mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

Draft Environmental Impact Assessment And Environmental Management Programme

for Listed Activities Associated with the Proposed Middeldrift Resources Within the Existing New Clydesdale Colliery Mining Right, Situated in the Magisterial District of Nkangala, Mpumalanga Province

DMRE Reference Number: MP30/5/1/2/2/492MR

Environmental Authorisation in Support of the Middeldrift Resources Project

SUBMITTED FOR ENVIRONMENTAL AUTHORISATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) (NEMA) AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 (ACT NO. 59 OF 2008) (NEM:WA) IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (ACT NO. 28 OF 2002) (MPRDA) (AS AMENDED).

Name of Applicant:	Universal Coal Development IV (Proprietary) Limited
Tel no:	+27 (0)10 900 2384
Fax no:	+27 (0)12 460 2417
Physical Address:	467 Fehrsen Street, Brooklyn, Pretoria, 0181
DMRE Reference Number:	MP30/5/1/2/2/492MR

This document has been prepared by Digby Wells Environmental.

Report Type:	Draft Environmental Impact Assessment and Environmental Management Programme Report
Project Name:	Mining of the Middeldrift Resources within the existing New Clydesdale Colliery Mining Right, Magisterial District of Nkangala, Mpumalanga
Project Code:	UCD6587

Name	**Responsibility**	**Signature**	**Date**
Njabulo Mzilikazi	Project Manager		July 2021
Moleboheng Mahloko	Report Compiler		July 2021
Mia Smith	Senior Reviewer		July 2021

IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment (EIA) and an Environmental Management Programme (EMPr) report in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014 (GN R982 of 04 December 2014, as amended), any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17(1)(c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner (EAP) must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

OBJECTIVE OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The objective of the Environmental Impact Assessment (EIA) process is to, through a consultative process:

- Determine the policy and legislative context within which the proposed activity is located and how the activity complies with and responds to the policy and legislative context;
- Identify the alternatives considered, including the activity, location, and technology alternatives;
- Describe the need and desirability of the proposed alternatives;
- Through the undertaking of an impact and risk assessment process inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on these aspects to determine:
  - The nature, significance, consequence, extent, duration, and probability of the impacts occurring to; and
  - The degree to which these impacts:
  - Can be reversed;
  - May cause irreplaceable loss of resources; and
  - Can be managed, avoided or mitigated.
- Through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to:
  - Identify and motivate a preferred site, activity and technology alternative;
  - Identify suitable measures to manage, avoid or mitigate identified impacts; and
  - Identify residual risks that need to be managed and monitored.

EXECUTIVE SUMMARY

Introduction

Universal Coal Development IV (Pty) Ltd (hereafter Universal Coal) operates the New Clydesdale Colliery (NCC), situated in the Nkangala Magisterial District of the Mpumalanga Province with Mining Right (MR) reference **MR Ref. No. MP30/5/1/2/2/492MR.**

Universal Coal is proposing to extend its existing opencast pit known as the Roodekop section to the Middeldrift Resources (Middeldrift) in the northern section of its Mining Right Area (MRA). The proposed expansion will include:

- Opencast coal mining through a pan (wetland);
- Diversion of the district road D1651;
- Construction of a new road (linked to the diversion) (approximately 4 km long); and
- Construction of a bridge over the Steenkoolspruit.

Digby Wells Environmental (Digby Wells) has been appointed by Universal Coal to undertake an Environmental Impact Assessment (EIA) process for the mining of the Middeldrift coal reserve. Other legislative processes include an application for an Integrated Water Use License (IWUL) supported by an Integrated Water and Waste Management Plan (IWWMP).

Project Applicant

The details of the Project Applicant are included in the table below.

Company name:	Universal Coal Development IV Proprietary Limited
Contact person:	Sthembiso Hinani
Physical address:	467 Fehrsen Street, Brooklyn, Pretoria, 0181
Telephone:	+27 (0)10 900 2384
Cell phone:	+27 (0)71 519 6849
Email:	s.hinani@universalcoal.com

Project Overview

The Roodekop section at NCC is currently being mined through opencast mining method and will expand to the 150 ha Middeldrift reserves upon depletion. The plan is to concurrently create the Middeldrift box cut with the final mining stages of the Roodekop section to avoid production interruptions. Universal Coal proposes to mine Middeldrift through a wetland (pan) using opencast truck-and-shovel methods.

The existing infrastructure at NCC for stockpiling and processing of coal will be used. Additional infrastructure proposed at Middeldrift will include:

- District road (D1651) diversion around the opencast pit to allow mining through the identified coal seams; and
- Bridge construction over the Steenkoolspruit for access to the mining area.

Purpose of this Report

The purpose of this report is to document the findings of the EIA Process, including:

- Describing the baseline environment of the project area;
- Summarising the specialist findings;
- Presenting the methodology employed to conduct the EIA Process;
- Documenting the findings of the EIA Process;
- Documenting findings of the Public Participation Process (PPP); and
- Making recommendations as appropriate.

The EIA Process was supported by the following specialist studies:

- Soils, Land Use and Land Capability Assessment;
- Surface Water Assessment;
- Groundwater Assessment;
- Geochemical and Waste Classification Assessment;
- Fauna and Flora Assessment;
- Aquatics Assessment;
- Wetlands Assessment;
- Air Quality Assessment;
- Heritage Assessment;
- Traffic and Transport Assessment; and
- Rehabilitation and Closure Assessment.

Environmental Assessment Practitioner Contact Details

The contact details for the independent Environmental Assessment Practitioner (EAP) are provided in the table below.

Company name:	Digby Wells Environmental
Contact person:	Ms Mia Smith
Physical address:	Digby Wells House, Turnberry Office Park, 48 Grosvenor Road, Bryanston, 2191, South Africa
Telephone:	+27 (0)11 789 9495
Cell phone:	+27 (0)66 269 4345
Email:	sh@digbywells.com

Approach and Methodology for the Public Participation Process

The COVID-19 Regulations, 2020 [Directions Regarding Measures to Address, Prevent and Combat the Spread of Covid-19 Relating to National Environmental Management Permits and Licences (GN R650 of 5 June 2020)], as well as the EIA Regulations, 2014 (GN R982 of 4 December 2014, as amended) (the "EIA Regulations, 2014") promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), were considered for the Public Participation Process (PPP).

A PPP was initiated during the Scoping Phase. Public participation is important to the investigation of environmental and social impacts since it allows stakeholders affected by the project an opportunity to voice their opinions and concerns. The process also seeks to ensure that local knowledge, needs and values are well understood and considered in the EIA process. The comments from the stakeholders are included in the Comment and Response Report (CRR) (Attached in **Appendix B**).

The Draft EIA and Environmental Management Programme (EMPr) will undergo a 30-day public review period. The commenting period will be from **22 July 2021** till **25 August 2021**. The electronic copy of the Draft EIA/EMPR can be downloaded from the Digby Wells website www.digbywells.com (Public Documents), the data-free service portal, at the request of the local municipality, as well as the local library.

Focus group meetings are contemplated during this commenting period to present the Draft EIA/EMPr and obtain comments from the Interested and Affected Parties (I&APs). These meetings will be undertaken with strict adherence to the latest COVID-19 Regulations. The Draft EIA/EMPr will be updated with the comments received from the I&APs prior to submission of the Final EIA/EMPr to the Department of Mineral Resources and Energy (DMRE) for consideration. Once the DMRE has made a decision, it will be communicated to all the registered I&APs.

Project Alternatives

No formal alternatives to the project were contemplated. The Life of Mine (LoM) however depends on the approval of the road diversion. Two options in this regard are considered: *Option 1* is based on the possibility of the wayleaves and diversion not being approved; and *Option 2* assumes that the road diversion will be permitted.

Environmental Impact Assessment Summary

The findings of the EIA Process can be summarised as follows:

- **Wetlands:** High biodiversity sensitivity, major impacts are expected on the wetland environment.
- **Aquatics:** The road construction will have minor impacts while major impacts are anticipated for the bridge construction, this is prior and post mitigation.
- **Groundwater:** Impacts on groundwater resources during the construction and operational phases are minor before and after mitigation. Major impacts associated with Acid Mine Drainage (AMD) are anticipated during closure.
- **Surface water:** Impacts on the surface water environment are major throughout all phases of the project. These impacts are however acceptable with mitigation.
- **Soils, Land Use and Land Capability:** The project site has high soil sensitivity, major impacts are therefore identified prior and post mitigation. These are associated with the clearance of vegetation, the road construction and open pit mining.
- **Hydropedology:** Major impacts anticipated throughout all stages of the project. The impacts are assessed as minor with mitigation.
- **Fauna and Flora:** Impacts are largely major prior to mitigation and are anticipated to be minor or negligible with mitigation.
- **Heritage:** Heritage environment is highly sensitive, but some positive impacts are anticipated with mitigation.
- **Air Quality**: The impacts are minor and can be mitigated to acceptable levels.

Most of the above impacts are major prior to mitigation but are anticipated to be minor or negligent with the application of mitigation measures. All recommendations from the specialists need to be contemplated and requirements of the EMPr must be strictly adhered to.

Conclusions and Recommendations

The environmental impacts associated with the proposed NCC expansion into Middeldrift can be mitigated and avoided. The project is anticipated to positively impact the local and national socio-economic environment and should be approved, provided that the recommendations from the EAP and all regulatory requirements are adhered to. The project however has residual impacts on wetlands, groundwater and surface water as well as fauna and flora. A wetland mitigation strategy should therefore be developed and implemented. Stringent monitoring measures should be implemented during decanting to avoid impacts on groundwater resources. A species management plan should also be developed to conserve fauna and flora.

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LIST OF ACRONYMS, ABBREVIATIONS AND TERMS

ABA	Acid Base Accounting
AIP	Alien Invasive Plant
Al	Aluminium
AMD	Acid Mine Drainage
ASTM	American Standard Test Method
ASPT	Average Score Per Taxa
CEC	Cation Exchange Capacity
CBA	Critical Biodiversity Area
CFP	Chance Finds Protocol
CVB	Channelled Valley Bottom
Cl	Chloride
CRF	Comments and Registration Form
CRR	Comments and Response Report
COTO	Committee of Transport Officials
CMP	Conservation Management Plan
dBA	Decibels
DFFE	Department of Forestry, Fisheries and Environment
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation (previously DWA)
Digby Wells	Digby Wells Environmental
DEM	Digital Elevation Model
DO	Dissolved Oxygen
ESA	Ecological Support Area
EN	Endangered
EL	Electro-Magnetic
ELM	Emalahleni Local Municipality
EMPr	Environmental Management Programme
EAP	Environmental Assessment Practitioner
ECA	Environment Conservation Act
EIA	Environmental Impact Assessment

GIS	Geographic Information Systems
FRAI	Fish Response Assessment Index
FGMS	Focus Group Meetings
GDP	Gross Domestic Product
GCC	Ground Level Concentration
GN	General Notice
Ha	hectares
HIA	Heritage Impact Assessment
HGM	Hydro Geomorphic Unit
IBA	Important Biodiversity Area
IDP	Integrated Development Plan
IWULA	Integrated Water Use License Application
I&AP	Interested and Affected Party
IUCN	International Union for the Conservation of Nature
IHIS	Invertebrate Habitat Assessment System
IHI	Index for Habitat Integrity
LC	Least Concern
LCT	Leachable Concentration Threshold
LoM	Life of Mine
MAE	Mean Annual Evaporation
Mamsl	Metres Above Mean Sea Level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mbgl	Metres below ground level
Middeldrift	Middeldrift Resources Area
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MRA	Mining Right Area
MDPWRT	Mpumalanga Department of Works, Roads and Transport
NAF	Non-Acid Forming
NCC	New Clydesdale Colliery
NDM	Nkangala District Municipality
NAAGS	National Ambient Air Quality

NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEM:BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NFEPA	National Freshwater Ecosystem Priority Area
NHRA	National Heritage Resources Act, 1999 (Act No. 25 od 1999)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
NT	Near Threatened
NGOs	Non-Government Organisations
PEST	Parameter Estimation
PAF	Potential Acid Forming
PES	Present Ecological Status
PHR-G	Provincial Heritage Resources Authority of Gauteng
PPP	Public Participation Process
Project Area	The Middeldrift Resources Area, including the proposed construction of a bridge and diversion of the district road.
QDS	Quarter Degree Square
REC	Recommended Ecological Category
RoD	Record of Decision
RoM	Run of Mine
RQO	Resource Quality Objectives
REMP	River Ecosystem Monitoring Programme
RHP	River Health Program
RMSE	Root Mean Square Error
SQR	Sub-quaternary Reaches
Soil Form Indicator	Soil Form Indicator
SSV	Soil Screening Values
SWI	Soil Wetness Indicator
SADC	Southern Africa Development Community
SAHRA	South African Heritage Resources Agency
SAIAB	South African Institute of Aquatic Biodiversity
SANAS	South African National Accreditation System

SANParks	South African National Parks
SANS	South African National Standards
SASS	South African Scoring System
SAWQG	South African Water Quality Guidelines
Universal Coal	Universal Coal Development IV (Pty) Ltd
SIDRA	Signalized Intersection Design and Research Aid
SDF	Standard Design Flood
SWMP	Storm Water Management Plan
SG	Surveyor General
SCC	Species of Conservational Concern
SSC	Species of Special Concern
SEP	Stakeholder Engagement Plan
SDF	Standard Design Flood
SWMP	Storm Water Management Plan
SLP	Social and Labour Plan
TDS	Total Dissolved Solids
TC	Total Concentrations
Tc	Time of Concentration
UVB	Unchanneled Valley Bottom
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
VKS	Vaalkranz South
VU	Vulnerable
WMA	Water Management Area

Part A: Scope of Environmental Impact Assessment and Environmental Management Programme

1. Introduction and Background

Universal Coal Development IV (Pty) Ltd (hereafter Universal Coal) operates the New Clydesdale Colliery (NCC), situated in the Nkangala Magisterial District of the Mpumalanga Province with Mining Right (MR) reference **MR Ref. No. MP30/5/1/2/2/492MR** (see Appendix A)**.**

Universal Coal plans to expand the North Opencast Pit to the Middeldrift Resources (Middeldrift). This expansion involves the following:

- Opencast coal mining through a pan (wetland);
- Diversion of the district road D1651;
- Construction of a new road (linked to the diversion) (approximately 4km long); and
- Construction of a bridge over the Steenkoolspruit.

Digby Wells Environmental (hereafter Digby Wells) has been appointed by Universal Coal to undertake an Environmental Impact Assessment (EIA) Process for the mining of the Middeldrift Coal Reserves (Middeldrift) within the existing NCC Mining Right Area (MRA) (referred to as the "project"). This will include the undertaking of a Scoping and EIA Process and the compilation of an Environmental Management Programme (EMPr). Other applications will include an Integrated Water Use License (IWUL) supported by an Integrated Water and Waste Management Plan (IWWMP) in accordance with the following relevant legislation:

- 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); and
- Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).

1.1. Project Applicant

This section provides the details of the Project Applicant, as well as the appointed Environmental Assessment Practitioner (EAP).

1.2. Details of the Applicant

Table 1-1 provides the contact details of the applicant.

Table 1-1: Contact Details of the Applicant

Name of Applicant:	Universal Coal Development IV (Pty) Limited		
Registration number (if any):	2008/028397/07		
Trading name (if any):	N/A		
Responsible Person : ***(E.g. CEO, Director, etc.)***	Minah Moabi		
Contact person:	Sthembiso Hinani		
Physical address:	Universal Coal Head Office 467 Fehrsen Street Brooklyn Pretoria 0181		
Postal address:	PO Box 2423 Brooklyn Square Pretoria		
Postal code:	0075		
Telephone:	+27 71 519 6849 +27 10 900 2384	**Fax:**	012 460 2417
Email:	s.hinani@universalcoal.com		

1.3. Details of EAP

Digby Wells has been appointed by Universal Coal as the independent EAP to conduct the EIA Process and the Integrated Water Use License Application (IWULA). The details of the EAP representative are contained in Table 1-2 below.

Table 1-2: Contact details of the EAP

Company Name:	Digby Wells and Associates (South Africa) (Pty) Ltd
Name of Practitioner:	Mia Smith
Telephone:	+27 11 789 9495

Fax:	011 789 9498
Email:	sh@digbywells.com

1.4. Expertise of the EAP

The EAP's Curriculum Vitae (CV) and qualifications are attached as Appendix B of this report.

1.4.1. The qualifications of the EAP

Ms Mia Smith holds the following qualifications:

- Masters of Science Geography – University of Johannesburg (2008);
- Bachelor of Sciences Honours Geography – University of Johannesburg (2006)
- Bachelor of Sciences Geography and Environmental Management - University of Johannesburg (2005)

1.4.2. Summary of the EAP's Experience

Mia Smith is the Divisional Manager for Environmental Services and has an MSc in Geography, with associated studies in Environmental Management and Energy. She has experience within the environmental services field including but not limited to mining, energy, oil and gas, pulp and paper, and agriculture. Mia re-joined Digby Wells Environmental as Manager of the new Compliance Department in 2018. She previously worked for Sappi SA as the Risk Manager and has over 14 years' experience in project management, risk assessment, IFC compliance, auditing of ISO14001:2015 Environmental Management Systems, environmental legal compliance and ESG. Mia is a registered EAP with EAPASA (Reg. No. 2019/1282).

2. Description of the Property

The Project is located within the Emalahleni Local Municipality (ELM) and the Nkangala Magisterial District (NDM) and is approximately 9 km north of the town of Kriel in the Mpumalanga Province. The affected farm portions and Surveyor General (SG) Code(s) are indicated in Table 2-1, the farm portions directly affected by the proposed project are shown in Figure 3-1.

The existing NCC operations across Steenkoolspruit just to the south of the project area, known as the Roodekop section, will be used for the processing of the resources extracted from Middeldrift. This application is in relation to the opencast pit and the infrastructure required for the transportation of coal to NCC. This infrastructure includes the construction of a new road, the diversion of the D1651 district road as well as a bridge crossing to connect the Middeldrift and the Roodekop section. The approximate centre point coordinates of the opencast pit are 26° 8'37.13"S and 29°14'47.63"E.

Table 2-1: Project Locality Details

Farm Name:	**Farm Portion**	**21-digit Surveyor General Code**
	Portion 1 of Middeldrift 42 IS	T0IS00000000004200001
	Portion 2 of Middeldrift 42 IS	T0IS00000000004200002
	Portion 3 of Middeldrift 42 IS	T0IS00000000004200003
	Portion 4 of Middeldrift 42 IS	T0IS00000000004200004
	Portion 2 of Diepspruit 41 IS	T0IS00000000004100002
	Portion 9 of Diepspruit 41 IS	T0IS00000000004100009
	Portion 15 of Roodepoort 41 IS	T0IS00000000004000015
	Portion 21 of Roodepoort 41 IS	T0IS00000000004000021
	Portion 3 of Hartbeestfontein 39 IS	T0IS00000000003900003
	Portion 7 of Hartbeestfontein 39 IS	T0IS00000000003900007
	Portion 9 of Kromfontein 30 IS	T0IS00000000003000009
Application Area (Ha):	~150 ha	
Magisterial District:	Nkangala District Municipality	
Distance and direction from nearest town:	Approximately 9 km north of Kriel in the Mpumalanga Province	
21-digit Surveyor General Code for each farm portion:	As above.	

3. Project Locality, Regional and Local Setting

The project setting is depicted in Figure 3-1, Figure 3-2 and Figure 3-3 below. The farm portions associated with the Project Area are indicated in Figure 3-1, while Figure 3-2 shows the Regional Setting and the Local Setting is depicted in Figure 3-3.

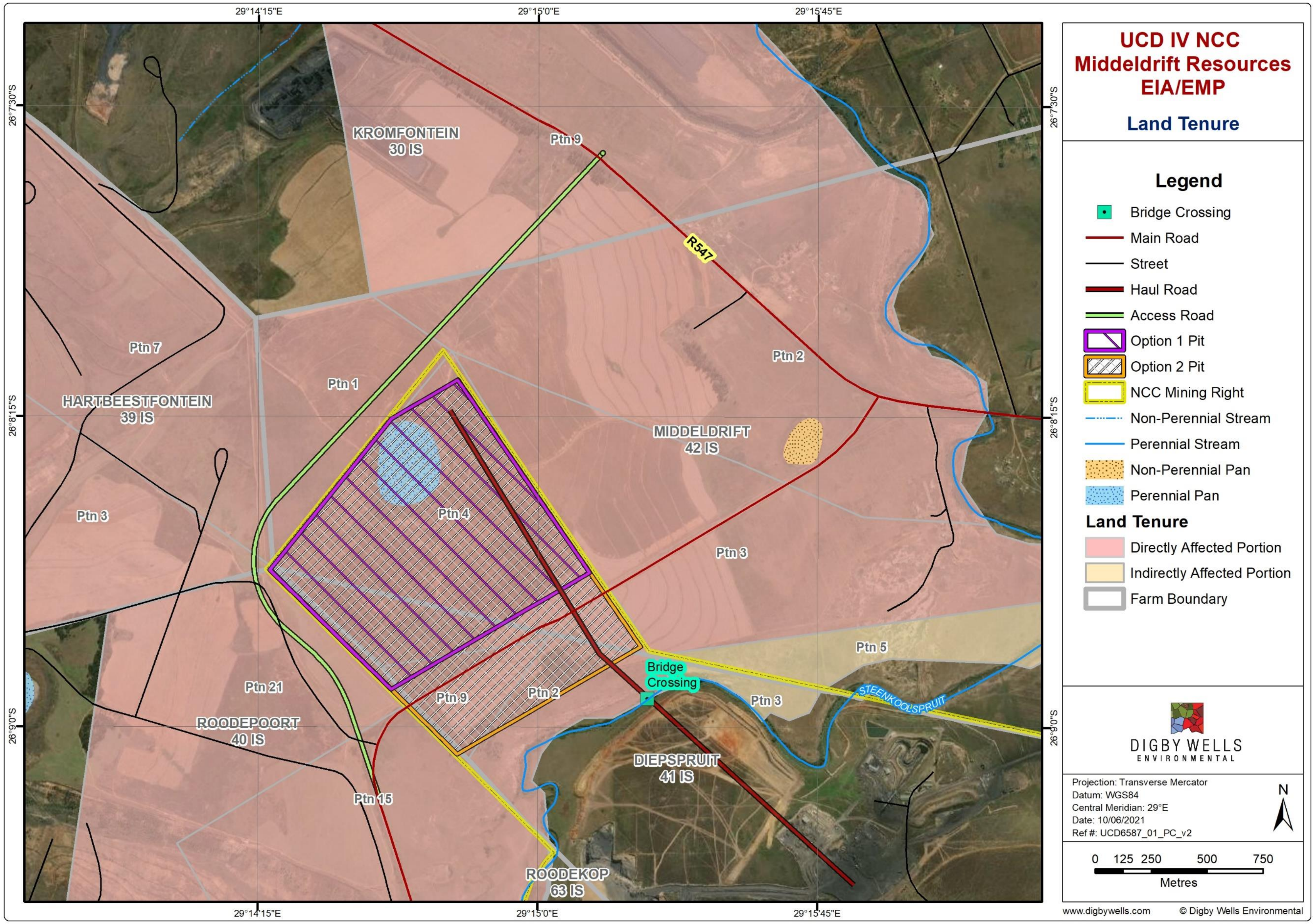

Figure 3-1: Land Tenure

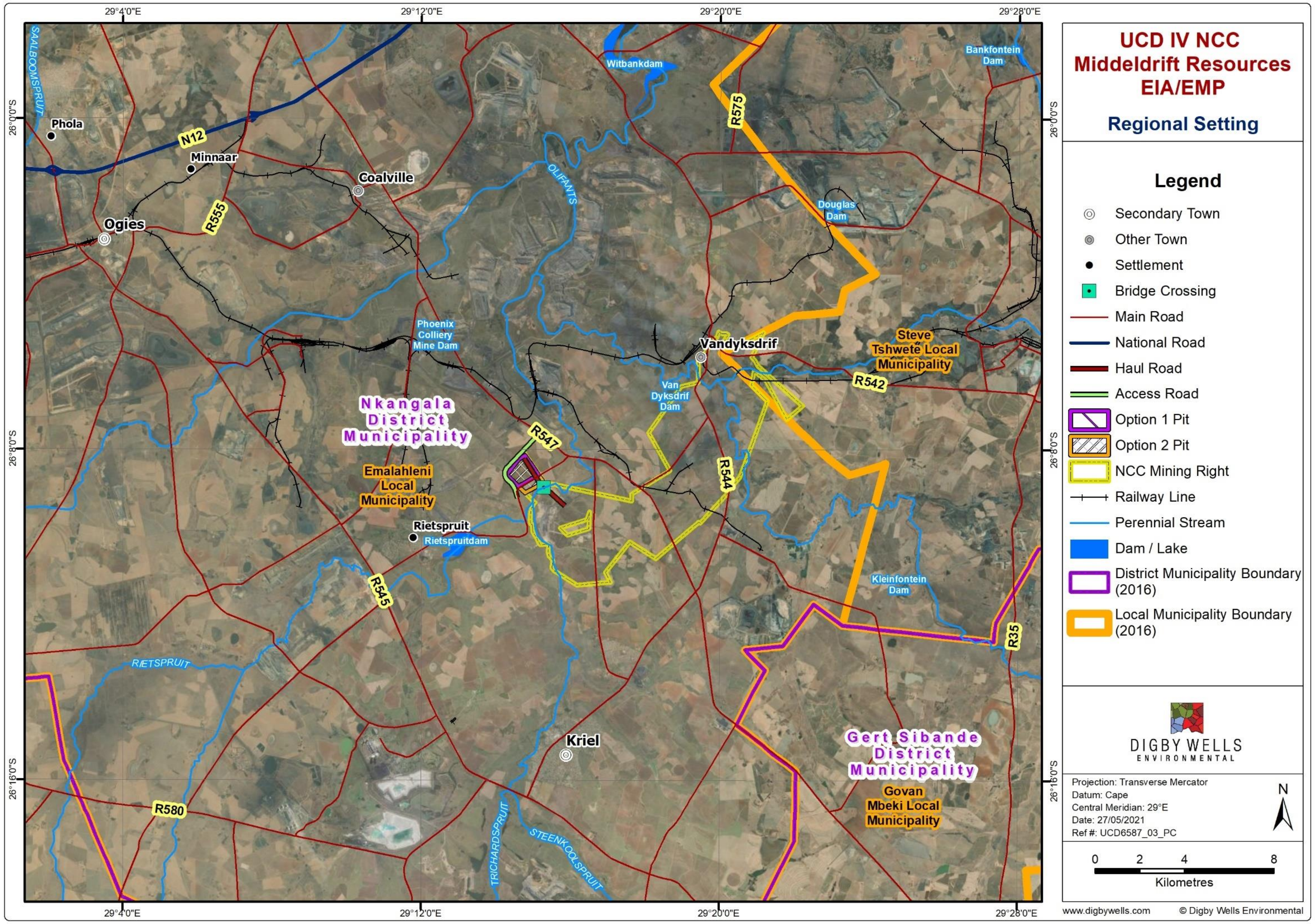

Figure 3-2: Regional Setting

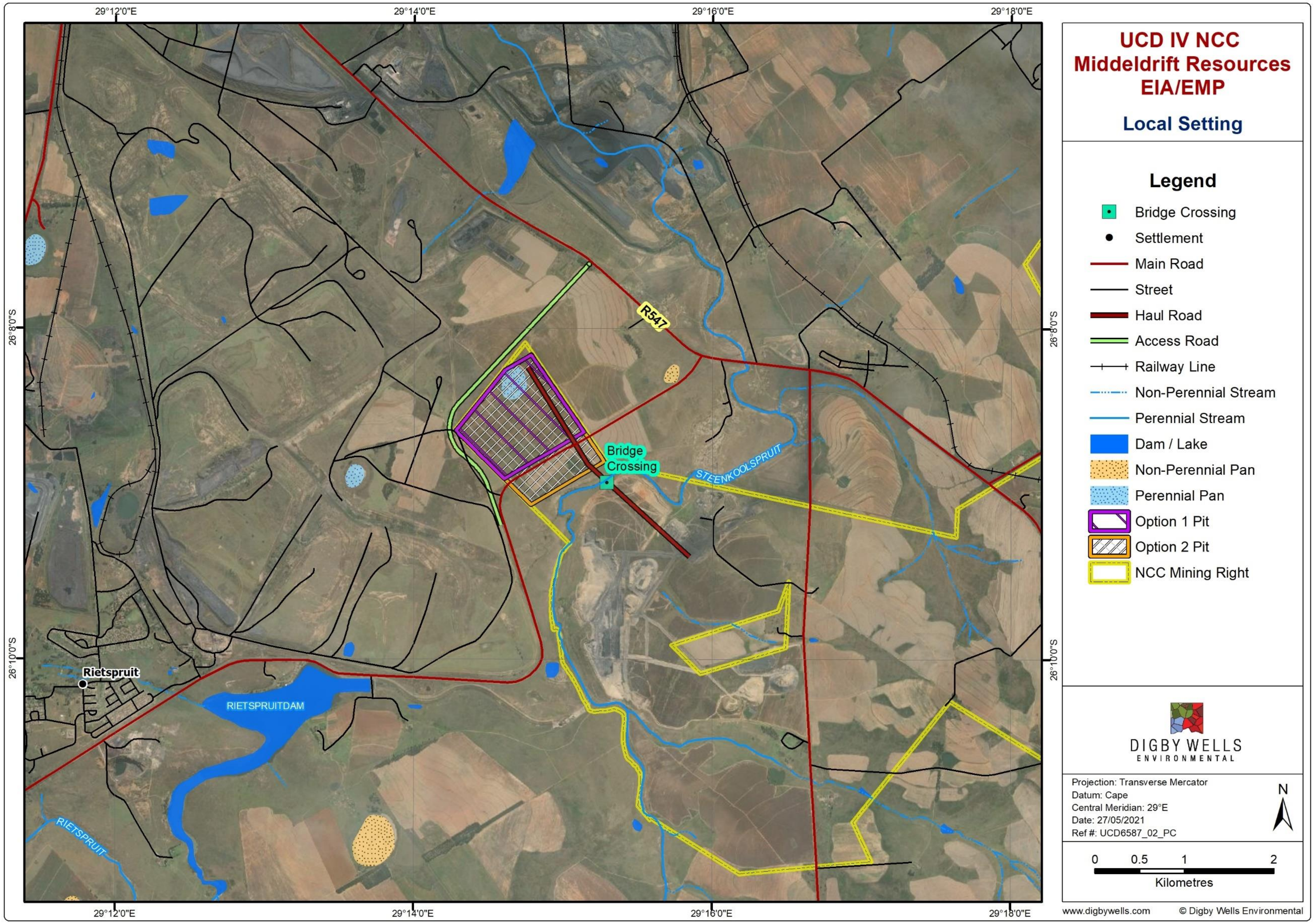

Figure 3-3: Local Setting

4. Description of the Scope of the Proposed Overall Activity

The proposed infrastructure layout plans, inclusive of Figure 4-1 below are attached in Appendix C.

For the purposes of this project, the following terms are used throughout the report:

- **MRA** defines the farms included in the MR boundary of the NCC with MR Reference MP30/5/1/2/2/492MR;
- **Project area** defines the footprint directly affected by the proposed opencast pit and additional infrastructure at Middeldrift; and
- **Study area** is determined by each specialist and the zone of influence for each environmental aspect.

4.1. Listed and Specified activities

The activities associated with the proposed project and those listed in terms of the EIA Regulations, 2014 (as amended) are recorded below. Table 4-1 lists the project activities per phase (i.e., Construction, Operational and Decommissioning Phases).

Table 4-1: Proposed Project Activities

Project Phase	Project Activity
Construction Phase	Site/vegetation clearance
	Contractors laydown yard
	Access and haul road construction
	Topsoil stockpiling
Operational Phase	Open pit establishment
	Removal of rock (blasting)
	Stockpiling (i.e. soils) establishment and operation
	Operation of the open pit workings
Decommissioning Phase	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation
	Post-closure monitoring and rehabilitation

As indicated in Table 4-2 below, activities listed in Listing Notice 1 (GN R983 of 04 December 2014, as amended) and Listing Notice 2 (GN R984 of 04 December 2014, as amended) of the EIA Regulations, 2014 (as amended) are triggered by the proposed project. The purpose of the EIA Process is to obtain an Environmental Authorisation (EA) from the Department of Mineral Resources and Energy (DMRE) prior to the commencement of these activities.

Table 4-2: Listed Activities Applicable to the Project

Name of Activity	Areal extent of the activity	Listed Activity	Applicable Listing Notice	Waste Management Authorisation
Opencast mining Any activity including the operation of that activity which requires a MR in terms of section 22 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice, in Listing Notice 1 of 2014 or Listing Notice 3 of 2014, required to exercise the MR.	150 ha	17	Listing Notice 2 (GN R984 of 04 December 2014, as amended by GN R715 of 11 June 2021)	N/A
Mining through a Watercourse (Pan)[1] The infilling or depositing of any material of more than 10 cubic metres into*, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse*; but excluding where such infilling, depositing, dredging, excavation, removal or moving- (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies; (d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or (e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.	10 ha	19	Listing Notice 1 (GN R983 of 04 December 2014, as amended)	N/A
Clearance of vegetation The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for-(i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	Will exceed 20 ha.	16	Listing Notice 2 (GN R984 of 04 December 2014, as amended)	N/A
Construction of a bridge over the Steenkoolspruit to access Middeldrift[2] The development of infrastructure or structures with a physical footprint of 100 square metres or more where such development occurs within a watercourse.	Will exceed 100 m^2.	12 (ii)(a)	Listing Notice 1 (GN R983 of 04 December 2014, as amended)	N/A
Diversion of the provincial road which runs through the Middeldrift area The development of a road with a reserve wider than 30 metres.	Approximately 4 km long	27	Listing Notice 2 (GN R984 of 04 December 2014, as amended)	N/A

[1] This activity will also require a WUL in terms of Section 21(c) and (i) of the NWA.

[2] This activity will also require a WUL in terms of Section 21(c) and (i) of the NWA.

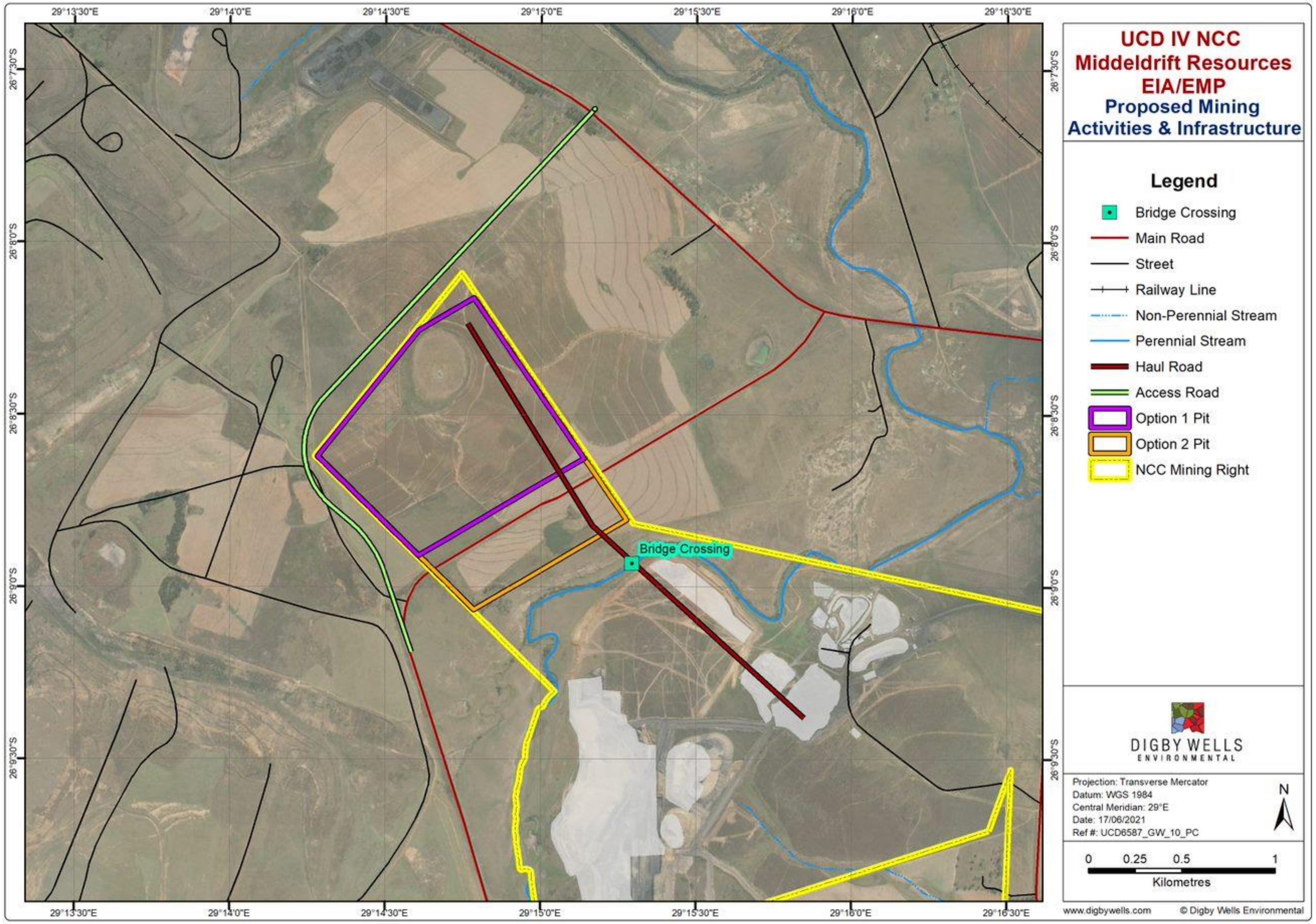

Figure 4-1: Proposed Mining Activities and Infrastructure

4.2. Description of the activities to be undertaken

The current mining activities at the NCC within the MRA with MR Reference MP30/5/1/2/2/492MR consist of:

- Diepspruit Underground: Three board-and-pillar sections mining the No. 2 lower seam;
- Diepspruit West: Opencast truck and shovel mining operation; and
- Roodekop: Opencast truck and shovel mining operation.

Opencast mining from the Diepspruit West and Roodekop sections is on-going and will continue until the reserves are depleted; mining will then progress to Middeldrift. The box cut for Middeldrift will be created concurrently with the resource depletion at Roodekop to allow production to continue uninterrupted. The total Life of Mine (LoM) of Middeldrift is approximately ten years.

