have low to moderate intensity	
Spatial scale	2	Limited to the site and its immediate surroundings.	
Probability	4	It is probable that the impact will occur.	

8.2.3.5. Groundwater

This section describes the potential impacts to groundwater that may occur on site post closure.

8.2.3.5.1. Groundwater Level Recovery

After the end of life of mine pumping of groundwater from the open pits will seize, the voids will be backfilled and groundwater levels are allowed to recover. Groundwater levels in the surrounding area which were drawn down due to the dewatering will subsequently return to close to the natural, pre-mining state. However, due to the low recharge influx and increased porosity of the backfill materials it will take a long time before groundwater levels will return to pre-mining conditions. The numerical model was used to simulate groundwater rebound and indicated the rebound will indeed be slow. Groundwater levels in the vicinity of the site are expected to take approximately 20 years to recover. However, due to the limited scale of the drawdown cone it is expected that the long-term recovery will have a minor impact.

Dewatering should cease as soon as possible after mining activities are completed to allow for groundwater level recovery. The groundwater recovery should be frequently (at least quarterly) monitored to identify deviations from the predicted recovery rate and groundwater quality should be frequently sampled (at least quarterly) to establish if a contaminant plume is migrating. At the start of the post-closure phase, clean water and runoff should be diverted where possible towards the pits to flood these areas as fast as possible after mining has stopped to slow the rate of interaction of the backfilled materials with oxygen.

Table 8-38: Impacts during the Post-Closure Phase – Groundwater Level Recovery

Dimension	Rating	Motivation	Significance
Activity and Interaction: Mine Dewatering and residual effect on rebounding groundwater levels			
Impact Description: Due to the dewatering activities during the operational phase, groundwater levels surrounding the mining areas will be subdued at the start of the Post Closure Phase, after it will gradually recover towards pre-mining levels.			
Pre Mitigation/Management			
Duration	6	Reduced groundwater levels will be fully recovered within 20 years post-closure	Minor (negative) - 66

Dimension	Rating	Motivation	Significance
Extent	2	Limited to opencast and underground mining areas and surroundings.	
Intensity	3	Moderate, short-term effects are expected	
Probability	6	This impact is likely to occur	
Nature	Negative		
Mitigation/Management Actions			
• Dewatering should cease as soon as possible after mining activities are completed to allow for groundwater level recovery; • Groundwater level recovery should be frequently monitored to identify deviations from the predicted recovery rate Groundwater quality should be frequently sampled to establish if a contaminant plume will migrate; and • Clean water and runoff should be diverted where possible towards the open pit voids to flood areas as fast as possible after mining has stopped.			
Post-Mitigation			
Duration	5	Reduced groundwater levels will be fully recovered within 20 years post-closure	Minor (negative) - 60
Extent	2	Limited to opencast and underground mining areas and surroundings.	
Intensity	3	Moderate, short term effects are expected	
Probability	6	This impact is likely to occur	
Nature	Negative		

8.2.3.5.2. Groundwater Contamination

Once the mining has ceased, AMD is still likely to form given the partially unsaturated conditions and the consequent contact of water and oxygen in the backfilled pits, underground voids and co-disposal facility. Groundwater contaminants could migrate from these areas once groundwater levels in the mining areas start to recover.

The migration of contaminated water from the mining areas and co-disposal facility was simulated for 50 and 100 years post-closure (Figure 8-1). The maximum extent of the contaminant plume (sulphate >50 mg/l) for the weathered aquifer was calculated to be ~750 m from the mining areas 100 years post-closure.

The contaminant migration indicates that the plumes will mainly flow towards and follow local drainage lines, such as the two tributaries of the Olifants River, located to the north and the east of the opencasts (Figure 8-1) are expected to receive an increased salt load due to the contaminant plumes. Expected post-closure sulphate concentrations in groundwater close to the western tributary (north of Pit 1) may go up to 2 800 mg/l, while concentrations close to the eastern tributary (east of Pit 2) may go up to 1 500 mg/l. This is expected to have a high impact on the streams and associated wetlands.

Based on the contaminant transport simulations no third party boreholes are projected to be within the zone of contamination and it is therefore unlikely that any of these boreholes will be impacted.

The dewatering of the pits should cease as soon as possible after mining activities are completed to allow for groundwater level recovery. To mitigate the contaminant plume migration the open pits should be properly rehabilitated, including reduction of recharge to these areas by properly top-soiling and vegetating the areas. This will reduce infiltration of water into the groundwater and reduce plume extents.

Clean water and runoff should be diverted where possible towards the rehabilitated pits immediately after mining has stopped to allow for faster recovery of pit water levels, to reduce the interaction of potentially acid forming materials with oxygen. After completion of the pit rehabilitation surface water runoff should be diverted away from the pits to reduce pit water inflows that may contribute to long-term decant volumes.

Groundwater quality should be frequently sampled to establish if a contaminant plume will migrate If a contaminant plume is detected from Pit 1 or Pit 2, groundwater may need to be captured or actively lowered in Pit 1 and 2 to prevent contaminant plumes to move away from the pits.

Table 8-39: Impacts during the Operational Phase – Groundwater Quality

Dimension	Rating	Motivation	Significance
Activity and Interaction: AMD formation in open pits, underground voids and co-disposal facility.			
Impact Description: Due to AMD taking place within the backfilled open pits and in co-disposal facility, groundwater contamination with elevated sulphate and low pH could occur.			
Prior to Mitigation/Management			
Duration	7	The impact will remain long after the life of the Project and are irreversible.	Moderate (negative) -90
Extent	2	Opencast and underground mining areas and surrounding areas.	
Intensity	6	Serious impact on expected on tributaries and associated wetlands.	

Dimension	Rating	Motivation	Significance
Probability	6	This impact will likely occur	
Nature	Negative		
Mitigation/Management Actions			
• Dewatering of the pits should cease as soon as possible after mining activities are completed to allow for groundwater level recovery; • Rehabilitation of the pits and co-disposal facility to reduce infiltration of rainwater into the dump to reduce seepage generation; • Clean water and runoff should be diverted where possible towards the rehabilitated pits as fast as possible after mining has stopped; • Groundwater quality should be frequently sampled to establish if a contaminant plume will migrate; and • If a contaminant plume is detected from Pit 1 or Pit 2, groundwater may need to be abstracted and treated before release into the environment.			
Post-Mitigation			
Duration	7	The impact will remain long after the life of the Project and are irreversible.	Minor (negative) - 78
Extent	2	Opencast and underground mining areas and surrounding areas.	
Intensity	4	Reduced impact on expected on tributaries and associated wetlands.	
Probability	6	This impact will likely occur	
Nature	Negative		

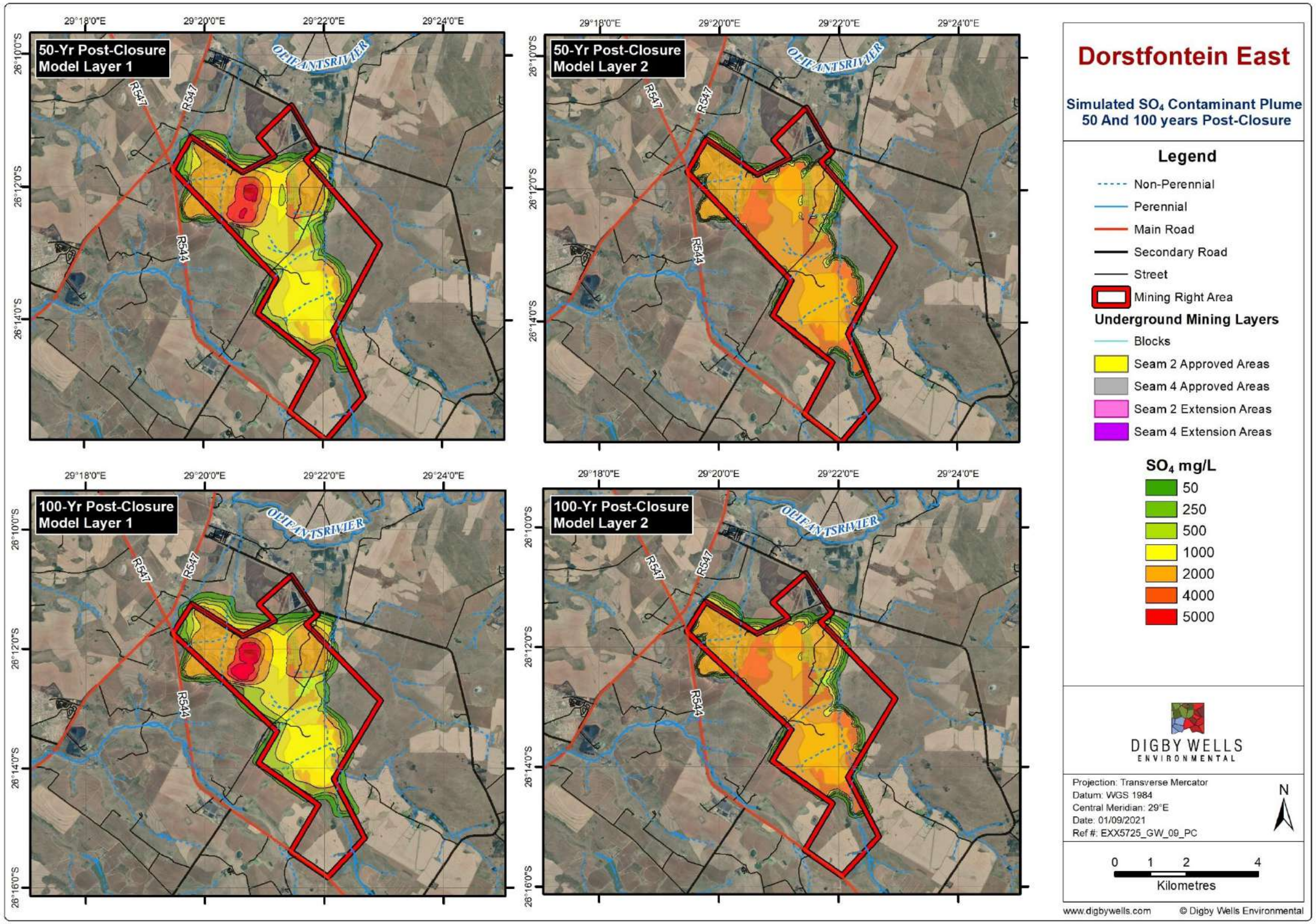


Figure 8-1: Impacts during the Operational Phase – Groundwater Quality

8.2.3.5.3. Mine Decant

For open pit mining the decant point can be established as the lowest topographical point of the pit outline at the end of life of mine. When the active dewatering of the opencasts and underground voids has ceased, groundwater levels will rebound. As the underground voids and backfilled opencasts flood, decant will occur when the groundwater level recovers to above the lowest surface elevation of the pit. This can occur long after the end of life of mine and is referred to as the time-to-decant.

At the DECM proposed mining is planned for Pit 1, the Pit 1 extension and Pit 2. Based on the updated historical and proposed mine plans and updated site topography (based on 5 m surface contours) the potential decant points have been determined for each pit (Figure 8-2).

The volume of the opencast mines at the DECM was based on the depth and extent of the No. 2 and No. 4 coal seams in combination with the updated historical and proposed mine plans. It is assumed the pits will be backfilled.

Decant calculations were carried out for Pit 1, Pit 1 extension and Pit 2. Pit 3 was not taken into consideration for decant calculations as based on the surface elevation of the pit the likelihood of decant is low. In addition, the size of the pit is small and decant from the pit would be negligible when compared to potential decant flows from Pit 1, Pit 1 extension and Pit 2 (Table 8-40).

Values for porosity and recharge to opencast areas were taken from information on rehabilitation of the DECM opencast areas as obtained from Golder & Associates and du Plessis, J.L., 2010, “Decant Calculations and Groundwater – Surface Water Interaction in an Opencast Coal Mining Environment”.

The porosity of the backfill material was taken to be between 15% and 25% of the total mined volume. A recharge rate of between 6.5% and 20% was used for the time-to-decant and decant volume calculations. The lower recharge rate was taken based on the information of the current rehabilitation plan.

The calculations for the opencasts only show that the time-to-decant ranges between approximately 35 and 230 years (Table 8-41). Decant volume calculations show discharge rates of between approximately 75 and 450 m^3/d.

Table 8-40: Open Pit Mine Volume Calculations

Opencast	Total mined volume m^3 (below decant position)	Void volume (15% effective porosity)	Void volume (25% effective porosity)
Pit 1	51119000	7667850	12779750
Pit 2	31042000	4656300	7760500

Table 8-41: Time-To-Decant (years)

Opencast	Effective porosity 15%	Effective porosity 25%
	Recharge 20%	Recharge 6.5%
Pit 1	31	161
Pit 2	34	176

However, decant discharge rates could be higher if the underground voids stay interconnected with the opencasts (Table 8-42). The proposed underground block northwest of Pit 1 would in that case contribute to the inflow into Pit 1 and groundwater from underground blocks south of Pit 2 would contribute to the flow into Pit 2. This would increase the decant volumes as shown in Table 8-43, with decant volumes expected for Pit 2 to increase significantly.

Time-to-decant will also decrease if the underground voids stay interconnected with the opencasts due to the additional inflow as shown in Table 8-43. As such, declines, entrances and other connections between the underground voids and the opencasts should be sealed after mining ceases.

Table 8-42: Open pit And Underground Mine Volume Calculations

Opencast + UG	Total mined volume m^3 (below decant position)	Void volume (15% effective porosity)	Void volume (25% effective porosity)
Pit 1	51714500	8114475	13226375
Pit 2	40454500	13769925	16874125

Table 8-43: Decant volumes (m^3/d)

Opencast +UG	Pit surface area (m^2)	Recharge 6.5%	Recharge 20%
Pit 1	1649000	242	695
Pit 2	913000	639	890

Table 8-44: Time-To-Decant (years)

Opencast + UG	Effective porosity 15%	Effective porosity 25%
	Recharge 20%	Recharge 6.5%
Pit 1	32	150
Pit 2	44	74

The calculated volumes and quality of the potential decant indicate a high impact on the water quality of the tributaries (north of Pit 1 and east of Pit 2) of the Olifants River and subsequently the Olifants River itself, if not mitigated. There is also potential to impact on the hillslope seep and channelled valley bottom wetland associated with the western tributary and the channelled valley bottom wetland areas associated with the eastern tributary (Figure 8-3).