In the existing NCC MRA, the strip ratios are favourable for opencast mining. Middeldrift will be an opencast truck-and-shovel operation, focusing on the No. 4 upper and lower seams, No. 2 upper and lower seams and the No. 1 and No. 1A seams. A total of 12.23 million tonnes (Mt) of coal has been identified, with Eskom's Kriel Power Station as the target market to ensure that Eskom's minimum quality specifications are achieved. The coal from the Middeldrift area will be transported to the NCC by truck via haul road. The Run of Mine (RoM) coal will be washed at the NCC coal handling and processing plant. No new handling and processing infrastructure will be constructed at Middeldrift.

Middeldrift is separated from the existing NCC opencast areas by the Steenkoolspruit River. To protect this watercourse, the intension is to mine Middeldrift as a separate opencast operation once the existing NCC mining area(s) (ie., Roodekop section) has been mined out. The district road to the north of the existing Roodekop opencast pit will therefore need to be diverted for mining to continue. A bridge crossing Steenkoolspruit River will be constructed to access Middeldrift. A preliminary infrastructure layout has been included as Figure 4-1 above.

5. Policy and legislative context

The proposed project is required to comply with legislative requirements of the NEMA and the MPRDA. Other legislative pieces guiding the project are outlined in Table 5-1 below.

Table 5-1: Policy and Legislative Context

Applicable legislation and guidelines used to compile the report	Application
The Constitution of the Republic of South Africa, 1996 Under Section 24 of the Constitution of the Republic of South Africa, 1996 (the Constitution) it is clearly stated that: *Everyone has the right to* *(a) an environment that is not harmful to their health or well-being; and* *(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that -* *(i) Prevent pollution and ecological degradation;* *(ii) Promote conservation; and* *(iii) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*	Digby Wells has undertaken an EIA Process to identify and determine the potential impacts associated with the project. Mitigation measures recommended aim to ensure that the potential impacts are managed to acceptable levels to support the rights as enshrined in the Constitution.
National Waste Management Act, 2008 (Act No. 59 of 2008)(NEM:WA) The legislation governing waste management in South Africa was reformed with the promulgation of the NEM: WA. In terms of this Act, all listed waste management activities must be licensed and in terms of section 44 of the Act, the licensing procedure must be integrated with the environmental impact assessment process. One of the major amendments effected by the National Environmental Management Amendment Act 2014 is the insertion of section 24S, as a result of which the NEM: WA is now also applicable to residue deposits and residue stockpiles. This section entitled ''Management of residue stockpiles and residue deposits stipulates that residue stockpiles and residue deposits must be deposited and managed in accordance with the provisions of the NEM: WA on any site demarcated for that purpose in the environmental management plan or environmental management programme in question.	All residue stockpiles and deposits will be managed in accordance to the requirements of GN R. 632. Contaminated soils will be managed in adherence to NEM: WA requirements All required mitigation measures are stipulated in the EMPr in Section B of this report.
NEMA and EIA Regulations, 2014 (as amended) NEMA was set in place in accordance with Section 24 of the Constitution. 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 authorizing, permitting, or otherwise allowing the implementation of an activity.* The EIA Regulations, 2014 were published under GN R982 on 4 December 2014 and came into operation on 08 December 2014. The Minister also published three listing notices in terms of Sections 24(2) and 24D of the NEMA, as amended. The EIA Regulations, 2014 (as amended) have been made applicable to prospecting and mining activities.	Activities associated with the proposed project are listed in Listing Notice 1 (GN R983 of 04 December 2014, as amended) and Listing Notice 2 (GN R984 of 04 December 2014, as amended) and require an EA prior to Commencement. This EIA Report is informed by the requirements of the NEMA and its Regulations.
MPRDA 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 requires that mining companies assess the socio-economic impacts of their activities from start to closure and beyond. Companies must develop and implement a comprehensive Social and Labour Plan (SLP) to promote socio-economic development in their host communities and to prevent or lessen negative social impacts.	The EIA Process is undertaken to meet the requirements of the MPRDA read with the EIA Regulations, 2014 (as amended). Financial Provisioning and Closure Costs will be included in the EIA.
NWA	An IWULA and an associated IWWMP are required in terms of Section 21 of the NWA for the project. The IWULA and IWWMP will be compiled and submitted to the Department of Water and Sanitation (DWS).

Applicable legislation and guidelines used to compile the report	Application
The NWA provides 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. Regulations on Use of Water for Mining and Related Activities aimed at the Protection of Water Resources (GN R704 of 4 June 1999) (GN R704) promulgated under the NWA aim to regulate the use of water for mining and related activities for the protection of water resources and states the following: 1. Regulation 4: 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 that may cause water pollution; 2. Regulation 5: No person(s) may use substances for the construction of a dam or impoundment if that substance will cause water pollution; 3. Regulation 6 is concerned with the capacity requirements of clean and dirty water systems, and 4. Regulation 7 details the requirements necessary for the protection of water resources. Furthermore, the Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals (GN R267 of 24 March 2017) promulgated under the NWA will be applied.	
DWS[3] Best Practice Guideline – G1: Storm Water Management Plan (SWMP) These are guidelines provided by the DWS for the development of a SWMP. The following will be undertaken to develop the conceptual SWMP: 1. Delineate the clean and dirty area contributing to runoff (based on the final layout plans) and site-specific hydrological assessments to determine volumes that require to be handled. The SWMP should ensure that temporary drainage installations should be designed, constructed, and maintained for recurrence periods of at least a 25-year, 24-hour event, while permanent drainage installations should be designed for a 50-year, 24-hour recurrence period; and 2. Site specific assessments to establish the appropriate mitigation measures and surface water monitoring programme.	All water management infrastructure will be designed for a 1:100-year, 24-hour rainfall event.
DWS Best Practice Guideline – G4: Impact Prediction The impacts of mine activities on the groundwater environment must be assessed as part of the application as well as for the IWUL Application. The baseline conditions must be assessed to define the current aquifer systems, groundwater use and groundwater conditions before mine commencement and to determine the extent of possible future impacts on the groundwater resources.	An IWULA and an associated IWWMP are required in terms of Section 21 of the NWA. The IWULA and IWWMP will be compiled and submitted to the DWS. The EIA Process assesses potential impacts on groundwater resources as a result of the Project.
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA) The NEM:BA regulates the management and conservation of the biodiversity of South Africa within the framework provided under NEMA. This Act also regulates the protection of species and ecosystems that require national protection and takes into account the management of alien and invasive species. The following regulations which have been promulgated in terms of the NEM:BA are also of relevance: 1. Alien and Invasive Species Lists, 2014 published (GN R599 of 1 August 2014); 2. Threatened and Protected Species Regulations, 2015 (GN R255 of 31 March 2015); and 3. National list of Ecosystems Threatened and in need of Protection under Section 52(1)(a) of the Biodiversity Act (GN R1002 of 9 December 2011).	A Fauna and Flora Impact Assessment has been conducted as part of the EIA Process. Species such *Gladiolus crassifolius, Gladiolus dalenii* and *Habenaria filicornis* have been identified in the project area and will require approval before removal. *Protected species such as Pyxicephalus adspersus (African Bullfrog)* have also been found in the area and will need relocation as part of the wetland offset strategy.
National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) The prevailing legislation in the Republic of South Africa with regards to the Air Quality field is the National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA). According to the Act, the DEA, the provincial environmental departments and local	An Air Quality Impact Assessment has been undertaken as part of the EIA Process. The project's activities will set out to abide by the NEM:AQA and standards set out in the NAAQS. The required mitigation has been included in the EMPr.

[3] Previously the Department of Water Affairs (DWA)

Applicable legislation and guidelines used to compile the report	Application
authorities (district and local municipalities) are separately and jointly responsible for the implementation and enforcement of various aspects of NEM:AQA. A fundamental aspect of the new approach to the air quality regulation, as reflected in the NEM:AQA is the establishment of National Ambient Air Quality Standards (NAAQS). These standards provide the goals for air quality management plans and also provide the benchmark by which the effectiveness of these management plans is measured. The NEM:AQA provides for the identification of priority pollutants and the setting of ambient standards with respect to these pollutants.	
Mpumalanga Nature Conservation Act, 2008 (Act No. 10 of 2008) (MNCA) This Act makes provision with respect to nature conservation the Mpumalanga province. It provides for, among other things, protection of wildlife, hunting, fisheries, protection of endangered fauna and flora as listed in the Convention on international Trade in Endangered Species of Wild Fauna and Flora, the control of harmful animals, freshwater pollution and enforcement.	The fauna and flora assessment identified four species under Schedule 11 Protected Plants (Section 69 (1) (a)) of the MNCA (1998). The species is listed as *Declining* by the IUCN and is protected under the Mpumalanga Nature Conservation Act, 1998 (MNCA) and permits will be required to authorise the removal of such species as indicated in Section 69 (1) (a) and 70 (1) of Chapter 6 of the MNCA (1998).
National Dust Control Regulations, 2013 The Minister of Water and Environmental Affairs, released on the 01 November 2013 the National Dust Control Regulations, 2013 (GN R827 of 2013) in terms of Section 53, read with Section 32 of the NEM:AQA. In the published National Dust Control Regulations, terms like target, action and alert thresholds were omitted. Another notable observation was the reduction of the permissible frequency of exceedance from three to two incidences within a year. The standard actually adopted a more stringent approach than previously and would require dedicated mitigation plans now that it is in force.	An Air Quality Impact Assessment has been undertaken as part of the EIA Process. The project's activities will set out to abide by the NEM:AQA and standards set out in the NAAQS. The required mitigation has been included in the EMPr.
National Noise Control Regulations, 1992 (GN R154 of 10 January 1992) promulgated in terms of Section 25 of the Environmental Conservation Act, 1989 (Act No. 73 of 1989) (ECA) The National Noise-Control Regulations (GN R154 of 10 January 1992) form part of the ECA and these Regulations apply to external noise. The National Noise-Control Regulations, 1992 differentiate between Disturbing Noise levels (which is objective and scientifically measurable which are generally compared to existing ambient noise level) and Noise Nuisance (which is a subjective measure and is defined as noise that "*disturbs or impairs or may disturb or impair the convenience or peace of any person*"). Local Authorities use Controlled Areas to identify areas with high noise levels. Restrictions have been set out for development that occurs in these Controlled Areas. These regulations make provision for guidelines pertaining to noise control and measurements. The regulations make reference to the use of the SANS 10103:2008 guidelines for the Measurement and Rating of Environmental Noise with Respect to Land Use, Health, and Annoyance and to Speech Communication. As such, a Noise Impact Assessment in accordance with the National Noise-Control Regulations, 1992 must be undertaken to determine the potential disturbing and nuisance noise levels associated with a particular development. This can occur during the construction and operational phases of the project.	A Noise Impact Assessment has not been conducted during the EIA Process. Universal Coal will need to comply with the National Noise Control Regulations, 1992.
The National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) The NHRA is the overarching legislation that protects and regulates the management of heritage resources in South Africa. The Act requires that Heritage Resources Agencies in this case the South African Heritage Resources Agency (SAHRA) and Provincial Heritage Resources Authority of Gauteng (PHRA-G), be notified as early as possible of any developments that may exceed certain minimum thresholds. This act is enforced through the National Heritage Regulations, 2000 (GN R548 of 2 June 2000).	A Heritage Impact Assessment (HIA) was undertaken as part of the EIA Process.
Financial Provisioning Regulations, 2015 (GN R 1147 of 20 November 2015) The Financial Provisioning Regulations, 2015 prescribe methods for determining the quantum of financial provision for rehabilitation and mechanisms for providing for it. Section 41 (1) of the MPRDA has been repealed and Section 24P of the NEMA, as amended, which provides that the holder of a MR must make financial provision for rehabilitation of negative environmental impacts. The financial provision must guarantee the availability of sufficient funds.	The Financial Provisioning Regulations, 2015 are applicable to rehabilitation and closure plans as they prescribe the minimum content of an annual rehabilitation plan and the minimum content of a final rehabilitation, decommissioning and mine closure plan. This has been provided in 28.

Applicable legislation and guidelines used to compile the report	Application
MPRDA Regulations, 2004 (GN R527 of 23 April 2004, as amended) The MPRDA Regulations, 2004 specifies that the EMPr must include environmental objectives and specific goals for mine closure. The applicant for a MR must make prescribed financial provision for the rehabilitation or management of negative environmental impacts, which must be reviewed annually. The Regulations provide specific principles for mine closure including safety and health, residual and latent environmental impacts, etc.	The EMPr is contained in Part B of this report.
Climate Change Bill, 2018 (GN R580 of 8 June 2018) *To build the Republic's effective climate change response and the long term, just transition to a climate resilient and lower carbon economy and society in the context of an environmentally sustainable development framework; and to provide for matters connected therewith.*	Although not promulgated, Universal Coal must adhere to national climate change legislation in terms of South Africa's goals and commitments in terms of the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement.

6. Need and Desirability of the Proposed Activities

Globally, coal plays a vital role in electricity generation. South Africa is primarily reliant on electricity generation from coal-fired power stations. About 77% of the country's primary energy needs are provided by coal (Eskom, 2018). In addition to supplying the local economy, approximately 28% of South Africa's production is exported. Renewable and alternative energy sources cannot yet meet the demands of the country's electricity needs. Coal mining is therefore crucial for the supply of coal to meet the energy needs of the country's economy and until alternative energy generation options can be implemented on a sufficiently large scale, South Africa remains mainly dependent on coal mining.

The proposed project will supply coal to Eskom, therefore alleviating shortages in supply. It should be noted that NCC has an existing commitment to supply Eskom with coal, Middeldrift would therefore contribute to the continuance of the contract.

Coal mining is already ongoing at the existing NCC MRA, but resources in existing mining sections are however becoming depleted. The extension of the mining to Middeldrift will ensure continued employment for existing staff and may include the benefits of additional income generation in the area. The proposed project will result in the development of the mine within the ELM and thus ensure that the mining activities create economic benefits to support the local and national economic and social needs. The employment of local labour will decrease the unemployment rate (by implementing an SLP) in the area, as well as allow for the upliftment of the local communities. The proposed project will therefore result in employment opportunities and skills development in the area.

6.1. Questions to be Engaged with when Considering Need and Desirability

The Guideline on the assessment of Need and Desirability (DEA, 2017) includes a number of questions, the answers to which should be considered during the EIA Process. Table 6-1 presents the need and desirability analysis undertaken for the project.

Table 6-1: Results of the Need and Desirability Analysis

Theme	No.	Question	Response
Securing ecological sustainable development and use of natural resources"	1	How will this development (and its separate elements/aspects) impact on the ecological integrity of the area?	The proposed project is within an ecologically sensitive area, especially with regards to the pan to be mined through. During the EIA Phase, the impacts to each environmental aspect have been assessed according to the Digby Wells impact assessment methodology detailed in Section 11.2
	1.1	How were the following ecological integrity considerations taken into account?	
	1.1.1	Threatened Ecosystems	The project is located within the Endangered Eastern Highveld Grassland. Several Near Threatened fauna and flora have been identified as potentially occurring. Refer to Section **Appendix K** for a list of these species.
	1.1.2	Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.	The Digby Wells Wetland Assessment Report (2021) has identified a Depression and Seep National Freshwater Ecosystem Priority Areas (NFEPA) Wetland within the Project Area. The transformed habitat unit was associated historical agricultural activities, altering the ecological structure of the associated Eastern Highveld Grassland. The overall ecological functionality was deemed to be low.
	1.1.3	Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs)	The project area consists of areas that are classified as Other Natural Areas and is in very close proximity to a CBA.
	1.1.4	Conservation targets	These were considered during the EIA Phase and were responded to accordingly (See Section 9, Section 17 and Section B of this report)
	1.1.5	Ecological drivers of the ecosystem	
	1.1.6	Environmental Management Framework	
	1.1.7	Spatial Development Framework	The NDM IDP which is informed by the SDF was considered in the EIA Phase.
	1.1.8	Global and international responsibilities relating to the environment (e.g. RAMSAR sites, Climate Change, etc.)	A wetlands assessment study was carried out for the EIA Phase. NFEPA wetlands were found and delineated. No RAMSAR sites are present in the vicinity of the project area.
	1.2	How will this development disturb or enhance ecosystems and/or result in the loss or protection of biological diversity? What measures were explored to firstly avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	With the identification of a Depression and Seep NFEPA wetland, the hierarchy of mitigation measures will be employed by the wetland specialist during the EIA Phase. This will inform the final mitigation measures which Universal Coal will need to consider. Digby Wells' impact assessment methodology will be utilised to identify, determine and assess the potential impacts during the EIA Phase.
	1.3	How will this development pollute and/or degrade the biophysical environment? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	
	1.4	What waste will be generated by this development? What measures were explored to firstly avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and/or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	The alternatives take into consideration options to minimise the amount of waste stockpile material on site and / or ways to reduce their impact on the receiving environment. The existing waste management infrastructure at NCC will be utilised to minimise the generation of waste at Middeldrift and therefore no waste material will be stored at Middeldrift.
	1.5	How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	The Heritage Assessment undertaken during the EIA Phase has revealed a sensitive heritage environment. Measures need to be employed to demarcate the existing heritage sites. The decommissioning Phase is believed to positively impact on the heritage environment with the application of conservation measures.

Theme	No.	Question	Response
	1.6	How will this development use and/or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	Coal is a non-renewable energy resource, however, South Africa is dependent on coal and until the energy supply and demand can feasibly be replaced with renewable energy, non-renewable energy sources will be required. The extent of any positive impacts associated with this Project have been investigated in the EIA Phase. The environmental impacts of the proposed project have been identified and mitigation measures aimed at avoiding, reducing and / or managing the negative impacts as well as enhancing the positive impacts have been recommended. See Section 17 and Section B of this report.
	1.7	How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?	The project area lies within the Olifants Water Management Area (WMA). The EIA Phase has confirmed the presence of wetlands and the potential for extensive water management on site for the proposed mine due to disturbance of the natural groundwater aquifers and surface water flows. The impacts of the project on wetlands, groundwater and surface water resources are residual and should be followed by comprehensive mitigation measures including wetland offsetting, monitoring and rehabilitation.
	1.7.1	Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)? (note sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reduce the amount of waste they generate, without compromising their quest to improve their quality of life)	Historically, Eskom has struggled to secure coal from South African mining operations due to international prices of coal yielding more profit for mines. South Africa will be a coal-dependent country for the foreseeable future.
	1.7.2	Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources this the proposed development alternative?)	
	1.7.3	Do the proposed location, type and scale of development promote a reduced dependency on resources?	The Project is for the mining of a coal resource. The resource was identified to be suitable for exploitation.
	1.8	How were a risk-averse and cautious approach applied in terms of ecological impacts?	Sufficient information was gathered prior to the onset of this process to indicate that the potential mining of coal is feasible.
	1.8.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Each specialist has investigated the impacts and present the gaps and / or limitations in knowledge in their respective reports. Gaps in knowledge are collated and expressly provided in the EIA Report, which is submitted to the Competent Authority for consideration. Universal Coal are yet to approve the undertaking of a Social Impact Assessment, which currently does not form part of Digby Wells' scope.
	1.8.2	What is the level of risk associated with the limits of current knowledge?	
	1.8.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	
	1.9	How will the ecological impacts, resulting from this development impact on people's environmental right in terms following:	These will be investigated and quantified by each specialist and presented in the EIA Phase.
	1.9.1	Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	
	1.9.2	Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	

Theme	No.	Question	Response
	1.10	Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	
	1.11	Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives/targets/considerations of the area?	
	1.12	Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	Alternatives in terms of mining method have been considered, the operation will use truck and shovel methods. No alternatives to the road diversion have been proposed. Stringent mitigation measures have however been contemplated Section B of this report.
	1.13	Describe the positive and negative cumulative ecological/biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	Negative cumulative impacts include impacts on wetlands and groundwater resources. The project area may potentially result in positive land use impacts during closure.
Promoting justifiable economic and social development"	2.1	What is the socio-economic context of the area, based on, amongst other considerations, the following considerations?	
	2.1.1	The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area,	The spatial and economic development projects will be implemented through the Municipal IDP. The proposed Project will promote and support the sustainability of existing business, as well as assist in increasing local beneficiation and shared economic growth for the confirmed 17-year LoM.
	2.1.2	Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.),	
	2.1.3	Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and	
	2.1.4	Municipal Economic Development Strategy ("LED Strategy").	
	2.2	Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	The proposed Project will result in limited job opportunities as well as the continuation of the existing employment at the NCC.
	2.2.1	Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	The Applicant is committed towards contributing to the socio-economic activities of the immediate community and the region. In addition, the company will ensure that the contractors have fully developed skills plans and all colliery employees receive training and development in accordance with these plans.
	2.3	How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	Universal Coal will implement the SLP Community Development projects and initiatives which are based on the requirements identified by surrounding communities through the SLP consultation process.
	2.4	Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	The aim of the SLP is to initiate projects which develop the surrounding communities which may be impacted by a proposed mining project. The mine itself will have a LoM of 17 years depending on the road diversion approval. The operations will therefore present long-term sustainable employment. However, the SLP initiatives must also provide long-term sustainable projects that the community can adopt and manage.
	2.5	In terms of location, describe how the placement of the proposed development will	
	2.5.1	result in the creation of residential and employment opportunities in close proximity to or integrated with each other,	The Project will result in the continuance of existing employment at the NCC and short-term employment opportunities during the construction phase.

Theme	No.	Question	Response
	2.5.2	reduce the need for transport of people and goods	Coal product will be trucked or transported via road to Eskom for electricity generation.
	2.5.3	result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms public transport),	
	2.5.4	compliment other uses in the area,	A Traffic Impact Assessment has been undertaken in the EIA Phase and has established the potential congestion on surrounding roads and provides mitigation measures to manage the impact of the district road diversion. The Applicant will be required to obtain wayleave approvals in regard to the road diversion.
	2.5.5	be in line with the planning for the area,	The proposed LoM is at least 17 years depending on the proposed road diversion approval.
	2.5.6	for urban related development, make use of underutilised land available with the urban edge,	Not applicable. The proposed Project area is outside an urban area.
	2.5.7	optimise the use of existing resources and infrastructure,	No infrastructure is available at Middeldrift which can be utilised as part of the mining operation. The existing infrastructure at NCC will be utilised as far as possible.
	2.5.8	opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	No bulk infrastructure will form part of this development.
	2.5.9	discourage "urban sprawl" and contribute to compaction/densification,	The project area and surrounds are agricultural and rural and cannot therefore influence urban sprawl.
	2.5.10	contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs,	The employment will prioritise Historically Disadvantaged South Africans as beneficiaries. Existing infrastructure at the NCC will be utilised as far as possible for the transportation, stockpiling and processing of coal. No municipal infrastructure will be used.
	2.5.11	encourage environmentally sustainable land development practices and processes,	The proposed land use for the Project will be developed with effort made towards being environmentally sustainable in the long term. One of the key aspects to ensuring long terms land sustainability will be to ensure successful rehabilitation and post mining land-use capability.
	2.5.12	take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	The location of the proposed Project is dependent on the location of the identified coal resource.
	2.5.13	the investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential),	The proposed project will allow the mine to continue contributing to the local, regional and national Gross Domestic Product (GDPs), and also to the local communities through continued employment of workers and local contractors, as well as other influences and community upliftment programmes that are undertaken by the mine.
	2.5.14	impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and	The Heritage Assessment has defined te project area to have a sensitive heritage environment.
	2.5.15	in terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	The proposed project will ensure continued employment in the area, as well as programmes implemented from the mine's SLP.
	2.6	How were a risk-averse and cautious approach applied in terms of socio-economic impacts?	The existing SLP was compiled in consideration of the socio-economic impacts for the entire MRA.
	2.6.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Gaps in knowledge, uncertainties and assumptions are listed in Section 23 below.

Theme	No.	Question	Response
	2.6.2	What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	
	2.6.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	
	2.7	How will the socio-economic impacts, resulting from this development impact on people's environmental right in terms following:	
	2.7.1	Negative impacts: e.g. health (e.g. HIV- Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	A Social Impact Assessment was not undertaken as part of the EIA Process. Middeldrift lies within the existing NCC MRA and as such shall comply with the existing and approved SLP.
	2.7.2	Positive impacts. What measures were taken to enhance positive impacts?	
	2.8	Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socio-economic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	
	2.9	What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	
	2.10	What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)?Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	
	2.11	What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	
	2.12	What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	
	2.13	What measures were taken to:	
	2.13.1	ensure the participation of all interested and affected parties,	During the pre-application and Scoping Phase, an Interested and Affected Parties (I&AP) database was developed to identify and verify the directly and indirectly affected landowners or land occupiers as well as the potentially affected surrounding communities. This database was updated throughout the EIA Process to ensure adequate consultation.
	2.13.2	provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	Digby Wells has maintained and updated the I&AP database to ensure communication with all registered I&APs. Site notices have been erected in various locations around the site and in the nearest communities to announce the Project, SMS notifications have been utilised to provide progress reports to I&APs as well as Digby Wells contact information for further consultation. Public meetings will be held in both the Scoping and EIA Phases to engage with any I&AP who

Theme	No.	Question	Response
			wishes to attend, and the Project will be presented at these meetings as well as the findings of the impact assessments.
	2.13.3	ensure participation by vulnerable and disadvantaged persons,	Site notices have been placed and Focus Group Meetings (FGMs) will be held with the affected community. The Background Information Document (BID) will be distributed and a translator will also attend all FGMs to fully engage with all affected stakeholders.
	2.13.4	promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means,	The consultation process seeks to inform affected communities of the positive and negative impacts associated with a proposed Project and provide opportunity for any stakeholder to raise concerns which will be responded to both on record in the reports and through direct written response (where possible).
	2.13.5	ensure openness and transparency, and access to information in terms of the process,	Digby Wells is bound by legislation and regulations to share information pertaining to the project, to be transparent and impartial.
	2.13.6	ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge, and	All stakeholder needs will be accommodated as far as is reasonable.
	2.13.7	ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein was be promoted?	The EAP cannot force participation from specific demographic groups. Cultural norms will be respected and adhered to; however, no demographic group can be excluded from public consultation and therefore, all registered stakeholders and meeting attendees will be considered intrinsic to the public consultation process and outcomes.
	2.14	Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	
	2.15	What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected	The Applicant must produce a Health and Safety Policy and best practice on site, compliant with the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).
	2.16	Describe how the development will impact on job creation in terms of, amongst other aspects:	
	2.16.1	the number of temporary versus permanent jobs that will be created,	Most of the staffing will be employed by the mining and engineering contractors and will be primarily from the Local Municipality with some from other parts of South Africa and/or neighbouring countries.
	2.16.2	whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area),	The planned workforce will consist of permanent employees and contractor employees primarily from the Local Municipality with some from other parts of South Africa and/or neighbouring countries.
	2.16.3	the distance from where labourers will have to travel,	Job opportunities will be created as a result of the Project, however, it is too early in the process to confirm from what distance labourers will be required to travel, as the labour force has not yet been appointed. The Applicant is committed to source labour from the nearest affected community and only search beyond the constraints of the immediate employment catchment zone if the skills required cannot be accommodated.
	2.16.4	the location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and	
	2.16.5	the opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	The number of farm workers who may be displaced should the project proceed will be determined during the recruitment process prior to construction.
	2.17	What measures were taken to ensure:	

Theme	No.	Question	Response
	2.17.1	that there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and	Digby Wells has identified the relevant government organisations which must be consulted throughout the EIA Process. Furthermore, this application is in terms of the One Environmental System and Digby Wells shall endeavour to align the various procedures to reduce stakeholder fatigue.
	2.17.2	that actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	The Scoping and EIA Process requires governmental departments to communicate regarding any application. In addition, all relevant Departments and key stakeholders have been notified about the project by the EAP and registered as I&APs who will continue to be notified and engaged with regarding the project throughout the EIA Process.
	2.18	What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	The Financial Liability for the Applicant has been calculated to determine the cost of decommissioning and rehabilitating the mine site to a post-closure end land use which is sustainable and in the best interest of both the surrounding communities and the environment.
	2.19	Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	
	2.20	What measures were taken to ensure that he costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	
	2.21	Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	The layout of the proposed project was informed by the location of coal resources.
	2.22	Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	Positive cumulative impacts associated with the proposed project include job creation and skills development; Negative impacts include the discharge of greenhouse Gas Emissions and water resource depletion.

7. Motivation for the Preferred Development Footprint within the Approved Site as Contemplated in the Accepted Scoping Report

The NCC is operates under a MR, reference **MR Ref. No. MP30/5/1/2/2/492MR**. Current activities at the NCC include the Diepspruit Underground Mining which involves three board-and-pillar sections mining of the No. 2 lower seam; Diepspruit West and Roodekop which are opencast truck and shovel mining operations.

The NCC has identified the Middeldrift reserve within its existing MRA and has contemplated to mine the resources upon depletion of the Diepspruit West and Roodekop Resources. The total Life of Mine (LoM) of Middeldrift is approximately ten years. It is for this reason that no site alternatives were identified.

7.1. Details of the Development Footprint Alternatives Considered

The alternatives considered for the proposed project are described below:

7.1.1. Property on which or location where it is proposed to undertake the activity

The NCC MR (MR Ref. No. MP30/5/1/2/2/492MR) boundary is depicted in Figure 3-2 and Figure 3-3. The MR allows for the Diepspruit Underground Mining as well as Opencast Mining at Diepspruit West and Roodekop.

Coal reserves (Middeldrift) with a LoM of about ten years have been identified within the existing MRA, making the current location preferable for the proposed activity.

7.1.2. Type of activity to be undertaken

The geological environment of the proposed project encourages opencast mining, which is a surface mining technique involving mineral extraction from an open pit in the ground. This type of mining does not require extractive methods or tunnels and is considered when minerals are identified close to the surface of the earth.

7.1.3. Design or layout of the activity

The Middeldrift annual mine schedule depends on the approval of the road diversion. Two options were identified: Option 1 which is based on the possibility of the wayleaves and road diversion not being approved; and Option 2, which assumes that the road diversion will be permitted. The different options are displayed in Figure 7 1 and Figure 7 2 below.

7.1.4. Technology to be used in the activity

Middeldrift will be mined using truck-and-shovel methods. The coal will be transported by truck via a haul road and the RoM coal will be washed at the NCC coal handling and processing plant. No new infrastructure will be constructed at Middeldrift.

7.1.5. Operational aspects of the activity

The proposed mining activity is anticipated to have a LoM of at least 17 years, contributing an estimated 20.9 Mt to the NCC coal reserves. The total reserve at NCC is about 26.6 Mt, which will amount to 47.7 Mt including the Middeldrift reserves.

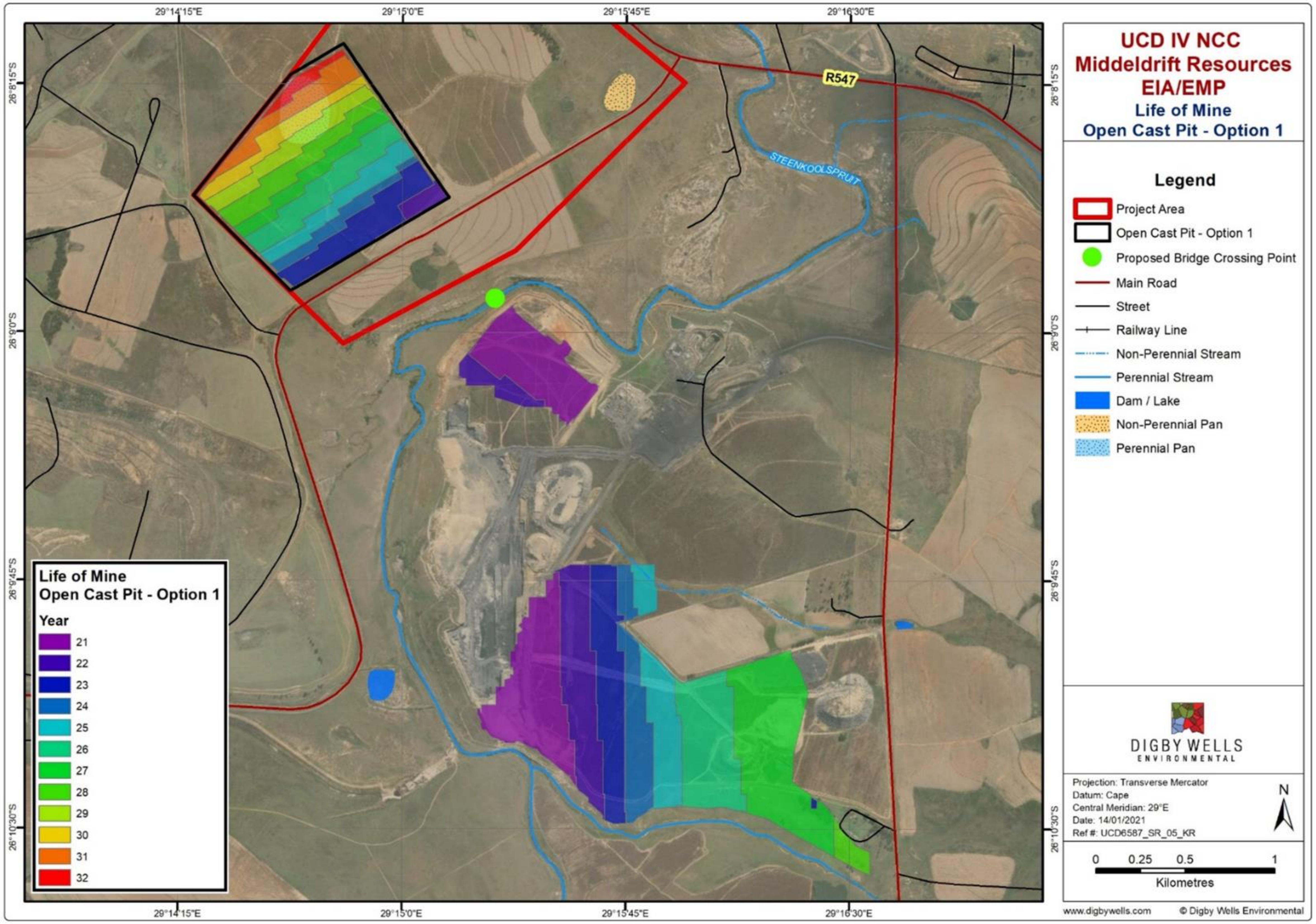

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Figure 7-1 Middeldrift Proposed Yearly Mine Schedule Option 1

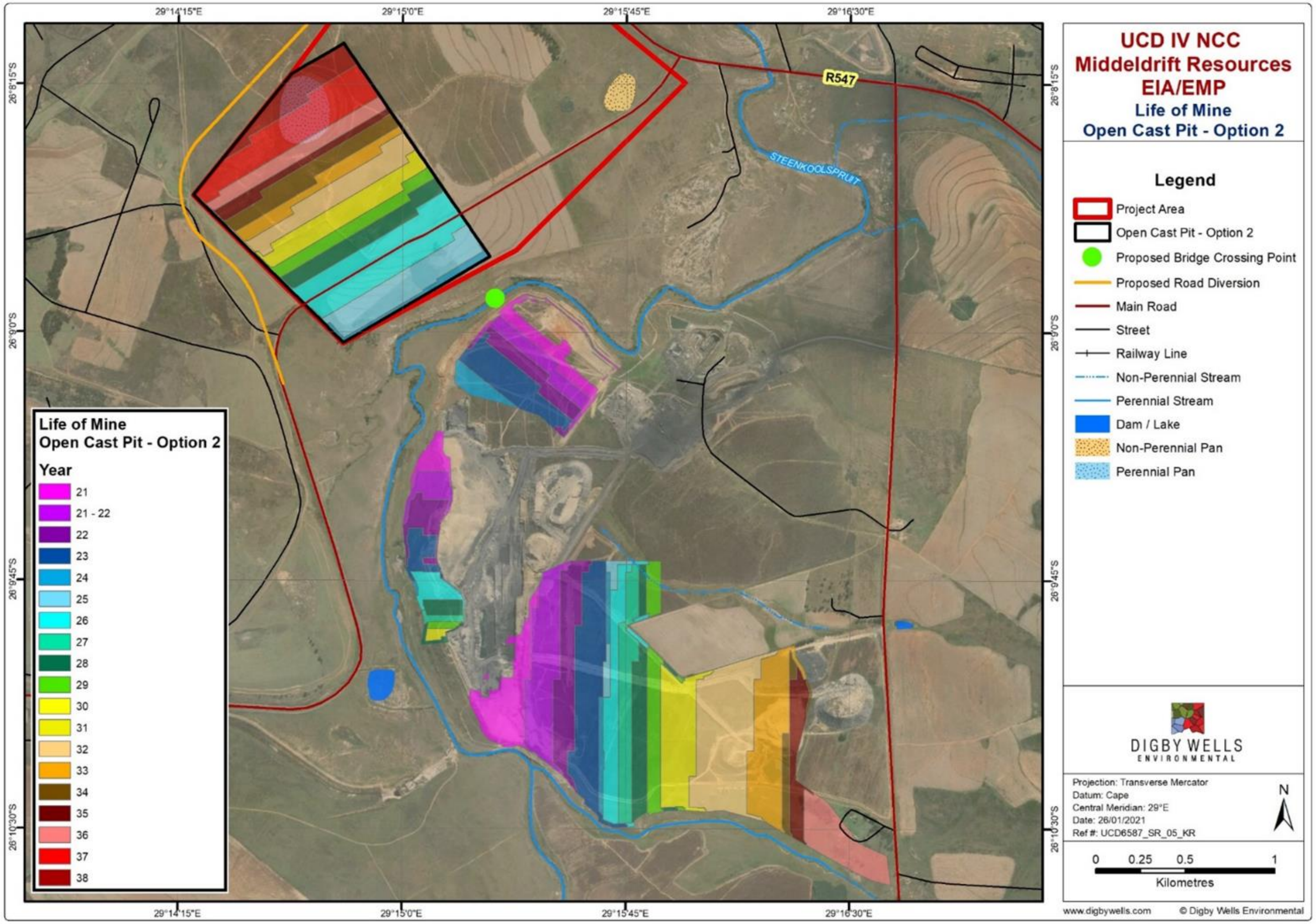


Figure 7-2 Middeldrift Proposed Yearly Mine Schedule Option 2

7.1.6. Option of not implementing the activity

The option of not implementing the activity was not considered for the proposed project since mining of Middeldrift will allow Universal Coal to maintain the contractual agreement between NCC and Eskom, therefore contributing to the security of the country's power supply.