Inter-connections between the mining areas at DECM should be sealed, especially between the underground mine voids and the opencast pits, to prevent additional decant volumes to emanate from the backfilled pits through flooded underground voids. This should focus on the primary pathways between opencast and underground, but also focus on compartmentalising of the underground voids to prevent flow of AMD water from one void to another and therefore reducing the flows that will report to the backfilled opencasts.

To reduce the impact on surface water quality and wetland areas post-closure, decant capture and treatment will be required to prevent deterioration of the post-closure water quality emanating from Pit 1 and Pit 2.

Table 8-45: Impacts during the Operational Phase – Decant

Dimension	Rating	Motivation	Significance
Activity and Interaction: Mine decant causing contamination of groundwater			
Impact Description: If groundwater levels within the open pits recover to elevations higher than surface elevations, this water may then flow from the pit areas and cause groundwater contamination down gradient of the mine.			
Pre Mitigation/Management			
Duration	7	The impact will remain long after the life of the Project. The impacts are irreversible.	Moderate (negative) - 75
Extent	2	Decant points and downgradient	
Intensity	6	Serious, long-term impact o surface water and ecosystems down gradient of the decant points	
Probability	5	This impact is likely to occur	
Nature	Negative		
Mitigation/Management Actions			

• The post-closure sealing of inter-connections between the mining areas at DECM, especially between the underground mine voids and the opencast pits; • Installation of groundwater abstraction boreholes at decant points, or formation of a pit lake, to reduce water level and prevent decant flow and treatment of the abstracted water; • Rehabilitation of the pits and co-disposal facility to reduce infiltration of rainwater into the dump to reduce seepage generation; and • Groundwater level recovery in the rehabilitated open pits should be frequently monitored to create stage curves and predict the final water recovery level.			
Post-Mitigation			
Duration	6	The impact will remain long after the life of the Project. The impacts are irreversible.	Minor (negative) - 55
Extent	2	Decant points and downgradient	
Intensity	3	Moderate, short-term impact on surface water and ecosystems down gradient of the decant points	
Probability	5	This impact is likely to occur	
Nature	Negative		

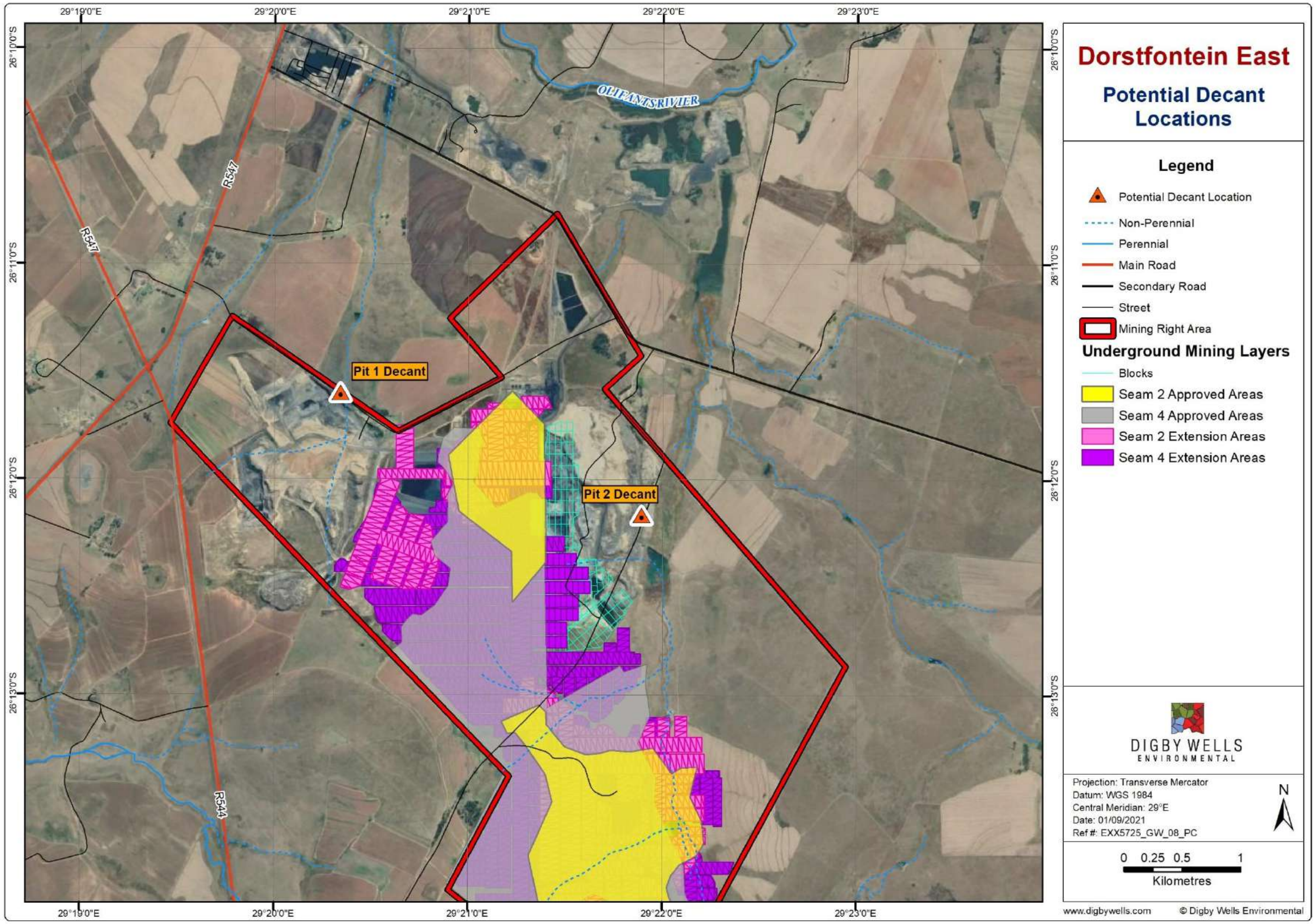


Figure 8-2: Potential Decant Points

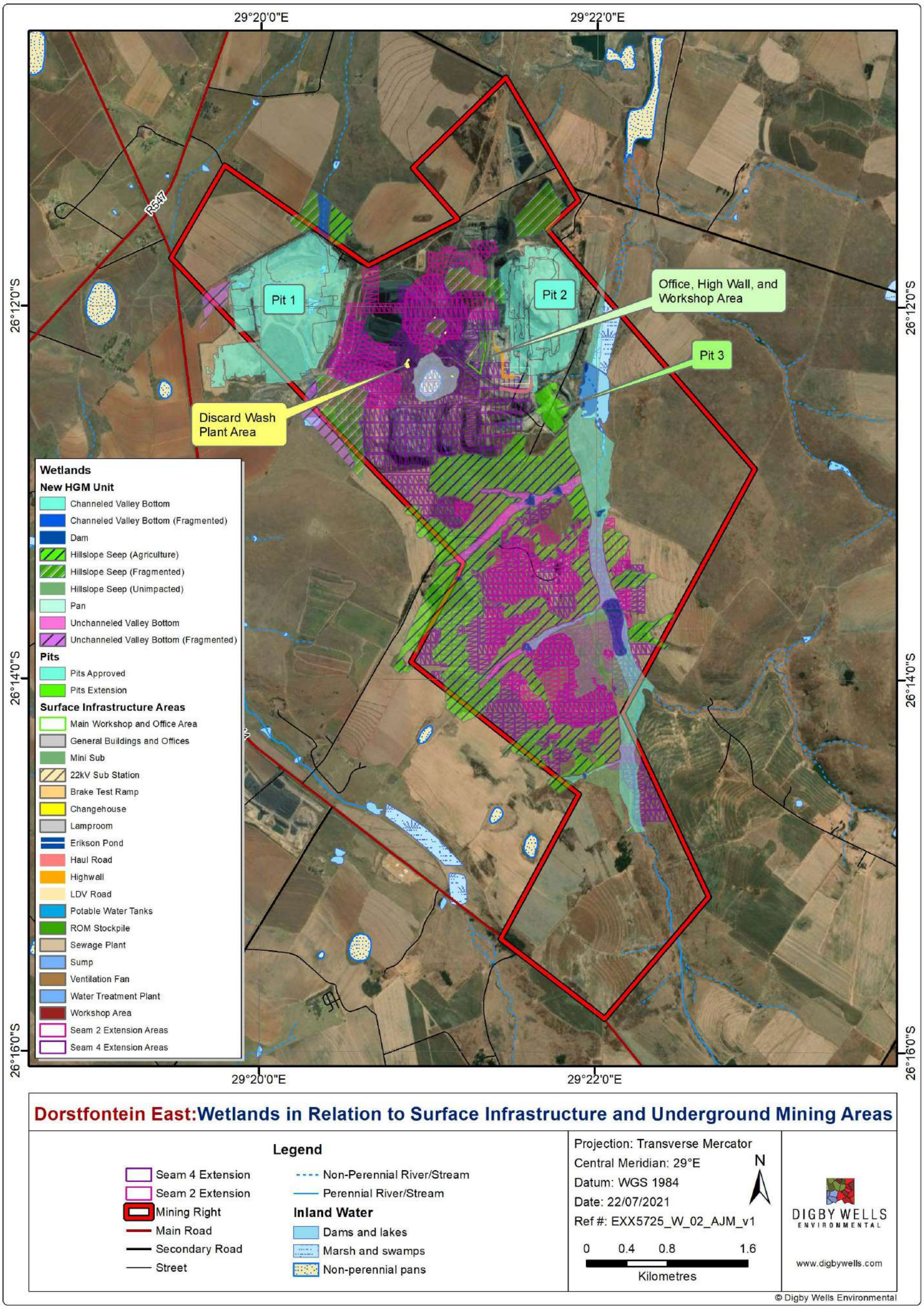


Figure 8-3: Wetland Areas And Drainage Features

8.3. Acid Mine Drainage Strategy

AMD is a well-defined process where sulphide minerals (mainly pyrite) are oxidized to produce acidic leachate. This reaction is a two-step process where the first reaction results in sulphuric acid and ferrous sulphate, then with further oxidation ferric hydroxide and more sulphuric acid is formed. Pyrite is a common minor constituent in many mineral deposits, such as coal. In the natural environment this reaction takes place at a very slow rate and as a result naturalization almost always removes the acidity. Mining activities disturb the in-situ rocks and expose pyrite, which accelerates the oxidation reaction.

Where the potential for AMD exists, provisions for prevention of AMD formation is essential and should start in the planning stages of each project. With increased geochemical information and knowledge, the AMD treatment plan process can be integrated into the operational plan which will enhance the closure processes (Figure 8-4). The information will also inform the decision-making process on how to manage the pit closure and mine void management.

The AMD treatment plan will further assist engineering consultants in the final design of mining areas, including pit rehabilitation, the topography surrounding the co-disposal facility, water management plans and the treatment of water.

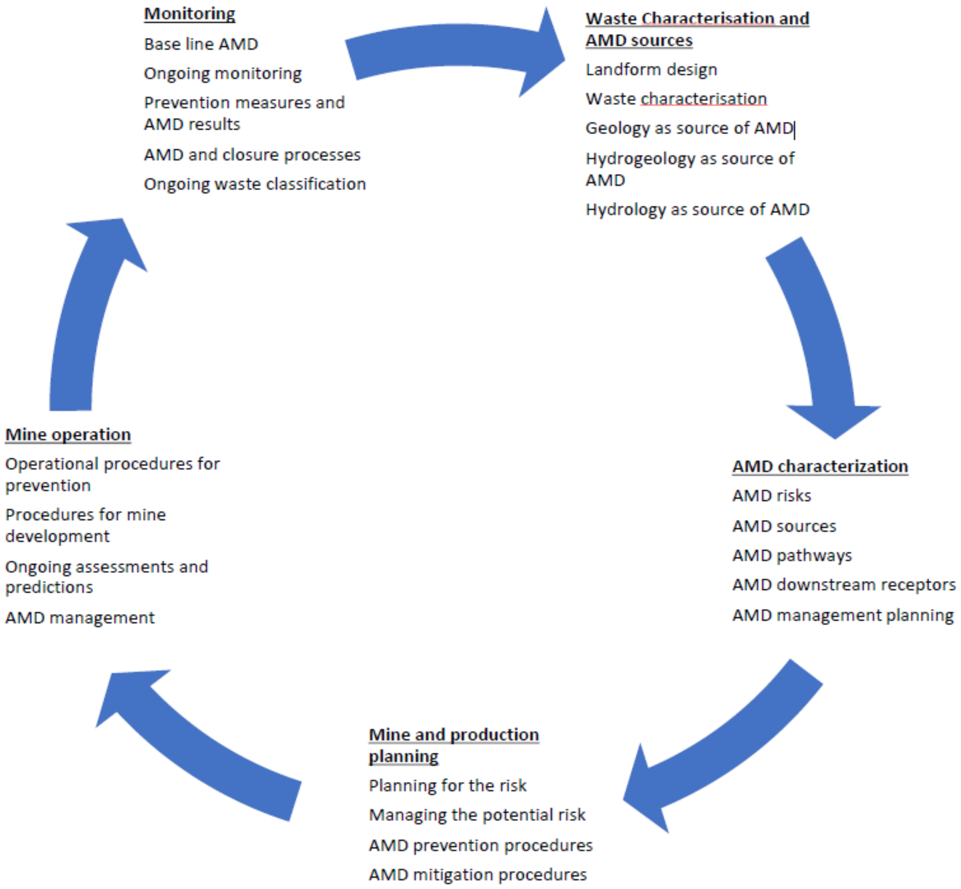


Figure 8-4: Risk-Based AMD Approach (Source: GCS, 2019)

The AMD treatment plan consists of the following management actions:

- Source characterisation: identify all geological units that are/will be disturbed during mining and determine which of these units are potential acid forming. This is done based on ongoing geochemical assessments;
- Development of an AMD conceptual model. This model will describe the following:
  - Sources – as above;
  - Pathways – what is the most likely pathway for contaminants to migrate off-site and reach potential receptors (surface or groundwater); and
  - Receptors – identify all potential current and future receptors that could be impacted by AMD, during operations but also post-closure.
- AMD prevention: to determine what can be done to prevent AMD from forming. This includes minimisation of contact of acid forming materials with air and/or water;

- AMD reduction: where AMD has already taken place or is expected to take place and where this cannot be prevented from occurring, the formation should be as minimal as possible;
- AMD control: if AMD is formed, the AMD water should be diverted in such a way that it can be capture in a centralized place to prevent flowing along pathways as described above and reach potential receptors; and
- AMD treatment: if the collected or captured AMD water is of such a nature that it cannot be released into the environment, treatment of the water will be required to prevent contamination of groundwater, surface water, water users or ecosystems.