7.2. Details of the Public Participation Process followed

The Public Participation Process (PPP) was developed to ensure compliance with environmental regulatory requirements and to provide I&APs with an opportunity to express their views and opinions on the project. This sub-section details the PPP undertaken for the NCC project (A full Public Participation Report is attached in **Appendix D**)

7.2.1. Public Participation during the Scoping Phase

7.2.1.1. Compilation of Stakeholder Database

A site visit was conducted to place site notices in and around the project, the locations of these site notices was chosen based on how often the place was frequented. The following activities were then carried out after placement of site notices:

- Development of a local regional setting and land tenure maps showing the district and local municipal levels in the area;
- A review of existing stakeholder database provided by Universal Coal and updated with new stakeholders;
- A map was also developed showing the different land parcels found within the area in order to identify landowners. The information gathered was complemented by Windeed and internet searches to identify and verify land ownership and obtain contact details;
- Additional stakeholders were identified when the site notices were displayed in the surrounding areas and distribution of the BIDs was undertaken via email; and
- Internet searches to identify government officials and for the confirmation of their contact details.

Additional stakeholders were identified through requests to register after the public release of the Draft Scoping Report.

A consolidated database was then compiled with all the I&APs.

7.2.1.2. Announcement and Public Participation Communication Channels

The legislative requirements indicate that specific materials and communication tools be utilised as part of the PPP to identify, inform and engage with I&APs as outlined below:

- **Site Notices**: English site notices were placed at various public places. These site notices contained a brief project description, information about the required legislation, details of the appointed EAP, details on how to register as an I&AP as part of the PPP.

- **A BID with Comment and Registration Form (CRF)** was emailed to I&APs. The BID entailed a project description, geographic location of the project, legislative processes, and requirements, triggered listed activities in terms of NEMA and NWA, the stakeholder engagement and registration processes as well as contact details of the Digby Wells Stakeholder Engagement Office. A CRF was attached to the BID and provided for stakeholders to use for formal registration as I&APs or to submit comments. The BID was available in English only.
- **Announcement Letter:** A letter was sent via email in English which contained information about the proposed project, applicable legislation, details of the environmental process, information about availability of the Draft Scoping Report for public comment.
- **Newspaper Advertisement:** Newspaper advertisement was placed on Highveld Chronicles, this advertisement contained a brief project description, information about the required legislation, details of the appointed EAP, details on how to register as an I&APs as part of the PPP.

The various Public Participation materials and communication tools used during the Scoping phase have been included as Appendix A to Appendix G in the Public Participation Report (**Appendix D** of this report).

Table 7-1 Public Participation Scoping Phase Activities

Activity	Details	Reference in Report
Identification stakeholder database	Stakeholder database which represents government authorities, landowners, various business Forums and Non-Government Organisations (NGOs.)	Refer to **Appendix D** **Final Scoping Report**
Stakeholder Engagement Plan (SEP)	An SEP was submitted to the Regional DMRE prior to the commencement of the Scoping Phase on **26 January 2021.**	
Placement of site notices	English site notices were placed in areas that are frequently visited by locals on 27 January 2021. Areas included: • Kriel Library; • Kriel Post Office; • Emalahleni Local Municipality and; • Emalahleni Post Office.	
Distribution of BID and CRF.	English BIDs and CRFs were emailed to stakeholders on **29 January 2021.**	
Distribution of Notification letter	A Notification letter was emailed to I&APs on **29 January 2021**.	
Stakeholder Consultation	FGMs were held with I&APs as indicated below: • Emalahleni Local Municipality at Emalahleni Local Municipality Main Offices: Environmental and Waste Management Department on **19 February 2021 from 10H00-11H00** • Landowners at New Clydesdale Colliery BI Boardroom on **19 February 2021 from 14H00-15H00**. • Various business Forums and NGOs at New Clydesdale Colliery BI Boardroom on the **20 February 2021 from 10h00-13h00**	

Activity	Details	Reference in Report
Announcement of Scoping Report	Announcement of the availability of the Draft Scoping Report was emailed to stakeholders together with the formal project announcement letter on 29 January 2021**.** The Draft Scoping Report was made available on http://view.datafree.co/PublicDocuments/ (under Public Documents). ***Due to the COVID-19 national regulations and associated restrictions, the Draft Scoping Report was released electronically via a data free resource.*** *(The Draft Scoping Report was made available for a 30-days commenting period from 29 January 2021 until 1 March 2021.*	
Announcement of the Final Scoping Report	Scoping Report was submitted to DMRE on **19 March 2021.** A notification letter for availability of the Scoping Report was emailed to all stakeholders on the database. The Scoping Report is available on http://view.datafree.co/PublicDocuments/ under Public Documents.	
Obtaining comments from stakeholders	Comments, issues of concern and suggestions received from stakeholders have been captured in the Comment and Response Report.	

7.2.2. Public Participation during the EIA Phase

The details of the activities conducted for the EIA phase are displayed in Table 7-2 below.

Table 7-2 Activities conducted under the EIA Phase

Activity	Details
Publication of newspaper advertisement	A Newspaper advertisement will be published in English, IsiZulu and SePedi in the Highvelder Newspaper on 22 **July 2021,** which is a local newspaper that covers the proposed project surrounding areas. The aim of the newspaper advertisement during the EIA Phase is to notify I&APs of the availability of the Draft EIA Report and EMPr for public review and commenting.
Announcement of Draft EIA Report	Notification on the availability of the Draft EIA Report and EMPr will be emailed and SMS' will be sent to stakeholders together with the formal project notification letter and CRF on Friday 22 **July 2021.** The Draft EIA Report will be made available on Digby Wells' website via a data free link on http://view.datafree.co/PublicDocuments/ (Under Public Documents). *(A 30-day legislated public review and commenting period for the draft EIA report will commence on 12 July 2021 until 11 August 2021)*
FGM	Focus Group Meetings will be confirmed and held during the public review period to be held from 22 July2021 – 23 August 2021.
Obtaining comments from stakeholders	Comments, issues of concern and suggestions received from stakeholders will be captured in the CRR.
Announcement of the Final EIA Report	The Final EIA Report and EMPr will be submitted to DMRE after completion of the public review period. A notification letter on the submission of the Final EIA Report will be emailed to all stakeholders on the database. The Final EIA Report will also be made available on Digby Wells' website via a data free link on http://view.datafree.co/PublicDocuments/ under Public Documents.

7.2.3. Decision-making Process

The DMRE accepted the Scoping Report on 28 May 2021. Attached hereto is the acceptance letter for the Scoping Report, allowing Universal Coal to proceed to the EIA phase.

The documentation appended to this report provide all stakeholder material generated and distributed as part of the PPP for the prosed project. The detailed CRR as well as copies of all comments received to date have also been included in **Appendix D**, where applicable, all the stakeholders' comments will be shared with the various specialists on the project for further consideration during the EIA phase.

Documentation related to the acceptance or rejection of the Draft EIA Report and EMPr, an updated CRR (including stakeholder and I&APs' comments raised during the Draft EIA phase), and PPP chapter will be publicly available on the date of the submission of the Final EIA Report to the DMRE.

7.3. Summary of issues raised by I&APs

The CRR captures all stakeholder comments obtained during the Scoping and EIA Phases of the project. The CRR will be continuously updated to include stakeholder comments for documentation in the Final EIA Report and EMPr. Comments received to date are attached in **Appendix D**.

8. Environmental Attributes associated with the Development Footprint Alternatives

This section describes the baseline environment of the project area. The purpose of understanding the environmental baseline conditions is to recognise sensitivities of the project site in relation to the proposed project.

The specialist studies aiding this EIA process are listed in Table 8-1 below.

Table 8-1: Specialist Reports and Associated Appendices

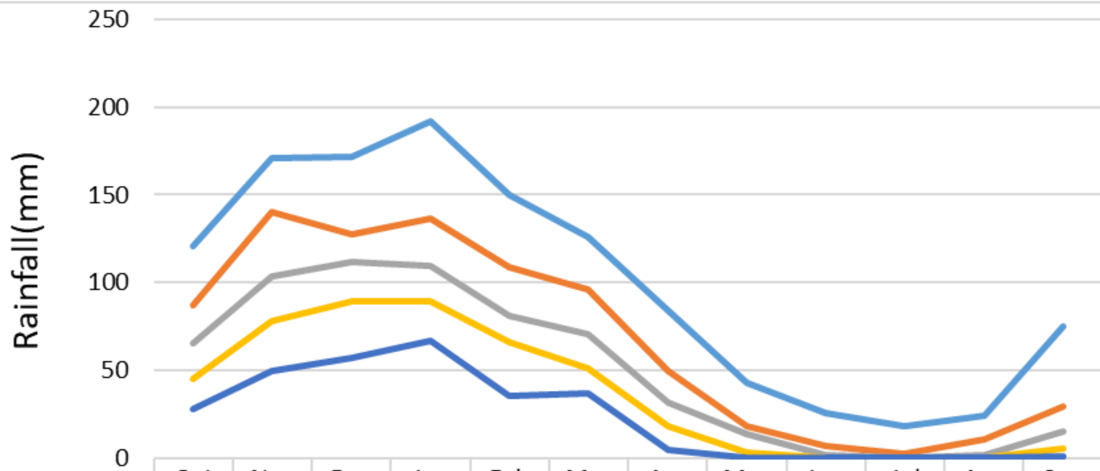
Specialist Study	Appendix
Wetland Assessment	Appendix E
Aquatics Impact Assessment	Appendix F
Groundwater Assessment	Appendix G
Surface Water Assessment	Appendix H
Soil, Land Use and Land Capability Assessment	Appendix I
Hydropedology Impact Assessment	Appendix J
Fauna and Flora Assessment	Appendix K
HIA	Appendix L
Air Quality Assessment	Appendix M

Specialist Study	Appendix
Traffic Assessment	Appendix O
Closure Assessment	Appendix N
Geochemical and Waste Classification Assessment	Appendix R

8.1. Type of environment affected by the proposed activity

8.1.1. Climate

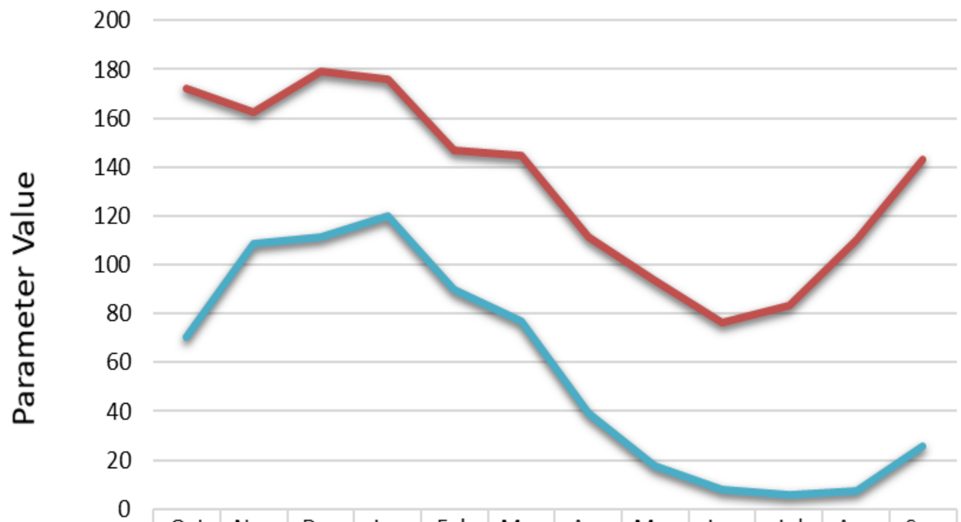
The Mean Annual Precipitation (MAP) for Quaternary Catchment B11E is estimated to be 682 mm. The NCC operations fall within the summer rainfall region of South Africa, where more than 80% of the annual rainfall occurs between the months of October to March (SRK Consulting, 2016). Figure 8-1 depicts the likely monthly distribution of rainfall in the catchment. January as the wettest month has a 90th percentile of 192 mm and 10th percentile of 67 mm, the graph also shows that the area experiences dry winters and it receives low to moderate rainfall during rainy seasons.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
90 Percentile	121	171	171	192	150	126	84	43	26	18	25	75
70 Percentile	87	140	127	136	108	96	50	19	7	3	11	29
50 Percentile	65	104	112	110	81	71	32	14	2	0	2	15
30 Percentile	45	78	89	89	66	51	18	3	0	0	0	6
10 Percentile	28	50	57	67	36	37	5	0	0	0	0	1

Figure 8-1: The Monthly Rainfall Distribution within the Quaternary Catchment B11E

The area recorded a high Mean Annual Evaporation (MAE) of 1 950 mm, which is significantly higher than the MAP. The monthly MAP and MAE is likely to be distributed as shown in Figure 8-2. Evaporation is higher during the wet seasons, therefore both rainfall and evaporation show similar trends.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Evaporation(mm)	172	163	179	176	147	145	111	94	76	83	110	143
Rainfall(mm)	70	108	111	120	90	77	39	17	8	6	7	26

Figure 8-2: Monthly Evaporation and Rainfall within the Quaternary Catchment B11E

8.1.2. Topography and Drainage

Middeldrift is located within the B11E quaternary catchment falling under the Olifants Water Management Area (Figure 9-3). The area is located predominantly on a topographical low within the catchment, with elevation ranging from approximately 1 529 meters above mean sea level (mamsl) to 1 574 mamsl. Most of the project area has a slope range of 1-2^{o} (See Figure 9-4 below).

Drainage within the project area is facilitated by the Steenkoolspruit, one of the major tributaries of the Olifants River.

8.1.3. Decision-making Process

The DMRE accepted the Scoping Report on 28 May 2021 Attached hereto is the acceptance letter for the Scoping Report, allowing Universal Coal to proceed to the EIA phase.

The documentation appended to this report provide all stakeholder material generated and distributed as part of the PPP for the prosed project. The detailed CRR as well as copies of all comments received to date have also been included in **Appendix D**, where applicable, all the stakeholders' comments will be shared with the various specialists on the project for further consideration during the EIA phase.

Documentation related to the acceptance or rejection of the draft EIA, an updated CRR (including stakeholder and I&APs' comments raised during the Draft EIA phase), and PPP chapter will be publicly available during the submission of the Final EIA Report.

8.2. Summary of issues raised by I&APs

The CRR captures all stakeholder comments obtained during the Scoping and EIA Phases of the project. The CRR will be continuously updated to include stakeholder comments for documentation in the Final EIA/EMPr. Comments received to date are attached in **Appendix D**.

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This section describes the baseline environment of the project area. The purpose of understanding the environmental baseline conditions is to recognize sensitivities of the project site in relation to the proposed project.

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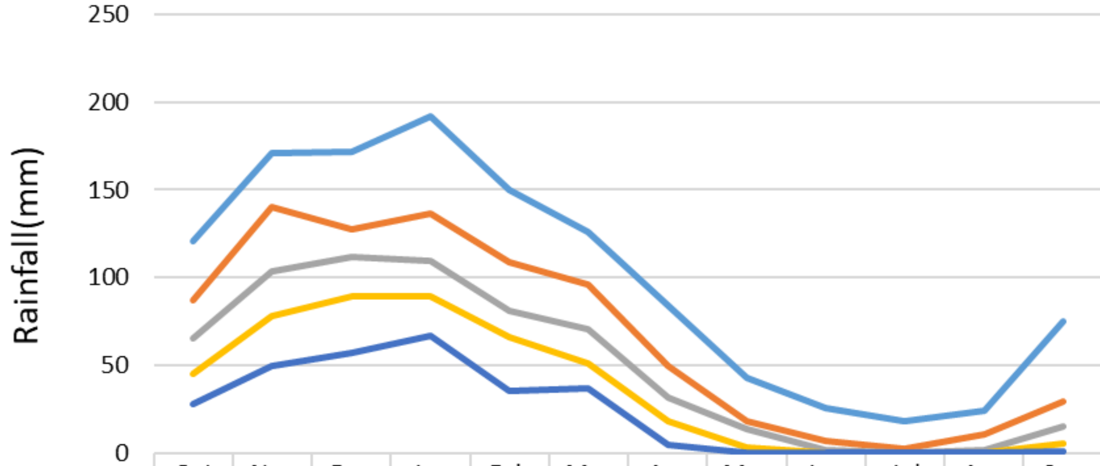
Specialist Study	Appendix
Traffic Assessment	Appendix O
Closure Assessment	Appendix N
Geochemical and Waste Classification Assessment	Appendix R

9.1. Climate

The Mean Annual Precipitation (MAP) for Quaternary Catchment B11E is estimated to be 682 mm. The NCC operations fall within the summer rainfall region of South Africa, where more than 80% of the annual rainfall occurs between the months of October to March (SRK Consulting, 2016). Figure 8-1 depicts the likely monthly distribution of rainfall in the catchment. January as the wettest month has a 90th percentile of 192 mm and 10th percentile of 67 mm, the graph also shows that the area experiences dry winters and it receives low to moderate rainfall during rainy seasons.



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10 Percentile	28	50	57	67	36	37	5	0	0	0	0	1

Figure 9-1: The Monthly Rainfall Distribution within the Quaternary Catchment B11E

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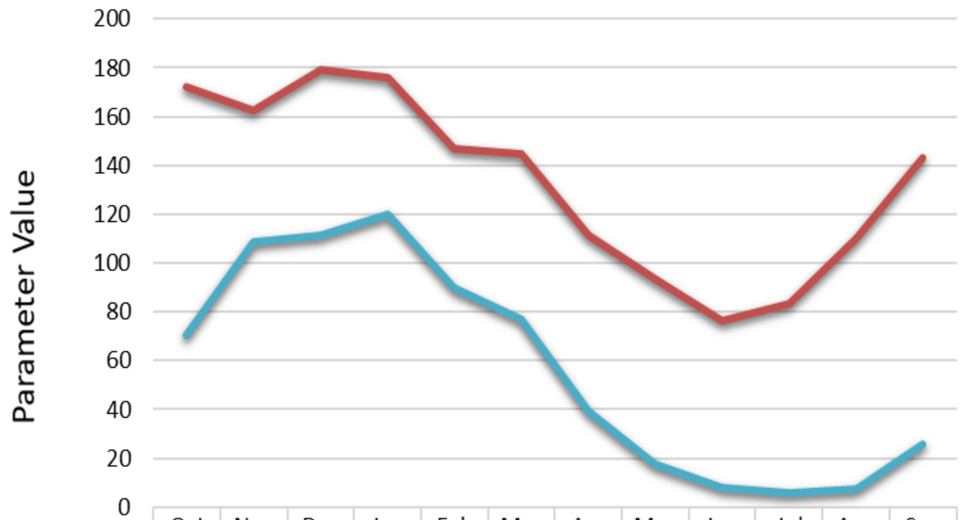

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9.2. Topography and Drainage

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Drainage within the project area is facilitated by the Steenkoolspruit, one of the major tributaries of the Olifants River.

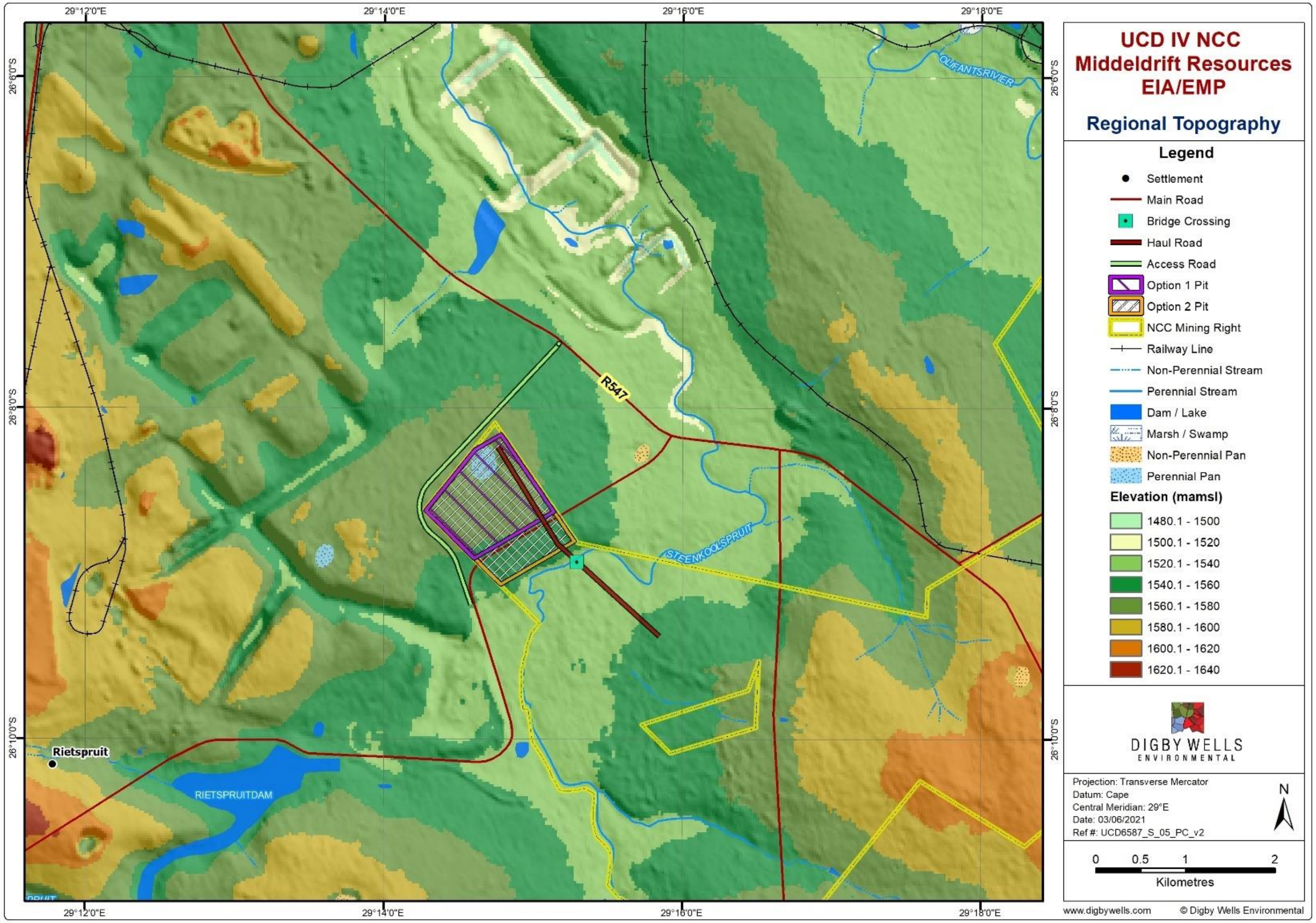


Figure 9-3: Topographic Map of the Project Area

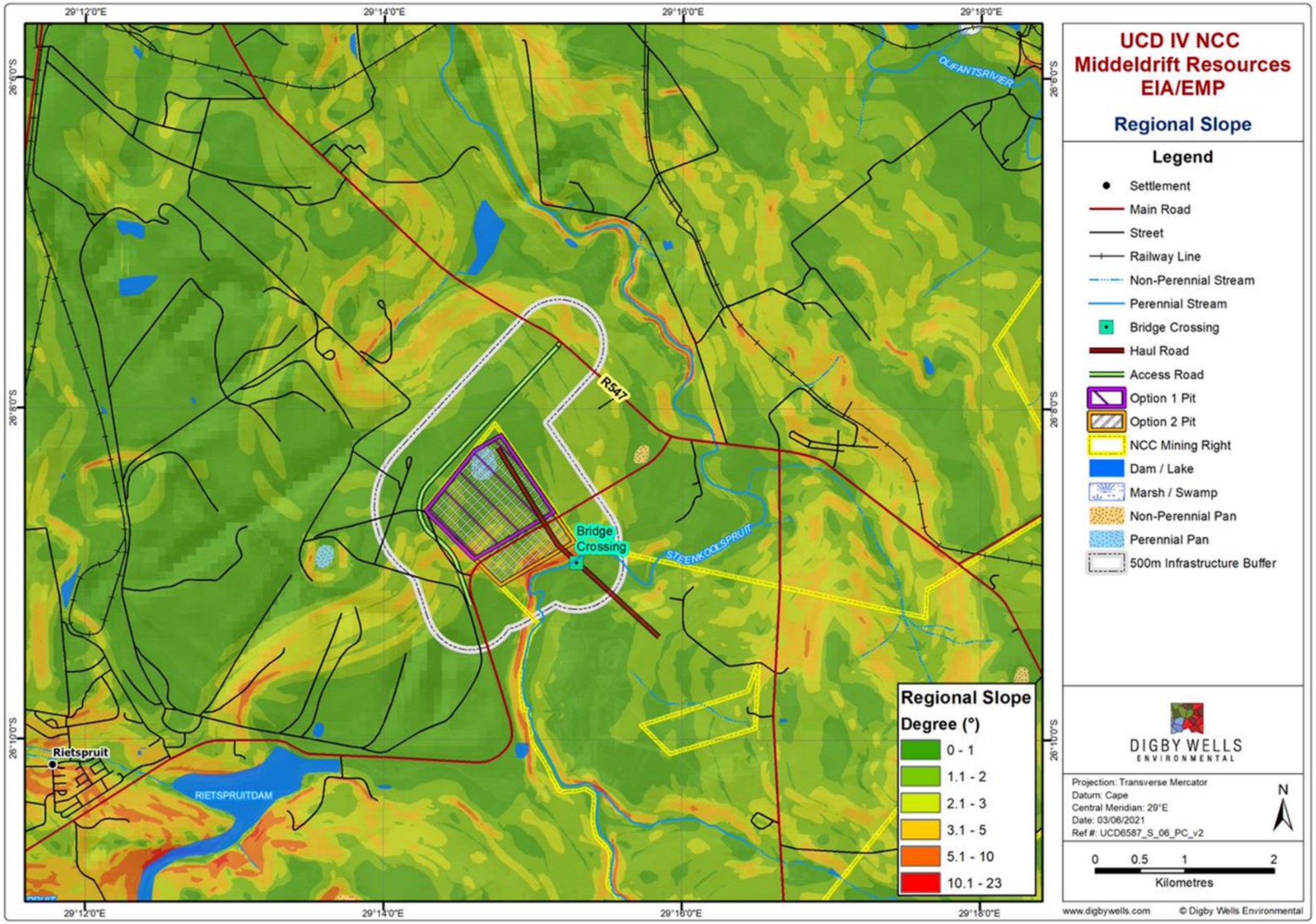


Figure 9-4 Slope of the NCC project area

9.3. Wetlands

The wetlands associated with the project area are delineated at desktop level using detailed aerial imagery and identifying wetland signatures. These were then confirmed during a rapid site survey undertaken on 24 and 25 February 2021. The site survey was used to refine the wetland delineation and to determine the Present Ecological State (PES) and the Ecological Importance and Sensitivity (EIS).

Seven wetland systems were identified, some comprising several HGM units, these include(See Figure 9-5) :

- HGM unit 1: Channelled Valley Bottom (CVB)and Floodplain (CVB & FP);
- HGM unit 2: Unchannelled Valley Bottom (UVBs) and Hillslope seep wetlands connected to a watercourse (UVBs & Seep);
- HGM unit 3: Depressions and Seeps (Pan & Seep);
- HGM unit 4: Pan & Seep;
- HGM unit 5: Pan & Seep;
- HGM unit 6: Seep; and
- HGM unit 7: Seep.

9.3.1. Wetland Indicators

The wetland delineation was completed using a combination of the accepted methodologies from "*A practical field procedure for identification and delineation of wetlands and riparian areas"* (Department of Waer Affairs and Forestry, 2005) and the "*Updated manual for identification and delineation of wetlands and riparian areas*" (Department of Water Affairs and Forestry, 2008). The methodology includes four wetland indicators; Soil Wetness Indicator (SWI), Soil Form Indicator (SFI), Vegetation and Terrain ((Full methodology appears in **Appendix E**).).

9.3.2. Wetland Delineation and Hydrogeomorphic Unit Identification

The delineated wetlands cover approximately **224.35 ha** of the Study Area (500 m Zone of Regulation) and **108.74 ha** of the project area. The wetlands comprise approximately **2.16%** of the total project area. The delineated wetlands with associated HGM units are displayed in Figure 9-5 and Table 9-2 below.

The HGM units were categorised into seven wetland systems. The wetland delineations together with their 100 m and 500m Zone of Regulation are illustrated in Figure 9-5 below.

Table 9-2 Wetland Hydrogeomorphic Units

HGM Unit Number	HGM Unit	Area (ha)
1	CVB & FP	59.4

HGM Unit Number	HGM Unit	Area (ha)
2	UVBs & Seep	80.8
3	Pan & Seep	7.3
4	Pan & Seep	26.9
5	Pan & Seep	3.6
6	Seep	17.8
7	Seep	28.5
Total Wetlands (ha)		**224.4**

Field verification focused on the wetlands located within the project area, specifically near the large NFEPA perennial pan where impacts are expected to be greatest. Wetlands that will be impacted to a lesser extent, such as wetlands located within the 500 m Zone of Regulation were only verified at a desktop level.

Each HGM unit type identified within the project area is described below.

9.3.2.1. Zone of Regulation

Zones of Regulation are placed around the delineated wetlands within a project area to facilitate the protection of the wetlands. If any activity takes place within the 500 m Zone of Regulation of a wetland, the requirement for an IWUL is triggered. The purpose of the Zone of Regulation is to minimise anthropogenic impacts that may arise from the activities of the proposed mining expansion on the water resources. A Zone of Regulation is defined as:

"The strips of undeveloped, typically vegetated land (composed in many cases of riparian habitat or terrestrial plant communities) which separate development or adjacent land uses from aquatic ecosystems (rivers and wetlands)" (Macfarlane *et al.,* 2009).

A Zone of Regulation of 500 m has been placed in Figure 9-5 below, as recommended by the NFEPA Implementation Manual and NWA and General Authorisation (GA) in Terms of Section 39 of the NWA, around the identified wetlands in a study area.

9.3.2.2. Floodplain

The general features that are typical of floodplain wetlands such as oxbows, were identified in the floodplain wetland (HGM 1) within the study area. However, due to historical and current land use activities (e.g., river diversion, incision, erosion, mining and agropastoral activities) altering the hydrology, geomorphology and vegetation, some features have been lost.

The floodplains are unlikely to contribute significantly to stream flow regulation. The generally clayey nature of floodplain soils retains water, which is likely to be lost through evapotranspiration, thereby limiting their contribution to stream flow regulation and groundwater recharge (Kotze *et al.,* 2005). However, due to the deep incisions and increased runoff, the floodplain is contributing more than natural flow to the catchment. Naturally, once the flood overflows the riverbanks, the velocity of flow decreases laterally, permitting the deposition of particles within the floodplain landscape, whereas in this case, the riverbanks are head cut, heavily grazed with low vegetation cover, increasing the flow and preventing riverbanks from overflowing. Generally, the inundation period in floodplains is short, but in the oxbow depression portions of the floodplain inundation is more prolonged and some of the deposited phosphates may be released as a consequence of change in redox potential, given that phosphorus is held more tightly to soil particles under oxidised conditions than under reduced conditions (Cronk, 2001).

9.3.2.3. Channelled Valley Bottoms

According to Kotze *et al.* 2005, CVB systems are characterised by less active deposition of sediment and an absence of oxbows and other floodplain features such as levees and meander scrolls. These wetland types tend to be narrower and have somewhat steeper gradients and the contribution from lateral groundwater input relative to the mainstream channel is generally greater. The primary cause of this channelling is the result of erosion.

The CVB wetlands within the study area (HGM 1) are narrow, deeply eroded and somewhat well vegetated, however indications of overgrazing in some areas reduces natural vegetation cover causing erosion and sedimentation. These systems are an important service provider to both the environment (e.g., habitat, food source, sediment trapping, toxicant removal and flood attenuation) and humans (e.g., water provisions and fishing).

9.3.2.4. Depressions (Pans)

Depressions are usually hydrologically disconnected from the stream network as they are inward draining wetlands. Most of the depressions together with their catchments within the Study Area are heavily impacted by cultivation, cattle grazing and historical mining activities. Impacts include trampling, channelling, construction of berms, loss of vegetation cover in the catchments, sedimentation and increased nitrates and phosphates. The following impacts are related to the specific HGM units:

- HGM 3: Historical mining activities;
- HGM 4: Cultivation and cattle grazing. The large pan has however been less impacted and has an appropriate buffer around the pan. The pan is grass dominated containing various special species (e.g., Gladiolus crassifolius and Habenaria filicornis) (DWE, 2021. Fauna and Flora Impact Assessment); and
- HGM 5: Historically completely cultivated

9.3.2.5. Hillslope Seep Wetlands

Seep wetlands are usually associated with a perched groundwater table. Precipitation within the greater catchment is temporarily stored within the soils as a result of impervious strata in the soil profile. The impervious strata are normally made up of weathered parent material or swelling clays typically associated with granites, sandstones or shales. Hillslope seepage wetlands are expressed where the soil profile is shallow enough such that impervious layer and the water stored within the soil profile are expressed on the surface. The soils are waterlogged long enough for oxygen to be depleted through a chemical process of reduction which results in the presence of redox features (mottles) in the soil. Hillslope seepage wetlands are created and maintained by infiltration processes that occur in the surrounding non-wetland areas within the catchment.

The seep wetlands within the study area (HGM 6 and 7) were all connected to a watercourse. The dominant land use for the seep wetlands is intensive cultivation where the soil depth is adequate for crop production and cattle grazing in areas where the soil depth is too shallow for crop production. The seep wetlands contribute significantly to the groundwater as the soils are dominantly interflow and recharge soils.

9.3.2.6. Unchanneled Valley Bottoms

Only one UVB wetland was delineated within the Study Area (HGM unit 2) and was therefore grouped as Valley Bottoms (VBs) with the one CVB within the Study Area. The UVB wetland of the study area are generally characterised by gentle slopes that are dominantly used for cultivation and cattle grazing. The agricultural impacts on this wetland will ultimately result in the formation of channels whereby the HGM unit will be converted to a CVB where the associated ecosystem services will be lost/or changed. By forming a channel, the wetland will be narrowed and concentrated, drying out the sides of the UVB. These may arise because of overgrazing, the establishment of farm roads, infrastructure, culverts and dams that initiate the process of erosion, compaction and increased runoff.

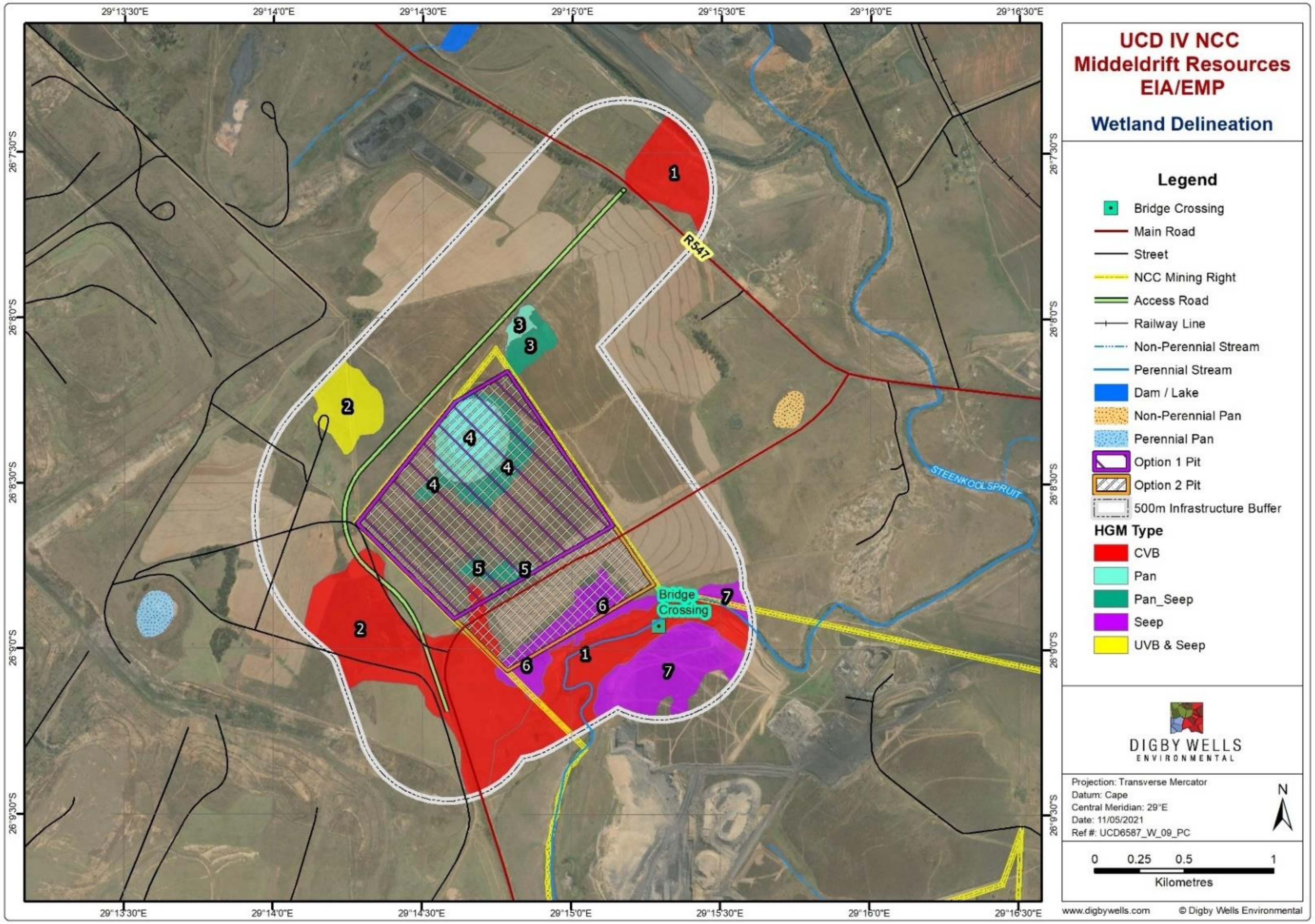


Figure 9-5 Wetland Delineation Map

9.3.3. Wetland Assessment

Land use activities and in-field studies have shown that some of the wetland systems are similar from a catchment management perspective, as they would be subject to similar overall land use impacts. Therefore, it was considered practical to group the HGM units by systems that have similar land use and impacts to calculate more accurately the PES, ES, as well as EIS scores.

The dominant land use activities affecting the wetland health, integrity and functionality in the study area are shown in Figure 9-6 and include:

- Agropastoral activities, including intensive cultivation, cattle grazing and related infrastructure; and
- Current and historical mining activities, such as underground mining, dewatering, groundwater contamination, roads, stockpiling, excavations, housing, AIPs and rehabilitated areas.

The overall approach to determine the wetland health and functionality is to quantify the impacts of human activity or visible impacts, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial extent of the impact of individual activities and then separately assessing the intensity of the impact of each activity in the affected area.

Pan that has been dammed and planted with Pennisetum clandestinum (AIP). Pan is impacted by cattle grazing, erosion and sedimetnation from upstream agropastroal activities (cultivation).

Hillslope seep impacted by hisotical mining and agropastroal activities. Including an old borrow pit, AIPs, cultivation and infrastructure.

Pan that has historically been cultivated. This caused changes to the natural hydrology, geomorphology and vegetation. The pan is currently AIPs domindated.

Figure 9-6: Land use activities

9.3.3.1. Wetland Ecological Health Assessment

The PES of the HGM units were found to range from **Moderately Modified (C) to Severely Modified (F)** with the most impacted wetlands associated with current and historical mining related activities, infrastructure and agropastoral activities. According to the PES score determination method described by Macfarlane *et al.* (2009):

- **Category C** wetlands have moderate changes to the ecosystem. Loss of natural habitat has taken place, but the natural habitat remains predominantly intact;

- **Category D** wetlands have been subject to changes in the ecosystem processes and loss of natural habitat and biota has occurred. This can be attributed to the historic and current land use of the project area, including artisanal mining and agropastoral activities;
- **Category E** wetlands are defined as wetlands where the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable; and
- **Category F** wetlands are defined as wetland where the modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.

Table 9-3: Wetland Ecological Health Assessment Scores

HGM Unit Number	HGM Unit	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final PES	PES Category
1	CVB & FP	21	2.6	14.46	5.437	D
2	VBs & Seep	12	3.7	16.7	4.629	D
3	Pan & Seep	21	5.45	17.2	6.236	E
4	Pan & Seep	19.5	0.45	10.2	4.307	D
5	Pan & Seep	22.5	4.25	16.4	6.164	E
6	Seep	12	1.3	8.9	3.171	C
7	Seep	28.5	9.95	18.9	8.193	F

The following was derived from Table 9-3 and Figure 9-7.

- The Seep wetland (HGM 6), in the southern side of the project area, feeding into the Steenkoolspruit was classified as PES **C** as the historical and current impacts are lower than the other areas. The area consists of shallow soils which limit cultivation and cattle grazing due to low vegetation cover. The hydrology, morphology and vegetation has thus been less impacted and changed from its original state. The wetland also included several Species of Conservational Concern (SCC), such as *Gladiolus crassifolius, Gladiolus dalenii* and *Habenaria filicornis;*
- The CVB and floodplain systems were classified as PES **D** due to historical and current land uses. These include, amongst other things, excavations, hardened

surfaces, stockpiling, cultivation and cattle grazing, changing the natural flows, habitat and geomorphology. These systems however still provide habitat, natural resources and hydrological functions to the environment. Some protected species were observed in these systems, such as the *Pyxicephalus adspersus* (African Bullfrog);

- The HGM units measured as PES **D** and **E** (HGM units 1, 2, 3, 4 and 5) were mostly associated with the pans and seep wetlands. The dominant land use of these wetlands was cultivation, almost completely altering the natural flows, functionality and habitat. Other activities impacting these wetlands include impacts from historical mining and anthropological impacts, infrastructure and cattle grazing; and
- The seep wetland, south of the project area were rated as PES **F** (HGM 7). The wetland is almost completely destroyed by mining and associated activities. Some areas have completely been mined out, whereas other areas are heavily impacted by erosion, sedimentation, possible contamination and AIPs. Little, or no functionality and natural vegetation is left of this wetland.

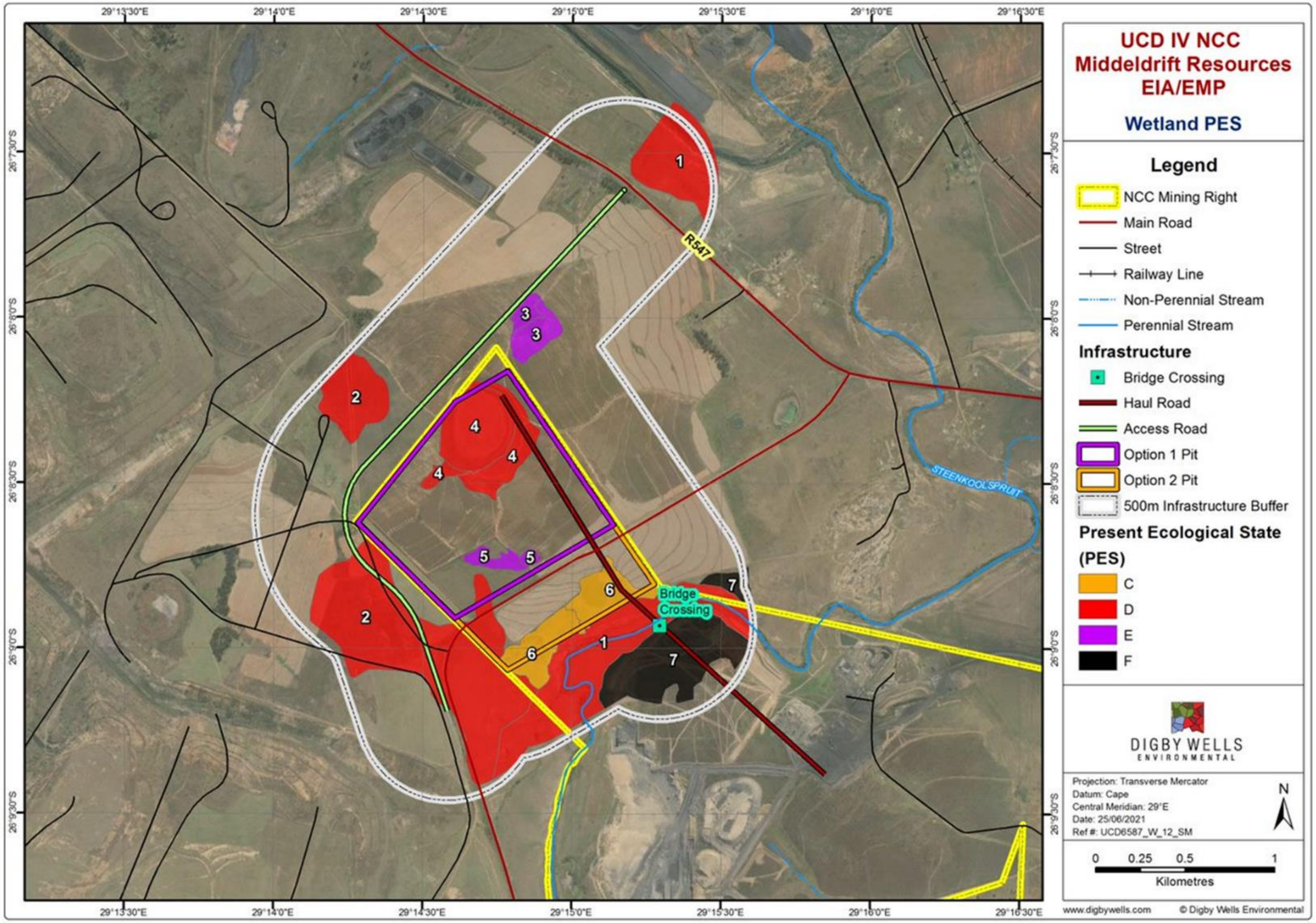


Figure 9-7: Wetland Present Ecological State

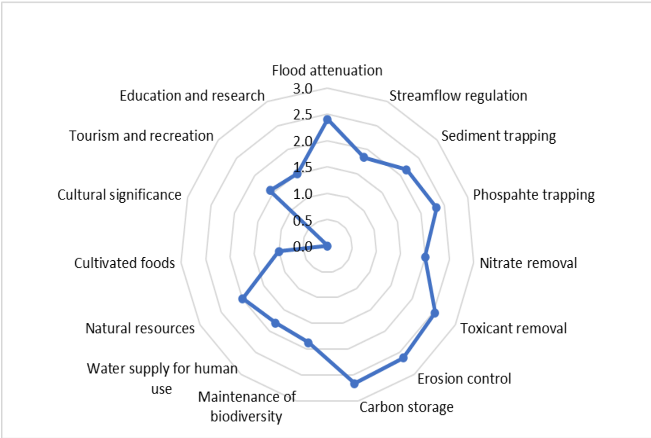
9.3.3.2. Wetland Ecological Services

The ES of the seven HGM units were all rated as **Intermediate**. It is however important to note that the ES vary from one HGM unit to the other. Figure 9-8 represents radial plots showing the relative importance of each ecosystem service and lists the summary of the scores obtained.

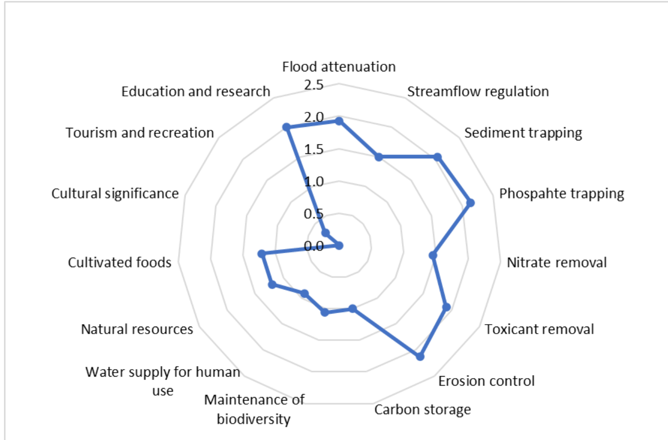
The following was derived from the data:

- The dominant importance of the wetlands include:
  - Flood attenuation;
  - Sediment trapping;
  - Phosphate assimilation;
  - Toxicant assimilation;
  - Erosion control;
  - Carbon storage; and
  - Biodiversity maintenance.
- The HGM unit with the highest ES is the CVB & FP (HGM 1), followed by HGM 2, 3, 4 and 5;
- Due to the highly impacted HGM 6, the ES is lower than the other HGM units; and
- HGM unit 7 has the lowest ES score.

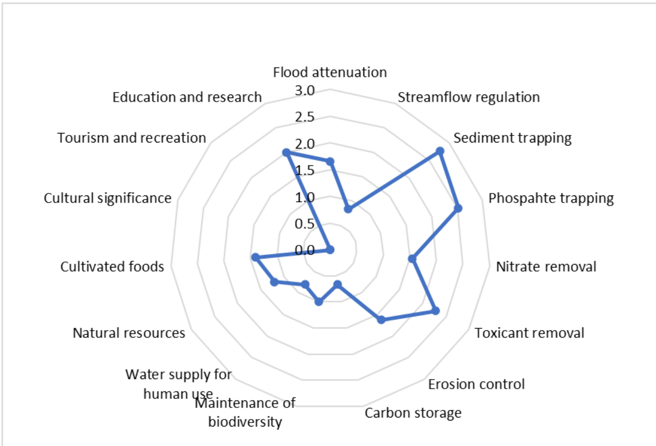
1. CVB & FP



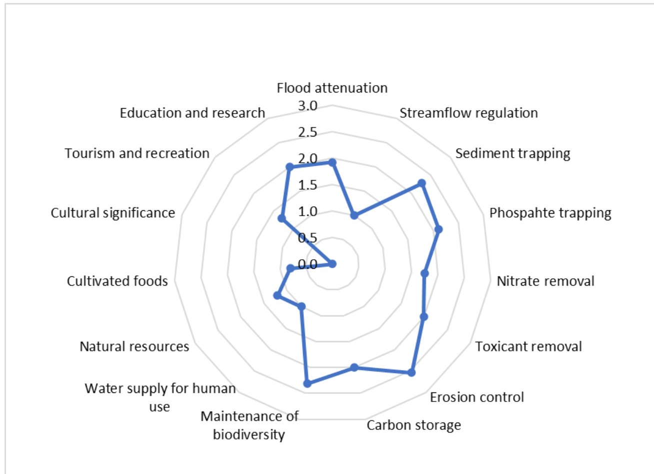
2. VBs & Seep



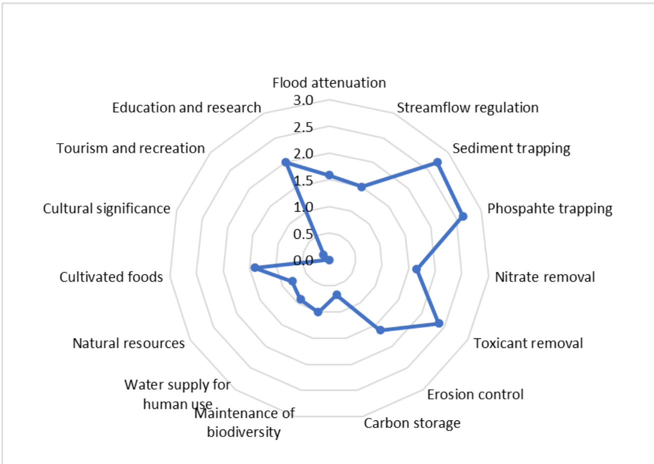
3. Pan & Seep



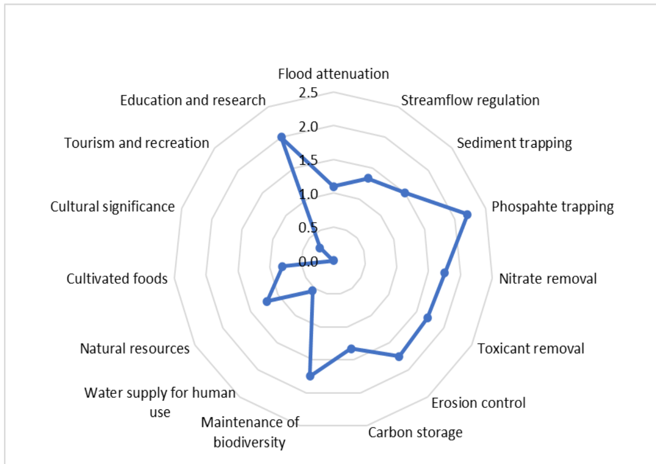
4. Pan & Seep



5. Pan & Seep



6. Seep



7. Seep

Figure 9-8: Wetland Ecological Services

Table 9-4: Wetland Ecological Services

Ecosystem Service	1. CVB & FP	2. UVBs & Seep	3. Pan & Seep	4. Pan & Seep	5. Pan & Seep	6. Seep	7. Seep
Flood Attenuation	2.4	1.9	1.7	1.9	1.6	1.1	1.8
Streamflow Regulation	1.8	1.5	0.8	1.0	1.5	1.3	1.2
Sediment Trapping	2.2	2.0	2.8	2.3	2.7	1.5	2.5
Phosphate Assimilation	2.3	2.1	2.5	2.1	2.6	2.2	1.9
Nitrate Assimilation	2.0	1.5	1.6	1.8	1.7	1.8	1.4
Toxicant Assimilation	2.5	1.9	2.3	2.0	2.4	1.7	1.8
Erosion Control	2.6	2.1	1.6	2.5	1.6	1.8	1.0
Carbon Storage	2.7	1.0	0.7	2.0	0.7	1.3	0.0
Biodiversity Maintenance	1.9	1.1	1.0	2.3	1.0	1.8	1.0
Water Supply	1.8	0.9	0.8	1.0	0.9	0.6	0.9
Harvestable Resources	2.0	1.2	1.2	1.2	0.8	1.2	2.0

Ecosystem Service	1. CVB & FP	2. UVBs & Seep	3. Pan & Seep	4. Pan & Seep	5. Pan & Seep	6. Seep	7. Seep
Education and Research	1.0	1.2	1.4	0.8	1.4	0.8	0.8
Cultural Value	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tourism and Recreation	1.6	0.3	0.0	1.3	0.1	0.3	0.0
Cultivated Foods	1.5	2.0	2.0	2.0	2.0	2.0	1.5
Average Score	1.9	1.4	1.4	1.6	1.4	1.3	1.2
Category	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**

9.3.3.3. Ecological Importance and Sensitivity

The EIS scores for the delineated wetlands were found to range from **Moderate** to **High** as shown in Table 9-5 and Figure 9-9 below. The following can be derived from the data:

- The scores for the EIS and the Hydrological/Functional Importance were mostly the dominant areas of sensitivity;
- Direct Human Benefits were the lowest due to the nature of the wetlands and the wetlands being away from villages;
- The EIS scores should be assessed individually, as well as combined, to determine the EIS of the wetlands;
- HGM units 1 and 4 (CVB & FP and the large Pan & Seep) both rated as **High** EIS due to Hydrological/Functional Importance and the EIS. The high EIS scores can be attributed to the highly impacted catchment, as well as the SSC species found within these HGM units (for a detailed species list, refer to the Fauna & Flora report);
- Human benefits (e.g., drinking water, firewood, thatching grass, medicinal plants) are low in these systems, however, some systems are cultivation and grazing;
- Biological/fauna activity (e.g., bullfrogs, moths and birds) are relying on these systems for food and water provision;
- The most important and sensitive areas are associated with the floodplain (HGM 1), Seep (HGM 6) and the large pan and associated seep (HGM 4), as these areas consist of permanent, seasonal and temporary wet areas compared to the other more seasonal and temporary HGM units; and
- The biodiversity of the systems delineated was found to be sensitive to flow and habitat modifications. The wetlands are important in moderating the quantity and quality of water in major rivers.

The overall catchment has been modified due to anthropological impacts, specifically historical mining and agricultural practices. The outcomes are changes in the water input volumes and flow regimes, as well as water distribution and retention patterns of water passing through the wetlands. Sedimentation from mining and agricultural activities decrease the quality of water, as well as affect large areas of vegetation, the geomorphology and natural habitats. Roads, buildings and other infrastructure that have been built increases run-off, cause fragmentation, creating preferential and artificial flow paths.

Table 9-5 Wetland Ecological Importance and Sensitivity Scores

HGM Unit Number	HGM Unit	Ecological Importance & Sensitivity	Hydrological/Functional Importance	Direct Human Benefits	Final EIS	EIS Category
1	CVB & FP	1.9	2.3	1.3	2.3	High
2	UVBs & Seep	1.1	1.8	0.9	1.8	Moderate
3	Pan & Seep	1.0	1.7	0.9	1.7	Moderate
4	Pan & Seep	2.3	1.9	1.0	2.3	High
5	Pan & Seep	1.0	1.8	0.9	1.8	Moderate
6	Seep	1.8	1.6	0.8	1.8	Moderate
7	Seep	1.0	1.4	0.9	1.4	Moderate

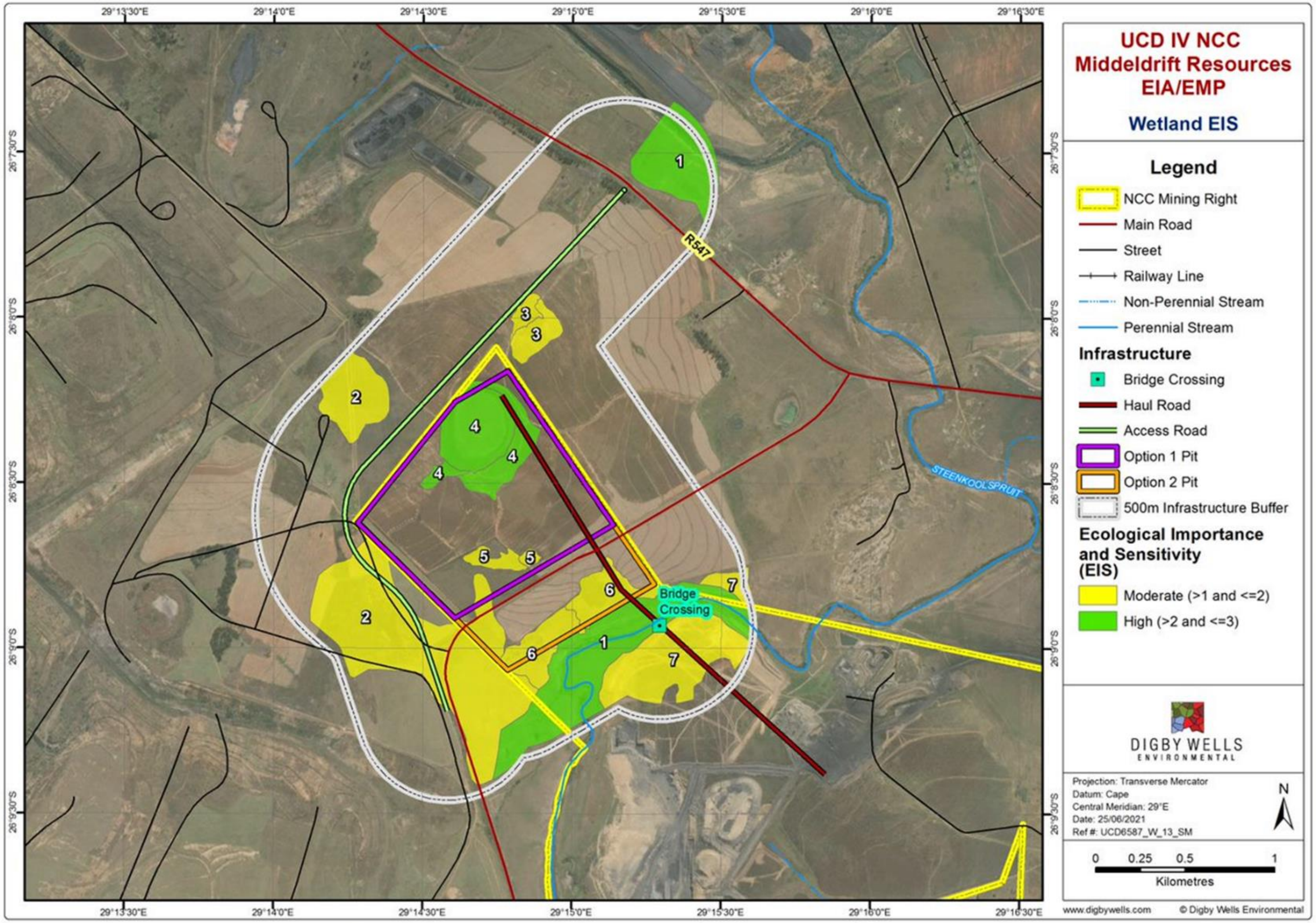


Figure 9-9: Wetland Ecosystem Importance and Sensitivity

9.3.4. Sensitivity Areas

Based on the PES, ES and EIS analysis of the wetlands, the sensitivity of HGM units 1, 4 and 6 were rated as **High**; HGM units 2 and 5 as **Medium**; and HGM units 3 and 7 as **Low** (Table 9-6 and Figure 9-10).

Table 9-6: Sensitive Areas Identified in the Study Area

HGM Unit Number	HGM Unit	PES	ES	EIS	Sensitivity
1	CVB & FP	D	1.9	2.3	High
2	VBs & Seep	D	1.4	1.8	Medium
3	Pan & Seep	E	1.4	1.7	Low
4	Pan & Seep	D	1.6	2.3	High
5	Pan & Seep	E	1.4	1.8	Medium
6	Seep	C	1.3	1.8	High
7	Seep	F	1.2	1.4	Low

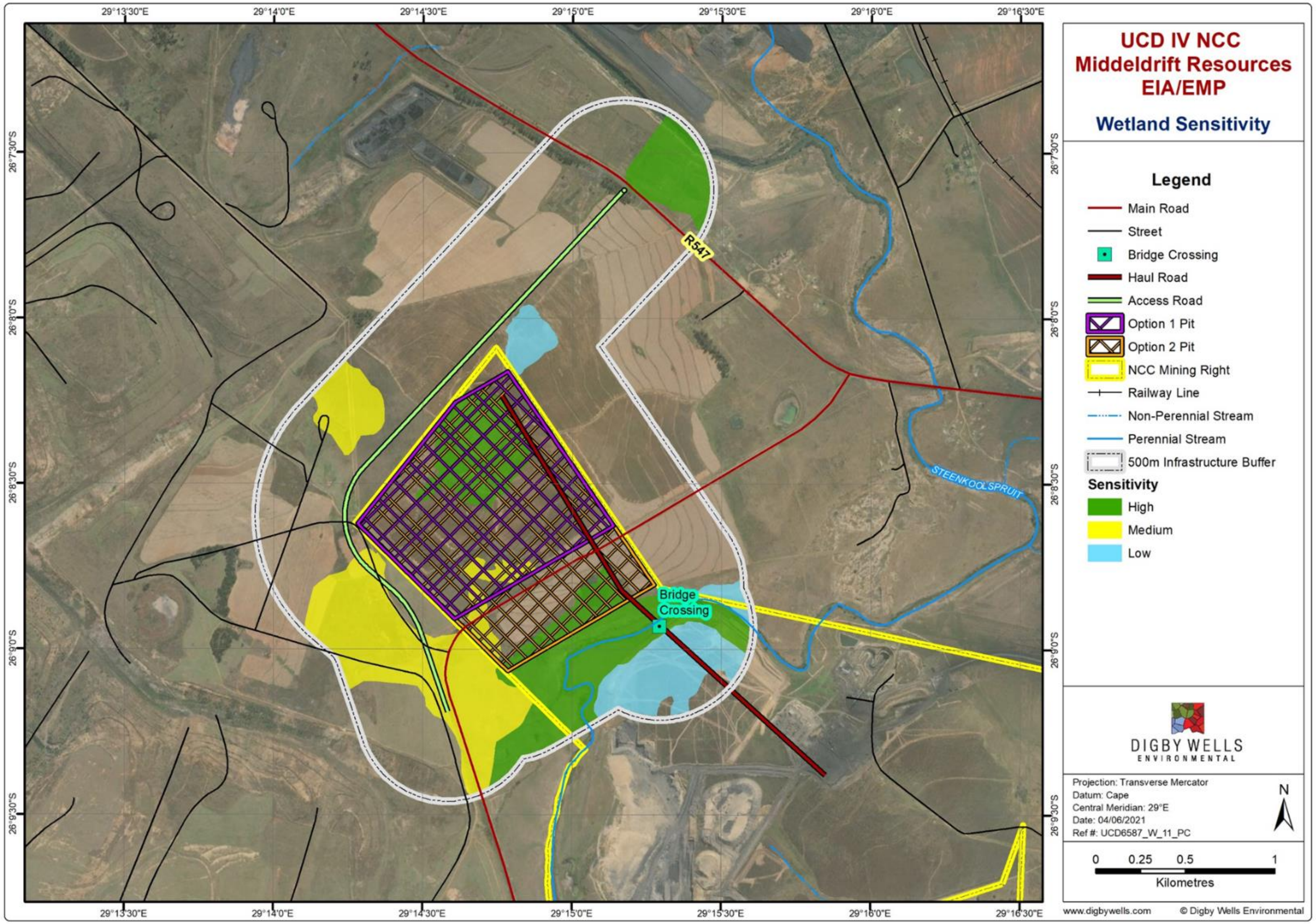


Figure 9-10: Wetland Sensitivity Areas

9.4. Aquatics

9.4.1.1. Water quality

The aquatic environment of the project area and the PES were determined through the evaluation of Stressor, Habitat and Response Indicators and were compared to those discussed by (SAS, 2016). The sites of monitoring were selected based on the location of the project infrastructure, the MRA and areas suspected to inhabit sensitive/conservational important aquatic species (Figure 9-11) The full methodology appears in **Appendix D**.

For the purposes of the assessment, each of the values recorded during the survey were compared against various water quality guidelines originating from the following sources:

- pH and saturation percentage guidelines obtained from (Department of Water Affairs and Forestry, 1996a)
- Conductivity guideline value of 500 µS/cm stipulated in (U.S. Environmental Protection Agency, 2010) and
- Dissolved oxygen concentration guideline for macroinvertebrates from Nebeker *et al*. (1996) and dissolved oxygen saturation for aquatic biota from DWAF, 1996.

The *in-situ* water quality results of the 2021 late wet season survey for the watercourses associated with the proposed project are presented in Table 9-7 and discussed in the sections below.

Table 9-7: In situ water quality results for watercourses associated with the proposed project

Monitoring Site	Riet-spruit	Steenkoolspruit			Guideline
	NC1	NC2	NC3	NC4	
Time	08h40	9h52	11h26	12h12	-
Temperature (°C)	19.4	21.2	22.7	23.1	5-30
pH	8.74	7.98	8.46	7.68	6-8
Conductivity (µS/cm)	524	564	487	3570	≤500
Dissolved oxygen (mg/l)	6.24	6.63	8.12	7.13	>5
Dissolved oxygen (Saturation %)	74.1	76.3	80.3	68.5	80-120
Clarity (cm)	41	22	10	5	-
*Red values indicate constituents exceeding recommended guideline values					

9.4.1.1.1. In situ Temperature

Water temperature is an important abiotic factor in aquatic ecosystems, it influences organisms' growth, feeding and metabolic rates, emergence, fecundity, and behaviour. Thus all organisms have an optimum temperature range within which they survive. The temperatures of inland waters in South Africa generally range from 5-30 ºC, which is the range within which most aquatic invertebrates in southern Africa thrive (Department of Water Affairs and Forestry, 1996). Human-induced changes in temperature include (amongst others), water abstraction, heated return-flows of irrigation water; and discharge of water from impoundments (Department of Water Affairs and Forestry, 1996)

Temperature values recorded at monitoring sites associated with the proposed project ranged from 19.4 ºC to 23.1 ºC, typical of the summer season temperatures in South Africa. Therefore, all recordings were within the normal temperature of inland waters in the country, thus all sites were not expected to deter occurring aquatic biota due to temperature influences.

9.4.1.1.2. In situ pH

The pH value is a measure of hydrogen (H^+), hydroxyl (OH^-), bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) ions in water (Dallas and Day, 2004). The pH of natural water is determined by geological and atmospheric influences and may also vary both diurnally and seasonally. Diurnal fluctuations occur in productive systems where the relative rates of photosynthesis and respiration vary over a 24-hour period because photosynthesis alters the carbonate/ bicarbonate equilibrium by removing carbon monoxide (CO) from the water, thus elevated pH levels may be a characteristic of eutrophic systems where biological activity is increased. The toxicity of many elements in water is determined by pH, aluminium for example, is mobilized in acidic waters (Department of Water Affairs and Forestry, 1996)

The pH values recorded exhibited close to neutral to slightly alkaline conditions, ranging from 7.68 pH units to 8.74 pH units during the present study. The DWAF (1996) guideline upper limit of 8 pH units was exceeded at sites NC1 and NC3 only. The recorded pH levels were likely influenced by natural processes such as photosynthesis.

9.4.1.1.3. In situ Electrical Conductivity

Electrical conductivity (conductivity) is a measure of the ability of water to conduct an electrical current. This ability is a result of the presence of total dissolved salts or dissolved compounds that carry an electrical charge. Conductivity in natural waters varies in part on the characteristics of geological formations which the water has been in contact with and the dissolution of minerals in soils and plant matter. Anthropogenic sources of increased dissolved salts include domestic and industrial effluent discharges and surface runoff from urban, industrial and cultivated areas (DWAF, 1996).

Conductivity values were recorded above the recommended guideline of 500 µS/cm (USEPA, 2010) at all the sites except at Site NC3. The conductivity at sites NC1 and NC2 were however only slightly above the recommended guideline (i.e. 524 µS/cm and 564 µS/cm), whilst an elevated conductivity level was recorded at Site NC4 (3570 µS/cm). Lying directly below a wetland system (Figure 9-11) this elevated conductivity was suspected to be attributed to the accumulation of contaminants stemming from the surrounding land uses which were carried through surface and sub-surface flows (Dallas and Day, 2004); (Tuladhar and Iqbal, 2020).

Figure 9-11: Wetland system lying above Site NC4

Figure 9-12: High sediment loads observed at Site NC4

9.4.1.1.4. In situ Dissolved Oxygen

Gaseous oxygen (O_2) from the atmosphere dissolves in water and is also produced in water by aquatic plants and phytoplankton. The maintenance of adequate dissolved oxygen (DO) concentrations is critical for the survival and functioning of the aquatic biota because it is required for the respiration of all aerobic organisms. Therefore, the DO concentration provides a useful measure of the health of an aquatic ecosystem.

Sampled sites generally lacked primary drivers of dissolved oxygen in river systems, that is instream aquatic vegetation and rapids, with the exception of site NC3 where rapids were present at the time of the survey. Despite this, DO concentration levels were recorded above the recommended guideline of 5 mg/l (Nebeker *et al*., 1996) at all sites. Site NC3 recorded the highest dissolved oxygen concentration (8.12 mg/l), this was likely attributed to the rapids at this site, i.e. the turbulence facilitates the diffusion of oxygen from the surrounding air (Dallas & Day, 2004).

9.4.1.1.5. Water Clarity/Turbidity

Most of the sampled sites were largely sedimented, smothering the substrates of the sites. A wide variety of water clarity measurements were recorded ranging from 5 cm at Site NC4 to 41 cm at Site NC1. Despite the high clarity at Site NC1, this site contained high sediment loads which had settled at the surface. This site lies downstream of intensive mining areas and agriculture fields thus the high sediment content was likely attributed to associated land uses such as the clearing of vegetation leading to soil erosion. High sediment composition in water bodies directly impacts on aquatic organisms by smothering and blocking the gills (and other respiratory apparatus) in fish and aquatic invertebrates and indirectly by reducing the amount of available food as the vegetation gets covered and trapped in fine particles. It is therefore important to avoid land use activities that result in surface runoff of soil into these watercourses.

9.4.1.2. Aquatic and Riparian Habitat

Assessment of aquatic habitat within the study area was based largely on the application of recognised assessment indices at each of the selected sampling points, as well as associated reach) within the assessed watercourses, namely the Invertebrate Habitat Assessment System (IHAS) and the Index Habitat Integrity (IHI). The IHI is a rapid, field-based, visual assessment of modifications to a number of pre-selected biophysical drivers (i.e. semi-quantitative) used to determine the Ecological Category of associated instream and riparian habitats.

9.4.1.2.1. Index for Habitat Integrity

The IHI was completed at a desktop level for each aquatic ecosystem considered in the present survey and populated with observations recorded during the field survey (Table 9-8).

It should be noted that this assessment index is applied to a pre-determined segment or portion of the associated watercourse and is typically delineated by major riverine homogeneities (e.g., adjoining tributaries) and/or potential instream barriers (e.g., dams, weirs, etc.). Consequently, for the purposes of the present study, each river reach was delineated by adjoining tributaries upstream and downstream of the reach, thus encompassing habitat assessment units.

Table 9-8: IHI findings for the watercourses associated with the proposed project

Site	Habitat Component	IHI Score	Ecological Category	Major Impacts
Rietspruit	Instream	48.36	D	Highly sedimented due to upstream bank disturbances including removal of indigenous vegetation.
	Riparian	63.72	C	Isolated infestations of alien-invasive Eucalyptus trees observed in the surrounding area.
Steenkoolspruit	Instream	56.3	D	High sedimentation and water quality deterioration due to activities associated with mines, agriculture and residential areas.
	Riparian	53.49	D	Removal of indigenous vegetation indicated by the dominance of Bankrupt Bush plants.
N/A = Not suitable for assessment				

The findings from the IHI assessments conducted during the current 2021 survey indicate that the habitat integrity along the assessed Rietspruit reach was *Largely Modified* (Ecological Category D) for the instream component and *Moderately Modified* (Ecological Category C) for the riparian component. Major impacts of the instream habitat were bed modification and the dominance of exotic fauna. Site NC1 was observed to contain high sediment loads and only the alien Mosquito Fish was collected. At the assessed Steenkoolspruit reach, both instream and riparian components were determined to be in *Largely Modified* (Ecological Category D) conditions. Similarly, to the assessed Rietspruit reach, bed modification due to high sediment loads and the dominance of alien-invasive fauna were the major impacts of the instream habitat, whilst the removal of indigenous vegetation and the dominance of Bankrupt Bush (*Seriphium plumosum;* Figure 9-13) was the major impact of the riparian habitat.

The survey conducted in 2016 (SAS, 2016) indicated that both the instream and riparian habitats were in *Moderately Modified* (Ecological Category C) conditions for the Steenkoolspruit. Similarly to the current 2021 survey, major impacts included bed modifications and water quality modifications for the instream component whilst the riparian zone impacts included flow modification, bank erosion, water quality modification and inundation.

Figure 9-13: Bankrupt Bush (*Seriphium plumosum*) observed to dominate the surroundings at Site NC2

9.4.1.2.2. Aquatic Macroinvertebrate Assessment

The following sections provide insights into the available habitat that was sampled at each respective monitoring sites at the time of the current 2021 survey, as well as the SASS5 metrics obtained and the subsequent determination of the ecological condition of the observed assemblages in relation to reference conditions.

9.4.1.3. Invertebrate Habitat Assessment System

The IHAS, Version 2.2, developed by (McMillian, 1998) has routinely been used in conjunction with the South African Scoring System (SASS) approach as a measure of variability in the quantity and quality of representative aquatic macroinvertebrate biotopes available during sampling. However, according to a study conducted within the Mpumalanga and Western Cape regions, the IHAS method does not produce reliable scores at assessed sampling sites, as its performance appears to vary between geomorphologic zones and biotope groups (Ollis *et al*., 2006). While no conclusion can be made regarding the accuracy of the index until further testing has been conducted, these potential limitations and/or shortfalls should be noted. Nevertheless, due to the value of basic instream habitat assessment data and its suitability for comparison of available macroinvertebrate habitats between various sampling sites, an adapted IHAS approach was maintained during the interim period, excluding assessment of the '*surrounding physical stream condition*.'

Table 9-9 shows the adapted IHAS scores at the sites assessed during the current 2021 survey.

Table 9-9: IHAS Values and Interpretation for the Sampled Sites

Site/Point	IHAS Score (%)	Interpretation
Rietspruit		
NC1	60.0	Good
Steenkoolspruit		
NC2	47.3	Poor
NC3	49.1	Poor
NC4	40.0	Poor

During the current late wet season survey, the sampled systems were dominated by deep, slow to moderately flowing water and generally lacked the stones biotope. Marginal vegetation and sand were the common features throughout the sites. Consequently, most of the assessed sites exhibited largely *Poor* habitat availability with varying degrees of aquatic and marginal vegetation with sand and mud being the dominant biotopes. An exception was observed at Site NC1 where the invertebrate habitat availability was scored as *Good.* Aquatic/marginal vegetation, and the gravel/sand/mud (GSM) biotopes were in high abundance and occurred in varying water depth and flow classes at this site.

9.4.1.4. Benthic Communities and Composition

Due to the differential sensitivities of aquatic macroinvertebrates, the composition of the aquatic macroinvertebrate community can provide an indication of changes in water quality and other ecological conditions within a watercourse. The use of the SASS has undergone numerous advances, culminating in Version 5 (SASS5) presently being utilised in river health studies along with the application of the Macroinvertebrate Response Assessment Index (MIRAI).

Table 9-10 presents the SASS5 results for the assessed monitoring sites within the proposed project area.