8.3.1. Source Characterisation

8.3.1.1. Geochemical Test Work

Various geochemical assessments and waste characterisations have been carried out for Dorstfontein in 2014, 2016 and 2020 and these have given an outline of the materials that are most acid forming. However, it is important to update these assessments with additional samples from different lithologies from new mining areas and to re-assess the boundary conditions of the geochemical modelling based on changes in mining and/or closure plans. It is recommended to carry out additional geochemical testing annually or as new sampling material becomes available.

Geochemical test work to predict AMD consists of the following:

- Static testing, such as Acid Base Accounting (ABA). Static test gives an indication of the overall potential that a rock sample will generate acidic leachate. It determines the balance of acid generating and acid neutralizing capacity of a sample. This is a relatively low-cost procedure which can be done in a matter of hours to a few days;
- Kinetic testing, such as humidity cell tests attempt to predict the quality of the leachate over time. Rocks / samples with a net acid generating potential will be subjected to kinetic test. Kinetic test is defined as a group of test work procedure wherein acid generation and metal mobilization from a sample is measured over time. These procedures could take up to 26 weeks to complete; and
- Field trails are set up as large-scale column leach tests on-site - under actual field conditions. Laboratory tests need to be converted to field conditions and the best way of “calibrating” the lab results are using these field trails.

As part of the AMD treatment plan for DECM the following geochemical assessment will be continuously updated throughout the operational phase:

- Sample selection. A sample plan should be developed to get information of the disturbed geological units (geochemical analyses) as well as the surface and groundwater quality. The sample plan will determine which materials and locations needs to be sampled;

- Review of the geological units that are disturbed during mining. The geological database will be used to develop conceptual geochemical units of all the disturbed lithologies; determinations of the volumes of each lithology will be made based on the available information;
- Each geo-stratigraphical unit will be sampled and submitted for static test work;
- All geo-stratigraphical units that are potentially acid forming will be submitted for kinetic test work;
- Field trials, such as barrel leach tests, with potentially acid forming lithologies will be set up at the mine;
- Review all (surface and groundwater) hydrochemical data with reference to acidic leachate; and
- Once test results are available, a geochemical assessment report will be produced which will include proposals for the handling and disposal of the potentially acidic materials. This report will inform the closure scenario selections for the various mining voids and will serve as input into the groundwater model update.

8.3.1.2. Groundwater Contaminant Modelling

Hydrogeological conceptual and numerical modelling is required to determine the risk of contamination of water sources from AMD sources as characterised based on the geochemical assessments. Groundwater flow modelling uses the outcomes of the geochemical test results and modelling to predict the range of possible outcomes for the backfilled open pits and flooded underground voids.

The outcomes of the model will guide further technical studies and site-specific closure plans. Groundwater flow models provide predictions for water level recovery rates and equilibrium levels for the mining areas at closure. The outputs from the modelling guides the AMD treatment plan and informs the environmental impact assessment using the source, pathway, receptor approach.

The numerical groundwater model will be kept up-to-date depending on changes in mine schedules, mine layout, changing mining methods, updated closure plans and backfill designs, geochemical data and characteristics of backfill and capping materials (permeabilities, compaction rates, porosities etc.) that will be used once mining ceases. This will increase the predictions of decant volumes and qualities for the post-closure phase.

8.3.2. AMD Prevention

The most effective and economical method of controlling AMD is to prevent its formation. Once established, acid drainage is often difficult and costly to treat. Because most metal ions are increasingly soluble with decreasing pH, AMD frequently results in elevated heavy metal concentrations. Management by prevention requires characterisation of overburden or waste material and knowledge of the hydrology of the site so that the likely occurrence of acid drainage can be predicted and potentially acid-producing material selectively handled and isolated. Where the potential for AMD exists, provisions for prevention of AMD formation is essential and should start in the planning stages of each project.

Oxygen and water are required for acid formation and prevention methods aim to exclude either reactant from the pyritic material. This involves controlled placement of acid forming materials and appropriate water management strategies. Prevention is dependent on identifying the pyritic material before mining in order to:

- Adopt mining procedures that can selectively handle acid forming materials for placement within mine waste facilities, such as the co-disposal facility. If calcareous strata or other alkaline material, which can neutralise and acidity generated, are available, mining methods and dump construction should enable blending of material within mine waste facilities;
- Control the hydrology of the site to prevent water from contacting pyritic material by diverting surface water away from pyritic material (such as ROM pads, waste rock dumps, etc.) and preventing ponding and subsequent infiltration;
- In case of backfilling of materials onto mined out areas, the acid-forming materials should be submerged. This can be an effective strategy where enough water is available. It has been suggested that a water cover enough to maintain the partial pressure of oxygen below 1% is necessary to inhibit pyrite oxidation; and
- Isolate the pyritic material (whether in a waste rock dump or co-disposal facility) from water by placing it above the water table and capping with clay or other impermeable materials. The cap can then be covered with soil and vegetation established. This technique reduces infiltration and leaching. Waste rock dumps are unlikely to have an impermeable or semi-impermeable base or sides. The task of reshaping and encapsulation is consequently greater and costlier.

8.3.3. AMD Reduction

8.3.3.1. Closure Landform Designs and Final Topography

Landform re-design is required to include, place and move all new overburden spoils to create a final topography that coincides with the surface drainage areas of the site. The best result of a final topography can be achieved when the landform is designed during the early stages of the operation. Key elements of a successful landform design include:

- The comprehensive characterisation of the properties of soils, overburden and mineral processing wastes to determine their:
  - potential erodibility;
  - capacity to support plant growth; and
  - potential to have adverse impacts on water quality (AMD formation);

- The segregation and selective placement of those materials to ensure the creation of a favourable medium for plant growth and the protection of water resources;
- Quantifying the LoM material balance and developing the post mining landform design with the available backfill volumes; and
- Aligning the post mining landform with the site wide surface drainage framework and informing the design with dedicated hydrological and erosion modelling.

Some of the key aspects that require management throughout the mine operation include:

- A final landform design should be developed during the operational phase. The final landform design will benefit the mine as it would influence numerous aspects including the placement of coal discard and slurry materials, waste rock, topsoil and final water management requirements;
- Regularly update the post mining landform design for the open cast pit to replace estimated bulking and compaction values with accurate survey data;
- Backfilled opencasts and waste rock dumps landscaped as raised topographical features will require larger drainage features than existed in the pre-mining setting;
- Long steep slopes and sharp angles typically associated with constructed mine waste facilities should be avoided. Reduced slopes (less than 1:3) constructed to geomorphic principles, covered with suitable growth medium and well vegetated require less maintenance and are more resistant to erosion;
- Where stable slope profiles are not achievable, additional stormwater management measures (contour drains, chutes or benches) should be designed to reduce the velocity of run-off. The engineered solutions should be informed by dedicated storm water and erosion modelling;
- The volume and velocity of the runoff water must be controlled prior to entering the watercourses in surrounding areas. An increase in runoff could result in erosion and increased sedimentation in downstream areas of the catchment;
- Side slopes of rehabilitated areas are to be covered by clay/subsoils/topsoil sourced from the stockpiles which were created during the clearing of specific areas. The cover configuration and functionality should be designed to meet specific closure objectives and agreed to with the relevant authorities (refer to relevant documents and best practice guidelines from the DWAF/DWE/DWS and ICCM);
- The Post-mining landform design must align with the site wide drainage framework and the surrounding macro-topography;
- Each deposit on the mine site requires a specific management plan to ensure that volumes, angles, drainage lines and waterways, are incorporated into the operational site wide surface water management plan;

- A change management procedure is required to reconsider and amend the post mining landform when the mine plan changes;
- An integrated approach is required to ensure that all aspects of the rehabilitation process is considered during the changes on the mine;
- Develop a post mining landform design informed by the end land use objectives, providing design elevations to manage backfilling operations;
- Concurrent rehabilitation of waste facility side slopes to reduce infiltration into the waste body and deliver clear surface water runoff back into the catchment;
- Concurrent rehabilitation of the opencasts as an integrated part of the mining activities, including:
  - Backfilling as mining progresses and preferential handling of material to ensure reactive overburden is placed in the deepest portion of the pit;
  - Backfilling in layers rather than end tipping to provide a level of compaction by the traversing equipment;
  - Placement of softs over hard overburden, combined with the above points will reduce oxygen ingress;
  - Replacement of topsoil stripped ahead of mining and vegetation establishment to reduce recharge, limit erosion and deliver clean surface water runoff back into the catchment; and
  - Implementing topsoil management throughout the life of the operation to limit damage to the physical properties and combat compaction. Compaction can lead to poor quality rehabilitation and increased recharge through the development of preferential pathways.

8.3.4. AMD Control

The final site topography and drainage designs will be important to channel AMD waters to a centralised location after which, if required, optimal treatment options need to be considered prior to release into the environment. These designs and options should be focused on during the operational phase to ensure quality of any potential discharges of waters during operation and for post-closure.

8.3.4.1. Surface Water Management

The design of the site’s surface water management should include consideration of AMD requirements. The management of surface water should include options for:

- Managing AMD waters with store and release cover systems;
- Designing of slopes to drain surface water runoff to surrounding water networks; and

- During operation, direct discharges to drainage lines should be avoided where possible by re-directing flows towards PCDs, backfilled mine pits or pit lakes.

Considerations include the fate of the captured water, the potential for surface water recharge to the groundwater system and stability of the impacted landforms to changes in surface water flows.

The selection and design of these alternatives will need to be made over the life of mine with consideration of materials, geochemistry, environmental guideline values and hydrology and the water management plan should be updated in case any changes to the management system are made or when new information becomes available.

8.3.4.2. Groundwater Management

Groundwater or decant that may emanate from mining areas should also be controlled during the operational and post-closure phases. During the operational phase, the following actions should be adhered to:

- All discard material and coal slurry should be placed only at the co-disposal facility;
- Any pollution control dams and/or ROM coal stockpile areas should be lined, thereby preventing contamination of the underlying aquifers; and
- To ensure a cone of drawdown is maintained towards the mining areas, groundwater abstraction should continue for the LoM and groundwater quality in the area surrounding the mining areas should continue throughout the LoM. Groundwater levels surrounding the pits should be monitored on a regular basis throughout the LoM to verify the extent of the cone.

For the post-closure phase, the following actions are required:

- The dewatering of the pits should cease as soon as possible after mining activities are completed to allow for groundwater level recovery;
- Clean water and runoff should where possible be directed towards the rehabilitated pits immediately after mining has stopped to allow for faster recovery of pit water levels, to reduce the interaction of potentially acid forming materials with oxygen;
- To minimise contaminant plume migration, the open pits should be properly rehabilitated, including reduction of recharge to these areas by properly top-soiling and vegetating the areas. This will reduce infiltration of water into the groundwater and reduce plume extents;
- After completion of the pit rehabilitation surface water runoff should be diverted away from the pits to reduce pit water inflows that may contribute to long-term decant volumes;

- If AMD contaminated waters are migrating away from Pit 1 or Pit 2, groundwater may need to be captured or actively lowered in Pit 1 and 2 to prevent contaminant plumes to move away from the pits;
- Inter-connections between the mining areas at DECM should be sealed, especially between the underground mine voids and the opencast pits, to prevent additional decant volumes to emanate from the backfilled pits through flooded underground voids. This should focus on the primary pathways between opencast and underground, but also focus on compartmentalising of the underground voids to prevent flow of AMD water from one void to another and therefore reducing the flows that will report to the backfilled opencasts;
- Groundwater level recovery in the rehabilitated open pits should be frequently monitored to create stage curves and predict the final water recovery level.
- Rehabilitation of the pits and co-disposal facility to reduce infiltration of rainwater into the dump to reduce seepage generation.
- Installation of groundwater abstraction boreholes at decant points to reduce water level and prevent decant flow and treatment of the abstracted water.
- Decant capture and treatment will be required to prevent deterioration of the post-closure water quality emanating from Pit 1 and Pit 2.

8.3.5. AMD Treatment

Treatment procedures for dealing with acid leachates will vary according to site conditions. An optimization study based on the AMD treatment plan will be done to determine what are the most suitable options for DECM. Treatment methods previously adopted include the following:

- Incorporation or mixing in of lime or other neutralising materials onto the surface of the co-disposal facility where discard is deposited. The neutralising capacity of the available materials and the "lime demand" of the discard materials should be tested to determine feasibility;
- Channelling run-off from the co-disposal facility to selected recharge areas i.e. ponds or ditches filled with alkaline material or areas of the facility where selected materials with high neutralising capacity have been placed;
- Injection of neutralising fluids e.g. sodium carbonate, anhydrous ammonia or caustic soda into the facility to intercept flow paths of acid drainage;
- Collection of acid drainage downstream of the facility and/or decant points for active chemical treatment or inline aeration;
- Directing acid drainage to artificial wetlands where biological production of bicarbonate neutralises the acidic drainage. Metals are removed through hydrolysis and biological formation of insoluble sulphides and carbonates; and

- In areas where evaporation consistently exceeds precipitation, disposal by evaporation may be feasible. Safe disposal of sludge with elevated levels of heavy metals and salts is then required.

8.4. Mitigation Hierarchy

No wetlands will be directly impacted by the surface infrastructure, however, the surface infrastructure falls within the 100 m and 500 m Zone of Regulation of the Pan and Hillslope Seep (fragmented) (HGM 1 and 7). According to the Groundwater Impact Assessment Report (Digby Wells, 2021), dewatering of the groundwater will potentially occur, however due to the nature of the wetlands and dominant surface and subsurface water supply, the wetlands should not be impacted by the dewatering cone. It is however evident that decanting will potentially occur on the eastern side of the Project Area, adjacent of the Olifants River tributary that could potentially lead to soil, water and wetland contamination. Subsidence could potentially occur over time, affecting the natural topographies, hydrology and functionality of the wetlands.

The impact assessment revealed a spectrum of impacts ranging from major to minor before the implementation of suitable mitigations. Many of these impacts can be reduced to minor and negligible impacts after the implementation of the mitigation, monitoring and the EMPr). Based on the Impact Assessment significance ratings, it is the opinion of the specialist that this Project is feasible and should be considered. However, it is highly recommended that concurrent rehabilitation, management, mitigation measures and wetland monitoring are correctly implemented to minimise potential impacts on the wetlands and associated catchments to maintain wetland health and functionality. Wetland management and monitoring requirements should form part of the conditions for environmental authorisation.