Table 9-10 SASS5 Data Obtained for the Assessed Sites

Monitoring Site	Rietspruit	Steenkoolspruit		
	NC1	NC2	NC3	NC4
SASS5 Score	67	95	44	72
Taxa	16	22	12	17
ASPT	4.2	4.3	3.7	4.2
ASPT = Average Score Per Taxon				

The aquatic macroinvertebrate community assemblages were predominantly composed of taxa that have *“Low”* water quality requirements. Of the collected invert families, only four families with a *Moderate* water quality requirement (i.e. SASS sensitivity score of >8) were collected. All four families with "*Moderate"* water quality requirements (Atyidae, Hydracarina, Aeshnidae and Dixidae) were collected along the Steenkoolspruit sites, whilst only Atyidae was collected at the Rietspruit Site NC1.

Only 16 invertebrate families were collected at the Rietspruit Site NC1 and a total of 29 were collected throughout the Steenkoolspruit sites. With the highest score for macroinvertebrate habitat availability obtained at Site NC1 for the present survey, it was expected that the highest number of invert families would be collected at this site. The highest number of invert families were however collected at the Steenkoolspruit Site NC2 (22) followed by Site NC4 (17). This finding suggests that there were factors other than habitat availability driving the composition of invert families at the assessed sites.

Similarly to the 2016 study (SAS, 2016), a higher SASS score and Average score per taxa (ASPT) was obtained at the Steenkoolspruit upstream Site NC2 (named NCC1 in 2016) compared to the downstream Site NC3 (named NCC2 in 2016). This is attributed to the lack of habitat diversity at Site NC3 where bedrock dominates the habitat. However only 8 and 7 invert families were collected at sites NCC1 and NCC2 during the 2016 survey, 14 more families were collected at Site NC2 and 5 more at Site NC3 during the present 2021 survey. This notable difference in the number of collected invertebrates could be attributed the difference in timing for the surveys (i.e. the current 2021 survey was undertaken early March while the 2016 survey in April).

9.4.1.5. Ecological Condition of the Aquatic Macroinvertebrate Assemblages

Although Chutter (1998) originally developed the SASS protocol as an indicator of water quality, it has since become clear that the SASS approach gives an indication of more than mere water quality, but also a general indication of the current state of the macroinvertebrate community. While SASS does not have a particularly strong cause-effect basis for interpretation, as it was developed for application in the broad synoptic assessment required for the old River Health Programme (RHP), the aim of the MIRAI is to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic macroinvertebrate community (assemblage) from the reference condition (Thirion, 2008). This does not preclude the calculation of SASS scores, but encourages the application of MIRAI assessment, even for RHP purposes, as the preferred approach. Accordingly, the SASS5 data obtained was used in the MIRAI (Thirion, 2008) to determine the PES, or Ecological Category of the associated macroinvertebrate assemblage.

Results for the MIRAI at the assessed sites are shown in Table 9-11 and discussed below

Table 9-11: MIRAI data for the Assessed Sites

Site	MIRAI Value	Ecological Category	Description
Rietspruit			
NC1	40.22	D/E	Largely to Seriously Modified
Steenkoolspruit			
NC2	51.8	D	Largely Modified
NC3	32.1	E	Seriously Modified
NC4	42.5	D	Largely Modified

The macroinvertebrate assemblage at the Rietspruit Site NC1 exhibited *Seriously to Largely Modified* conditions (Ecological Category D/E) and ranged between *Largely Modified* and *Seriously Modified* conditions at the Steenkoolspruit sites.

During the 2016 survey (SAS, 2016), the ecological category at sites NCC1 and NCC2 (NC2 and NC3 in the present survey) were determined to be *Largely Modified.* Thus, the biotic integrity at Site NC2 had remained the same whilst that of Site NC3 had deteriorated since the previous 2016 study.

9.4.1.5.1. Fish Communities

Using fish as a means to determine ecological disturbance has many advantages (Zhou *et al*., 2008). Fish are long living, respond to environmental modification, continuously exposed to aquatic conditions, often migratory and fulfil higher niches in the aquatic food web. Therefore, fish can effectively give an indication into the degree of modification of the aquatic environment.

The catch record and subsequent ecological condition of the collected fish communities is discussed in the sub-sections below.

9.4.1.5.2. Catch Record

Six indigenous fish species were expected to occur within the study area, with none of the species deemed a potential conservation concern.

A total of five fish species were collected (or observed), two of which were regarded as alien invasive species (*Gambusia affinis* or Mosquitofish and *Micropterus salmoides* or Largemouth Bass). The number of fish collected per site sampled is shown in Table 9-12.

Table 9-12 Fish collected (or observed) within the sampled reaches

Scientific Name	Rietspruit	Steenkoolspruit			Total Catch
	NC1	NC2	NC3	NC4	
Clarias gariepinus	-	-	-	-	0
Enteromius anoplus	-	-	-	-	0
Enteromius paludinosus	-	3	-	-	3

Scientific Name	Rietspruit	Steenkoolspruit			Total Catch
	NC1	NC2	NC3	NC4	
Labeobarbus polylepis	-	-	-	-	0
Pseudocrenilabrus philander	-	7	3	-	10
Tilapia sparrmanii	-	3	-		3
*Micropterus salmoides**	-	1	-	-	1
*Gambusia affinis**	8	16	4	-	28
Number of Species	1	5	2	0	8
Total Catch	1	30	7	0	38
* Alien species; Values in parenthesis indicated observed specimens					

Of the three collected indigenous fish species, two are known to be tolerant to water quality modifications, whilst one (*E. paludinosus* or Straightfin Barb) is regarded as moderately sensitive. A single species (*Gambusia affinis*) was sampled at the Rietspruit reach, whilst five species were collected along the Steenkoolspruit reaches. Along the Steenkoolspruit, most of the fish were collected/observed at the upstream site NC2, with the highest catch (30 specimens) whilst only seven specimens were collected at the downstream Site NC3. No fish were collected at the Steenkoolspruit adjoining tributary Site NC4.

The alien species *G. affinis* (Mosquitofish) dominated the assessed watercourses and was collected at three of the four sites. The Mosquitofish (Figure 9-14) was introduced in South Africa as a mosquito control agent and forage for bass, but has proved to be an aggressive invader species capable of restricting other fish populations by preying on fish larvae (Skelton, 2001). Its occurrence and dominance at Site NC2 can be attributed to its habitat requirements, which were suited at the time of the survey (i.e. slow-flowing water with plant cover).

Figure 9-14: *Gambusia affinis* (Mosquitofish) collected within the assessed watercourses

9.4.1.5.3. Ecological Condition of the Fish Assemblages

The River Ecosystem Monitoring Programme (REMP) uses the Fish Response Assessment Index (FRAI) which is based on the preferences of various fish species as well as the frequency of occurrence. The electro-narcosis technique was applied to sample the available fish species within the project area.

FRAI results for the sampled river reaches are shown in Table 9-13 and discussed below.

Table 9-13: FRAI Results for the current aquatic assessment

Site	FRAI Score (%)	Ecological Category	Description
Rietspruit			
NC1	20.0	E/F	Seriously to Critically Modified
Steenkoolspruit			
NC2	47.8	D	Largely Modified
NC3	26.1	E	Seriously Modified
NC4	20.0	E/F	Seriously to Critically Modified

Of the expected fish species, three are known to be tolerant to water quality modifications and three are intolerant, only one of the intolerant species (*Enteromius paludinosus*) was collected/observed during the current study. Thus, the absence of the two species *Enteromius anoplus* and *Labeobarbus polylepis,* which are intolerant to water quality modifications (and require suitable habitat) suggests the impacted state of the water quality associated with the sampled reaches within the project area.

FRAI results indicate *Seriously to Critically Modified* conditions (Ecological Category E/F) at the Rietspruit Site NC1. At the Steenkoolspruit reaches, the ecological conditions appeared to deteriorate along the longitudinal profile i.e. *Largely Modified* (Ecological Category D) at the upstream Site NC2, *Seriously Modified* (Ecological Category E) at the downstream Site NC3 and *Seriously to Critically Modified* (Ecological Category E/F) at the adjoining tributary of the Steenkoolspruit. However, this may have been a result of the limited depth of sampling due to unsafe conditions at Site NC3.

The biotic integrity for the previous assessment (SAS, 2016) was determined to be *Seriously Modified* (Ecological Category E) at both sites NCC1 and NCC2 (NC2 and NC3 in the present survey). Thus, in the current study, the biotic integrity at Site NC2 had improved since the 2016 study whilst that of Site NC3 remained the same. Only two species were sampled during the 2016 study, namely *G. affinis* and *T. sparrmanii*, compared to three sampled during the current study.

9.4.1.6. Integrated EcoStatus Determination

The EcoStatus is defined as: "*The totality of the features and characteristics of the river and its riparian areas that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services*" (Iversen *et al*., 2000). In essence, the EcoStatus represents an integrated ecological state representing the drivers (hydrology, geomorphology, physico-chemical) and responses (fish, aquatic invertebrates and riparian vegetation; (Kleynhans and Louw, 2008)). The instream biological integrity, as well as the integrated EcoStatus, for the sampled river reaches within the project area were determined below Table 9-14.

Table 9-14: The PES of the reaches under study through the use of the ECOSTATUS4 (Version 1.02; Kleynhans & Louw, 2008)

Site	Response Indices				EcoStatus	
	MIRAI EC	FRAI EC	Instream EC	Riparian Vegetation EC (IHI)	Score	Category
Rietspruit						
NC1	40.2	20.0	32.5	63.7	50.4	D
Steenkoolspruit						
NC2	51.8	47.8	50.3	53.5	52.1	D
NC3	32.1	26.1	29.8	53.5	43.4	D
NC4	42.5	20.0	33.9	53.5	45.1	D

Following integration of the defined ecological conditions obtained for the instream biological integrity (i.e. MIRAI from aquatic ecological invertebrates) and the riparian component (i.e. IHI from riparian vegetation assessment), it was determined that the sampled river reaches along the Rietspruit and Steenkoolspruit systems represented an integrated EcoStatus of *Largely Modified* (Ecological Category D).

In relation to the Recommended Ecological Category (REC), the assessed sections of the Rietspruit and the Steenkoolspruit systems were observed to attain the stipulated Ecological Category of D, as gazetted in April 2016 (*Proposed Classes and Resource Quality Objectives of Water Resources of the Olifants Catchment in Terms of Section 13(1)(a) and (b) of the National Water Act, 1998 (Act No.36 of 1998)*, 2016). It should be noted that the Integrated Unit of Analysis (IUA) referred to for the RECs was that of the Upper Olifants River catchment, i.e., Steenkoolspruit (confluence with the Olifants).

9.5. Groundwater

The groundwater studies were conducted from the collection and review of all groundwater, surface water, geological and Geographical Information Systems (GIS) data and databases.

It should be noted that all groundwater results presented in this section is only based on current results. Previous groundwater results can be found in the groundwater assessment report attached in **Appendix G**.

The groundwater environment of the proposed project area is described below.

9.5.1. Hydrogeology

9.5.1.1. Aquifers

The aquifers at for the Roodekop mining area were conceptualised by Digby Wells (2011) to be composed of four units: the shallow weathered Karoo, the intermediate fractured Karoo, the Dwyka tillite and the fractured igneous basement aquifer. Below a more detailed description of these aquifers, based on (Digby Wells Environmental , 2011) and (GCS, 2014)

9.5.1.1.1. Shallow Weathered Aquifer

The weathered material in the shallow weathered aquifer consists mostly of decomposed and highly weathered coarse-grained sandstones, with shales and siltstones in some areas. The depth of weathering encountered during drilling was observed to be between 6 and 17 mbgl. The sustainability in terms of aquifer yields of the shallow weathered aquifer is dependent on the effective recharge, which is the portion of rainfall that infiltrates through the soil and eventually reaches the saturated zone.

Hodgson (2006) reported that the aquifers in the project area were not high yielding, with the highest reported yield of 5 l/s associated with a dolerite dyke. The typical yields associated with the sedimentary formations were < 0.5 l/s, and in the order of 1 – 2 l/s where dykes were intersected.

The aquifer transmissivity of the weathered material was estimated to be between 0.5 and 1.5 m^2/day.

9.5.1.1.2. Fractured Aquifer

The fractured aquifer consists of an interlaminated sequence of sandstone, shale, carbonaceous shale and coal. The pores within these sediments are well cemented and generally do not allow for any significant permeation of water. the main groundwater movement within this aquifer is therefore along secondary structures such as fractures, cracks and joints. However, not all secondary structures are water bearing. The apertures of water bearing structures open to flow are relatively small and therefore have characteristic low hydraulic conductivities.

Of all the fractured sedimentary layers the coal seams often show the highest hydraulic conductivity. Aquifer tests conducted within this aquifer indicated a low overall hydraulic conductivity.

9.5.1.1.3. Dwyka Tillite

The Dwyka tillite unconformably overlies the basement rocks and, where present, forms a hydraulic barrier between the overlying mining activities and the basement aquifer, due to its low hydraulic conductivity. The aquifer permeability of the Dwyka tillite was estimated between 0.0002 and 0.0148, with mean value of 0.0034 m/d (Digby Wells Environmental, 2011).

9.5.1.1.4. Basement Aquifer

The basement aquifer is composed of Rooiberg felsites, characterised by low yielding fractures. However, higher yields are expected in areas where pre-Karoo diabase intersects the basement aquifer. A yield of 2.5 l/s was measured in a borehole in close proximity to the project area, which was drilled into a diabase intrusion.

The basement aquifer is characterised by low recharge because of the overlying Dwyka Tillite. Higher recharge to the basement aquifer is possible in areas where basement rocks outcrops

9.5.1.2. Aquifer Parameters

9.5.1.2.1. Hydraulic Conductivity

Aquifer parameters were estimated during previous investigations by (Geo Pollution Technologies , 2006) and (Groundwater Square, 2007).

Based on these studies, aquifer permeabilities typically ranges over several orders of magnitude and were approximated as follows (Groundwater Square, 2007):

- Overburden material (10 m/day to 0.001 m/day);
- Fractured rock (0.1 m/day to 0.001 m/day);
- Coarser sediments (0.1 m/day to 0.01 m/day); and
- Coal seams (0.001 m/day to 0.01 m/day).

Aquifer testing was carried out by Digby Wells in 2011 on five monitoring boreholes in the Roodekop mining area. The results are as shown below, based on one step/constant discharge/recovery test suite and four slug tests.

Table 9-15: Aquifer Testing Results-Digby Wells, 2011

Borehole ID	RBH1	RBH2	RBH3	RBH4	RBH5
Aquifer test conducted	Slug test	Slug test	Slug test	Slug test	SDT,CDT, RT
Thickness open to flow based on screen (m)	28	28	16	28	24
Hydraulic conductivity k (m/d)	0.016	0.054	0.004	0.031	-
Transmissivity T (m²/d)	0.44	1.51	0.06	0.88	9.3

A total of six new monitoring boreholes were drilled by GCS in close vicinity of the NCC discard dump (GCS, 2014). Deep and shallow wells were drilled to depths of 46 m and 15 m, respectively. No major water strikes were encountered during drilling, only seepage. Seepage was generally found at a depth of 10 to 12 mbgl. Constant rate pump tests with recovery measurements were conducted on the deep boreholes (i.e., NCCB9D, NCCB10D and

NCCB11D). The shallower boreholes were pumped in order to measure their recovery. The results of the aquifer pump tests are shown in Table 9-16 and Table 9-17 The results showed the boreholes were low yielding. Borehole NCCB11 had a poor recovery even after 13 hours, further substantiating a generally low yielding aquifer.

Table 9-16: Results of Historical Aquifer Tests- GCS, 2014

BH number	Constant discharge test duration (min)	Pump rate/ Yield l/s	Initial WL	Recovery Period (min)	Recovery %	Transmissivity (m^2/d)	
						Early T	Late T
NCCB9D	60	1.25	3.14	960	87.22	1.7	0.33
NCCB10D	20	0.62	6.85	900	96.2	4	0.26
NCCB11D	7	1.3	10.4	780	32.1	0.95	_

Table 9-17: Results of the Recovery Tests of Shallow Boreholes-GCS, 20141

BH number	Initial WL	Recovery Period (min)	Recovery %	Transmissivity (m^2/d)
NCCB9S	3.30	540	64.96	0.12
NCCB10S	7.06	300	96.97	4
NCCB11S	3.5	70	100	0.2

Table 9-18 below shows a comparison between the aquifer tests done as part of all available previous studies. The estimated hydraulic conductivity from the aquifer tests correlated well and show aquifer hydraulic conductivity values to be in the expected range of 10^{-1} to 10^{-3}m/d for Karoo aquifers. The values below, based on all previous studies, show the overall low potential of the aquifers, as is also stated in (Hodgson, 2006)

Table 9-18: Comparison of Aquifer Testing Results

Aquifer parameter	Digby Wells, 2011	Groundwater Square (2007)	GPT (2006)	GCS (2012)
Hydraulic conductivity (m/d)	0.004 – 0.05	0.001 - 0.05	0.002 - 0.02	0.006 - 0.2

9.5.1.2.2. Groundwater Recharge

Groundwater recharge in the Karoo fractured aquifer ranges from 1 to 3%, based on previous experience and other studies within the Karoo coal fields. For the NCC area, recharge from rainfall to the weathered aquifer was estimated to be ~3% of MAP (GPT, 2006). Studies by Hodgson (2006) and Groundwater Square (2007) propose a range of recharge values for NCC based on different mining methods and coal seam depths. Based on the various previous studies, the estimated recharge value for NCC approaches ~2% of annual rainfall and as such, a recharge value of 2.3% MAP was used for the latest hydrogeological study (GCS, 2014).

9.5.1.3. Groundwater Use / Potential Groundwater Receptors

The Ecca Group is not known for the development of major aquifers, but occasional high-yielding boreholes may be present. The aquifers that occur in the area can therefore be classified as minor aquifers (low yielding), but of high importance (Parsons, 1995). Groundwater use in the area is mainly for domestic and stock watering purposes. In general, only about 30% of the boreholes are in use and where in use they serve as a sole source of reliable and clean domestic water (SRK Consulting , 2019).

9.5.1.3.1. Current Data

Based on the updated hydrocensus (Figure 9-15) the closest groundwater users are two boreholes approximately 1 200 m northeast of the proposed mining area. In addition, an unused spring is present in the same area close to the Steenkoolspruit. This confirms the low density of groundwater use in the vicinity of Middeldrift.

Please refer to Appendix B for details of the current hydrocensus survey.

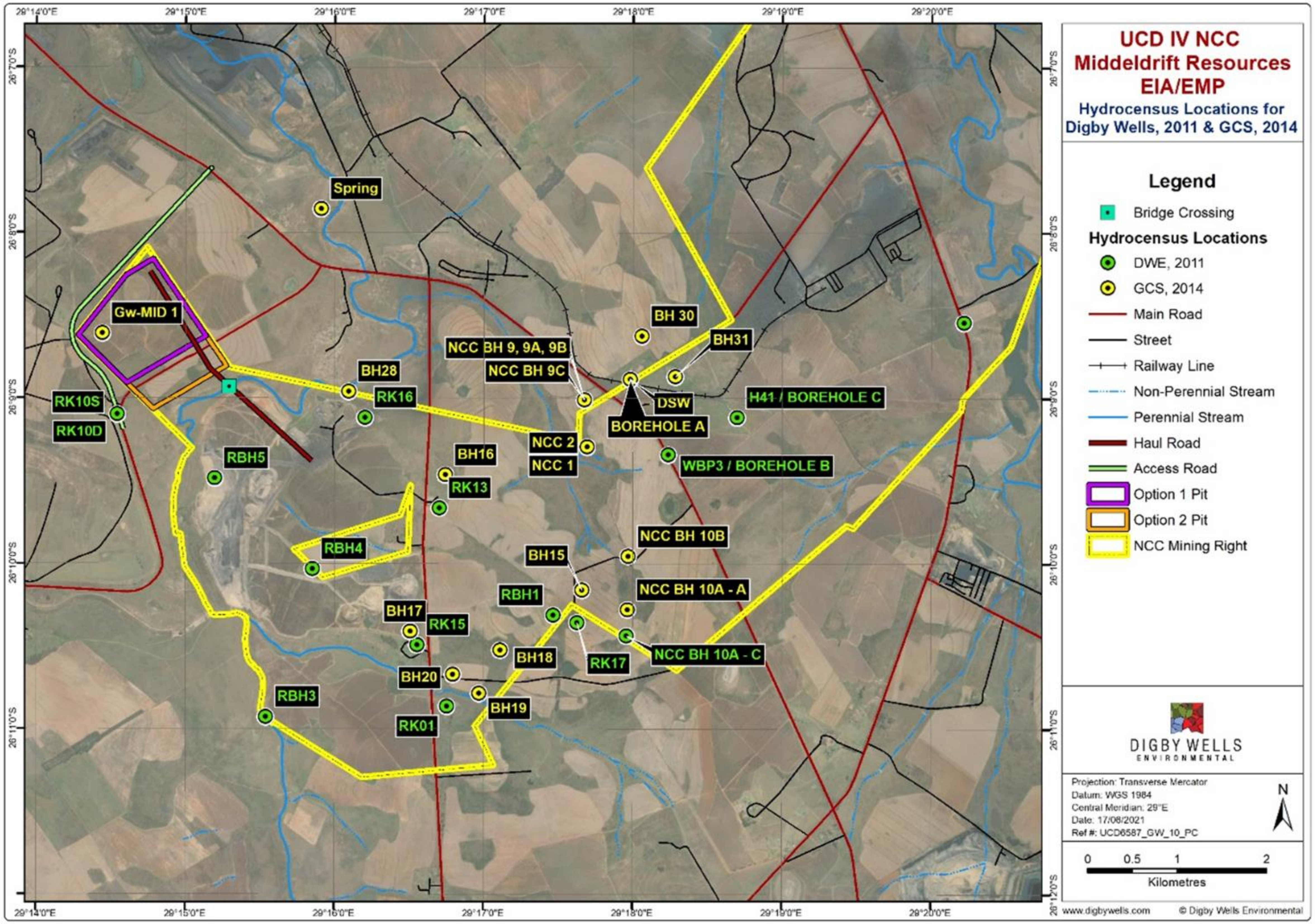


Figure 9-15: Historical Hydrocensus Locations for Digby Wells, 2011 and GCS, 2014 (SRK, 2016)

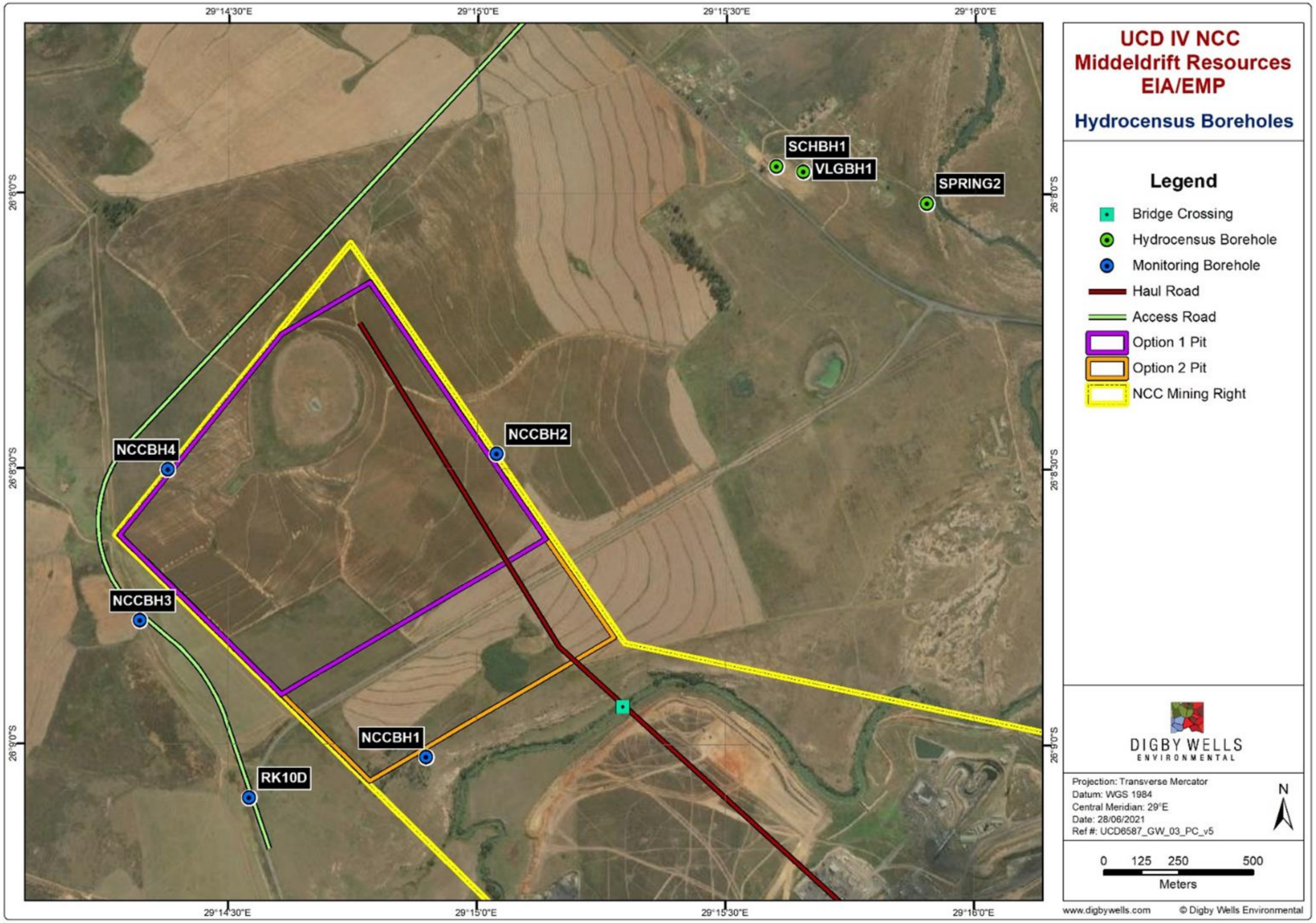


Figure 9-16: Current Hydrocensus Locations and Newly Drilled Boreholes

9.5.1.4. Groundwater Levels

9.5.1.4.1. Current Data

Based on the most recent ground water level monitoring data for the NCC mining area, the Roodekop mining area; and data from the recent hydrocensus and the newly drilled boreholes around Middeldrift, a 98% correlation between groundwater levels and surface elevations was derived, with exception of two boreholes (Borehole A and B – these are likely drilled into the nearby Vaalkranz South (VKS) mine underground void, as they are similar in depth as what was indicated for the VKS underground in (GCS, 2014). This would indicate that regionally groundwater flow directions follow topography, with exceptions of areas with underground voids, where groundwater levels can be significantly drawn down. These points would divert significantly from this correlation.

Groundwater levels measured for 2020 and in the first quarter of 2021 are provided in Table 9-18. The levels ranged between 0 mbgl and 83.9 mbgl with an average level of 10.35 mbgl, in line with previous studies.

The groundwater elevation trend is presented in Figure 9-17. The trends indicate relatively stable groundwater elevations with seasonal variations present in the majority of the boreholes. Only boreholes BHA, BHB and NCCBH10B have shown groundwater depths outside expected levels, likely related to underground mining.

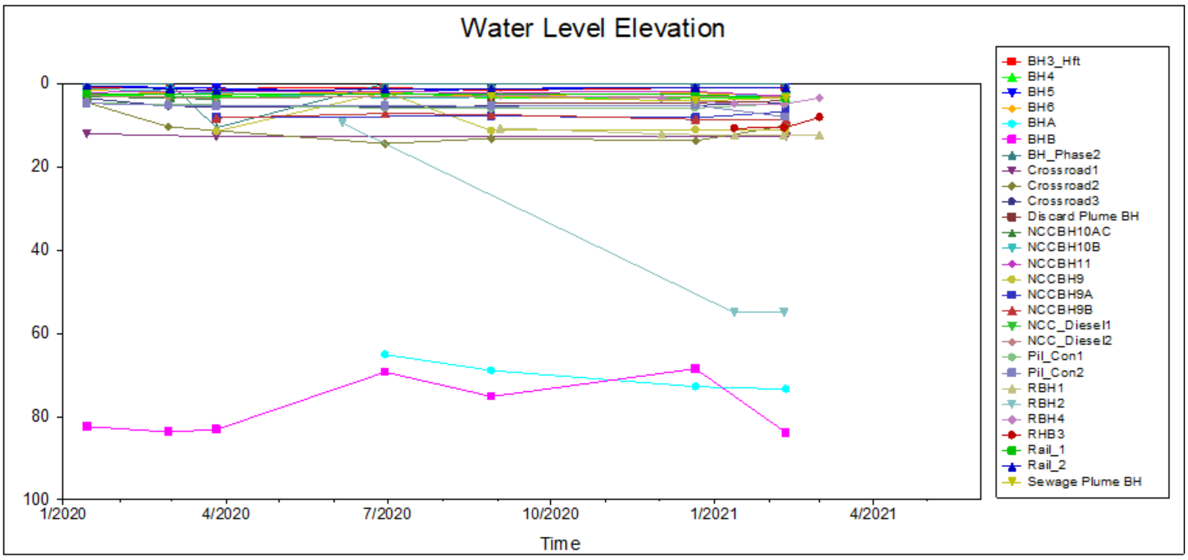


Figure 9-17: Water Level Depth Trend (in mbgl)

Table 9-19: Groundwater Level Measurements

Site ID	Ave. Water Level	Min. Water Level	Max. Water Level	Q1 2020 Water level (mbgl)	Q2 2020 Water level (mbgl)	Q3 2020 Water level (mbgl)	Q4 2020 Water level (mbgl)	Q1 2021 Water level (mbgl)
RBH1	11.68	10.65	12.31	-	-	10.65	12.09	12.31
RBH2	9.49	9.49	9.49	-	9.49	-	-	Dry
RHB3	7.28	2.69	9.58	-	2.69	9.55	9.58	-
RBH4	3.23	2.74	3.55	-	-	2.74	3.55	3.4
RBH5	-	-	-	-	-	-	-	Destroyed
NCC_Diesel1	3.18	2.91	3.29	3.29	3.23	2.91	3.28	-
NCC_Diesel2	3.19	2.97	3.36	3.36	3.17	2.97	3.25	-
NCCBH11	2.2	1.9	3.02	1.99	1.99	2.12	1.9	3.02
NCCBH9	9.43	2.05	11.46	11.46	2.05	11.29	11.08	11.29
GW_MID1				-	-	-	-	-
Crossroad1	12.75	12.73	12.82	12.73	-	-	-	12.82
Crossroad2	12.53	10.06	14.38	11.31	14.38	13.18	13.7	10.06
Crossroad3	5.3	4.73	5.63	5.52	5.63	5.42	5.2	4.73
Pil_Con1	5.53	4.78	6	5.12	5.88	6	5.88	4.78
Pil_Con2	5.87	5.2	7.97	5.29	5.38	5.5	5.2	7.97
BHA	70.06	65.11	73.41	-	65.11	68.93	72.8	73.41
BHB	76	68.5	83.88	83.1	69.3	75.2	68.5	83.88

Site ID	Ave. Water Level	Min. Water Level	Max. Water Level	Q1 2020 Water level (mbgl)	Q2 2020 Water level (mbgl)	Q3 2020 Water level (mbgl)	Q4 2020 Water level (mbgl)	Q1 2021 Water level (mbgl)
BHC	-	-	-	-	-	-	-	-
NCCBH9A	7.71	6.74	8.2	8.15	-	7.76	8.2	6.74
NCCBH9B	8	7.18	8.6	8.26	7.18	7.42	8.6	8.54
NCCBH9C	-	-	-	-	-	-	-	-
NCCBH10B	2.85	2.26	3.37	2.26	3.37	-	-	2.91
Rail_1	2.79	2.48	3.52	2.71	2.48	2.59	2.65	3.52
Rail_2	1.23	0.93	1.56	1.56	1.39	1.31	0.93	0.98
NCCBH10AB	-	-	-	-	-	-	-	-
NCCBH10AC	-	-	-	-	-	3.75	-	-
BH2_Hft	-	-	-	-	-	-	-	-
BH3_Hft	1.17	0.98	1.59	1.2	0.98	1.59	1	1.06
BH4	3.12	1.93	3.55	3.29	1.93	3.55	3.48	3.36
BH5	1.26	0.91	2.08	1.07	2.08	1.16	1.08	0.91
BH6	2.6	2.23	3.12	2.48	2.23	2.93	2.24	3.12
BH_Phase2	2.12	0	10.59	10.59	0	0	0	0
Sewage Plume BH	3.54	3.08	4.2	-	-	3.08	4.2	3.33
Discard Plume BH	4.46	4.12	4.66	-	-	4.66	4.6	4.12

Table 9-20: Groundwater Level Measurements

Site ID	Ave. Water Level	Min. Water Level	Max. Water Level	Q1 2020 Water level (mbgl)	Q2 2020 Water level (mbgl)	Q3 2020 Water level (mbgl)	Q4 2020 Water level (mbgl)	Q1 2021 Water level (mbgl)
RBH1	11.68	10.65	12.31	-	-	10.65	12.09	12.31
RBH2	9.49	9.49	9.49	-	9.49	-	-	Dry
RHB3	7.28	2.69	9.58	-	2.69	9.55	9.58	-
RBH4	3.23	2.74	3.55	-	-	2.74	3.55	3.4
RBH5	-	-	-	-	-	-	-	Destroyed
NCC_Diesel1	3.18	2.91	3.29	3.29	3.23	2.91	3.28	-
NCC_Diesel2	3.19	2.97	3.36	3.36	3.17	2.97	3.25	-
NCCBH11	2.2	1.9	3.02	1.99	1.99	2.12	1.9	3.02
NCCBH9	9.43	2.05	11.46	11.46	2.05	11.29	11.08	11.29
GW_MID1				-	-	-	-	-
Crossroad1	12.75	12.73	12.82	12.73	-	-	-	12.82
Crossroad2	12.53	10.06	14.38	11.31	14.38	13.18	13.7	10.06
Crossroad3	5.3	4.73	5.63	5.52	5.63	5.42	5.2	4.73
Pil_Con1	5.53	4.78	6	5.12	5.88	6	5.88	4.78
Pil_Con2	5.87	5.2	7.97	5.29	5.38	5.5	5.2	7.97
BHA	70.06	65.11	73.41	-	65.11	68.93	72.8	73.41
BHB	76	68.5	83.88	83.1	69.3	75.2	68.5	83.88

Site ID	Ave. Water Level	Min. Water Level	Max. Water Level	Q1 2020 Water level (mbgl)	Q2 2020 Water level (mbgl)	Q3 2020 Water level (mbgl)	Q4 2020 Water level (mbgl)	Q1 2021 Water level (mbgl)
BHC	-	-	-	-	-	-	-	-
NCCBH9A	7.71	6.74	8.2	8.15	-	7.76	8.2	6.74
NCCBH9B	8	7.18	8.6	8.26	7.18	7.42	8.6	8.54
NCCBH9C	-	-	-	-	-	-	-	-
NCCBH10B	2.85	2.26	3.37	2.26	3.37	-	-	2.91
Rail_1	2.79	2.48	3.52	2.71	2.48	2.59	2.65	3.52
Rail_2	1.23	0.93	1.56	1.56	1.39	1.31	0.93	0.98
NCCBH10AB	-	-	-	-	-	-	-	-
NCCBH10AC	-	-	-	-	-	3.75	-	-
BH2_Hft	-	-	-	-	-	-	-	-
BH3_Hft	1.17	0.98	1.59	1.2	0.98	1.59	1	1.06
BH4	3.12	1.93	3.55	3.29	1.93	3.55	3.48	3.36
BH5	1.26	0.91	2.08	1.07	2.08	1.16	1.08	0.91
BH6	2.6	2.23	3.12	2.48	2.23	2.93	2.24	3.12
BH_Phase2	2.12	0	10.59	10.59	0	0	0	0
Sewage Plume BH	3.54	3.08	4.2	-	-	3.08	4.2	3.33
Discard Plume BH	4.46	4.12	4.66	-	-	4.66	4.6	4.12

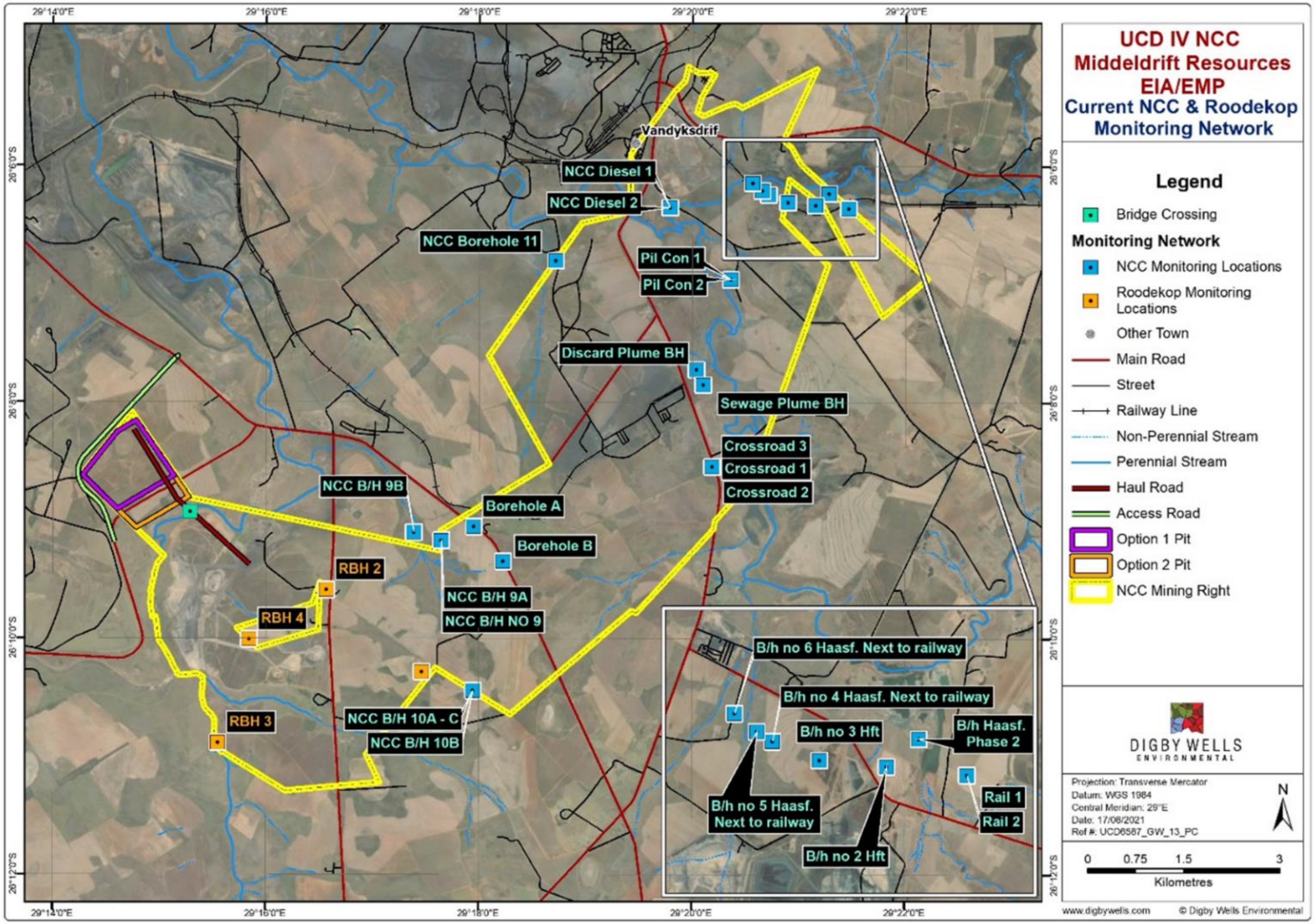


Figure 9-18: Current NCC and Roodekop Monitoring Boreholes (Ankone Consulting, 2020)

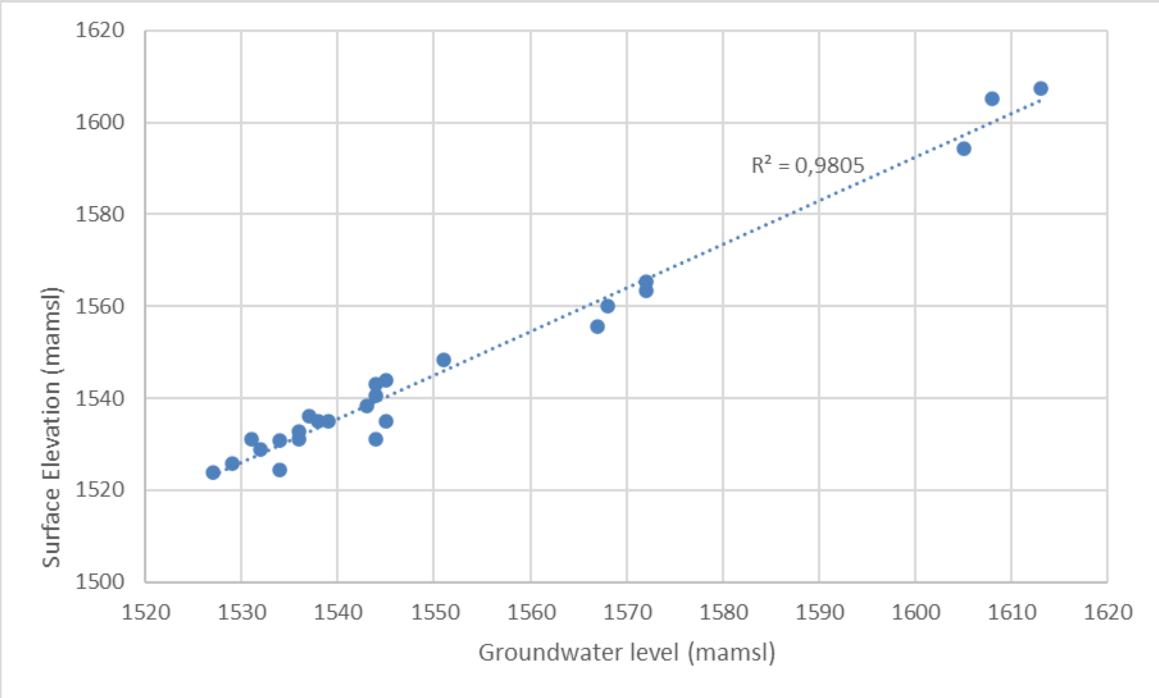


Figure 9-19: Bayesian Correlation - NCC and Roodekop section

However, for Middeldrift the Bayesian correlation cannot be directly applied. Due to the current, surrounding mining activities, groundwater flow is expected to be mainly towards the surrounding underground mine voids, depending on active/inactive mining, mining depth and void flood level. Groundwater levels within the project area are shallowest near the Steenkoolspruit, which acts as a source and locally recharges the aquifer.