The mitigation hierarchy for the wetlands within the Study Area are described in Table 8-46 below.

Based on similar projects within the area it is inevitable that the proposed activities will pose various impacts on the wetlands. Even when wetlands are avoided, impacts to the wetlands might still arise. Mining particularly affects surface and subsurface water flow in a catchment and consequently affects recharge and discharge of water and the hydrological expression in wetlands.

However, it is not always possible to avoid or prevent an impact and therefore minimization and rehabilitation should be considered. When it is found that it is not possible and feasible to avoid mining wetlands, Wetland Offset should be implemented where rehabilitation may be included as part of the Offset Plan. Wetland Offset are measures to compensate for residual negative effects on wetlands after effort have been made to minimize and avoid impacts.

Table 8-46: Mitigation Hierarchy for Wetlands

Mitigation Step	Actions
Avoid or Prevent	*Consider options to avoid impacts on biodiversity, ecosystem services and people (e.g., project location, siting, scale, layout, technology and project phase). This is the best option, however not always possible. Where the social and environmental impacts are too high, mining should not take place as it would be unlikely to rely on the taller steps to prove effective remedy for impacts.*
	• Avoid underground mining and infrastructure within delineated wetlands and a 500 m zone of regulation as this will potentially impact the groundwater level and subsurface water supply to the wetlands (dewatering), drying out over time; and • Establishment of a 500 m buffer zone to protect wetlands from infrastructure and mining within the Project Area. This would require that development occur further than 500 m from a delineated wetland area.
Minimise	*Consider alternatives to minimise impacts on biodiversity and ecosystem services (e.g., project location, scale, technology and layout). In areas where the environmental and social constraints are not too high, minimising should still be taking place.*
	• Avoid surface infrastructure within wetlands with a high PES, EIS and ES rating; • Establishment of a 100 m zone of regulation to protect wetlands from infrastructure within the Project Area. This would require that development occur further than 100 m from a delineated wetland area; • Use pumped out, underground water for re-wetting wetlands that loss water due to the potential dewatering and the draw-down plume. However, the water must be tested prior using it, if the water quality is low, it must first be cleaned in a water treatment plant; • Consider moving infrastructure outside the 100 m and 500 m zone of the wetlands; • Only the designated access routes are to be used to reduce any unnecessary impacts to the wetlands; • Minimize the period of exposed areas to prevent erosion, loss of vegetation and sedimentation within the wetlands; and • Monitor and prevent decanting into the wetlands.
Rehabilitate	*Rehabilitate areas where impacts were unavoidable. Measures must be taken to return impacted areas to conditions ecologically similar to their 'pre-mining natural state' or an agreed land use after mine closure. Rehabilitation is important and necessary, however even with significant resources and effort, rehabilitation is limited and almost always falls short of replicating the biodiversity and complexity of a natural system.*

Mitigation Step	Actions
	• Rehabilitate wetlands on-site; • Recreate/re-wet wetlands on-site after mining and decommissioning; • Ensure concurrent rehabilitation with special attention to re-wetting, re-shaping and re-vegetation where necessary; • Rip rehabilitated areas (surface infrastructure areas) to reduce compaction and reseed to increase vegetation cover; • Address areas of AIPs proliferation by utilising a AIPs Management Program; • Allow underground dewatering to re-enter the system/catchment to reduce the impacts on the Olifants River system; • Monitor the wetlands in the Project Area to determine subsidence and assess the water level, when it is recognised that the wetlands are losing water and drying out, rehabilitate and mitigate as soon as possible; • Monitor and rehabilitate decanting and subsidence; • If erosion has occurred, topsoil should be sourced, replaced, vegetated and shaped to reduce the recurrence of erosion in wetlands; • Monitor the wetlands to identify and rectify any areas that have begun to erode; • Clean up spills immediately to prevent migration of contaminants into the wetlands; • Conduct pollution monitoring along the low-lying areas (wetlands) to detect any high levels of pollutants if spills have occurred; and • Ensure proper stormwater management designs are in place to ensure no excessive run-off or pooling occurs.
Offset	*Compensating for remaining and residual (unavoidable) negative impacts on the biodiversity. Offset should be implemented when every effort has been made to minimise and rehabilitate remaining impacts to a degree of 'no net loss' of biodiversity against biodiversity targets.*
	• Develop and implement a Wetland (biodiversity) Offset Strategy and Rehabilitation Plan for the wetlands in the Project Area that will be unavoidable; and • Monitor and mitigate subsidence, dewatering, decanting and contamination of wetlands.

8.5. Unplanned Events and Low Risks

Unplanned events may occur during the Project that may have potential impacts which will require management and mitigation. Table 8-47 outlines unplanned risks and mitigation measures that must be adopted in the event of unplanned impacts throughout the life of the Project.

Table 8-47: Unplanned Events, Low Risks and their Management Measures

Potential Project Risk	Aspect	Mitigation / Management / Monitoring
Chemical and (or) contaminant spills through pipe leaks and bursts from the proposed Project, infrastructure and associated activities.	• Surface water; • Groundwater; • Aquatic Ecology; and • Wetlands	• An emergency response plan and spill kits should be in place and accessible to the responsible monitoring team in case of pipeline bursts, dam spillages, breaches or failure accidents. The Material Safety Data Sheets (MSDS) should be kept on site for the Life of Mine for anytime reference in terms of best practice guidelines for handling, storage and disposal of materials; • The wastewater storage dams (e.g. return water dam) should regularly be inspected in order to identify concerns regarding breach, failure, overflow or seepages; • Ensure correct storage of all chemicals at operations as per each chemical's specific storage requirements (e.g. sealed containers for hydrocarbons); • Conduct routine inspections for potential leaks and spills • Ensure staff involved at the proposed developments have been trained to correctly work with chemicals at the sites; and • Ensure spill kits (e.g. Drizit) are readily available at areas where chemicals are known to be used. Staff must also receive appropriate training in the event of a spill, especially near watercourses/drainage lines.
Accidental spillage or overflows of sewage effluent.		• Quick clean-ups should be practised to minimise contamination of water resources.

Potential Project Risk	Aspect	Mitigation / Management / Monitoring
Structural deterioration along with surface infrastructure in the vicinity of wetlands.		• Install safety valves and emergency switches that can be used to seal off leakages from pipelines when noticed or triggered; • Ensure that spill kits and trained staff capable of using the kits are available on-site in case of accidental spillages; and • Maintenance of roadways, river crossings and pipelines should be considered an ongoing process where leakages or issues with the pipe should be reporting to acting Environmental Control Officer (ECO) of the Project immediately after notice.
Decanting into the downstream and adjacent wetlands and water courses (refer to the Groundwater Impact Assessment, DWE, 2021).		• Prevent decanting by keeping the groundwater levels low post-closure; • Abstraction boreholes placed down gradient of the decant point to reduce decant generation and will lower the impact; • Prevent decant water from entering the wetlands; • Treat decant water before it is put back into the natural systems; • Fence off decant areas to prevent human and animal consumption; • Rehabilitate and mitigate areas where decanting has taken place; and • Monitor decant of AMD and implement management measures which include reverse osmosis or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses.
Subsidence.		• Evaluate the subsidence/sinkholes to determine the rehabilitation method and impacts to the wetlands (i.e., depth, cause, ingress of water, groundwater drawdown, geology, blanket layer and thickness, • If the subsidence is determined to be unstable, fence off and prevent animal and human entry;

Potential Project Risk	Aspect	Mitigation / Management / Monitoring
		• If subsidence is stable, the land can be rehabilitated back to pre-mining land use; • Compact the surface material (blanket layer) to stabilise the area; and • Backfill and revegetate.

9. Integrated Water and Waste Management Plan

There are various relevant acts and principles governing water and waste management, namely: NEMA, NWA, NEM:WA as well as Best Practice Guidelines (BPG) prescribed by the DWS. The subsections below provide an overview of the Project specific water and waste management plan.

9.1. Water and Waste Management Philosophy

All the relevant principles contained in DWS's BPG will be utilised for all designs and management practises. The mine will also ensure compliance with GN 704 of the NWA.

9.1.1. Water Management

The general principle of water management is the recognition that water is a scarce resource. Exxaro's water management policy outlines their commitment to the sustainable use of water with a particular focus on efficiency through reuse and recycling. This policy is aligned to the legislative environmental framework governed mainly by the NWA. In support of the Act, the DWS has issued an integrated water resource management hierarchy that prioritises mine and waste management decisions and actions. This hierarchy informs both Exxaro's policy and strategy on mine and waste water management as:

- Pollution prevention;
- Minimise environmental impacts;
- Maximise water reuse and reclamation;
- Responsible water discharge and disposal; and
- Water treatment.

The actioning of this policy is done through the development and implementation of IWWMPs (this document) across the life cycle of the mine which includes construction, operation, decommissioning, closure and rehabilitation phases.

The overall vision of Exxaro is to:

- Ensure a cost-effective integrated approach to water management;
- Be environmentally responsible; and
- Be ecologically sustainable.

Exxaro's management standards adhere to DWS best-practice guidelines on:

- The IWWMP;
- Stormwater management planning;
- W&SB;

- Water-monitoring systems;
- Water reuse and reclamation;
- PCDs; and
- Water efficiency performance indicators.

9.1.2. Waste Management

The waste management philosophy is the core strategy of waste prevention, minimization, reuse, recycling, energy recovery and final disposal. This is firmly established as a driving principle nationally and globally.

According to NEM:WA, the following measures should be implemented:

- Avoid the generation of waste and where such generation cannot be avoided to minimise the toxicity and amounts of waste that are generated;
- Reduce, re-use, recycle and recover waste;
- Where it must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner;
- Manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour or visual impacts;
- Prevent any employee or any person under their supervision from contravening the Act; and
- Prevent the waste from being used for an unauthorised purpose.

9.2. Key Performance Areas and Indicators

The overall objective is the prevention or minimisation of potential impacts on the surrounding water resources, as a result of activities, by actively practicing adequate water management programmes. To ensure this, key performance areas and indicators have been established as detailed in Table 9-1 below.

Table 9-1: Performance Areas and Indicators

Key Performance Area	Objective	Indicator
Legislation		

Key Performance Area	Objective	Indicator
Compliance with the waste and water legislation	To ensure that the Project activities comply with: • NEM:WA • NWA; • GN 704; and • Conditions of the WUL once it is issued.	Compliance audits must be undertaken annually regularly to determine compliance to the applicable legislation.
Freshwater Ecosystems		
Process water	Ensure that process water is used optimally.	• Monitor all process volumes to inform the water balance; and • Optimise the re-use of contaminated water into the mining process.
Stormwater	To ensure the separation of clean and dirty storm water throughout the Project Area.	• Separation of clean and dirty water in the Project Area where relevant, which is measurable against GN 704 requirements; • Prevent the leaking of clean storm water into the dirty water systems; and • All leaks should be addressed as a matter of urgency.
Erosion	To prevent erosion at the rehabilitated areas.	• Monitor erosion gullies to ensure that they are filled; and • Monitor vegetation establishment of the rehabilitated areas.
Water balance	To maintain the zero- discharge water balance and reduce risk of uncontrolled spillages into the natural environment with adequate storm water management measures.	• Monitor all necessary flow parameters to calibrate the water balance; and • Update water balance annually.
Surface water quality	To ensure that contamination of the surface water resources of the catchment is prevented, minimised or mitigated as far as possible.	Conduct monthly surface water quality inspections and monitoring.

Key Performance Area	Objective	Indicator
PES	Maintain and where possible improve the current ecological status of the river reaches.	• The control of contaminated surface and groundwater will allow for the maintenance of the downstream ecological structures; and • Biomonitoring must be conducted to ensure that temporary pollution events and diffuse pollutants not included in the surface water assessments are not negatively affecting the condition of the river downstream of the Project.
Wetlands	To ensure that the impact on the wetlands are contained / minimised to the smallest possible footprint	• Monitor the disturbances to the wetland as a result of discharge of dirty water; and • Prevent/ minimise spillages of coal to the wetland from the conveyor.
Groundwater		
Groundwater contamination	To prevent the contamination of the groundwater environment.	• Monitor groundwater quality around the potential pollution sources for changes in the water qualit; • Monthly site inspections should be undertaken to identify any potential contamination sources such as runoff from dirty water areas; • Monitor groundwater levels and quality for changes in groundwater that is available to downstream water users and to the nearby surface water sources; and • Update the numerical model every three years to monitor the pollution plume and potential draw down from the dewatering process
Waste Management		

Key Performance Area	Objective	Indicator
Waste Management	To implement the hierarchy of waste management: • Prevent; • Reuse; • Recycle; and • Dispose of (last resort).	• Measure and record waste generated, disposed and recycled; • Maintain waste disposal certificates for record purposes and • Comply to applicable norms and standard for waste.
	Prevention of pollution due to the storage and/or management of waste on site.	• Separate clean and dirty stormwater and • Contain any dirty water originating on the site.
Communication with external parties		
Stakeholder Engagement	To ensure effective and transparent communication with stakeholders.	• Implement a grievance mechanism to address any concerns raised by the public; • Attend water forums; and • Communicate project progress and determined closure objectives at regular intervals (at least every quarter) with all stakeholders and surrounding communities.

9.3. Integrated Water and Waste Management Action Plan

The water and waste management action plan is provided in Table 9-2 for those environmental aspects that will be impacted upon during the Construction, Operational and Decommissioning and Closure phases of the DECM Expansion Project. This plan has been based on the impacts identified in Section 8 above.

Table 9-2: Integrated Water and Waste Management Plan

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
CONSTRUCTION PHASE							
• Site/vegetation clearance and site establishment (construction of surface infrastructure; and • In-pit RoM Stockpiling.	Wetlands	• Loss of fauna and flora (biodiversity); • Increased erosion and sedimentation; • Quantity and quality changes to the hydrological functioning; • Destruction or complete removal of wetland habitat; • Increased AIPs; • Fragmentation of wetlands and wetland habitat; • Sedimentation of downstream and adjacent wetlands; and • Soil and water contamination leading to wetland contamination.	To prevent destruction of delineated wetlands as far as practicable.	Wetland monitoring programme	• If the destruction of wetlands is unavoidable disturbance must be minimised and suitably rehabilitated; • At areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing; • Environmental Practitioner and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; and • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction. • Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • If spills have occurred, it should be cleaned up immediately; • RoM must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; and • RoM stockpiles must be located outside wetlands and at least a 100 m buffer zone.	• NWA; • NEM:BA; and • NEMA.	• Mine Manager; and • Environmental Practitioner

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
Site clearing and infrastructure construction.	Aquatics	• Erosion and sedimentation • Altered hydrology	• To prevent erosion and the sedimentation of nearby freshwater systems; and • To prevent deterring of aquatic biota to affected reaches due to modifications of in-stream habitat	• No evidence of erosion • Handling and storage procedures	• Limit the footprint area of the construction activities to what is essential in order to minimise impacts as a result of vegetation clearing and potential erosion areas; • If possible, construction activities must be prioritised to the dry months of the year to limit mobilisation of sediments, dust generation and hazardous substances from construction vehicles used during site clearing; • Ensure soil management programme is implemented and maintained to minimise erosion and sedimentation; and • An efficient drainage system (e.g. diversion trenches > settling area (or sump) > baffled discharge outlets) should be implemented prior to construction.	• NWA; • NEM:BA; • NEMA; and • National Freshwater Ecosystems Priority Areas (NFEPA, Nel et al., 2011).	• Mine Manager; and • Environmental Practitioner
Construction activities, including vehicular activities and maintenance of access roads.		Water quality impairment	• To prevent deterring of aquatic biota to affected reaches due to modifications of in-stream habitat; and • To prevent pollution resulting from spillages of hazardous substances and waste	Handling and storage procedures	• Spillage management kits or controls should be taken seriously and put in place in order to reduce oil or fuel run offs to enter nearby river systems. • All vehicles must be frequently inspected for leaks; and • All waste must be removed and transported to appropriate waste facilities.		• Mine Manager; and • Environmental Practitioner
Construction of mining infrastructure including vegetation clearance, construction of access roads and associated infrastructure	Hydropedology	• Disruption of flow paths; • Soil erosion and compaction; and • Water quality degradation due to the use of hydrocarbons and other waste products.	• To prevent erosion and the sedimentation of nearby freshwater systems; • To prevent deterring of aquatic biota to affected reaches	Surface Water, Soils and Wetland Monitoring programmes	• Buffer zones need to be delineated and established as specified in the Wetlands report (Digby Wells , 2020) to prevent the destruction of wetlands within DECM; • Developments near undisturbed wetlands need to be avoided as much as possible; • Rehabilitate the land to the most suitable post-mining land use;	• NEMA; and • NWA	• Mine Manager; and • Environmental Practitioner

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
			due to modifications of in-stream habitat; and • To prevent pollution resulting from spillages of hazardous substances and waste.		• Clearing of vegetation must be limited to the development footprint and the use of any existing access roads must be prioritised to minimise creation of new ones; • Dust suppression on the haul roads and other cleared areas must be undertaken on regular basis to prevent or limit dust generation; • Hydrocarbon and hazardous waste storage facilities must be appropriately bunded to ensure that leakages can be contained. Spill kits should be in place and construction workers should be trained in the use of spill kits, to contain and immediately clean up any leakages or spills; • Vehicles should regularly be maintained as per the developed maintenance program. This should also be inspected daily before use to ensure there are no leakages underneath; and • Drip trays must be used to capture any oil leakages. Servicing of vehicles and machinery should be undertaken at designated hard park areas. Any used oil should be disposed of by accredited contractors.		
OPERATION PHASE							
• Blasting (only when dykes and other geological features are encountered); • In-pit RoM Stockpiling; • Transportation of coal from pit for further processing;	Surface Water, Wetlands	• Movement of the strata causing potential subsistence, resulting in ponding and undulating topographies; • Dewatering and drying out of wetlands; • Contamination and deterioration of water quality and quantity; and	To prevent sedimentation/ siltation of nearby freshwater systems	• No evidence of erosion; • Wetland monitoring programme; and • Water quality monitoring programmes	• All areas of high ecological sensitivity should be designated as "No-Go" areas and avoided; this include the CVB on the east boundary of the Project Area; • Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; • If it is unavoidable that any of the wetland areas present will be affected, the	• NEMA; • NWA; • NEM: BA; and • The Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP).	• Mine Manager; and • Environmental Practitioner

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
• Underground Mining Machinery Maintenance; • Operation of water and sewer reticulation; and • Use of existing haul roads.		• Loss or changes to natural wetland integrity and biodiversity. • Head cut erosion and channel forming from the roads (culverts); and • Increased erosion and consequently sedimentation potential into wetlands; • Wetland fragmentation; • Potential runoff from topsoil and subsoil stockpiles causing sedimentation into the wetlands; • Erosion and sedimentation of contaminants into the wetland areas; • Contamination from Hydrocarbon waste/spills (lubricants, oil, explosives and fuels); • Contamination from sewage and wastewater; and • Contamination of soil, water and wetlands.			disturbance must be minimised and suitably rehabilitated; • A SWMP should already be implemented. This should consider wetlands associated with the new developments/infrastructure which should divert stormwater and runoff away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible; • All vehicle maintenance must occur within designated areas; • All vehicles must be regularly inspected for leaks; • All spills must be cleaned up immediately to prevent contaminants to enter the wetlands; • Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil; • The edge of the wetland and a 100m buffer or 1:100 flood line buffer should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the operational phase; • All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel; • If it is unavoidable that any of the wetland areas present will be affected, the disturbance must be minimised and suitably rehabilitated; • No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines; • Culverts, roads and river crossings must be maintained, cleared and monitored; • No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their buffer areas. All		

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
					vehicles must remain on demarcated roads and within the operational footprint; • Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • ROM must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; • ROM stockpiles must be located outside wetlands and at least a 100 m buffer zone; • The SWMP should also convey contaminated water to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present and if so that a remedy is put in place as soon as possible; • Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; and • Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions.		

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
Operational aspects of proposed Project.	Aquatics	• Erosion and sedimentation; and • Water quality improvement/impairment.	To prevent sedimentation/ siltation of nearby freshwater systems.	• Water quality monitoring programmes; and • Biomonitoring programmes.	• Runoff from dirty areas should be directed to the storm water management infrastructure (drains and PCDs); • The aquatic biomonitoring program provided in this report should be adhered to for monitoring water resources within and in close proximity to the Project Area to allow detection of any contamination arising from operational activities; • The overall housekeeping and storm water system management (including the maintenance of berms, de-silting of dams and conveyance channels and clean-up of leaks) must be maintained throughout the life of mine; • The hydrocarbon and chemical storage areas and facilities must be located on hard-standing area (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This will prevent mobilisation of leaked hazardous substances; • Training of mine personnel and contractors in proper hydrocarbon and chemical waste handling procedures is recommended; • Vehicles must only be serviced within designated service bays; and • Wash bay and workshop runoff should flow through an oil separator as indicated on the infrastructure plan prior to discharge into the PCD.	• NWA; • NEM:BA; • NEMA; and • NFEPA, Nel et al., 2011).	• Mine Manager; and • Environmental Practitioner
Mine operational activities including blasting where necessary, use and maintenance of mining machinery.	Hydropedology	• Geotechnical instability as a result on mining out the underground coal seams may result in disruption of flow paths which feed downstream wetlands and • Deteriorating water quality as a result of handling waste products and hydrocarbons associated	To prevent pollution resulting from spillages of hazardous substances and waste.	Handling and storage procedures	• The management of general and other forms of waste must ensure collection and disposal into clearly marked skip bins that can be collected by approved contractors for disposal to appropriate disposal sites; • The overall housekeeping and storm water system management (including the maintenance of berms, de-silting of dams and conveyance channels and clean-up of leaks) must be maintained throughout the LoM;	• NEMA; and • NWA	• Mine Manager; and • Environmental Practitioner

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
		with the proposed mining activities.			• The hydrocarbon and chemical storage areas and facilities must be located on hard-standing area (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This will prevent mobilisation of leaked hazardous substances; • Training of mine personnel and contractors in proper hydrocarbon and chemical waste handling procedures is recommended; and • Vehicles must only be serviced within designated service bays.		
General	Groundwater	Groundwater flow	• Detect deviation of the groundwater flow; and • Minimise contamination of the shallow weathered aquifer.	• Groundwater monitoring plan; and • AMD Strategy	• Static groundwater levels should be monitored to ensure that any deviation of the groundwater flow from the idealised predictions is detected in time; • The monitoring results must be interpreted annually by a qualified hydrogeologist and network audited annually as well to ensure compliance with regulations; • A detailed mine closure plan should be prepared during the operational phase, including a risk assessment, water resource impact prediction etc. as stipulated in the DWA Best Practice Guidelines. The implementation of the mine closure plan and the application for the closure certificate can be conducted during the decommissioning phase; • A closure water management plan should be developed. This should assess the management of decant via channelled decant or the management of a critical water level to minimise contamination of the shallow weathered aquifer. The co disposal facility should also be assessed in terms of a remediation action plan should the risk for contaminating on the stream be high. This should all be analysed in a financial model to further inform the most effective closure water management options. The groundwater model should be	• NEMA; and • NWA	• Qualified hydrogeologist; • Mine Manager; and • Environmental Practitioner

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
					used as a management tool to inform this process; • The numerical model should be updated once every three years or after significant changes in mine schedules or plans by using the measured water ingress and water levels to re-calibrate and refine the impact predictive scenario. Updates to the model should be carried out more frequently if significant changes are made to the mine schedule or plan; • It is recommended that the geochemical assessment is updated during the life of the mine in order to calibrate and validate its results and to construct an effective closure plan; • All monitoring boreholes which are to be mined out or are not operational should be grouted and sealed to prevent cross contamination of aquifers; • If it can be proven that the mining operation is indeed affecting the quantity of groundwater available to certain users, compensation of affected parties should be considered. This may be done through the installation of additional boreholes for water supply purposes, or providing an alternative water supply; and • Should it be proven that the mining activities impact on any boreholes or springs an alternative water supply will need to be provided.		
Site water management	Groundwater	Groundwater quality.	Minimise groundwater contamination.	Groundwater monitoring plan	• A proper storm water management should be implemented and maintained. Berms should also be implemented to ensure separation of clean water and dirty water areas; • During the operational phase the mine water should be used or pumped to dirty water dams or pollution control facilities in order to avoid deterioration of the mine water. The longer the mine water resides in	• NEMA; and • NWA.	• Qualified hydrogeologist; • Mine Manager; and • Environmental Practitioner.

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
					the pit the higher it's TDS will be. It is not foreseen that mine water in contact with the pit material will acidify during the operational phase of the proposed mining but will depend on operational water management; • Poor quality runoff from dirty areas should be contained and diverted to the pollution control dams for re-use; and • The footprint of dirty water areas like the pollution control dams, water return dam and coal stockpiles, workshops and oil and diesel storage areas should be minimised.		
Mining areas	Groundwater	Groundwater level drawdown; and Aquifer yield.	• Detect deviation of the groundwater flow; and • Minimise contamination of the shallow weathered aquifer.	Groundwater monitoring plan	• As much as possible coal must be removed from the opencast/underground mine during the operational phase; • Keeping the workings dry is necessary for mining and mitigation is not possible. Monitoring boreholes for long term groundwater level monitoring should be maintained over the life of mine to compare measured groundwater levels to calculated impacts; • Runoff into the opencast pits should be diverted away from the pits as much as possible; • Fracturing of the overlying strata due to blasting or surface subsidence should be avoided so as to prevent increased infiltration of surface water into the mine workings; • If a risk of impact on the surface water bodies is established, a remediation action plan should be developed to negate the potential impact. • Mining should progress as swiftly as possible to reduce the period of active dewatering • The mining area extent should be kept to a minimum	• NEMA; and • NWA	• Qualified hydrogeologist; • Mine Manager; and • Environmental Practitioner

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
					• Dewatering of the open pits and underground voids should stop as soon as the mining activities cease; and • Groundwater levels surrounding the pits and voids should be monitored on a regular basis throughout the LoM to verify the extent of the cone of drawdown.		
Co-disposal facility and other infrastructure	Groundwater	Groundwater quality.	Minimise groundwater contamination	Groundwater monitoring plan	• Clean water needs to be diverted away from the co-disposal facility as much as possible to reduce seepage to groundwater. Groundwater quality monitoring is proposed; and • Sewage effluent emanating from latrines or ablution blocks, if any, should be treated to acceptable levels before discharge into the environment.	• NEMA; and • NWA	• Qualified hydrogeologist; • Mine Manager; and • Environmental Practitioner.
DECOMMISSIONING AND CLOSURE PHASE							
• Demolition and removal of infrastructure • Rehabilitation – spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation; and • Post-closure monitoring and rehabilitation.	Surface Water and Wetlands	• Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology of the wetlands; • The proliferation of AIPs; • Exposure of soils and subsequent compaction, erosion and sedimentation into the wetlands; • Deterioration of water quality; and • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of wetlands. • Water and soil contamination; • Loss of habitat integrity and ecosystem services such as toxicant removal	• To prevent sedimentation of freshwater systems as well as AIP infestation over rehabilitated areas; and • To ensure successful rehabilitation and consequently restoration of pre-mining flow regimes	• No evidence of erosion; • Surface Water and Wetland monitoring programme; and • AIP control programme	• Closure should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands; • Stormwater must be diverted from decommissioning activities; • Stored mine-affected water should be treated before decommissioning of any mine-related water retention areas, such as PCDs and wastewater facilities; • The edge of the non-directly impacted freshwater resources and at least a 100m buffer or 1:100 flood line buffer, should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the decommissioning phase; • All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel; • Actively landscape and re-vegetate disturbed areas as soon as possible to	• NWA; • NEM:BA; and • NEMA.	• Mine Manager; and • Environmental Practitioner

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
		and water for human use; and • Decanting.			avoid loss of soil, organic material and sedimentation into wetland areas; • Implement and maintain a Wetland and AIPs Plan for the duration of the decommissioning phase and into closure; • No material should be dumped/stockpiled within any wetlands or watercourses; • No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads; • Wetland monitoring must be carried out during the decommissioning phase into mine closure to ensure no unnecessary impact to wetlands takes place; • Decanting must be controlled by groundwater monitoring and by following the mitigation measures stipulated in the geohydrological report; • Rehabilitation must be done as soon as any impacts are observed; • Monitor decant of AMD and implement management measures which include in-situ passive treatment or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses; • Seal the shaft by placing concrete plugs as well as implement a monitoring plan to ensure no decant; and • Newly shaped and topsoiled areas must be revegetated as soon as possible to prevent sedimentation and erosion.		
• Demolition and removal of infrastructure; and • Rehabilitation and closure.	Aquatics and Surface Water	• Erosion and sedimentation • Altered hydrology; and • Restoration of the pre-mining streamflow regime in the associated watercourses.	• To prevent the migration of contaminant to surrounding water resources.	Post-Closure water quality monitoring	• Restore the topography to pre-mining conditions as much as is practically possible; • Clearing of vegetation should be limited to the decommissioning footprint area and immediate revegetation of cleared areas;	• NWA; • NEM:BA; and • NEMA.	• Mine Manager; and • Environmental Practitioner.