9.5.1.5. Groundwater Quality

9.5.1.5.1. Hydrogeochemical Characterisation

The Piper (Figure 9-20) and Expanded Durov diagrams (Figure 9-21) are presented to discuss the hydrogeochemical characterisation of the monitoring locations. The Piper diagram is particularly useful in creating groundwater facies that groups groundwater of similar chemistry into one section. The expanded Durov diagram improves the Piper diagram by displaying important hydrochemical process, such as ion exchange, simple dissolution and mixing of waters of different qualities (Nadiri. A, Moghaddam, A.A, Fijani. E. , 2013).

The average sample distribution on the Piper diagram plot shows varied water signatures within the study area. The Trilinear diagram shows that calcium and magnesium are more dominant over the alkalis (sodium and potassium). In addition, some samples show permanent hardness dominated by sulphate and calcium/magnesium (NCCBH11). Most samples show temporary hardness dominated by bicarbonate. Most samples do not have a dominant cation; however, the dominant anion signatures are shared between bicarbonate and sulphate. Only two samples (BH6 and BH5) show chloride dominance. The samples dominated by sulphate as the dominant anion can be attributed to influence from acid rock drainage from the exposed coal. The samples dominated by the bicarbonate anion can be attributed to background water signature in the area, possibly from the interaction with the underlying dolomites. Generally, waters with bicarbonate are considered freshly recharged.

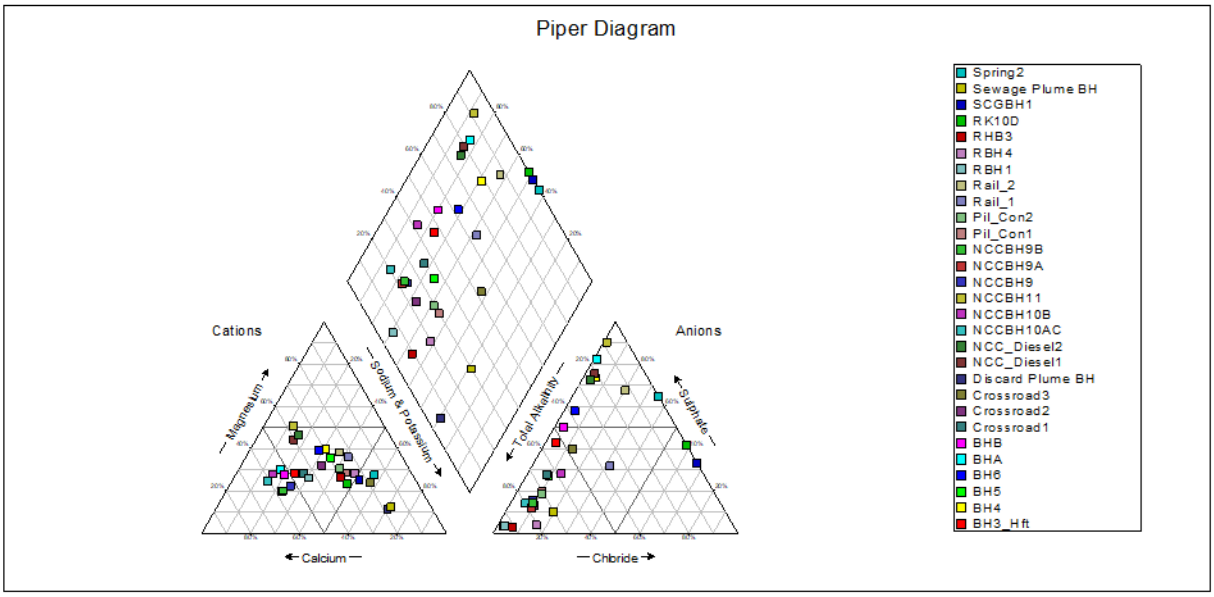


Figure 9-20: Piper Diagram for Monitoring Locations

The expanded Durov Diagram shows waters which plot in the following facies:

- Calcium/Magnesium-bicarbonate (Ca/Mg-HCO_3), these waters represent freshly recharged water into the aquifer;
- Magnesium-sulphate (Mg-SO_4), this signature is associated with some acid rock drainage influence on the groundwater; and
- Some samples plot within the sodium-bicarbonate (Na-HCO_3), sodium-sulphate (Na-SO_4), magnesium-chloride (Mg-Cl) and sodium-Chloride (Na-Cl). These signatures arise from the interaction between country rock and groundwater.

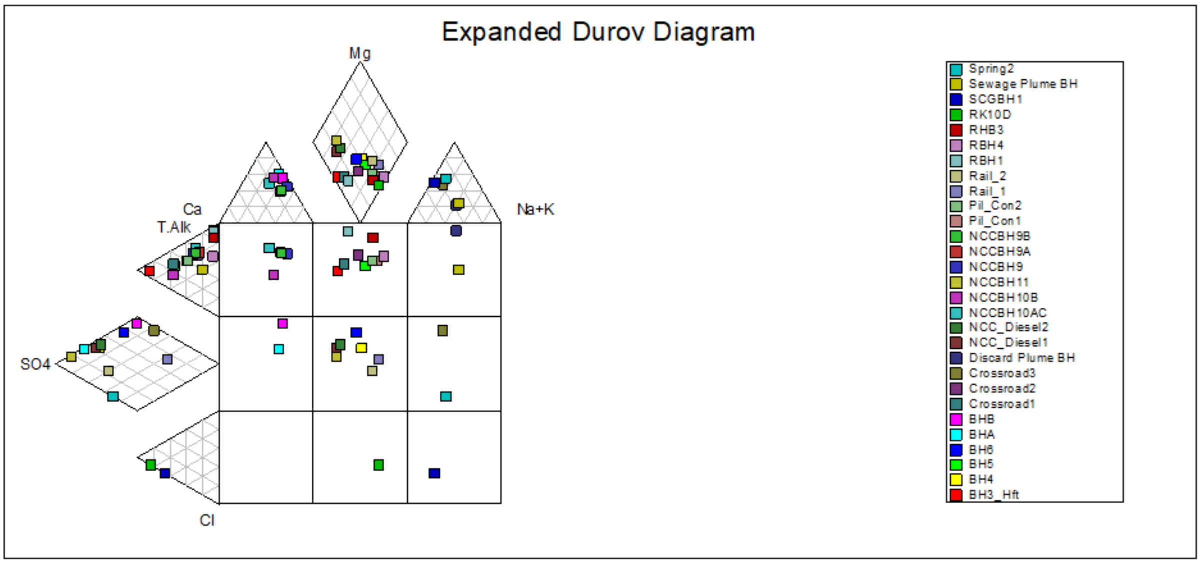


Figure 9-21: Expanded Durov Diagram for Monitoring Locations

9.5.1.5.2. Comparison with SAWQG: Drinking water

As the surrounding area is dominated by farming and farm houses the samples were compared to South African Water Quality Guidelines (SAWQG): Drinking Water (DWAF, 1996). Table 9-21 summarises the results from the monitoring points in 2020:

- The pH in most of the sampling points is within the SAWQG: Drinking waters ideal limit, except Spring 2 which was collected during the hydrocensus. The spring has a pH of 5.23;
- Generally, most analytes are within the ideal limit with a few exceedances above the unacceptable limit;
- BHA, BHB, BH4, BH6, NCC_Diesel 1, NCC_Diesel 2 and NCCBH11 are amongst the relatively most contaminated sampling points, showing exceedances above the unacceptable limit in multiple analytes such as electrical conductivity, total dissolved solids, calcium magnesium and sulphate; and
- Arsenic, cadmium, chromium, lead, zinc and zircon were not included in the table as most of the samples were not assessed for these analytes.

Table 9-21: Monitoring Borehole Samples Benchmarked Against the SAWQG Drinking Water Standards

Sample ID	Date	pH	EC mS/m	TDS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Cl mg/L	SO4 mg/L	F mg/L	Al mg/L	Fe mg/L	Mn mg/L
Ideal		6	70	450	32	30	100	50	100	200	1	0.15	0.1	0.05
Acceptable		9	150	1000	80	50	200	100	200	400	1.5	0.5	0.3	0.1
Unacceptable		<6 or >9	>150	>1000	>80	>50	>200	>100	>200	>400	>1.5	>0.5	>0.3	>0.1
RBH1	2021/03/01	7.6	27.4	138.5	23.0	8.4	17.3	2.7	3.2	4.2	<0.09	<0.01	0.10	0.05
RHB3	2021/03/01	7.1	11.6	55.0	5.9	3.2	8.1	3.1	2.5	1.5	0.35	<0.01	<0.01	0.07
RBH4	2021/03/01	9.2	13.2	68.7	5.0	3.7	7.9	6.8	3.8	1.2	0.11	<0.01	0.12	<0.01
NCC_Diesel1	2020/03/26	6.5	140.0	969.6	131.0	81.4	50.3	4.4	22.1	573.0	0.1	<0.01	0.09	0.35
NCC_Diesel2	2020/03/26	6.6	103.0	650.9	82.4	58.6	42.2	2.3	17.9	348.0	0.12	<0.01	0.24	1.25
NCCBH11	2020/03/26	6.2	227.0	2087.0	228.0	207.0	76.3	15.7	15.1	1444.0	1.84	<0.01	10.20	12.1
NCCBH9	2020/03/26	7.3	40.1	225.7	38.9	9.9	23.9	1.6	14.5	33.6	0.11	<0.01	0.02	0.02
Crossroad1	2020/03/26	7.5	35.3	196.2	31.3	12.2	17.7	4.2	11.1	49.3	0.76	<0.01	0.01	0.41
Crossroad2	2020/03/26	7.4	19.3	107.4	14.8	6.7	13.7	3.0	8.4	14.7	0.29	0.01	0.03	<0.01
Crossroad3	2020/03/26	7.1	21.7	101.8	3.3	3.4	25.5	0.9	9.7	44.9	0.24	<0.01	<0.01	0.02
Pil_Con1	2020/03/26	8.7	16.6	79.0	10.3	5.8	11.4	2.0	8.1	2.0	0.19	<0.01	0.10	<0.01
Pil_Con2	2020/03/26	7.9	18.5	88.9	11.7	7.6	10.2	2.0	11.0	5.1	0.17	<0.01	0.28	0.01
BHB	2020/03/26	7.6	28.9	149.3	30.6	7.2	13.5	4.8	5.4	4.0	0.2	<0.01	<0.01	<0.01
NCCBH9A	2020/03/26	7.3	28.6	161.4	33.3	5.0	11.6	2.3	9.1	11.6	0.1	<0.01	<0.01	0.04
NCCBH9B	2020/03/26	7.3	25.6	141.3	28.9	5.5	8.1	2.1	8.7	7.9	0.09	<0.01	<0.01	0.03
NCCBH10B	2020/03/26	7.5	69.3	307.3	54.0	17.0	12.5	17.4	20.0	69.1	<0.09	<0.01	0.02	0.11
Rail_1	2020/03/26	7.0	42.5	229.3	17.7	16.9	35.4	3.2	46.1	63.3	0.26	<0.01	0.30	0.03
Rail_2	2020/03/26	7.1	78.8	486.8	39.4	37.0	65.5	3.3	63.1	235.0	0.1	<0.01	<0.01	0.7

Sample ID	Date	pH	EC mS/m	TDS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Cl mg/L	SO4 mg/L	F mg/L	Al mg/L	Fe mg/L	Mn mg/L
NCCBH10AC	2020/03/26	7.1	43.3	240.1	54.0	13.3	12.1	4.8	8.9	25.0	<0.09	<0.01	<0.01	<0.01
BH3_Hft	2020/03/26	8.1	51.8	313.7	52.1	18.7	26.0	3.3	8.1	119.0	0.11	<0.01	<0.01	<0.01
BH4	2020/03/26	7.6	147.0	950.8	91.8	75.2	104.0	6.9	31.3	540.0	0.21	<0.01	<0.01	<0.01
BH5	2020/03/26	7.7	94.0	568.5	61.6	44.2	77.2	5.6	32.5	174.0	0.36	<0.01	0.01	0.25
BH6	2020/03/26	7.7	135.0	875.5	99.3	69.5	84.3	5.6	22.7	421.0	0.2	<0.01	0.46	0.99
BH_Phase2	2020/03/26	7.9	57.6	353.9	56.0	20.9	32.3	3.6	11.8	146.0	0.24	<0.01	0.21	0.06
RBH 1	2020/06/05	7.7	19.6	95.6	16.3	6.2	10.7	2.7	11.5	7.2	<0.09	<0.01	<0.01	-
RBH 3	2020/06/05	7.3	12.6	52.2	5.6	2.9	8.1	2.6	2.8	-0.5	0.21	<0.01	<0.01	-
RBH 4	2020/06/05	7.4	12.7	75.7	5.5	3.6	8.6	6.9	6.5	-0.5	<0.09	<0.01	0.01	-
NCC_Diesel1	2020/06/29	7.1	145.0	1062.1	140.0	96.9	66.2	4.7	21.8	629.0	<0.09	<0.01	0.09	0.24
NCC_Diesel2	2020/06/29	7.1	122.0	890.5	113.0	84.9	57.0	2.7	20.8	517.0	<0.09	0.11	0.13	0.06
NCCBH11	2020/06/29	7.2	42.8	240.8	42.7	10.5	27.3	2.2	13.6	52.5	<0.09	<0.01	<0.01	<0.01
NCCBH9	2020/06/29	7.4	43.1	244.9	43.0	10.6	27.6	2.2	13.9	52.0	<0.09	<0.01	<0.01	<0.01
Crossroad2	2020/06/29	7.5	18.3	90.3	10.4	5.8	14.4	3.0	7.0	5.2	0.22	0.02	0.01	<0.01
Crossroad3	2020/06/29	7.0	18.4	92.2	10.9	6.3	13.6	3.0	6.9	7.9	0.22	<0.01	0.09	<0.01
Pil_Con1	2020/06/29	7.7	21.0	98.0	11.9	7.7	12.8	2.9	10.8	7.2	<0.09	<0.01	0.28	0.02
Pil_Con2	2020/06/29	7.4	28.3	140.2	20.8	12.1	12.5	3.1	7.9	29.3	<0.09	<0.01	0.20	0.03
BHA	2020/06/29	7.0	351.0	3415.2	589.0	196.0	169.0	10.2	20.8	2286.0	1.41	<0.01	0.18	1.04
BHB	2020/06/29	7.1	205.0	1661.2	283.0	99.0	90.8	7.9	13.0	1058.0	0.21	<0.01	<0.01	0.64
NCCBH9B	2020/06/29	7.3	43.0	244.2	43.5	10.5	27.4	2.1	13.1	55.3	<0.09	<0.01	<0.01	<0.01
NCCBH10B	2020/06/29	7.4	80.2	426.9	64.5	17.8	8.3	12.2	40.0	35.8	<0.09	<0.01	0.03	0.1
Rail_1	2020/06/29	7.0	42.6	223.6	17.3	15.8	37.4	3.3	48.6	55.7	0.2	<0.01	0.05	0.08

Sample ID	Date	pH	EC mS/m	TDS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Cl mg/L	SO4 mg/L	F mg/L	Al mg/L	Fe mg/L	Mn mg/L
Rail_2	2020/06/29	7.1	68.5	411.4	29.6	30.9	57.9	2.4	62.6	202.0	<0.09	<0.01	0.09	0.18
BH3_Hft	2020/06/29	7.7	56.3	344.1	55.0	19.3	35.8	3.8	13.6	130.0	0.1	<0.01	0.08	0.05
BH4	2020/06/29	7.7	56.2	340.7	55.1	19.3	36.1	3.8	14.3	129.0	0.1	-0.01	0.09	0.06
BH5	2020/06/29	7.8	55.7	338.0	55.0	18.9	35.5	3.7	13.7	127.0	<0.09	-0.01	0.10	0.06
BH6	2020/06/29	8.0	55.7	341.7	56.0	19.7	36.5	3.8	13.6	129.0	0.1	-0.01	0.13	0.06
BH_Phase2	2020/06/29	7.6	56.6	351.2	54.9	19.6	37.5	4.1	15.9	134.0	-0.09	-0.01	<0.01	0.04
NCC_Diesel1	2020/08/28	7.1	146.0	1055.5	140.0	94.2	62.0	4.8	52.1	598.9	<0.09	-0.01	<0.01	0.3
NCC_Diesel2	2020/08/28	7.3	131.0	937.7	119.0	85.3	57.3	3.3	19.4	558.0	<0.09	-0.01	<0.01	0.03
NCCBH11	2020/08/28	7.8	42.5	213.3	38.9	11.1	20.8	2.5	10.1	29.6	0.09	-0.01	<0.01	0.01
NCCBH9	2020/08/28	7.9	40.4	217.9	39.2	11.1	21.8	2.4	10.4	24.5	<0.09	-0.01	<0.01	0.01
Crossroad2	2020/08/28	7.5	14.4	80.7	9.0	6.3	11.9	3.0	3.3	3.8	0.33	0.02	0.01	<0.01
Crossroad3	2020/08/28	7.4	17.3	90.5	11.0	6.3	13.2	3.0	8.1	3.9	0.35	0.06	0.03	<0.01
Pil_Con1	2020/08/28	7.7	30.7	163.0	23.7	14.8	10.5	3.4	6.6	37.4	<0.09	-0.01	<0.01	<0.01
Pil_Con2	2020/08/28	8.0	27.8	142.7	18.7	13.5	12.0	3.4	6.0	25.1	<0.09	<0.01	<0.01	<0.01
BHA	2020/08/28	7.4	34.6	188.6	24.4	12.1	23.9	8.0	7.5	13.9	0.11	0.06	0.73	0.16
BHB	2020/08/28	7.6	40.6	226.4	35.9	12.3	24.9	6.6	10.0	26.5	0.09	<0.01	0.13	0.04
NCCBH9A	2020/08/28	7.8	40.2	216.9	39.2	11.1	20.9	2.5	10.0	25.2	<0.09	<0.01	<0.01	0.01
NCCBH9B	2020/08/28	7.7	40.6	215.8	40.0	11.1	20.7	2.5	10.2	26.6	<0.09	<0.01	<0.01	0.03
Rail_1	2020/08/28	7.3	42.4	207.2	16.0	16.1	33.9	3.4	46.5	59.4	0.25	<0.01	0.08	0.12
Rail_2	2020/08/28	7.4	63.0	383.3	24.6	28.3	58.8	2.6	54.7	184.0	<0.09	<0.01	<0.01	0.58
BH3_Hft	2020/08/28	8.2	49.9	278.8	43.2	17.0	26.9	3.6	6.8	98.4	0.1	<0.01	0.02	<0.01
BH4	2020/08/28	7.8	155.0	1077.3	101.0	85.8	127.0	7.2	30.3	622.0	0.2	<0.01	0.02	<0.01

Sample ID	Date	pH	EC mS/m	TDS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Cl mg/L	SO4 mg/L	F mg/L	Al mg/L	Fe mg/L	Mn mg/L
BH5	2020/08/28	7.8	104.0	602.1	60.2	50.0	88.7	6.0	38.3	146.0	0.36	<0.01	<0.01	0.44
BH6	2020/08/28	7.8	155.0	1077.7	102.0	86.3	127.0	7.1	31.0	637.0	0.21	<0.01	0.03	<0.01
BH_Phase2	2020/08/28	7.9	57.0	324.1	46.4	19.9	35.3	4.2	13.6	121.0	0.32	<0.01	0.01	0.12
Sewage Plume BH	2020/08/28	8.2	20.1	98.0	6.1	2.1	31.4	2.2	1.7	-0.5	1.71	<0.01	<0.01	<0.01
Discard Plume BH	2020/08/28	8.1	20.8	106.4	7.0	2.4	31.7	2.1	1.8	2.7	1.62	<0.01	<0.01	<0.01
RBH 1	2020/12/02	7.7	20.0	92.8	16.0	6.1	10.6	2.2	10.1	2.0	0.12	<0.01	<0.01	0.13
RBH 3	2020/12/02	7.0	13.6	63.4	6.4	4.0	6.5	4.4	1.9	1.8	0.53	<0.01	0.17	0.13
RBH 4	2020/12/02	7.0	11.9	63.9	4.9	3.3	6.5	6.5	3.8	-0.5	0.22	<0.01	0.13	<0.01
NCC_Diesel1	2020/12/02	6.6	148.0	1155.2	151.0	98.6	66.2	4.5	18.4	709.0	-	<0.01	-1.00	-
NCC_Diesel2	2020/12/02	6.7	135.0	979.4	119.0	94.1	59.5	2.5	18.4	580.0	-	<0.01	-1.00	-
NCCBH11	2020/12/02	6.7	232.0	2080.1	241.0	198.0	86.1	16.2	14.2	1426.0	-	<0.01	-1.00	-
NCCBH9	2020/12/02	7.2	40.0	212.6	43.6	10.8	19.4	2.0	9.3	19.1	-	<0.01	-1.00	-
Crossroad2	2020/12/02	7.2	18.8	92.0	9.0	6.5	17.7	2.7	6.1	5.5	-	<0.01	<0.01	-
Crossroad3	2020/12/02	7.1	19.6	92.6	10.9	7.4	13.8	2.7	5.9	5.7	-	<0.01	<0.01	-
Pil_Con1	2020/12/02	8.8	57.2	330.4	2.4	2.5	121.0	0.8	20.8	70.6	-	<0.01	<0.01	-
Pil_Con2	2020/12/02	7.8	29.8	159.7	18.3	10.2	27.1	2.8	8.6	26.6	-	<0.01	<0.01	-
BHA	2020/12/02	7.3	28.0	135.6	22.8	8.2	16.3	3.7	4.4	3.4	-	<0.01	<0.01	-
BHB	2020/12/02	8.0	31.4	152.7	23.7	9.6	18.8	4.4	4.8	3.0	-	<0.01	<0.01	-
NCCBH9A	2020/12/02	7.5	41.9	232.9	45.2	12.1	20.0	2.2	13.3	29.7	-	<0.01	<0.01	-
NCCBH9B	2020/12/02	7.5	40.5	213.9	43.6	10.8	19.7	2.1	9.5	20.1	-	<0.01	<0.01	-
Rail_1	2020/12/02	6.5	42.5	223.0	18.0	16.5	35.1	3.0	43.8	56.8	-	<0.01	<0.01	-

Sample ID	Date	pH	EC mS/m	TDS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Cl mg/L	SO4 mg/L	F mg/L	Al mg/L	Fe mg/L	Mn mg/L
Rail_2	2020/12/02	6.6	73.2	467.4	39.0	33.0	62.0	3.1	47.2	262.0	-	<0.01	<0.01	-
BH3_Hft	2020/12/02	7.9	48.0	289.1	45.5	18.2	27.1	3.2	7.6	101.0	-	<0.01	<0.01	-
BH4	2020/12/02	7.5	162.0	1180.7	103.0	95.1	125.0	7.0	29.8	721.0	-	<0.01	<0.01	-
BH5	2020/12/02	7.3	248.0	1548.6	156.5	132.0	238.0	10.2	111.0	285.0	-	<0.01	<0.01	-
BH6	2020/12/02	7.5	163.0	1092.2	120.0	97.0	120.0	6.8	27.1	485.0	-	<0.01	<0.01	-
BH_Phase2	2020/12/02	7.9	53.7	327.4	48.8	19.1	34.3	3.6	12.8	118.0	-	<0.01	<0.01	-
Sewage Plume BH	2020/12/02	8.1	17.6	92.7	6.1	3.0	26.1	1.5	-0.5	2.6	-	0.79	<0.01	-
Discard Plume BH	2020/12/02	8.1	17.6	78.6	4.5	1.8	23.7	1.5	-0.5	-0.5	-	0.85	<0.01	-

9.5.1.5.3. Groundwater Quality Trend Analysis Compared to the SAWQG Guidelines

The water quality trends from the beginning of 2020 to the beginning of 2021 are presented in Figure 9-22 to Figure 9-26. The findings are summarised below:

- All samples were compliant with the SAWQG for drinking water in 2020 with regards to pH. NCCBH11 was the only exception in the beginning of 2020. In 2021, Spring 2 and RBH2 were not within the compliant range for pH;
- Most samples were within the ideal limit with regards to electrical conductivity, total dissolved solids and calcium standard when compared to SAWQG for drinking water except NCCBH11, BHA and BH5; and
- Generally, most of the samples plot within the SAWQG for drinking water. NCCBH11 consistently exceeds the limits in most of the analytes.

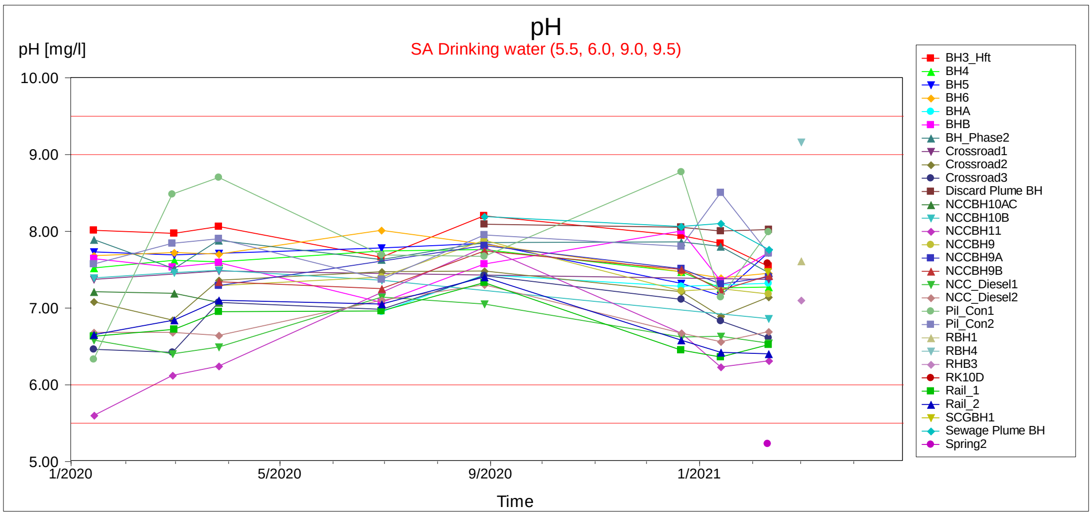


Figure 9-22: pH Trend

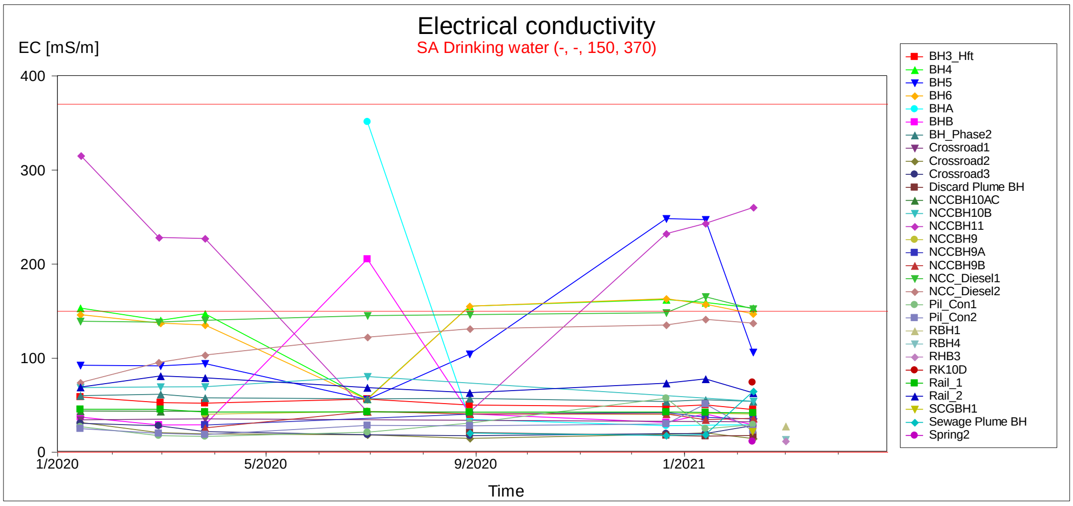


Figure 9-23: Electrical Conductivity Trend

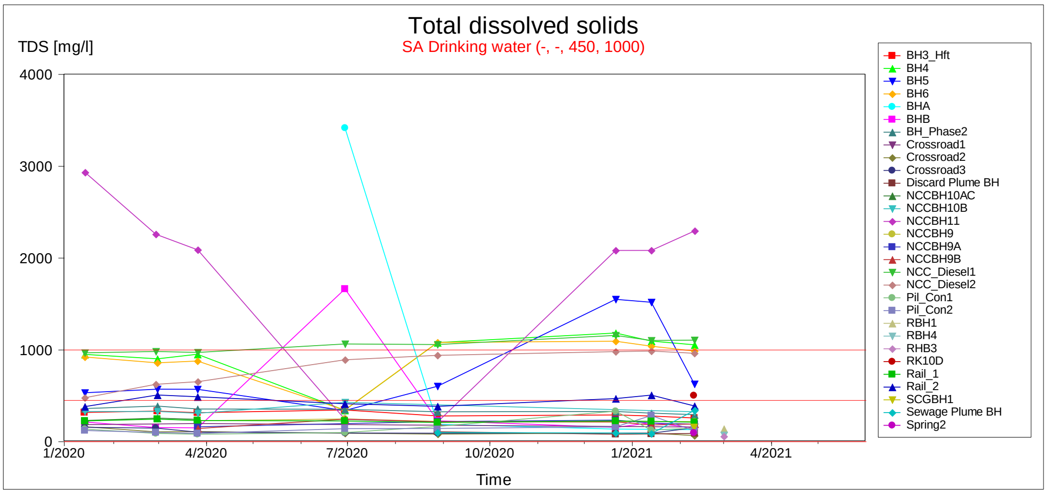


Figure 9-24: Total Dissolved Solids Trend

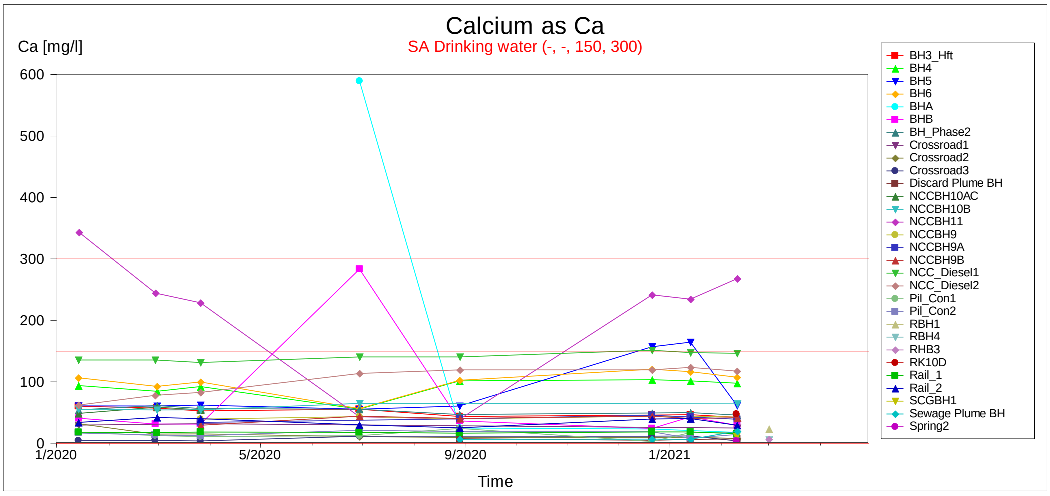


Figure 9-25: Calcium Trend

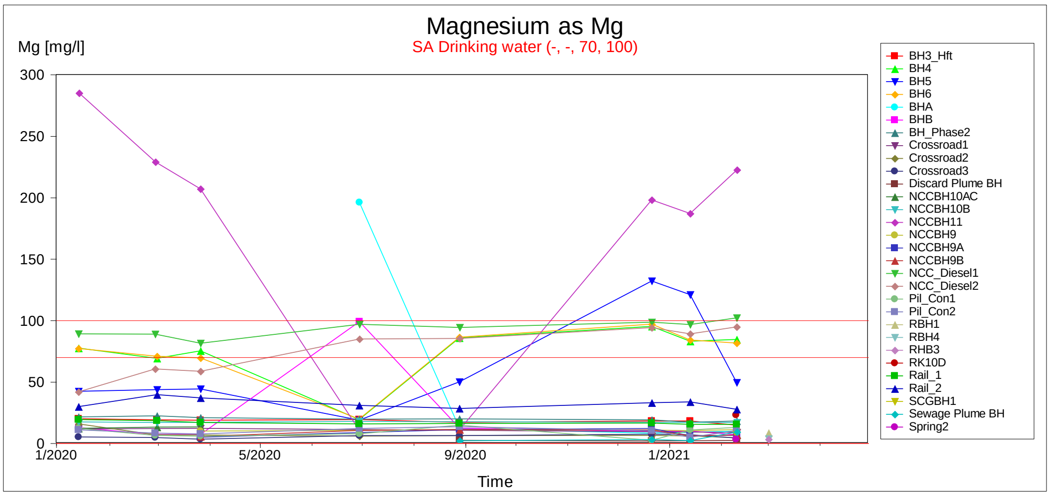


Figure 9-26: Magnesium Trend

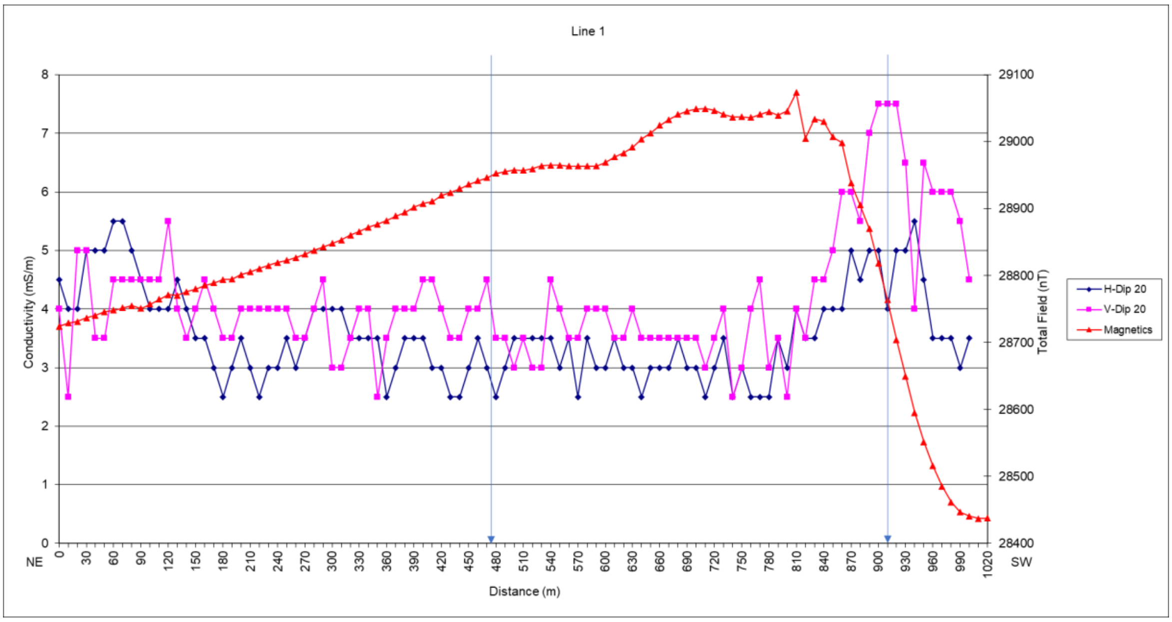
9.5.2. Geophysical Survey

During a geophysical survey, four lines were surveyed close to the proposed open pit at Middeldrift (Figure 9-27). The aim of the survey was to characterise the ground conditions in the vicinity of the proposed open pit, to indicate potential geological structures or preferential flow paths for groundwater and to generate targets for monitoring boreholes. The electromagnetic and magnetic survey methods were used.