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
					• Closure activities should be prioritized during dry months of the year where practical; • Disturbance of soils during infrastructure demolition should be restricted to relevant footprint areas; • Movement of demolition machinery and vehicles should be restricted to designated access roads to minimise the extent of soil disturbance; • Use of accredited contractors for removal or demolition of infrastructure during decommissioning is recommended; this will reduce the risk of waste generation and accidental spillages; • Ensure that the infrastructure (pipelines, fuel storage areas, pumps) are first emptied of all residual material before decommissioning; and • Capping, reprofiling and revegetation of TSF post-closure to limit the potential for future oxidation of stored tailings and enable clean runoff to be discharged to the surrounding environment.		
Closure and removal of infrastructure.	Hydropedology	Contamination of receiving waterbodies.	To prevent the migration of contaminant to surrounding water resources.	Post-Closure water quality monitoring	• Restore the topography to pre-mining conditions as much as is practically possible by backfilling, removing stockpiles and restore the slope gradient and angle of the site; • Immediate revegetation of cleared areas is recommended; • Decommissioning activities should be prioritized during dry months of the year (May to October) where practical; • All leaks and spillages should be cleaned as soon as possible and disposed of by accredited vendors; • Use of accredited contractors for removal or demolition of infrastructure is recommended; this will reduce the risk of waste generation and accidental spillages;	• NEMA; and • NWA.	• Mine Manager; and • Environmental Practitioner.

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
					• The constructed stormwater management infrastructure should remain intact until post closure to ensure dirty water is captured and contained during removal of infrastructures; • Ensure that the infrastructure (pipelines, fuel storage areas, pumps) are first emptied of all residual material before closure; • Surface inspection should be continuously undertaken to allow runoff to drain onto the natural streams until vegetation has fully established on the site; and • An appointed ECO must always be available to ensure implementation of the recommended mitigation/management measures during the planned closure of the Project.		
• General closure activities; • Mining Areas; and • Co-Disposal Facility and Other Infrastructures.	Groundwater	• Groundwater level recovery; • Groundwater contamination; and • Mine decant.	To prevent the migration of contaminant to surrounding water resources.	• Closure and rehabilitation plan; • Water monitoring plans; and • AMD Strategy.	• Implement as many closure measures during the operational phase, while conducting appropriate monitoring programmes to demonstrate actual performance of the various management actions during the life of mine; • The closure water management measures should be implemented which may include a decant management system and water treatment plant. • All old exploration boreholes must be sealed off after closure; • The drilling of boreholes into mining areas is recommended so that recovery of water can be monitored. • Multiple-level monitoring boreholes should be constructed to monitor base-flow quality within sensitive zones; • The results of the monitoring programme should be used to confirm/validate the predicted impacts on groundwater availability and quality after closure;	• NEMA; and • NWA.	• Mine Manager; and • Environmental Practitioner.

Activity	Aspect Affected	Impact Description	Objective	Performance Indicator	Mitigation Measures	Compliance with Standard	Responsible person(s)
					• Quarterly groundwater sampling should be done to establish a database of plume movement trends, to aid eventual mine closure; • The monitoring network should be audited annually; • The existing predictive tools should be updated to verify long-term impacts on groundwater, if required; • Surface water monitoring of the tributaries will be essential; • The feasibility and effectiveness of the following measures (Hodgson et al. 2007) at Dorstfontein could be investigated: • Select the mining method based on environmental considerations (deep bord-and-pillar mining generates the smallest water volumes, opencast mining the highest); • Mine from deep to shallow; • Flood the mine workings as soon as possible; and • Flush the mines after flooding		

9.4. Mine Closure and Rehabilitation

As part of the environmental regulatory process for the Project, a detailed Rehabilitation and Closure Plan (RCP) was developed for the Project. The RCP aims to provide comprehensive measures to minimise and mitigate the adverse impacts caused by construction and operational activities as well as to restore land back to its pre-mining/ agreed upon sustainable land use following the cessation of mining.

9.4.1. Rehabilitation Objectives

The objective of the Rehabilitation Plan is to ensure activities associated with the infrastructure located within the mining footprint area will be designed to prevent, minimise or mitigate adverse, long-term, environmental and social impacts and create a self-sustaining ecosystem. The following objectives have been identified thus far:

- Return land disturbed by mining activities as far as possible to land capabilities similar to that which existed prior to mining;
- Ensure that contamination of surrounding areas by mine affected water is limited as far as possible and that mine affected water is contained or treated post-closure;
- Remove mine infrastructure that cannot be used by a subsequent landowner or a third party. Where buildings can be used by a third party, arrangements will be made to ensure their long-term sustainable use;
- Clean up all stockpile footprint areas and loading areas and rehabilitate these areas to a land capability similar to that which existed prior to mining;
- Follow a process of closure that is progressive and integrated into the short and long term mine plans and that will assess the closure impacts proactively at regular intervals throughout project life;
- Rehabilitate the disturbed land to a state that facilitates compliance with applicable environmental quality objectives,
- Landscape the rehabilitated areas in alignment with the surrounding topography to prevent the unnecessary ponding of water and ensure all rehabilitated areas are free draining;
- Physically and chemically stabilise any remaining mining structures (i.e. discard dumps), where required, to minimise residual risk post-closure;
- Leave a safe and stable environment for both humans and animals;
- Prevent soil and surface/groundwater contamination by effectively managing water on site and ensure clean/ dirty water separation is implemented during the operational period to minimise post-closure contamination potential;
- Comply with local and national regulatory requirements; and

- Ensure the Social and Labour Plan speaks to the closure plan and land use plan and that social closure objectives (e.g. reskilling, retrenchment management, land use engagement etc.) are progressively met during the operational phase.

9.4.2. Rehabilitation Requirements

To achieve the rehabilitation objectives discussed above, rehabilitation and closure actions must be implemented throughout the LoM.

The Rehabilitation Plan has been compiled in support of the primary rehabilitation objectives discussed above which are to remove unwanted infrastructure and rehabilitate the land to a suitable mixed end land use which provides a safe and stable environment for surrounding receptors. The post-closure land use should be conducive to livestock grazing and areas not impacted by mining should continue to be utilised as per pre-mining development land use. This end land use can only be determined closer to the end of the LoM.

Table 9-3 provides a summary of the rehabilitation actions and plans which need to be followed.

Table 9-3: Site-specific Rehabilitation and Closure Measures

Aspect/ Area	Rehabilitation measures
Infrastructure	<u>Workshops, Offices, Discard Wash Plant and other Supporting Infrastructure</u> • Demolish and remove all concrete structures to 1 m below ground level; • Dismantle steel structures and store in designated salvage yard prior to removal/selling off; • Demolish brick structures and including concrete foundations; and • Demolish all paving walkways and parking areas. <u>Haul roads, tar and gravel roads</u> • Not applicable since the proposed Haul Roads are located over already disturbed mining land.
Mining Aspects	<u>Opencast pits and mining stockpiles</u> • Not applicable, existing disturbance and not costed for as part of the expansion project. <u>Discard dump</u> • Not applicable, existing disturbance and not costed for as part of the expansion project.
General Surface Rehabilitation	• Not applicable since all infrastructure and roads to be constructed as part of the expansion project are located on already disturbed mining areas.

Aspect/ Area	Rehabilitation measures
Monitoring and Maintenance	• Groundwater monitoring costs are included for ten years post-closure; • Surface water monitoring costs are included for ten years post-closure; and • Vegetation monitoring and maintenance on rehabilitated areas are excluded since there are no vegetation establishment costs allocated, under the assumption that the already disturbed land on which the proposed infrastructure will be located is costed for in the site wide closure cost liability for DECM. .

9.5. Financial Provision

The estimated financial provision for closure of DECM amounts to R 18,378,859 (excl. VAT and including P&Gs and Contingencies at 20% and 15%, respectively. The closure cost estimate breakdown is included Table 9-4.

Table 9-4: Closure Cost Summary for the Proposed Dorstfontein East Expansion Project

DIGBY WELLS ENVIRONMENTAL	**Digby Wells Environmental** **Exxaro Central Coal (Pty) Ltd, Dorstfontein East Coal Mine, EXX5725 Revision: 0**
Area and Description	**Life of Mine 2034**
Infrastructure demolition	
Area 1: Dorstfontein East	R12,759,441
Sub-total	**R12,759,441**
Rehabilitation	
Area 1: Dorstfontein East	R0
Sub-total	**R0**
Total Demolition & Rehabilitation	**R12,759,441**
Monitoring and Maintenance	
Monitoring Costs (Groundwater and Surface water)	R1,153,614
Sub-total	**R1,153,614**
Preliminary and General (20%)	R2,551,888

Contingency (10%)	R1,913,916
Sub-total	**R4,465,804**
GRAND TOTAL	**R18,378,859**

10. Monitoring

A monitoring programme is an essential management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented timeously. This section provides the details of the proposed monitoring programme that will be implemented at the DECM.

Generally monitoring and control for the Project will follow the process of:

- Design a monitoring programme and benchmarks that enables the detection of changes to water resources at and downstream of the operation;
- Implement monitoring programme (collect, capture and evaluate data);
- Report information and data; and
- Audit and amend monitoring programme with the progression/ changes to the mining operation to ensure its relevance to the entire operation and project activities.

10.1. Monitoring Objectives

The main objectives of the monitoring programme are to:

- Assist in gathering current environmental information;
- Determine spatial and temporary trends in water quality and water quantity with clearly defined monitoring and reporting frequencies;
- Assists in identifying potential and actual surface and groundwater impacts and to ensure actual impacts are addressed proactively and potential impacts are mitigated;
- The groundwater information from various aquifers is used to update the groundwater monitoring programme and to identify potential and actual impacts on the groundwater users;
- The biomonitoring is used to assess the impact of mining on the nearby surface water resources integrity;
- The monitoring data is used for current and post closure evaluation of impacts on surface water and groundwater resources associated with the mine; and
- Evaluate the effectiveness of surface and groundwater quality control programmes or standards.

The information provides early warning of potential and actual impacts of the mining operation to the water resources, thus allowing the DECM management to act swiftly to eliminate or minimise the impacts.

10.2. Monitoring Programme

This section details the water specialist recommended environmental monitoring requirements for the identified impacts associated with the DECM expansion project. Where relevant, an existing monitoring network is referred to. Table 10-1 summarises these functional requirements for water resource monitoring.

Table 10-1: Water and Waste Monitoring Programme

<table>
<tr><th>Activities</th><th>Aspect requiring monitoring</th><th>Monitoring Element</th><th>Functional requirements for monitoring</th><th>Roles and responsibilities</th><th>Monitoring and reporting frequency</th></tr>
<tr><td rowspan="6">All project phases and activities</td><td rowspan="5">Surface Water</td><td>Water Quality</td><td>• Water quality monitoring should continue to include historical monitoring points as well as the newly sampled points in adjacent rivers. Parameters should include but not limited to; pH, Electrical Conductivity, Aluminium, Sulphates, Phosphates, Iron, Manganese, Calcium, Magnesium, Nitrate, Ammonia, Fluoride, Chloride, Total dissolved solids, Suspended Solids; Sodium, Uranium, Potassium, heavy metals (e.g. As, Ni, Cu, Pb, Cr, Bo, Hg); and
• It is also recommended to monitor water quality within the mine water dams or water containment facilities to determine the concentration levels in case of an overflow or need for discharge.</td><td>Environmental Officer</td><td>• Monthly during operation and closure (hydrocarbons can be done on a quarterly basis at all surface water monitoring points); and
• Monitoring needs to carry on three years after the Project has ceased, as is standard or best practice to detect residual impacts.</td></tr>
<tr><td>Water Quantity</td><td>Flow monitoring should be carried out between flow linkages to obtain accurate flow volumes.</td><td>Environmental Officer</td><td>In operational areas where automatic flow meters are in place, daily records need to be kept</td></tr>
<tr><td rowspan="2">Physical structures and SWMP performance</td><td>Personnel should have a walk around facilities to determine the facilities conditions and pick out any anomalies such as leaks or overflows and system malfunctions.</td><td rowspan="2">Environmental Officer</td><td rowspan="2">Continuous process and formal report after every three years</td></tr>
<tr><td>Storm water channels and existing mine dams are inspected for silting and blockages of inflows, pipelines for hydraulic integrity; monitor the overall SWMP performance.</td></tr>
<tr><td>Meteorological data</td><td>Measure rainfall to provide more accurate rainfall records, if possible.</td><td>Environmental Officer</td><td>Real time system with tipping bucket rain gauge or alternatively using bulk rain gauge.</td></tr>
<tr><td>Wetlands</td><td>• Wetland Extent
• Wetland integrity
• Wetland functionality
• Soil disturbances
• Linear infrastructure
• Discharge points
• Erosion status
• Surface water quality and quantity
• Vegetation basal cover
• Vegetation species diversity
• Mine related infrastructure has been fully rehabilitated</td><td>• Inspect the area after a good rainfall event;
• Control and remove weeds where necessary;
• Define and establish the long-term land management system (grass needs regular defoliation if it is to be sustainable);
• Leave pasture to allow natural grasses to become established;
• Conduct annual monitoring (repeatable demarcated transect surveys)
• There must be no planting of alien plants (e.g. black wattle, eucalyptus and pampas grass) anywhere within the Project Area;
• Bi-annual (two-yearly) surveys, aimed at updating the AIPs list and establishing and updating the invasive status of each of the alien species, should be carried out (can be done by Exxaro staff);
• The transportation of soils or other substrates infested with AIPs should be strictly controlled;</td><td>• A wetland specialist must conduct the wetland monitoring and provide a short memo to the Mine Manager (MM) and the Environmental Practitioner (EP);
• The MM and the EP should ensure wetland monitoring on-site;
• EP to give training to sub-contractors and all workers on the operational procedures and mitigation measures; and
• The MM and the EP should be responsible to determine the effectiveness of erosion control structures.</td><td>• Annual (yearly) basis by a suitably qualified wetland specialist for the duration of the Construction Phase;
• Annually (one-yearly) for the duration of the Operational Phase;
• Annually (one-yearly) upon closure for at least three years to ensure no emerging impacts are identified, which may need to be addressed.</td></tr>
</table>

Activities	Aspect requiring monitoring	Monitoring Element	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency
			• Benefits to local communities as a result of the alien plant control program should be maximised by not only ensuring that local labour is employed but by also ensuring that cleared alien trees are treated as a valuable wood resource that can be utilised; • It is considered essential that appropriate veld management (particularly appropriate grazing levels and burning frequencies) should be applied to areas of secondary indigenous vegetation (e.g. secondary grassland of historically cultivated areas) and especially the grassland and wetland vegetation of untransformed habitats. Appropriate grazing levels and burning frequencies will not only ensure that good vegetation conditions and biodiversity levels are maintained but will also serve to control the spread and increase in cover of palatable AIPs such as Paspalum dilatatum. • Constant site surveys and monitoring should be incorporated to ensure no further erosion of the wetlands. If any changes to the landscape are observed immediate action need to be taken such as silt traps; • Continuous erosion monitoring of rehabilitated areas should be undertaken and zones with excessive erosion should be identified. Erosion can either be quantified or the occurrence there-of simply recorded for the specific location; • The functionality of the surface water drainage systems should be assessed on an annual basis. This should preferably be done after the first major rains of the season and then after any major storm. An assessment of the structures will ensure that the drainage on the recreated profile matches the rehabilitation plan as well as to detect early on when any drainage structures are not functioning efficiently. These must then be repaired or replaced before it causes significant erosion damage; and • The groundwater levels and quality should be measured and monitored in a similar way to the surface water to determine the impact of the mining activities on the groundwater resources. A hydrogeologist, together with the relevant authorities, should determine the locations of the monitoring boreholes. The monitoring frequency will be determined by the regulator.		
	Aquatics	Water Quality: • In situ water testing focusing on temperature, pH, conductivity and oxygen content.	• No noticeable change from the REC; • Salt concentrations must be at levels that do not threaten the ecosystem and are suitable for usersl • Dissolved organic carbon concentrations must not cause the ecosystem to become unsustainable; and	Qualified aquatic ecologist	Bi-annually

Activities	Aspect requiring monitoring	Monitoring Element	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency
			• The river water must not be toxic to aquatic organisms or be a threat to human health. Pathogens must be at levels safe for human use (excluding for direct consumption).		
		Habitat Quality: • Instream and riparian habitat integrity; and • Availability/suitability of macroinvertebrate habitat at each monitoring site.	• The Ecological Category determined for each assessed site must be maintained and improved for the watercourses); • The baseline IHAS scores should improve; and • Must be in a Largely Modified or better condition ≥ D (≥ 42)	Qualified aquatic ecologist	Bi-annually
		Macroinvertebrates: • Macroinvertebrate assemblages	• The baseline SASS5 scores should not noticeably deteriorate; • Baseline Ecological Categories should not be allowed to drop in category for each assessed site; and • Must be in a Largely Modified or better condition ≥ D (≥ 42)	Qualified aquatic ecologist	Bi-annually
		Fish: • Fish assemblages	• Baseline Ecological Categories should not be allowed to drop in category for each assessed site. The main goal for the Project must be to conserve the expected species; and • Must be in a Largely Modified or better condition ≥ D (≥ 42).	Qualified aquatic ecologist	Bi-annually
	Groundwater	Groundwater levels	Groundwater quality and levels must continue to be monitored as per the established approved monitoring programme on a quarterly basis. The results should be benchmarked against the limits set in the WUL.	Environmental Specialist	Quarterly
		Groundwater quality			

10.3. Monitoring Points

This section specifies the points where monitoring must take place for Surface Water and Wetlands

10.3.1. Surface Water

The existing and proposed monitoring points that should be added and their descriptions are presented in Table 10-2.

Table 10-2: Monitoring Points and Associated Descriptions

Monitoring Point	Description	Coordinates
Historical Points		
ED01	Erickson Dam 1	S26.1925 E29.3541
ED02	Erickson Dam 2	S26.1925 E29.3543
ED03	Erickson Dam 3	S26.1926 E29.3546
DCM06	Upstream of Western tributary	S26.2183 E29.3676
DCM07	Downstream of Western tributary	S26.1907 E29.3688
DCM08	Pond downstream of Pit 1	S26.1939 E29.3395
MP01	Downstream on western tributary of the Olifants River	S26.1714 E29.34
MP02	Downstream on western tributary of the Olifants River	S26.1728 E29.343
MP03	Bridge upstream of the old TNC	S26.1365 E29.345
MP04	Confluence of MP01 and MP02 tributaries with the Olifants River	S26.1555 E29.3436
MP05	Downstream of TNC	S26.1694 E29.3568
MP06	Upstream of mining activities on the Olifants River	S26.1681 E29.3746
Pan	Pan	S26.2054 E290.3504
PCD01	PCD 1	S26.1855 E29.3593

Monitoring Point	Description	Coordinates
PCD02	PCD 2	S26.1861 E29.36
PCD03	PCD 3	S26.1878 E29.3597
RWDF	RWD Discard Facility	S29.3430 E29.3430
Additional Proposed Points		
UPSW1	Upstream of eastern boundary tributary 1	S26.2533; E29.4054
UPSW2	Upstream of eastern boundary tributary 2	S26.2783; E29.3873
WPSW3	South of proposed opencast excavation	S26.2301; E29.3279
UWBSW4	Upstream western boundary	S26.2808; E29.3163
DWBSW5	Downstream western boundary	S26.2291; E29.2908

10.3.2. Wetlands

Recommended transects for monitoring of the wetland health and localities are indicated in Table 10-3.

Table 10-3: Wetland Monitoring Transects

Site	Co-Ordinates	Description
Transect 1	26°14'31.10"S;29°21'57.16"E 26°14'27.14"S;29°22'12.55"E	Transect crosses an unimpacted HS and UVB with high wetland integrity. Road crossing and dam present. Transect s upstream of the proposed mining activities.
Transect 2	26°13'51.43"S;29°21'50.57"E 26°13'47.80"S;29°22'5.93"E	Transect crosses an unimpacted HS with high wetland integrity. Road and cattle grazing present.
Transect 3	26°14'1.49"S;29°21'16.18"E 26°13'48.93"S;29°21'36.82"E	Transect crosses an HS Agriculture as well as a UCV with a dam used for agricultural activities.
Transect 4	26°13'29.52"S;29°22'5.51"E 26°13'26.69"S;29°22'14.92"E	Transect crosses an HS Agriculture that feeds into the main CVB. Sections of erosion present.
Transect 5	26°13'32.71"S;29°21'4.69"E	

Site	Co-Ordinates	Description
	26°13'27.05"S;29°21'12.74"E	Transect crosses an HS Agriculture that feeds into a dam. Large stands of AIPs and road crossings present.
Transect 6	26°12'47.91"S;29°21'41.89"E	Transect crosses an HS that feeds into the large CVB. The transect is downstream of the proposed activities. Areas of erosion and head-cut erosion present.
	26°12'46.19"S;29°22'0.15"E	
Transect 7	26°12'4.22"S;29°21'3.10"E	Transect crosses an HS fragmented by mining as well as a pan within the current mining activities. The HS and pan have been highly impacted.
	26°12'22.25"S;29°20'58.04"E	
Transect 8	26°11'36.01"S;29°20'13.71"E	Transect crosses an HS Agriculture that feeds into a CVB fragmented. The transect is upstream of the entire MR Area.
	26°11'32.63"S;29°20'21.03"E	

10.4. Data Management and Reporting

The WUL holder is responsible for ensuring that all data collected is adequately recorded and made available to DWS on request. Monitoring data should be stored in a database that includes both water quantity and quality.

10.4.1. Photographic Record

It is good practice to establish and keep a photographic record throughout the life of the DECM Project. The record must display the location, time and date that the photographs were taken.

10.4.2. Auditing and Reporting

Regular review and auditing is important to ensure systems are up-to-date and remain relevant for current operations. Evaluation is required to verify its appropriateness and suitability by comparing performance to objectives set. Changes or adjustments to systems are undertaken where review/auditing highlights shortcomings or gaps.

The action plan of the IWWMP is subject to an annual review based on the integrated water resource management principles of continual improvement throughout the entire life plan of the activities. Reporting to DWS, as stipulated in the WUL, must be undertaken.

Compliance to WUL conditions is monitored on an annual basis by means of an internal and external audit. Furthermore, annual site visit inspections are conducted by DWS to ensure compliance to the WUL.

11. Public Participation

The PPP for the IWULA is undertaken in terms of the regulatory requirements set out in GN 267 of 2017 promulgated under the NWA. The PPP enables stakeholders to partake and submit comments, suggestions or issues of concern.

It must be noted that a PPP was conducted for the EIA process during which the IWULA was overviewed as well as the following core stakeholder engagement activities:

- Stakeholders (including Government Departments, landowners, land occupiers, communities, Non-Governmental Organisations (NGOs) , agricultural organisations, Parastatals and businesses) have and will continue to be identified and captured in a stakeholder database;
- A Background Information Document (BID) and letter was distributed to the identified I&APs together with the placement of adverts and site notices around the Project Area;
- The environmental Scoping Report and associated documentation was made available for public comment for a period of 30 days, from 13 November 2020 to 14 December 2020;
- Due to the COVID-19 national lock down, the Draft Scoping Report was released electronically and could be accessed on the Digby Wells website and via our data-free service portal;
- A stakeholder database which represents government authorities, directly affected and adjacent landowners, as well as communities in and around the proposed Project Area compiled during the Scoping phase will continuously be updated until the final EIA Report to DMRE:
  - To Note: The Protection of Personal Information Act, 2013 (Act No. 4 of 2013) (POPI Act), took effect on 01 July 2021. The POPI Act regulates how personal information of individuals in South Africa is collected, stored, processed and shared; and
  - Digby Wells is required to comply with the POPI Act and requested all I&APs who were previously registered for this Proposed Project to provide consent to be included for the EIA phase.
- Suggestions and concerns received during the public comment period were recorded and responded to and included in the Public Participation Report of the final EIA.

A separate PPP for the IWULA will be undertaken during which the IWWMP will be covered as well as the results of the DWS audit outcomes.

This IWWMP is being made available for a 60-day public review and commenting period from 11 March 2022 – 17 May 2022. A Public Participation Report will be included once all comments and responses have been received.

Table 11-1 provides a summary of the PPP activities to be undertaken specifically for the IWULA process.

Table 11-1: Public Consultation Activities

Activity	Details
Identification of stakeholders	A stakeholder database which represents various sectors of society, including directly affected and adjacent landowners, in and around the proposed Project Area has been generated and is continuously updated throughout the Project.
Project Announcement	The project will be formally announced through the distribution of a notification letter and Background Information Document (BID) to identified stakeholders via email and SMS within the Project Area. Site notices will also be erected around the Project Area. All information distributed will contain general information about the proposed project, details pertaining to the IWULA regulatory process being undertaken and instructions to register as an I&AP to receive further information with the progression of the Project.
Announcement of Draft IWWMP Report	Announcement of the IWULA Process underway and the availability of the IWWMP for review will be sent via email and SMS to stakeholders on 11 March 2022. The IWWMP Report will be made available on www.digbywells.com (under Public Documents) for the legislated 60-day commenting period. Stakeholders will also be sent a data-free link where they can access the reports. http://view.datafree.co/PublicDocuments/ **(Comment period: –11 March 2022 – 17 May 2022)**
Obtaining comments from stakeholders	Comments, issues of concern and suggestions received from stakeholders will be captured and included in the updated Comments and Response Report (CRR) included in the Public Participation Report for the final appraisal of the IWULA.
Announcement of the Final IWWMP Report	The final IWWMP (inclusive of the CRR) will be made public to allow stakeholders to verify their comments and review the provided responses. Notification of availability of the final IWWMP Report and CRR will be sent to stakeholders and copies of the report will be made available on the Digby Wells Website (www.digbywells.com) under Public Documents.

12. Section 27 Motivation

Section 27 of the NWA specifies considerations for the DWS in respect to the issuing of the IWUL for the identified water uses. This section has been prepared in line with the requirements stipulated in the NWA.

12.1. Existing Lawful Water Use

ECC is the holder of a WUL for existing activities at DECM (Licence No.: 04/B11E/CIACGIJ/9789, dated 14 October 2020).

Under this WUL, the DECM operation is authorised for water uses in terms of Section 21 (a), (c), (g), (i) and (j) of the NWA for opencast and underground mining of coal reserves, processing plant and associated ancillary infrastructure and services.

This application is however a new application for the new proposed DECM Expansion Project and existing lawful water uses are not applicable here.

12.2. Need to Redress the Results of Past Racial and Gender Discrimination

ECC implements an SLP that was compiled for the entire Dorstfontein Complex Mines of which DECM is a part. The SLP is aligned with the Mining Charter's goal to achieve demographic representation, employment equity and empower women-in-mining. This SLP is approved together with the MR for DECM. Active efforts have been and continue to be made to drive the fulfilment of the SLP commitments and engage in project which ensure a sustainable socio-economic future for the communities in which the mine operates.

The SLP also highlights mechanisms to achieve demographic representation of Historically Disadvantaged South Africans (HDSAs) through skills transfer, preferential recruitment of HDSA candidates, accelerated training, promotions and transfers to the Exxaro group and a bursary scheme. The expansion of the operation to more underground reserves will ensure the continuation of initiatives and development programmes which redress past racial and gender discrimination as well as benefit the local host community at large in terms of local economic development (LED).

12.3. Efficient and Beneficial Use of Water

In terms of the NWA and in line with GN 704, no activity involving the use of water may commence without an approved water use authorisation. The demands of the mining operations on the affected surface and groundwater resources are considerably low in relation to the benefits that accrue from the Project in the public interest.

Responsible management of the water use and adhering to the principles of water conservation and demand management will benefit the community in terms of continued employment. Monitoring of water resources will continue to be implemented, as per the current DECM operation as well as recommended by specialist assessments, to detect any impacts in early stages and to mitigate these accordingly.

Therefore, the water uses in question are efficient and beneficial in the public interest to allow the mine to continue

12.4. Socio-Economic Impacts of Failure to Authorise the Water Use or Water Uses

The WUL is required for the proposed expansion to the DECM to be realised. This expansion will have both positive and negative socio-economic impacts. Coal mining remains a key contributor to the GDP in the Kriel and Witbank region. This WUL will allow DECM to further the life of its operation and hence further direct and indirect benefits to its existing employees and surrounding communities.