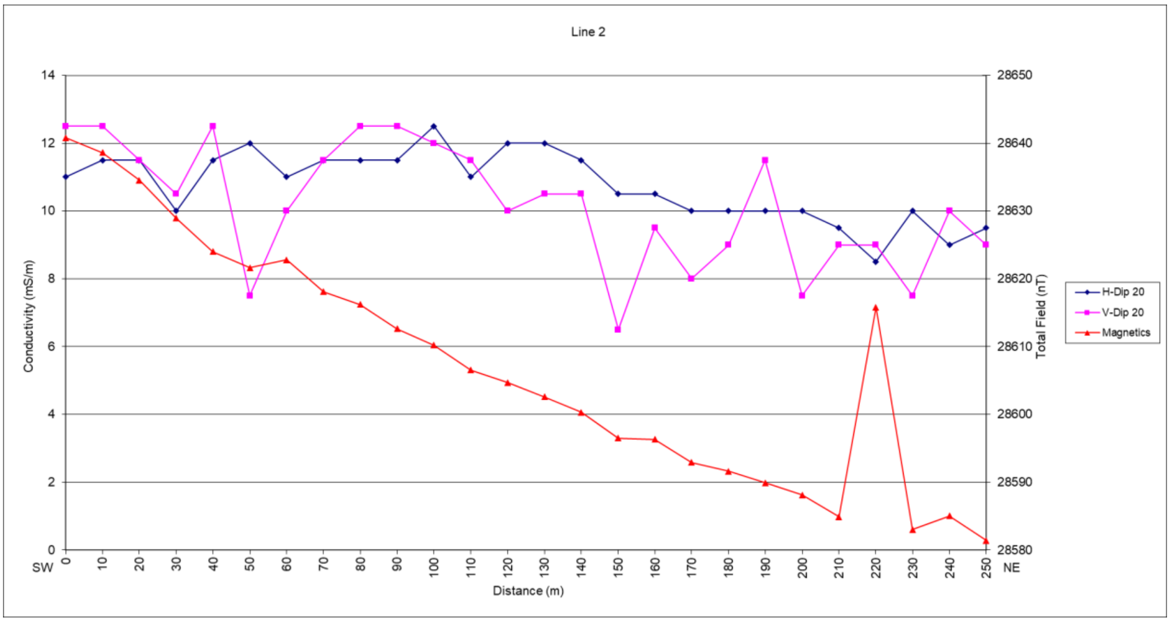
Electro Magnetic (EM) conductivity surveys measure ground conductivity by electromagnetic induction. The electromagnetic system used for the site investigation was the EM 34-3 ground conductivity meters. The system consists of a transmitter and receiver coil spaced at a fixed configuration. Magnetic surveys record spatial variation in the earth's magnetic field, i.e. orientation and strength of the field. The instrument used in magnetic surveying is a magnetometer, in this case a Geomatrix.

The lines were interpreted based on anomalies in the EM and magnetic data in conjunction with lithological units and geological structures, as indicated on the regional geological map. The results are shown in Figure 9-27. Four drill targets were identified (Figure 9-28). Targets 3 and 4 were moved westwards and south-eastwards, respectively, due to access constraints. Both targets were eventually chosen based on site access and local farm roads.

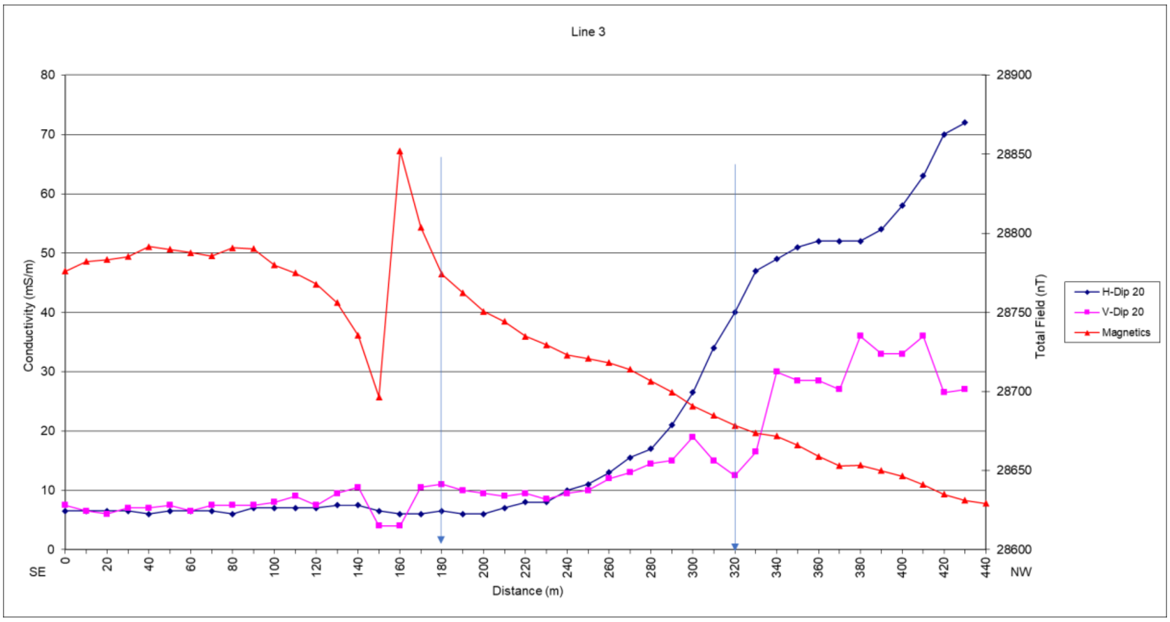
Line 1



Line 2


Line 2
Conductivity (mS/m)
Total Field (nT)
H-Dip 20
V-Dip 20
Magnetics
SW
NE
Distance (m)

Line 3


Line 3
Conductivity (mS/m)
Total Field (nT)
H-Dip 20
V-Dip 20
Magnetics
SE
NW
Distance (m)

Line 4

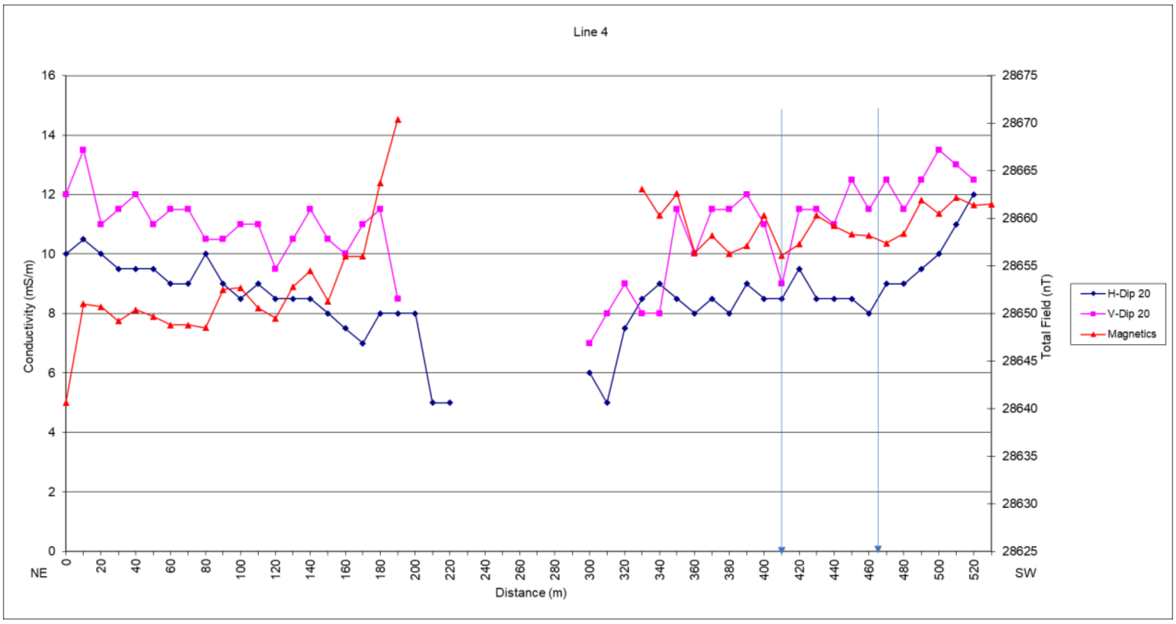


Figure 9-27: Geophysical Survey Line Results

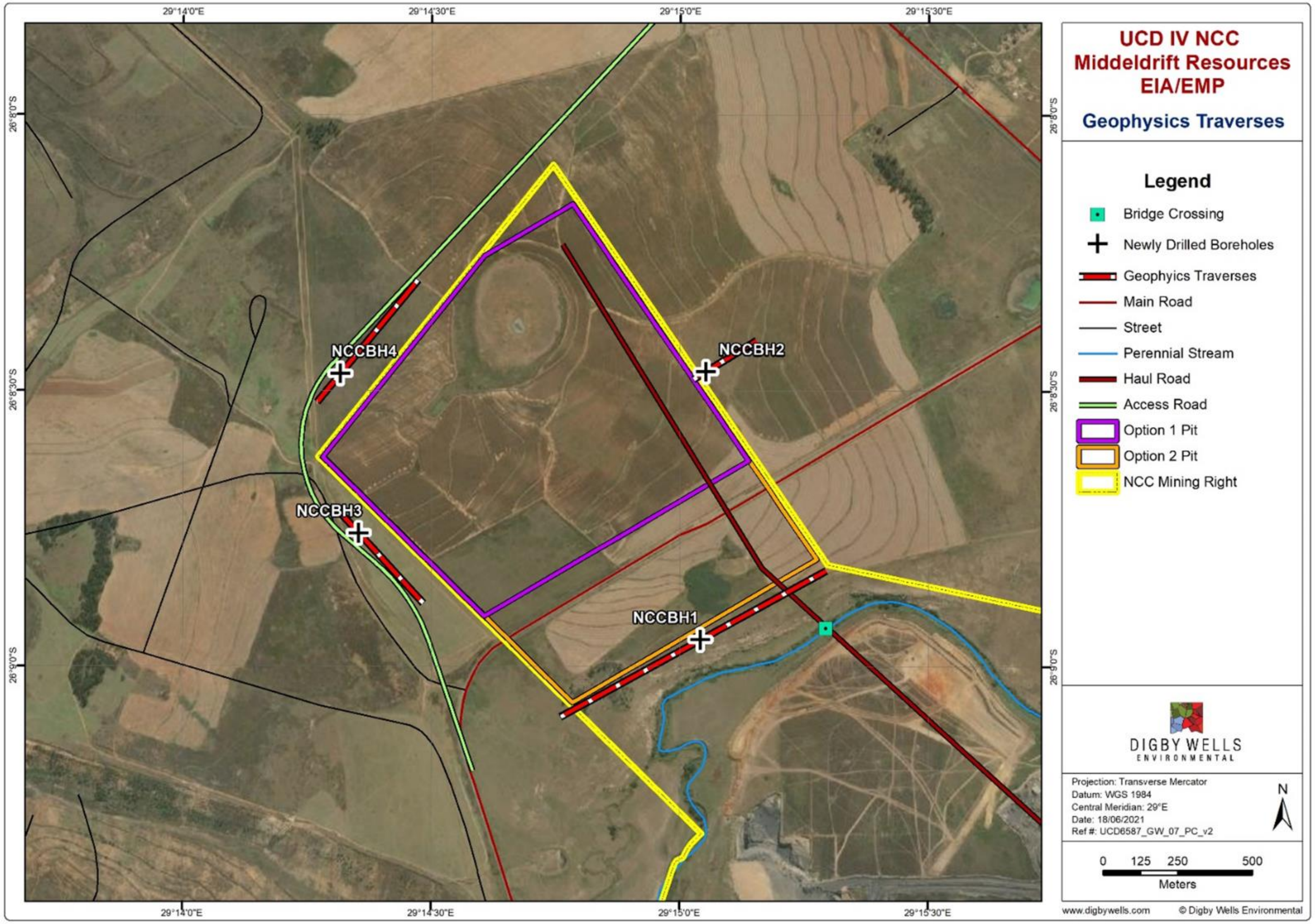


Figure 9-28: Geophysical survey lines and derived drill targets

9.5.3. Borehole Drilling

The drilling of four monitoring boreholes was carried out in April 2021. The boreholes were drilled to depths between 43 and 52 mbgl. The borehole construction for all four holes was as follows:

- Percussion drilling at 8 inch open hole diameter;
- Installation of 7 inch ID temporary mild steel casing to prevent hole collapse;
- Continue percussion drilling at 7 inch open hole diameter;
- Installation of 5.5 inch uPVC casing (85% slotted / 15% plain casing); and
- Backfill of the annulus with a gravel pack at the height of the slotted casing, bentonite seal on top of the gravel pack and backfill with arisings.

The boreholes were drilled for the following purposes:

- Description of the encountered lithologies;
- Identification of water strikes/seepages;
- Collection of samples for geochemical testing;
- Collection of groundwater samples; and
- Measurement of groundwater levels.

The drilling method used in this programme was rotary-air percussion. The drilling technique was selected for hydrogeological characterisation of the encountered geology, as identification of groundwater inflow and associated air-lift yield can be undertaken during the drilling process. The following information was recorded during the drilling at each drill target:

- Geological information:
  - Lithology – 1 m intervals;
  - Interpreted structure; and
  - Depth and degree of weathering.
- Hydrogeological information:
  - Depth of groundwater strikes and/or seepage; and
  - Air-lift yield.
- Other information:
  - Penetration rate (indication of weathered/competent rock) – where recorded.

The drill locations are shown on Figure 9-28 and the borehole logs are shown in Appendix A of **Appendix G**.

9.6. Geochemistry

The GCS environmental geochemistry study conducted in 2014 focused on the discard/slurry and coal and a gap was identified in the lack of waste rock characterisation. The geochemical study focused on the characterisation of the waste rock material. A total of eight samples were collected, namely two overburden and six inter-burden waste rock samples. A summary of the results is given below.

9.6.1. Mineralogy

The mineralogy of the samples indicates no acid-forming minerals in the overburden and inter-burden. The acid neutralising mineral dolomite that is dissolving is detected in overburden sample above No. 4 upper seam and inter-burden samples between No. 4 upper and lower seams; and between No. 2 upper seam and No. 1 Seam. Other acid neutralising minerals with weathering rates ranging from very fast to very slow were detected. The minerals include Goethite, Diopside, Chlorite, Biotite, Muscovite, Plagioclase, Kaolinite, Smectite and Microcline.

9.6.2. Acid Generation Potential

The Acid Base Accounting (ABA) test results indicate that the overburden samples are 100% Non-Acid Forming (NAF); and the inter-burden samples are 87% NAF, while approximately 13% of the inter-burden results were inconclusive. Relative to the slurry and discard samples from the GCS study are 100% Potentially Acid Forming (PAF), while the coal samples were 80% PAF and approximately 20% of the coal results were inconclusive.

9.6.3. Metal Leaching

The Metal Leaching potential of the waste rock samples were assessed against the IWUL limits for NCC and the background water quality from the hydrocensus study. The following was indicated:

- The pH of both the overburden (pH 6.3 - 6.5) and the inter-burden (pH 6.1 - 7.9) leachates are neutral,
- Arsenic, copper, manganese, molybdenum, nickel, and selenium exceed the baseline groundwater levels in both the overburden and the inter-burden material. There are no IWUL limits for these metals/metalloids,
- Sulphate (19 mg/l) in the overburden leachate exceeds the baseline groundwater levels (5.2 mg/l) in the overburden material, but is within the IWUL limits (600 mg/l),
- Nitrate as N (1.2 - 2.2 mg/l) exceeds the baseline groundwater levels (0.1 mg/l) but is within the IWUL limits (20 mg/l); and
- The discard/slurry and coal hydrogen peroxide leachate quality assessed against the IWUL limited and baseline groundwater quality indicated that boron, chromium, copper, electrical conductivity, manganese, nitrate, sulphate, total dissolved solids

and zinc. These parameters should be included in the surface and groundwater quality monitoring programme for the mine.

9.6.4. Waste Classification

The study classified the overburden and inter-burden materials against the Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R635 of 23 August 2013) and the Norms and Standards for Disposal of Waste to Landfills (GN R636 of 23 August 2013).

Total Concentrations (TC) of arsenic, barium, chromium and copper in the overburden and boron, chromium and copper in inter-burden exceeded the TCT0 threshold limit. The Leachable Concentration Threshold (LCT) of arsenic in the overburden and arsenic and selenium in the inter-burden exceeded the LCT0 threshold limit. The other metal ions are relatively immobile under the neutral pH and are not mobilised into the leachate with their Leachable Concentration (LC) below the LCT0 limit.

The overburden and the inter-burden are assessed to be Type 3 waste, LC ≤ LCT0 and TC ≤ TCT0. Applying GN R636 of 2013, the strict interpretation of this assessment is that the disposal of the overburden and inter-burden would require a barrier consistent with a Class C barrier system indicated in the figure below.

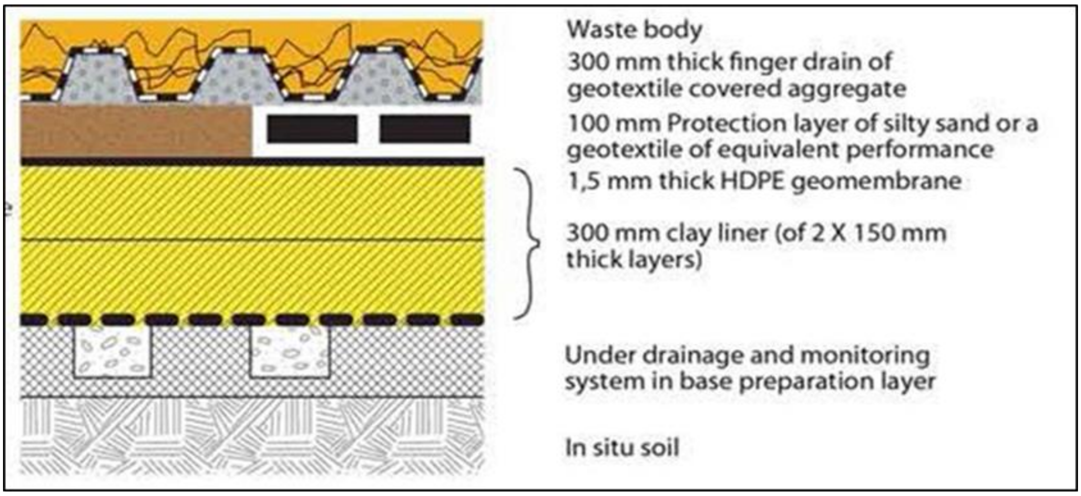


Figure 9-29: Illustration of a Class C barrier requirements for inter-burden and coal (GN R636 of 23 August 2013)

The classification and assessment of the spoils indicated that the overburden and the inter-burden require a liner consistent with a Class C barrier system. These barrier systems are not necessarily the default barrier systems if Universal Coal can demonstrate that the risks associated with the spoils can be adequately managed without the default barrier systems. While the regulation makes provision for a risk-based approach, there is no guidance by the legislation as to what information the authorities require in a risk-based approach.

9.6.5. Conceptual Model

9.6.5.1. Aquifers

For the study area, two main aquifers were identified: the weathered and the fractured Karoo aquifers. These are represented by:

- A shallow aquifer formed in the weathered zone; and
- A deeper aquifer formed by fracturing of the Karoo sediments, coal measures and dolerite intrusions.

The weathered material in the shallow weathered aquifer consists mostly of decomposed and highly weathered coarse-grained sandstones, with shales and siltstones in some areas. The depth of weathering encountered during drilling was observed to be between 6 and 17 mbgl.

The sustainability in terms of aquifer yields of the shallow weathered aquifer is dependent on the effective recharge, which is the portion of rainfall that infiltrates through the soil and eventually reaches the saturated zone.

Hodgson (2006) reported that the aquifers in the area were not high yielding, with the highest reported yield of 5 l/s associated with a dolerite dyke. The typical yields associated with the sedimentary formations were < 0.5 l/s, and in the order of 1 – 2 l/s where dykes were intersected. The aquifer transmissivity of the weathered material is estimated to be between 0.5 and 1.5 m^2/day.

Of all the fractured sedimentary layers the coal seams often show the highest hydraulic conductivity. Historical aquifer tests conducted within this aquifer indicated a low overall hydraulic conductivity.

The estimated hydraulic conductivity from previous aquifer tests correlated well and show aquifer hydraulic conductivity values to be in the expected range of 10^{-1} to 10^{-3}m/d for Karoo aquifers. The values also show the overall low potential of the aquifers, as also stated by Hodgson, 2006.

Based on previous experience, the groundwater recharge in the Karoo fractured aquifer ranges from 1 to 3%. Based on the various studies by GCS (results attached in **Appendix G**) for the NCC site their estimated recharge value approaches ~2% of the annual rainfall, and as such a recharge value of 2.25% MAP was used for their latest study in 2014.

9.6.6. Groundwater Use

Based on the previous hydrocensus data (GCS, 2016) there are no privately owned boreholes or monitoring boreholes within the study area. Regionally, groundwater is potentially used for livestock watering, crop irrigation and domestic purposes.

9.6.7. Groundwater Levels And Flow Directions

On a regional scale, groundwater flow directions follow topography, with exceptions of areas with underground voids (as seen in in the boreholes drill around the proposed Middeldrift open pit which are already impacted by mining) where groundwater levels can be significantly drawn down and these points would divert significantly from this correlation.

Deep, mining impacted groundwater levels (NCCBH2 had a groundwater level of 39.7 mbgl) were found in the proposed Middeldrift open pit area and are likely present for the parts of the project area in close vicinity to these underground voids. Groundwater levels are shallower towards the Steenkoolspruit, which locally acts as a source.

9.6.8. Anticipated Impacts – Receptors

9.6.8.1. Drainage Features

Surrounding river systems can act as potential pathways for contamination, especially when decant or contaminated seepage occur. The closest river system is the Steenkoolspruit system. When decanting occurs from the proposed operations, the contaminated water may enter the streams, where the contaminants are transported to downstream receptors.

Seepage emanating from the open pit and decant areas, may impact on the perched aquifer and migrate towards surface drainage features. Surface water groundwater water interaction is likely to occur, with the streams and river generally acting as gaining streams.

The Steenkoolspruit could potentially be affected by seepage and decant from the proposed Middeldrift open pit.

9.6.8.2. Pan/Wetland

There is a pan located in the mining area which is proposed to be mined out. However, given the current deep groundwater levels in close proximity to the pan, it is likely that current groundwater contribution to the pan, if any, is already largely reduced due to these adjacent mining activities.

9.6.8.3. Adjacent Mining Activities

As discussed, barrier pillars are assumed to exist between the NCC and surrounding mining operations. As such, mine interflow is not assumed as part of this study. However, if connections are present or will be created during mining of the Middeldrift resources, this could impact on estimated mine inflows, decant flows and contaminant plume migration as predicted as part of this study.

9.6.9. Numerical Model

9.6.9.1. Model Planning

9.6.9.1.1. Modelling Objectives

The main objective of the model was to develop a steady state and transient flow and contaminant model which would include the following aspects.

Numerical modelling was used to determine:

- Impacts on groundwater levels and quality due to mining;
- Impact on potential groundwater and surface water receptors due the proposed mining at Middeldrift;
- Potential contaminant plumes that could emanate from the mining area; and
- Assess the potential for mine water decant from the rehabilitated open pit.

9.6.9.1.2. Model Confidence Level Classification

An Australian Guideline Class 1 model classification (Barnette. B, Townley.L, Post, L, Evans. R, Hunt. R, Peeters. L, Richardson, Werner, A. , 2012) pursued and was evaluated from a semi-quantitative assessment of the available data on which the model was based, the way the model was calibrated and how the predictions were formulated. The level of confidence depended upon the available data for the conceptualisation, design and construction of the model. The model can thus be used for predicting long-term impacts of sources in low-value aquifers. The model thus serves as a starting point on which to develop higher class models as more data is collected and used.

Consideration was given to the spatial and temporal coverage of the available datasets in order to characterise the aquifer and the historic groundwater behaviour that was useful in model calibration. Factors that may affect the model confidence level during the calibration procedure were considered. These factors included the types and quality of data that was incorporated in the calibration, the degree to which the model was able to reproduce observations, and whether the model was able to represent present-day hydrogeological conditions. The time frame and level of stresses applied in the predictive models were consistent to that of the model calibration process.

9.6.9.2. Model Setup

During model setup, the conceptual model is translated into a numerical model. This stage entails selecting the model domain, defining the model boundary conditions, discretizing the data spatially and over time, defining the initial conditions, selecting the aquifer type and preparing the model input data. The above conditions together with the input data are used to simulate the groundwater flow in the model domain for pre-mining steady state conditions.

MODFLOW, a modular three-dimensional groundwater flow model developed by the United States Geological Survey (Harbaugh, 2005) was used for modelling purposes. MODFLOW uses 3D finite difference discretisation and flow codes to solve the governing equations of groundwater flow. MODFLOW NWT (Niswonger *et al*., 2011) was used in the simulation of the groundwater flow model. Both are widely used simulation codes and are well documented. GMS 10.3.8, a pre- and post- processing package for the MODFLOW modelling code was used for the construction of the numerical model.

MT3DMS is a 3D model for the simulation of advection, dispersion, and chemical reactions of dissolved constituents in groundwater systems. MT3DMS uses a modular structure similar to the structure utilized by MODFLOW and is used in conjunction with MODFLOW in a two-step flow and transport simulation. Heads are computed by MODFLOW during the flow simulation and utilised by MT3DMS as the flow field for the transport portion of the simulation.

9.6.9.3. Model Domain

The model domain (Figure 9-30) is irregularly shaped with dimensions of 36 km by 25 km. A rectangular mesh was generated for the model domain, consisting of 210 rows and 269 columns. The mesh was refined in the model domain to cell sizes of 75 m by 75 m in the area surrounding the Project site, with cells gradually coarser further away from the mining area (resulting in a total of 202,676 active cells for the four layers modelled). Although a smaller grid size may result in prolonged running time, it was important to refine the model close to the Project site to properly delineate geological units and to calculate the groundwater gradient and pollution plumes more accurately in the direct vicinity of the activities.

The model consists of four layers to allow for discretisation between the weathered and fractured lithologies. The weathered aquifer consisted of one layer of 30 m thickness. While the second layer has a variable thickness ranging from 6 to ~100 m and representing the fractured aquifer. The variable thickness is the result of the coal seam layer, which was simulated separately. The No. 2 seam coal floor contours of the entire project area were collated and used as the bottom elevation of the third layer (6 m thickness). This layer is important in terms of inter-mine flow. The fourth layer represents the lower slightly fractured aquifer but is unlikely to contribute significantly to flow in the model. Topographical contour data used to interpolate the surface topography; the data has a 5 m resolution. All the drain and rivers boundary conditions simulating rivers and stream were constructed in the top layer. Active mining areas were simulated as drain cells in the 3rd layer (No. 2 seam). The open pits were given the same parameters for layer 1 to 3; while the underground areas were only assigned specific parameters to layer 3.

9.6.9.4. Boundary Conditions

Boundary conditions express the way in which the considered domain interacts with its environment. In other words, they express the conditions of known water flux, or known variables, such as the hydraulic head. Different boundary conditions result in different solutions, hence the importance of stating the correct boundary conditions.

Boundary condition options in MODFLOW can be specified either as:

- Specified head or Dirichlet; or
- Specified flux or Neumann; or
- Mixed or Cauchy boundary conditions.

Local hydraulic boundaries were identified for model boundaries. They were represented by local perennial and non-perennial water courses and topographical highs and delineated the entire model domain. These hydraulic boundaries were selected far enough from the area of investigation to not influence the numerical model behaviour in an artificial manner. The model boundaries and model grid are shown in Figure 9-30. Table 9-22 provides a summary of the boundaries, boundary descriptions and boundary conditions specified in the hydrogeological model.

Table 9-22: Identification of Real-World Boundaries And Adopted Model Boundary Conditions

Boundary	Boundary Description	Boundary Condition
Internal boundaries	Flux and mixed types.	Mixed type: Drain cells for non-perennial streams. Recharge is constant for the whole model domain. Recharge flux is applied to the highest active cell. A river boundary condition was used for the Olifants River. Evapotranspiration (ET) was included across the model domain.
North	Stream boundary condition – perennial stream. Topographical boundary – no flow boundary type.	Catchment boundary (no flow boundary) and streams (drain boundary condition).
East	Topographical boundary – no flow boundary type.	Catchment boundary (no flow boundary).
South	Stream boundary condition – perennial stream. Topographical boundary – no flow boundary type.	Catchment boundary (no flow boundary) and streams (drain boundary condition).
West	Stream boundary condition – perennial stream. Topographical boundary – no flow boundary type.	Catchment boundary (no flow boundary) and streams (drain boundary condition).

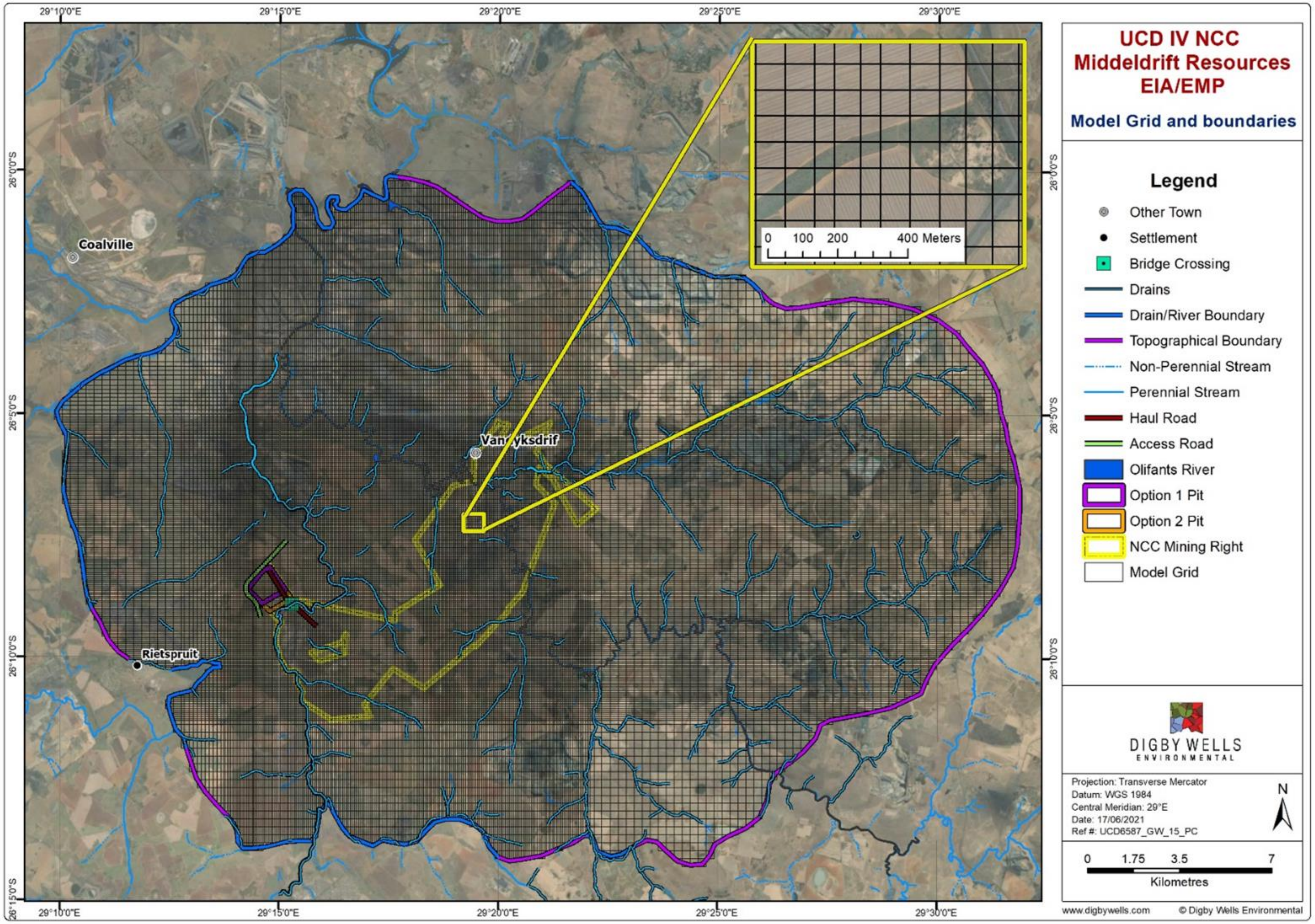


Figure 9-30: Numerical Model Domain, Grid and Boundaries

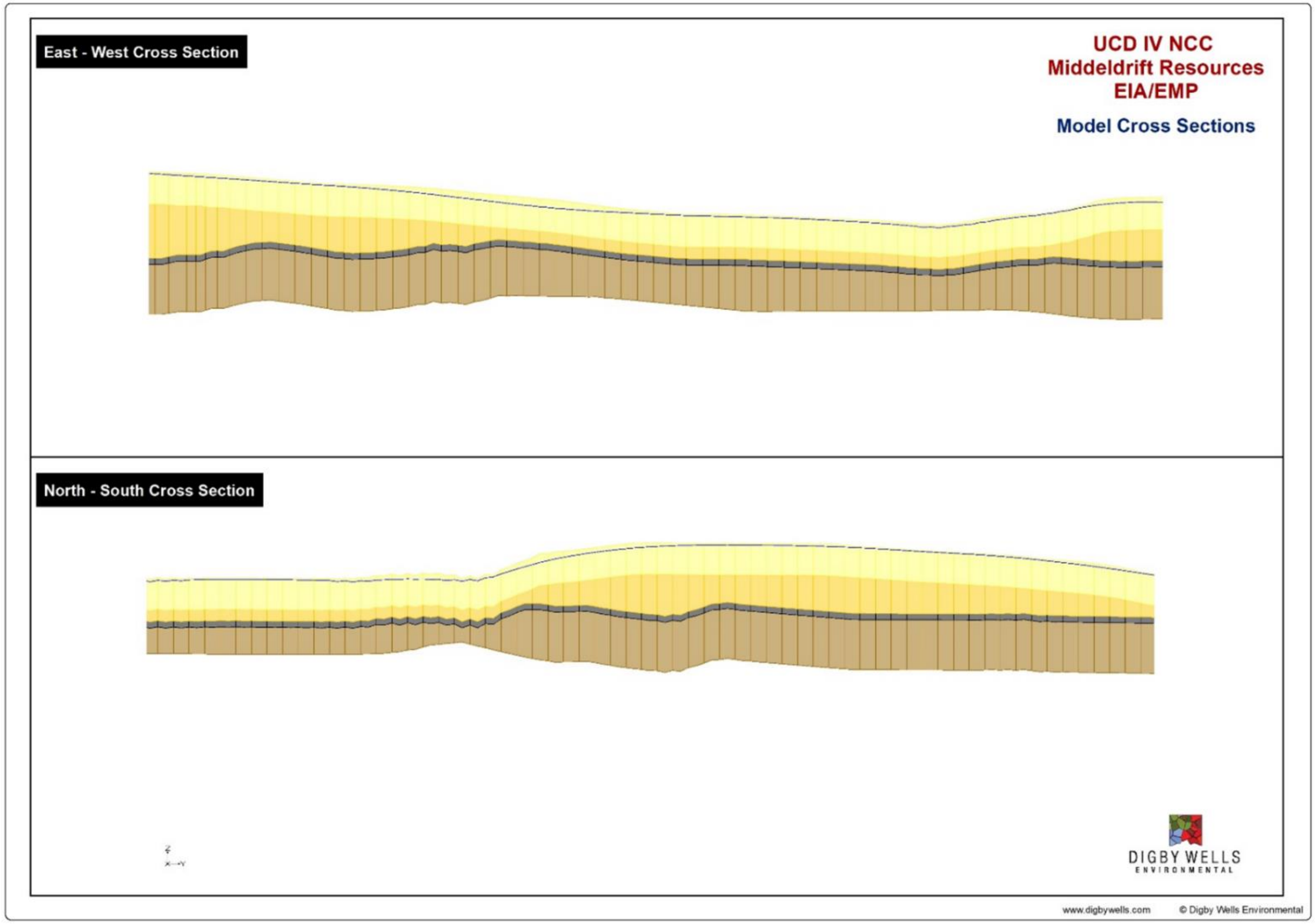


Figure 9-31: Numerical Model Cross Sections

9.6.9.5. Model Simulation

Prior to the simulation of the mining and dewatering activities, a baseline (pre-mining) steady state groundwater flow model was set-up and calibrated. The objective of the steady state model was to simulate the groundwater system in the region for the current situation (2021). The impacts of mining activities for the operational and post-closure phases will then be determined by comparing the transient state results with the steady state results.

9.6.9.5.1. Calibration

Digby Wells collated the most recent borehole data and hydrocensus information available for the Project site. The steady state model was calibrated with this data to produce a model simulating the pre mining groundwater conditions. A total of 21 observation boreholes were used for the steady state calibration, based on the most recent groundwater level data.

The model was calibrated by varying model input data over realistic ranges of values until a satisfactory match between simulated and observed water level data was achieved.