Negative socio-economic impacts which could be realised include nuisance impacts, potential health and safety risks associated with pollution and general operational activities as well as increased pressure on socio-economic infrastructure and services. These impacts have been assessed and mitigation / management measures prescribed accordingly to avoid or reduce the significance of these impacts as far as possible.

12.5. In Line with Catchment Management Strategy

The DWS is responsible for the National Water Resource Strategy for South Africa. According to the NWA, a Catchment Management Agency (CMA) should be established for each WMA. The CMA will then be responsible for the Catchment Management Strategy for each WMA.

No catchment management strategy is in place for this area. However the Internal Strategic Perspective (ISP) can be used in the meantime. The Olifants ISP states that the WMA is stressed and in deficit. The reconciliation strategy for the Olifants WMA recognizes the potential use of mine-affected water and development of groundwater resources. DECM will make use of water removed from underground, water from the WTP as well as dirty water from the STP for the functioning and processing required for the operation.

12.6. Likely Effect of the Water Uses to be Authorised on the Water Resource and on Other Water Users

The main source of water supply in and around the proposed mining area is groundwater. Through several privately own boreholes and springs which are mainly used for domestic and livestock purposes. In some instances, boreholes are used for single and/ or several households for various uses such as domestic (farm workers) and livestock use.

Potential impacts to surface water resources include surface water quality deterioration due to sedimentation and contamination as well as reduced catchment runoff and reduction of streamflow regime in the Olifants River tributaries.

Potential groundwater impacts include mine dewatering causing lowering of groundwater levels. Due to active mine dewatering required to ensure dry working conditions in the open pits and underground voids, certain groundwater volumes will be extracted from the existing open pits and underground mining areas, limiting the groundwater resource. In addition, due to AMD formation in the mining areas and co-disposal facility, or any seepage from infrastructures, the groundwater quality could be impacted upon.

12.7. Likely Effect of the Water Use on the Resource Class and Resource Quality Objectives

The Minister of Water and Sanitation is required to establish a classification system and to determine the class and resource quality objectives for all or part of the resources considered to be significant. It is noted that Resource Water Quality Objectives (RWQOs) have been established for the Olifants Catchment, however the limits stipulated by the Dorstfontein East WUL (number: 04/B11B/ACGIJ/957) for Water Resource Protection were used to benchmark water quality for DECM. In addition, the South African Water Quality Guidelines: Aquatic Ecosystems (DWAF, 1996) was also included for comparison purposes as the DWA's mandate also requires it to protect the health and integrity of aquatic ecosystems.

Operational machinery and haulage trucks at the mine site are potential sources of hydrocarbon and chemical spills and leakages. When not properly managed hydrocarbon and chemical spills and leakages will contaminate surface water resources in proximity to the DECM operations. The impact arising from hydrocarbon spillage and leakage will extend into the decommissioning phase of the Project, when infrastructure will be demolished and demolition material transported to final designated areas.

Water contamination may occur as a result of runoff from contaminated surfaces and from any dirty water discharges or effluent within the mine into nearby watercourses. The dirty water areas include RWDs, STP, mine plant and discard processing plant. Contamination of surface water resources will lead to the deterioration of water quality affecting aquatic ecosystems and downstream water users.

12.8. The Investments Already Made and to be Made by the Water User in Respect of the Water Use

Significant investments have been made by ECC in terms of the environmental investigations required in support of the EIA and IWWMP reports.

The monetary value of the investments is in orders of hundreds of millions of rand (ZAR). Through the ongoing operation and other secured capital investment, ECC has secured the required funds to extend the underground operations at DECM.

Provided that the proposed Project is approved, ECC will provide for closure as per the legal requirements. A liability assessment will also need to be undertaken annually to ensure the financial provision is in line with the closure cost.

12.9. Strategic Importance of the Water Use to be Authorised

The mining activity will have positive socio-economic benefits that will be experienced on local, regional, provincial and national scales. Of note, the Project will result in the production and supply of a needed resource for the continued generation of electricity. In addition, security of employment for current employees at DECM is a positive impact.

Water management measures have been prescribed and when correctly implemented, would avoid or reduce the significance of negative impacts to water resources while achieving the strategic importance of executing the Project.

In terms of the MPRDA, ECC must utilise their mineral rights optimally. Failure to do so will mean that they lose custody of these rights and they will be reverted back to the state by the Minister of Mineral Resources.

12.10. The Quality and Quantity of the Water in the Resource which may be Required for the Reserve

The water balance indicates a water volume for dust suppression amounting to 344 032 m^3/annum and this water is obtained from Erickson Dams and the Mine Plant. Most of this water is used during the dry season where high levels of dust emissions are expected since rainfall will be minimal or absent. The largest amount of water at DECM circulates within the Erickson Dams 1, 2 and 3 with an approximate value of 1 352 260 m^3/annum. The RWD/PCD and Mine Plant follow in water usage, having average volumes of 1 086 045 m^3/annum and 968 466 m3/annum, respectively. Potable water, which is used at the Mine Offices, Workshop and Change houses totals 62 057 m^3/annum. This water, originally from Erickson Dams 1, 2 & 3, is treated at the WTP before being pumped for use at the workshop, offices and change houses. The volume of effluent treated at the sewage treatment plant is in the order of 55 851 m^3/annum.

The Salt Balance shows that Erickson Dams and the Mine Plant have higher concentrations of dissolved salts amounting to 230.38 kg/ m^3/day and 171.87 kg/ m^3/day, respectively. These facilities should closely be monitored in case of any spills or seepages into the environment for immediate detection, mitigation and/or management. The RWD/PCD is lined and total salts in circulation amount to 12.55 kg/ m^3/day. Water levels in the RWD/PCD should also be monitored to prevent the occurrence of overflows.

12.11. The Probable Duration of the Water Uses

The total LoM of the expansion is approximately 14 years. Therefore the water use applied for is for a period of at least 14 years from approval of the WULA.

13. Conclusion

This IWWMP has been compiled in support of the WULA and serves to provide the necessary information to DWS as well as I&APs regarding the water uses in terms of Section 21 of the NWA.

13.1. Statement on Water Uses Requiring Authorisation, Dispensing with Licencing Requirement and Possible Exemption from Regulations

A summary of the water uses subject to this application is presented in Table 13-1.

Table 13-1: Summary of New Water Uses

Section 21 Water Use	Water use description
21 (c) and (i) Impeding or diverting the flow of water in a watercourse and Altering the	Seam 2 and 4 underground mining sections within 500 m regulated area of wetlands.

Section 21 Water Use	Water use description
bed, banks, course or characteristics of a watercourse.	Surface infrastructure within 500 m of regulated wetland areas.
21.(g): disposing of waste in a manner which may detrimentally impact on a water resource (affects all wetlands within which the mine will operate).	STP Water from the STP which will reused in the mining operation.
	Using water for dust suppression.
	Erickson dam .
21 (j) Removing, discharging or disposing of water found underground if it necessary for the efficient continuation of an activity or for the safety of people.	Dewatering from the S4L and S2L underground mine sections.

In addition, consolidate into the new licence, existing water uses as set out in Table 13-2below.

Table 13-2: Summary of Existing Water Uses

Water Use	Description of Water Use
Section 21 (a): Taking water from a water resource.	Dewatering process associated with the continuation of mining activities in the Pit 1 extension will result in water that will be used in washing plant area.
	Make up water supply for mine service requirements and the coal washing plant requirements.
Section 21 (c): Impeding or diverting the flow; and Section 21 (i): Altering the bed, banks course or characteristics of a watercourse.	For mining within a regulated area (Wetland).
	Diversion and altering on Olifants River for conveyor structure and rail loop. Wetlands and Olifants River crossings for conveyor structure and rail loop.
	Extension of Dorstfontein East Pit 1 within 500 m of wetland.
Section 21 (g): Disposing of waste which may impact on a water resource.	RWD (disposal of water from underground workings and mining process).
	Disposal of coal slurry and discarded material from the coal mining process.

Water Use	Description of Water Use
	PCD.
	Erickson dam 1 (Transfer of waste water).
	Erickson dam 2 (Transfer of waste water).
	Erickson dam 3 (Transfer of waste water).
	Tank number 4 (disposal of wastewater).
	Dust suppression
	DECM Stockpile (product stockpile)
	DECM East Rail Loop Stockpile (product stockpile)
Section 21 (j): Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Dewatering of pit 1 opencast
	Dewatering of pit 2 opencast
	Dewatering of pit 3 opencast
	Dewatering of Block A and B underground workings
	Dewatering of Block C underground commence after 6 years
	Dewatering process associated with the continuation of mining activities in the Pit 1 extension will result in water that will be used in washing plant area (taking water to re-use at the washing plant)

13.2. Key Commitments

ECC is committed to effective water management at the DECM. The following will be implemented in an effort to manage all potential impacts associated with the proposed Project:

- Monitoring of the following:
  - Surface Water;
  - Groundwater;
  - Biomonitoring;
  - Soil erosion; and
  - Waste.
- Clean and dirty water separation will be strictly implemented;
- The IWWMP Action Plan as set out in Section 9 of this report will be implemented; and
- The groundwater numerical model will be updated regularly as new data becomes available to predict impact such as decant more accurately.

13.3. Concluding Statement

The negative and positive impacts have been discussed in Section 8 of this IWWMP report. Based on the impact assessment, the key negative impacts include the loss of topsoil resources, soil erosion, loss of habitat, removal of protected species and subsequent sedimentation of freshwater systems from cleared areas as a result of construction site clearance as well as operational activities.

No wetlands will be directly impacted by the surface infrastructure, however, the surface infrastructure falls within the 100 m and 500 m Zone of Regulation of the Pan and Hillslope Seep (fragmented) (HGM 1 and 7).

Underground mining contains the risk of subsidence, dewatering, decanting and contamination which might impact the water environment significantly. Mitigation and management measures have been proposed for each identified impact associated with the proposed activities.

The most crucial impacts associated with the proposed DECM Project include but are not limited to:

- Potential for water resource contamination;
- Changes to wetland health and biodiversity; and
- Dewatering and drying out of wetlands.

The key positive impacts associated to the proposed DECM Project include but are not limited to:

- Social development as part of the SLP;
- Multiplier effects on the local and regional economy;
- Skills training; and
- Social investment in local communities.

No provision has been made for the treatment of mine-affected water during the operational phase of the Project as it is not expected that water discharge into the natural environment is required. In the event that water release is required water treatment options must be investigated during the operational phase.

14. References

Animal Demographic Unit (ADU) Virtual Museum database (http://vmus.adu.org.za). Accessed 22.

ARC. (2006). Land Types of South Africa. Pretoria: Agricultural Research Council of South Africa.

Australian National Pollutant Inventory Emission Estimation Technique Manual: Mining, Department of Sustainable, Environment, Water, Population and Communities, 2012.

BirdLife International (2019) Important Bird Areas factsheet: Amersfoort - Bethal - Carolina District. Downloaded from http://www.birdlife.org on 28/08/2019/02/2019.

Chibowski, E. (2011). Flocculation and Dispersion Phenomena in Soils. Image Analysis in Agrophysics, 301-304.

Climate-data.org. (n.d.). Climate-data.org. Retrieved from Climate-data.org: https://en.climate-data.org/

Department of Water Affairs and Forestry. (1996). South African Water Quality Guidelines. (Vol. 7) [Aquatic Ecosystems]. Department of Water Affairs and Forestry.

Department of Water Affairs and Forestry. (2009). Integrated Water Resource Management Plan for the Upper and Middle Olifants Catchment (Report Number: P WMA 04/000/00/7007). Directorate: National Water Resource Planning.

DEA. 2016. GHG National Inventory Report South Africa 2000 – 2012. Department of Environmental Affairs. Pretoria. Available: https://cer.org.za/wp-content/uploads/2014/02/Draft-GHG-Inventory-Report-SA.pdf [Accessed 11 December 2018]

DEA. 2017. Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry: A Companion to the South African National GHG Emissions Reporting Regulations, Version No. TG-2016.1, April 2017. Department of Environmental Affairs, Republic of South Africa. Pretoria. Available: https://www.environment.gov.za/sites/default/files/legislations/technicalguidelinesformrvofemissionsbyindustry_0.pdf. [Accessed 10 December 2018]

Digby Wells, 2021. Updated Project Description: Environmental Authorisation process for the proposed extensions to Exxaro Central Coal (Pty) Ltd.'s Dorstfontein East Coal Mine Near Kriel, Mpumalanga.

Digby Wells, 2013. Heritage Impact Assessment for the Consbrey Colliery Project, 2629BB and 2629BD, Mpumalanga Province, Digby Wells Environmental: Unpublished report prepared for Mosobo Coal (Pty) Ltd. SAHRIS ID: 1722.

DWA. (1996). South African Water Quality Guidelines: Volumes 1 to 6. Pretoria: Department of Water Affairs .

DWA. (2006). Water and Salt Balances: Best Practice Guidelines for Water Resource Protection in the South African Mining Industry. Pretoria: Department of Water Affairs.

ECC. (2021). Dorstfontein East Underground Risk Assessment. Johannesburg: Exxaro Coal Central unpublished internal specialist report.

Environmental Systems Research Institute (ESRI), 2016: Data Classification Methods. Available online: http://pro.arcgis.com/en/pro-app/help/mapping/symbols-and-styles/data-classification-methods.htm (Accessed: 2016/03/30).

MTPA. (2014). Mpumalanga Biodiversity Sector Plan Handbook. Mbombela (Nelspruit): Mpumalanga Tourism & Parks Agency.

Mucina, Ladislav, Michael C Rutherford, Leslie W Powrie, Adriaan Van Niekerk, and Johannes H Van der Merwe. 2014. Vegetation field atlas of continental South Africa, Lesotho and Swaziland: South African National Biodiversity Institute Pretoria.

WHO (World Health Organisation) (2000), Air quality guidelines for Europe, (2nd ed), Copenhagen, World Health Organization Regional Office for Europe, WHO Regional Publications, European Series, No. 91.

WRC. (2015). Water resources of South Africa 2012 study. Pretoria: Water Research Commission.

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Appendix A: EAP CV

Appendix B: Existing IWWMP

Appendix C: IWUL

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Appendix D: Surface Water Impact Assessment

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Appendix E: Wetland Impact Assessment

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Appendix F: Aquatic Impact Assessment

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Appendix G: Hydropedological Impact Assessment

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Appendix H: Groundwater impact Assessment

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Appendix I: Rehabilitation and Closure Plan

Appendix J: Final EIA (2021)

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