Since recharge and permeability are dependent on each other via the measured heads, the model was not calibrated by changing the permeability and recharge simultaneously. The permeability was calibrated based on the aquifer test results, while the recharge value was adjusted manually until a best fit was obtained.

Model parameter values and hydrologic stresses determined during the steady-state calibration were used to simulate a transient response. The groundwater level data (NCCBH1 and NCCBH2,; and the dry boreholes drilled into the underground voids, viz. NCCBH3 and NCCBH4) used for calibration around the Middeldrift area indicated that an impact on groundwater levels had already been caused by the adjacent underground workings.

Historically, hydrocensus borehole Gw-MID1 located within the proposed Middeldrift open pit also had a deep water level (~60.95 mbgl in 2012), this borehole could possibly have been drilled into the Phoenix Mine underground (GCS, 2014). It was therefore deemed necessary to include these underground workings as drains during the calibration process.

The Modflow-NWT package was used to solve the partial differential equations. Convergence criteria of a head change of 10^{-3} m were selected. After model calibration a good correlation was obtained between the simulated and observed groundwater elevation (Figure 9-32). The calibration was deemed acceptable with a Mean Residual Head of 0.81, a Mean Residual Absolute Head of 3.6 and a Root Mean Square Error (RMSE) of 4.38.

A water balance error (all flows into the model minus all flows out of the model) of less than 0.5% is regarded as an accurate balance calculation. The mass balance for entire model domain achieved a water balance error of less than 0.2%.

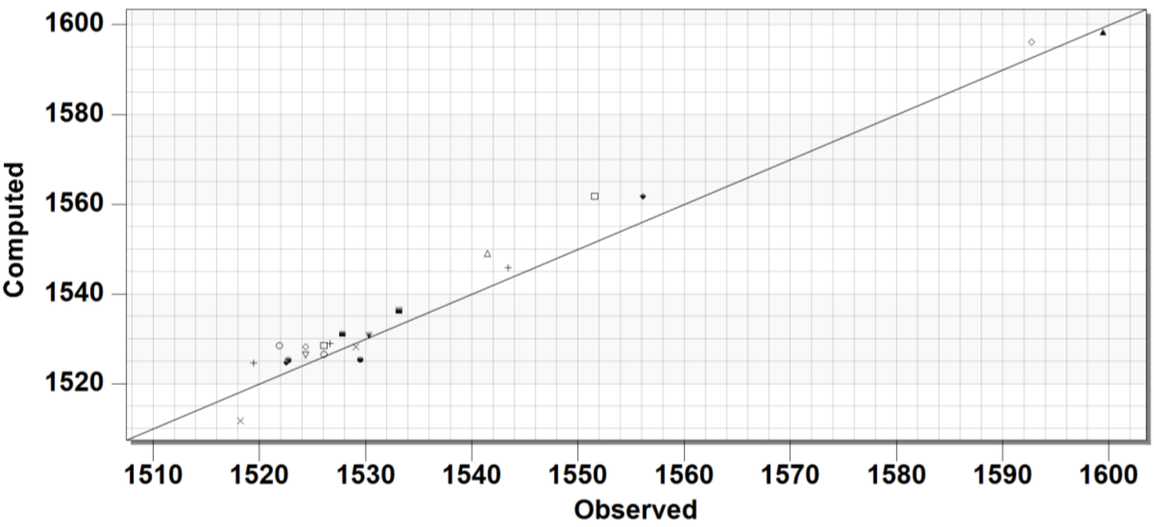


Figure 9-32: Correlation between observes and calculated heads

9.6.9.5.2. Aquifer Hydraulic Conductivity

Initial estimates of the hydraulic conductivity for the different geological units were obtained from previous aquifer test data and based on expert knowledge from other nearby model sites. These hydraulic conductivity values were assigned to hydrogeological layers within the model area. The initial estimates were used for a combination of Parameter ESTimation (PEST) and manual calibration. The resulting calibrated hydraulic conductivity values for each layer as summarised in Table 9-23.

Table 9-23: Calibrated values of horizontal and vertical hydraulic conductivities

Lithology	Hydraulic Conductivity		Porosity
	Horizontal	Vertical	
	[m/d]	[m/d]	
Weathered Aquifer	0.02	0.001	0.05
Fractured Aquifer	0.008	0.001	0.05
Slightly Fractured Aquifer	0.0002	0.00002	0.05
Open pit (post closure)	2.5	0.25	0.25
Note/s: m/d - metres per day			

9.6.9.5.3. Other Model Parameters

The groundwater recharge in the Karoo fractured aquifer ranges from 1 to 3%. Approximately 15.5 mm/annum, or 2.25% of the average annual precipitation (MAP of 689 mm/annum was applied to the model. The recharge flux applied to the highest active cell. A 20% recharge was used for the Middeldrift backfilled open pit.

Other model parameters used in the calibrated model were as follows:

- Non-perennial streams:
  - Drain level at 5 m below surface level; and
  - Drain conductance of 0.4 $m^2/d/m^2$.
- River (Olifants River) :
  - Head level at surface level;
  - River bottom level at 5 m below surface level; and
  - River conductance of 0.5 $m^2/d/m^2$.
- Mine drains:
  - Drain conductance of 0.2 $m^2/d/m^2$.
- A specific storage (Ss) value of 1 e-5 was used for the upper layer and 8 e-6 for layer 2 to 4. The specific yield (Sy) for the first layer was assumed as 0.01.
- Evapotranspiration was used, a value of 0.001 m/d was used which is average for grasslands, an extinction of 1m was simulated.

9.6.9.5.4. Simulated Water Levels And Flow Direction

The simulated groundwater levels for the current situation are shown in Figure 9-33. The groundwater levels show the general north to northwest flow direction of groundwater across the model domain, with highest groundwater levels along the south-eastern model boundary at the topographical divide and lowest groundwater levels at the northern end of the model, where the hydrological outflow point for the model is situated. Locally in the Middeldrift area, groundwater flows towards the southeast and drains towards the Steenkoolspruit.

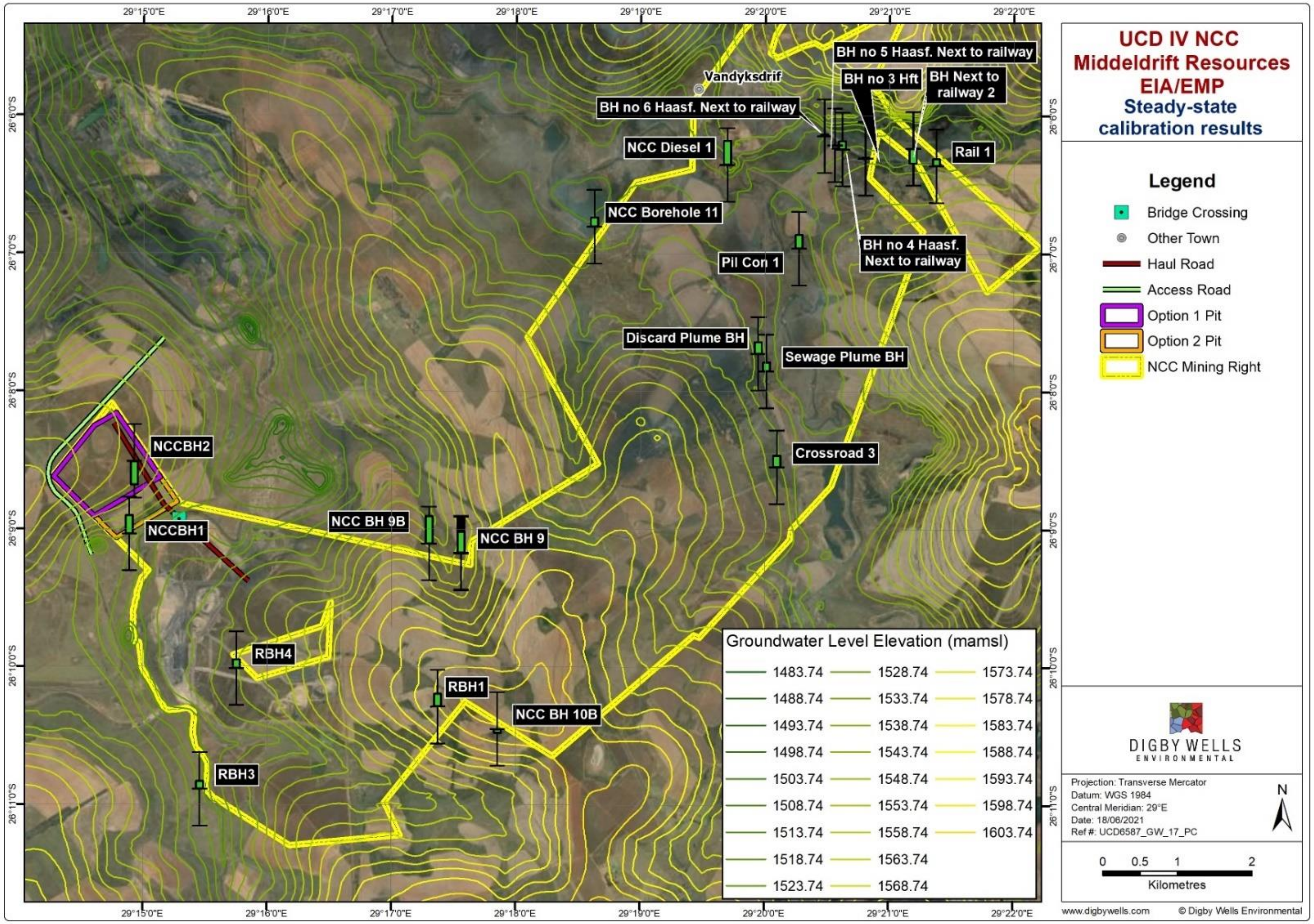


Figure 9-33: Steady-state calibration results

flow simulation was carried out to estimate groundwater drawdown for the operational phase and groundwater recovery in the post-closure phase. The transient flow model was based on coal seam floor depths and the latest mine schedule as provided by Universal Coal. The current LoM is 10 years for Option 1 and 17 years for Option 2 in total.

In addition, increased infiltration was modelled for the backfilled open pit. A seepage rate at ~20% of MAP was assigned for the backfilled, rehabilitated Middeldrift open pit area for the post-closure phase.

9.6.9.6. Mass Transport Simulation

Mass transport calculations were carried out for the open pit. Contamination from the open pit can occur when contaminated water from the backfill infiltrates into the surrounding aquifer. This will most likely only occur post-closure when water levels return to approximate pre-mining conditions. A modelling scenario assuming full backfill and rehabilitation of topsoil and vegetation within the open pit areas was carried out to calculate the expected plume extent.

9.6.9.6.1. Dispersion And Diffusion

No in-field verification of dispersion was available for this study. However, representative, generic values for dispersion and parameters have been used as input into the numerical model. The longitudinal dispersion was set at 50 m, with the following ratios applied for transverse dispersion:

- Horizontal transverse dispersion/longitudinal dispersion: 0.1; and
- Vertical transverse dispersion/longitudinal dispersion: 0.01.

9.6.9.6.2. Effective Porosity

Effective porosity input values for the weathered and fractured aquifers were assumed as 0.05 and 0.25 for the backfilled open pit. These values are based on previous investigations in similar geological settings

9.6.9.6.3. Selection Of The Contamination

As the main source of contamination with coal mining is the weathering of pyrite, the contaminant of choice is sulphate that is released, together with acidity, due to the solution of pyrite. The input concentrations were based on typical input concentrations for coal open pits. Conservatively, a value of 2 000 mg/l was used as input and is assumed a reasonable concentration as based on the geochemical composition of the coal materials (Section 9). This concentration was kept constant over the post-closure period.

9.6.9.7. Model Limitations and Exclusions

Groundwater models are inherently simplified mathematical representations of complex aquifer systems and this simplification therefore inevitably limits the accuracy with which groundwater systems can be simulated in general and lead to numerous sources of error and uncertainty. Model error commonly stems from practical limitations of grid spacing, time discretisation, parameter structure, insufficient calibration data, and the effects of processes not simulated by the model. These factors, alongside unintentional errors in field observations and measurements, result in uncertainty in the model predictions. Limitations of models are the result of generalisations, interpretations and assumptions made in attempting to simulate the natural environment.

An Australian Modelling Guideline Class 1 was assigned to the model due to the available data and the calibration which was achieved against heads. No information on fluxes (inflows), as well as an independent measurement of the recharge was available. Class 1 models are often used to provide an initial assessment of the problem and it is subsequently refined and improved to higher classes as additional data is gathered (often from a monitoring campaign that illustrates groundwater response to a development).

Model error and uncertainty are not uniformly distributed. Majority of the data available is located around the mining areas. Because there are only a limited number of boreholes and other hydrogeological data available to characterise the aquifer system, a level of uncertainty exists regarding how representative the measured values are of the average properties in the areas without data.

The heterogeneous subsurface within the relatively large model area, results in hydraulic conductivity being simulated as uniform broad areas and may not reflect the true complexity of the geology.

Nevertheless, models are a simplified approximation of reality. All efforts have been made to base the model on sound assumptions and was calibrated to observed data, however the results obtained from this exercise should be considered in accordance with the assumptions made. Limitations of models are the result of generalisations, interpretations and assumptions made in attempting to simulate the natural environment. The following limitations is true for the numerical groundwater model:

- The top of the aquifer is represented by the surface topography and used to construct a representative spatial extent;
- The model simulates the fractured rock environment as an equivalent porous medium, which is an overall simplification of the flow process;
- No inter-mine flow or impacts of other adjacent mining related activities were included;
- It is assumed that the adjacent underground workings were unflooded during the mining of the proposed pit;

- The flooding status and coal floor elevations of the adjacent underground workings will have a large effect on the final impact of the open pit and should be further investigated;
- No groundwater abstraction of external users was simulated;
- Recharge rates were assumed as constant throughout the simulated period; therefore, no wet-dry cycles are simulated; and
- Detailed geology as well as faults and dykes were not included.

9.7. Surface water

The surface water environment was determined through the following:

- Water Quality Assessments;
- Floodline determination;
- Development of a conceptual Stormwater Management Plan undertaken based on the "*Regulations on Use of Water for Mining and Related Activities aimed at the Protection of Water Resources*" (GN R704 of 4 June 1999) of the NWA; and
- A Water Balance for the New Clydesdale Colliery, determined using a Water Flow Diagram (WFD) developed by Digby Wells specialists in consultation with a representative of Universal Coal.

The full methodology can be found in **Appendix H** of this report.

9.7.1. Hydrological Setting

The water resources of South Africa are divided into quaternary catchments, which are regarded as the principal water management units in the country (Department of Water Affairs and Forestry, 2011). These catchments represent the fourth order of the hierarchical classification system, in which the primary catchments are the major units. The primary drainages are further grouped into or fall under WMAs. The DWS has established nine WMAs as contained in the National Water Resource Strategy 2 (2013) in terms of Section 5 subsection 5 (1) of the NWA.

The proposed coal mine falls within primary drainage region B of the Olifants WMA and the B11E quaternary catchment, Sub-Quaternary Reaches (SQRs) B11E-01353 and B11E-01297 (the Rietspruit and Steenkoolspruit). The Rietspruit SQR is a second order stream approximately 24 km in length, which drains from south-west along and joins the Steenkoolspruit SQR east of the project area boundary. The Steenkoolspruit SQR is a third order stream, approximately 18 km in length and flows along the east and north of the project area boundary before joining the Olifants River.

The major water use activities found within the quaternary catchment are mining and agriculture, there are also several small man-made dams within the mines and farms (Gyamfi, Ndambuki, & Salim, 2016).

Characteristic of the catchments in this area is the strong relationship between surface water and a shallow, interflow groundwater source (SRK Consulting, 2016). Deeper groundwater does not reveal direct connection to the streams in the upper reaches of these catchments. Responses to rainfall are rapid, with discharges reaching peak flows within 24 hours and dissipating within four to five days, despite the relatively flat topography (SRK Consulting, 2016).

Figure 9-34 indicates the B11E quaternary catchment and freshwater resources associated with the study area.

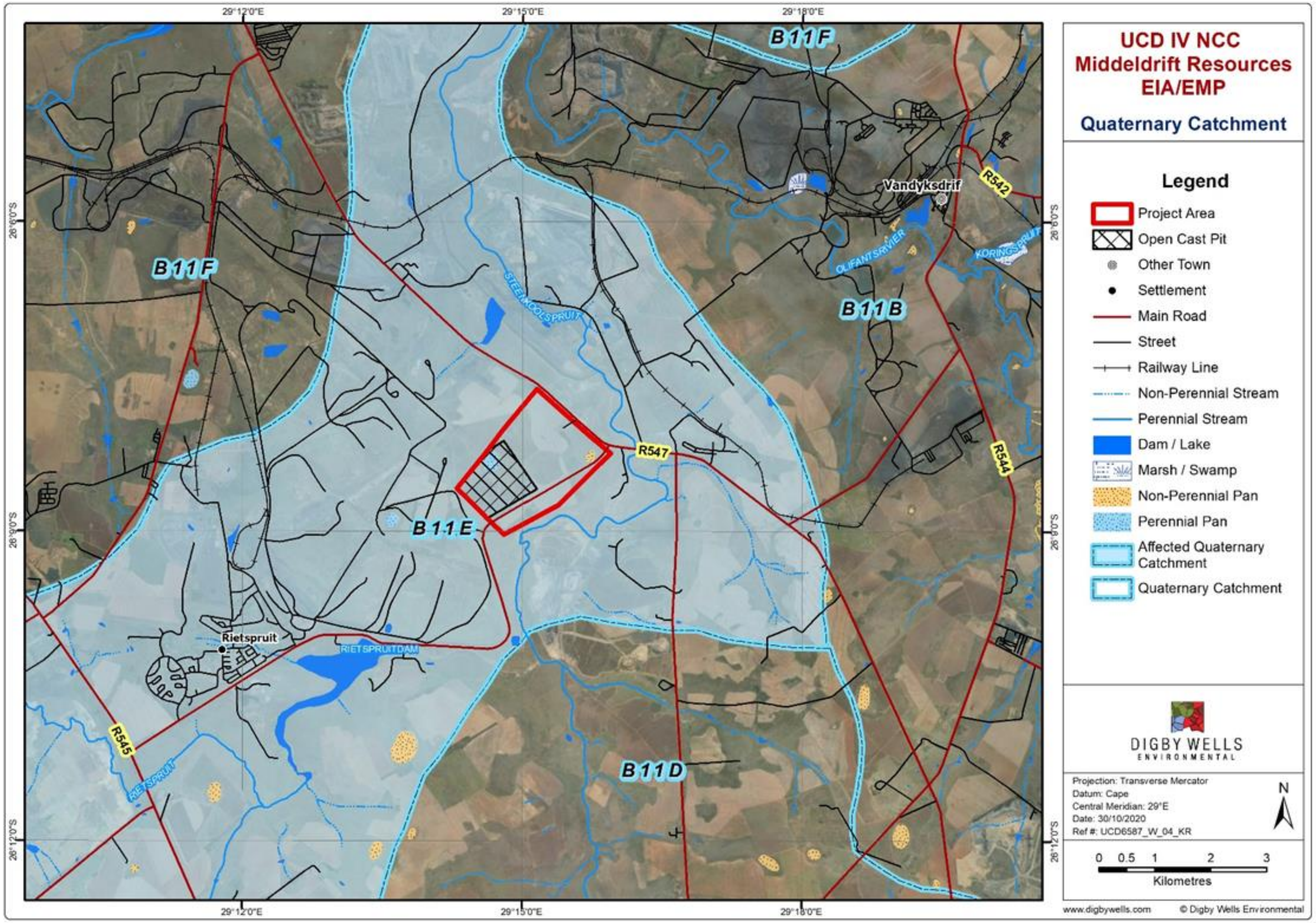


Figure 9-34: Hydrological Setting of Quaternary Catchment B11E

The rainfall, runoff and evaporation of the project area have been described in Section 8.1 above.

9.7.2. Land Use

Current land uses in the region include coal mining, farming, power generation facilities and small residential communities. The dominant land use within the project area is cultivated land. Other land uses within the project area include grassland and small areas are occupied by thickets/dense bush and wetland/ water areas. The land uses in the project area are comprehensively described in Section 9.8 below (Refer to Figure 9-45).

9.7.3. Baseline Water Quality

9.7.3.1. Sampling Points

Four surface water points were planned for sampling but only two (NCDSW2 and NCDSW3) were successfully sampled. Sampling point NCDSW1 was not accessible and NCDSW4 was dry during the site visit conducted on the 12th of February 2021. The sampling points are presented in Figure 9-35. Water quality descriptions of existing DWS monitoring points were included in this report since these points were considered relevant to the current project and these descriptions were obtained from a previous report (SRK Consulting, 2016). Locations of the DWS points are also shown in Figure 9-35.

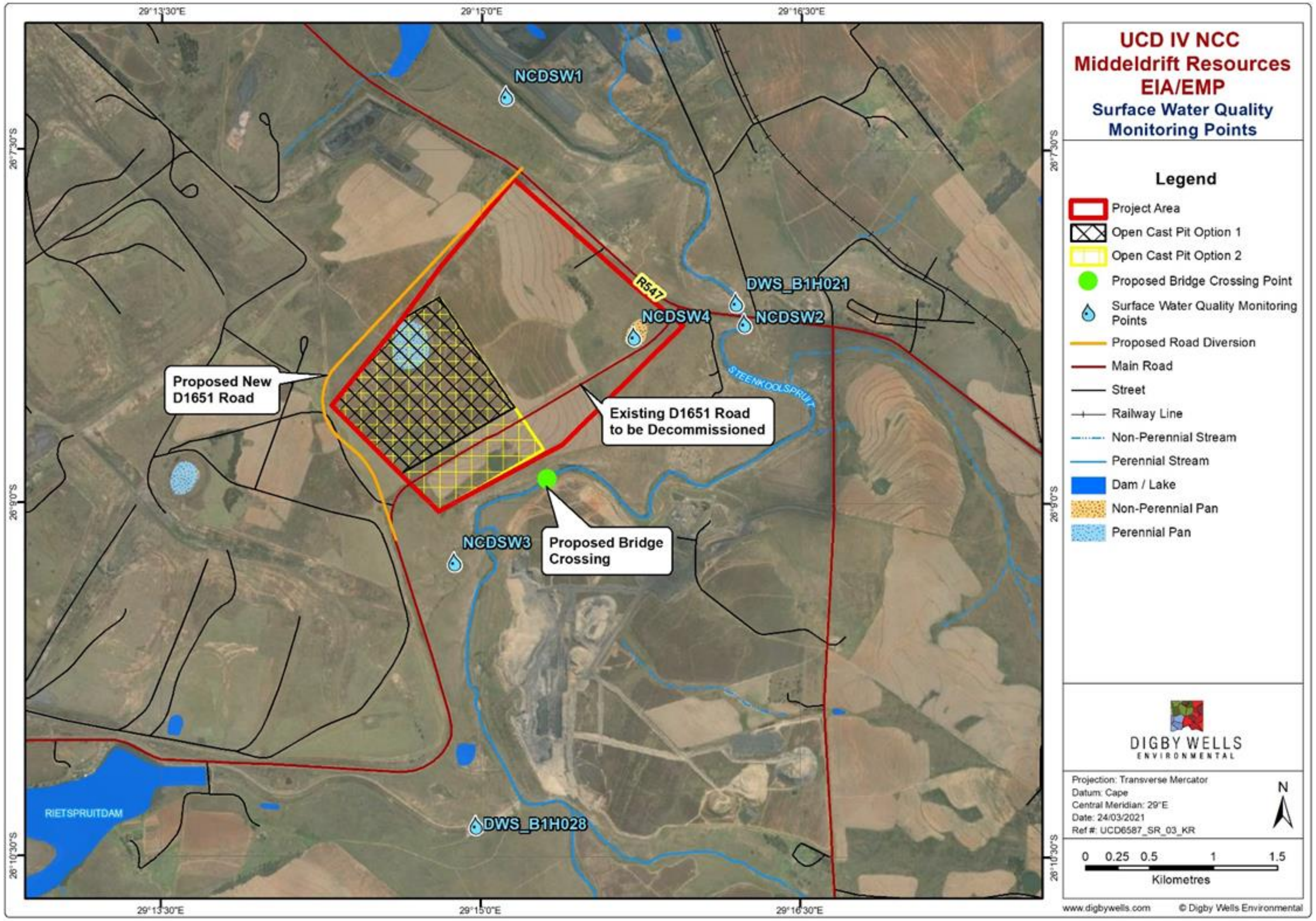


Figure 9-35: Surface Water Quality Sampling Points at the New Clydesdale Colliery

9.7.3.2. Historical Water Quality

Baseline water quality sampling was undertaken by Digby Wells in 2011, while monthly sampling was undertaken by Universal Coal from 2014 to 2016 at various locations in the Steenkoolspruit and smaller tributaries in proximity to the study area (SRK Consulting, 2016).

Based on the water quality results analysed by (SRK Consulting, 2016) none of the water quality determinants monitored exceeded domestic water quality standards systematically, except for Total Dissolved Solids (TDS) and Sulphate (SO_4) over short periods during the dry season. It was concluded that the low flows (implying less volume of water for the same amount of salt load) contribute to the increase in TDS and SO_4 concentrations, and thus are not likely to contribute significantly to the salinity load entering the Olifants River (SRK Consulting, 2016).

The salt loading of the Steenkoolspruit was estimated from discharge and sampled TDS concentrations (B1H021) to be approximately 23 000 tons/annum, whereas the total TDS load likely to leave the opencast mine is estimated as 62 tons/annum, which is less than 0.5% of the current total salt load in the Steenkoolspruit. The salt load discharged into the Steenkoolspruit as a result of mining in the NCC was considered minimal (SRK Consulting, 2016).

9.7.3.3. Recent Water Quality Conditions

The recent water quality within the Rietspruit upstream and downstream of the proposed Middeldrift opencast pit are presented in Table 9-24. Most of the analysed parameters are within the Olifants Resource Quality Objectives (RQOs) in which the proposed project site is located. Exceedances were, however, noted for Turbidity, Chloride (Cl), and Aluminium (Al) both upstream and downstream of the project site. Higher turbidity is likely attributed to livestock animals that agitate the water as they drink water from the Rietspruit during grazing. Cl and Al sources likely include sewage and industrial effluents emanating from the Reedstream Park upstream of the NCC within the Rietspruit catchment and from Kriel and Thubelihle Towns adjacent to the Steenkoolspruit before its confluence with the Rietspruit.

Table 9-24: Current water quality for the proposed in the study area

Parameters	Units	Olifants Resource Quality Objectives	NCDSW2 (Downstream)	NCDSW3 (Upstream)
pH - Value @ 25 ºC	pH meter units	5.9 - 8.8	7.7	7.8
Electrical Conductivity in mS/m @ 25°C	mS/m	≤ 111	47.7	46.7
Total Dissolved Solids @ 180°C	mg/l	N/S	424	422
Turbidity in N.T.U	NTU	≤ 10	37	32
Total Alkalinity as $CaCO_3$	mg/l	≥ 60	104	104
Chloride as Cl	mg/l	≤ 0.05	21	20
Sulphate as SO_4	mg/l	500	104	100
Fluoride as F	mg/l	≤ 3.00	0.4	0.4
Nitrate as N	mg/l	≤ 4.00	3.7	0.5
Sodium as Na	mg/l	N/S	31	30
Potassium as K	mg/l	N/S	7.8	7.6
Calcium as Ca	mg/l	N/S	32	31
Magnesium as Mg	mg/l	N/S	17	18
Aluminium as Al	mg/l	≤ 0.150	0.484	0.425
Boron as B	mg/l	N/S	0.063	0.065
Copper as Cu	mg/l	≤ 0.08	<0.010	<0.010
Iron as Fe	mg/l	N/S	0.866	0.751
Manganese as Mn	mg/l	≤ 1.300	0.127	0.124
Zinc as Zn	mg/l	≤ 14.4	<0.025	<0.025

9.7.4. Floodlines Determination

The floodline determination process is explained and indicated below. The delineated Steenkoolspruit Catchment is depicted in Figure 9-36 while the Floodlines for the Steenkoolspruit adjacent to the Middeldrift Resource project site are depicted in Figure 9-37. Figure 9-38 shows the storm water management plan for the proposed new pit at the New Clydesdale Colliery.

9.7.4.1. Delineated Catchments

One catchment was delineated for the Steenkoolspruit and the 1:50-year and 1:100-year peak flows were calculated for this catchment. The delineated catchment can be seen in Figure 9-36.

9.7.4.2. Design rainfall depths and Peak Flows

Design Rainfall Depths for the 1:2-year to 1:100-year return periods were calculated using the Design Rainfall Software for South Africa (Smithers and Schulze, 2000). The rainfall depths are presented in Table 9-25. Rainfall depths with durations equal to the time of concentration (Tc) of the Steenkoolspruit catchment were used to calculate peak flows using the RM3 method. The recalibrated modified Hershfield equation was used to determine precipitation depths used in the Standard Design Flood (SDF) method (Alexander, 2002). SDF peak flows were considered an over-estimate for the site possibly due to higher and regionally calibrated runoff coefficients not representative of the NCC site. RM3 flood peaks which were more conservative than those of the Midgley and Pitman (MIPI) method were used in HEC-RAS for hydraulic modelling. Calculated peak flows are presented in Table 9-26.

Table 9-25: Hour Design rainfall depths for NCC region

	Return Period (T/years)					
Duration	**2year**	**5year**	**10year**	**20year**	**50year**	**100year**
5 m	8.5	11.9	14.4	17.1	21.1	24.5
10 m	12.3	17.1	20.8	24.8	30.5	35.4
15 m	15.3	21.3	25.8	30.7	37.9	43.9
30 m	19.6	27.2	33	39.3	48.4	56.1
45 m	22.6	31.4	38.1	45.3	55.8	64.8
1 h	25	34.7	42.2	50.2	61.8	71.7
1.5 h	28.8	40.1	48.7	57.9	71.4	82.8
2 h	31.9	44.4	53.9	64.1	79	91.6
4 h	38	52.8	64.1	76.2	94	109
6 h	42	58.4	71	84.4	104	120.6
8 h	45.2	62.8	76.3	90.7	111.8	129.6

Return Period (T/years)						
Duration	**2year**	**5year**	**10year**	**20year**	**50year**	**100year**
10 h	47.8	66.4	80.6	95.9	118.2	137.1
12 h	50	69.5	84.4	100.4	123.7	143.5
16 h	53.7	74.7	90.7	107.8	132.9	154.2
20 h	56.8	79	95.9	114	140.6	163
24 h	59.5	82.7	100.4	119.4	147.1	170.6

Table 9-26: Peak flows for the Steenkoolspruit adjacent to the NCC project site

Catchment	Method					
	RM3		SDF		MIPI	
	1:50yr	1:100yr	1:50yr	1:100yr	1:50yr	1:100yr
	(m^3/s)					
Steenkoolspruit	959.03	1340.65	1128.07	1438.08	915.59	1156.54

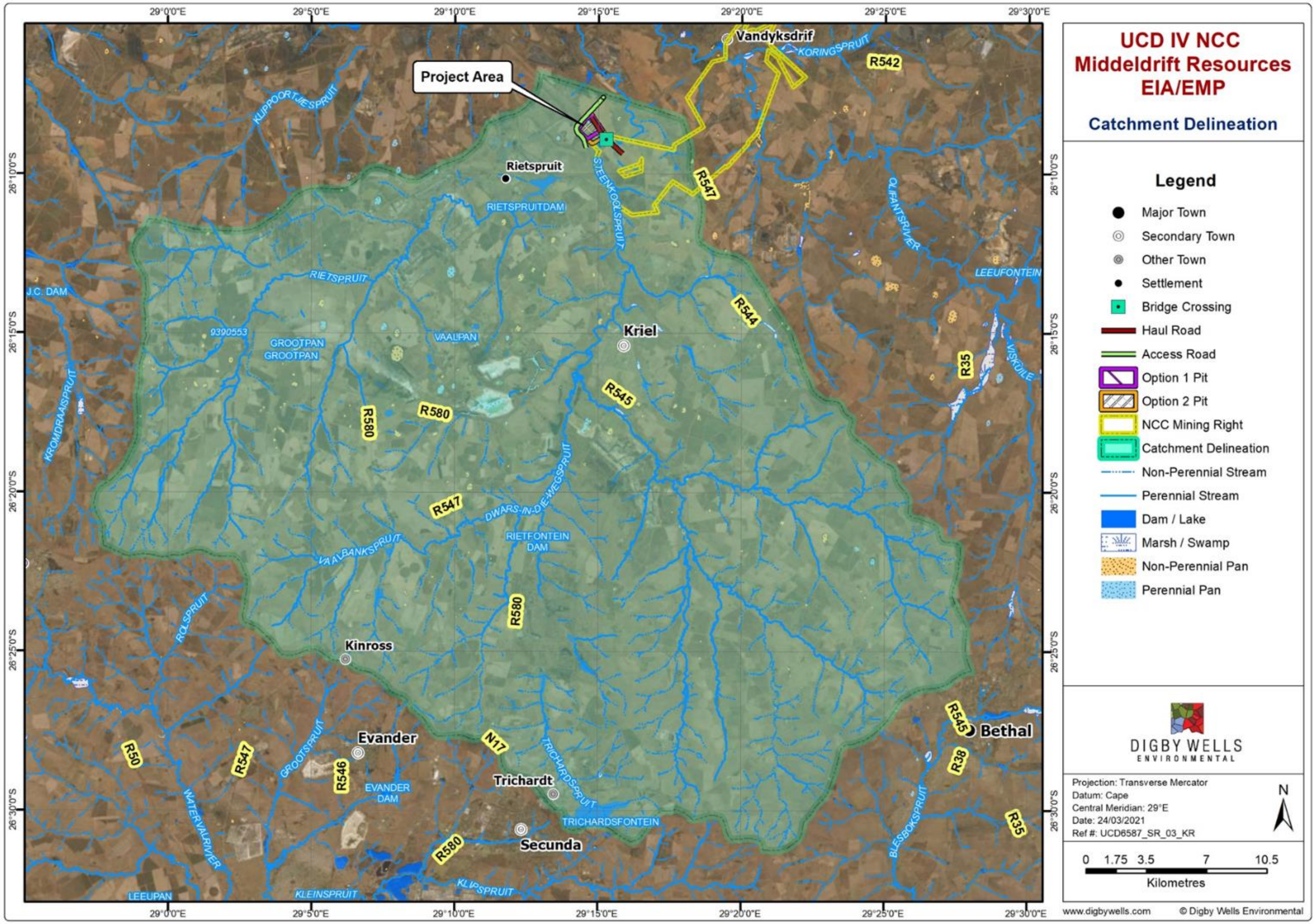


Figure 9-36: The delineated Steenkoolspruit catchment

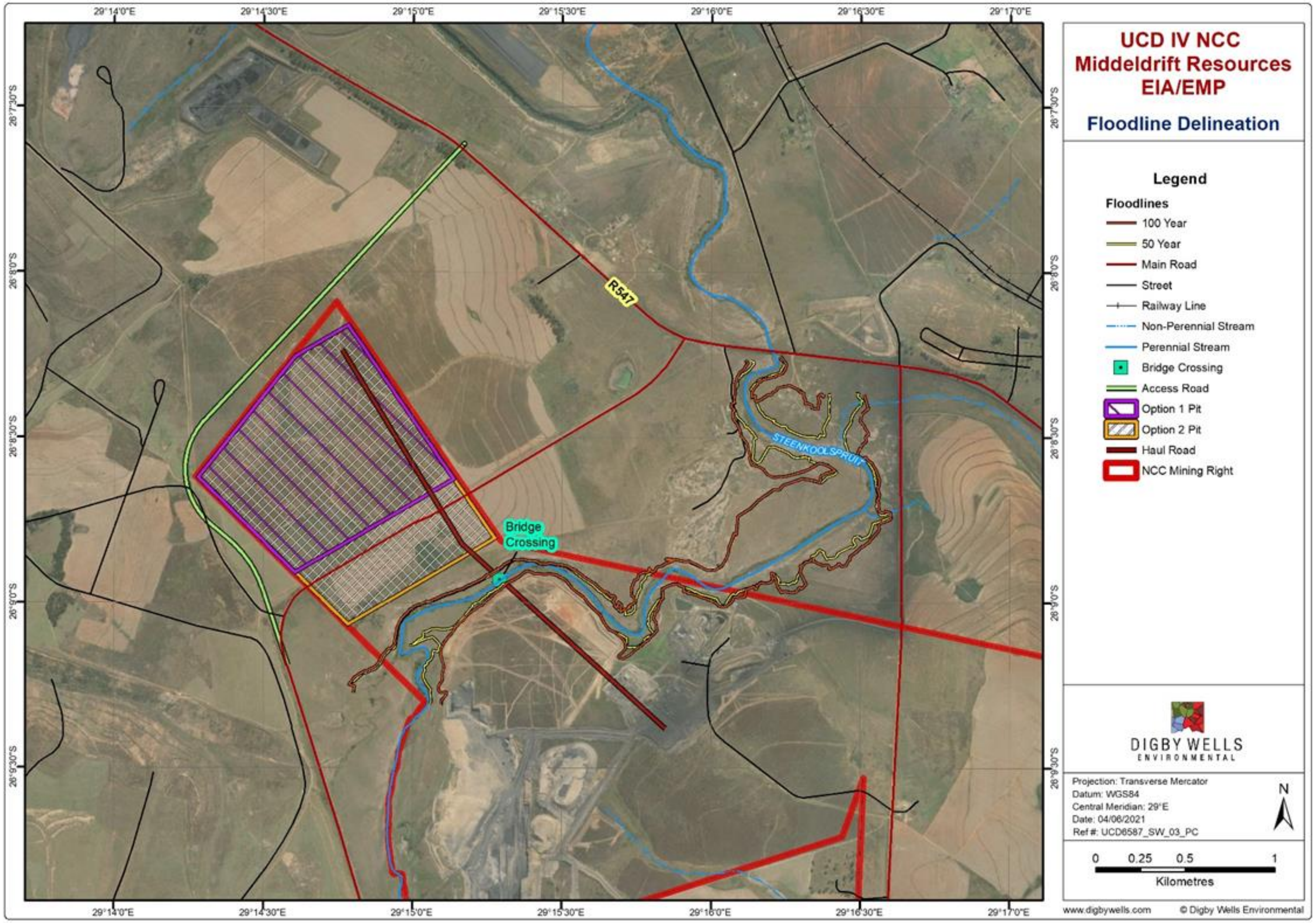


Figure 9-37: Floodlines for the Steenkoolspruit adjacent to the Middeldrift Resource project site

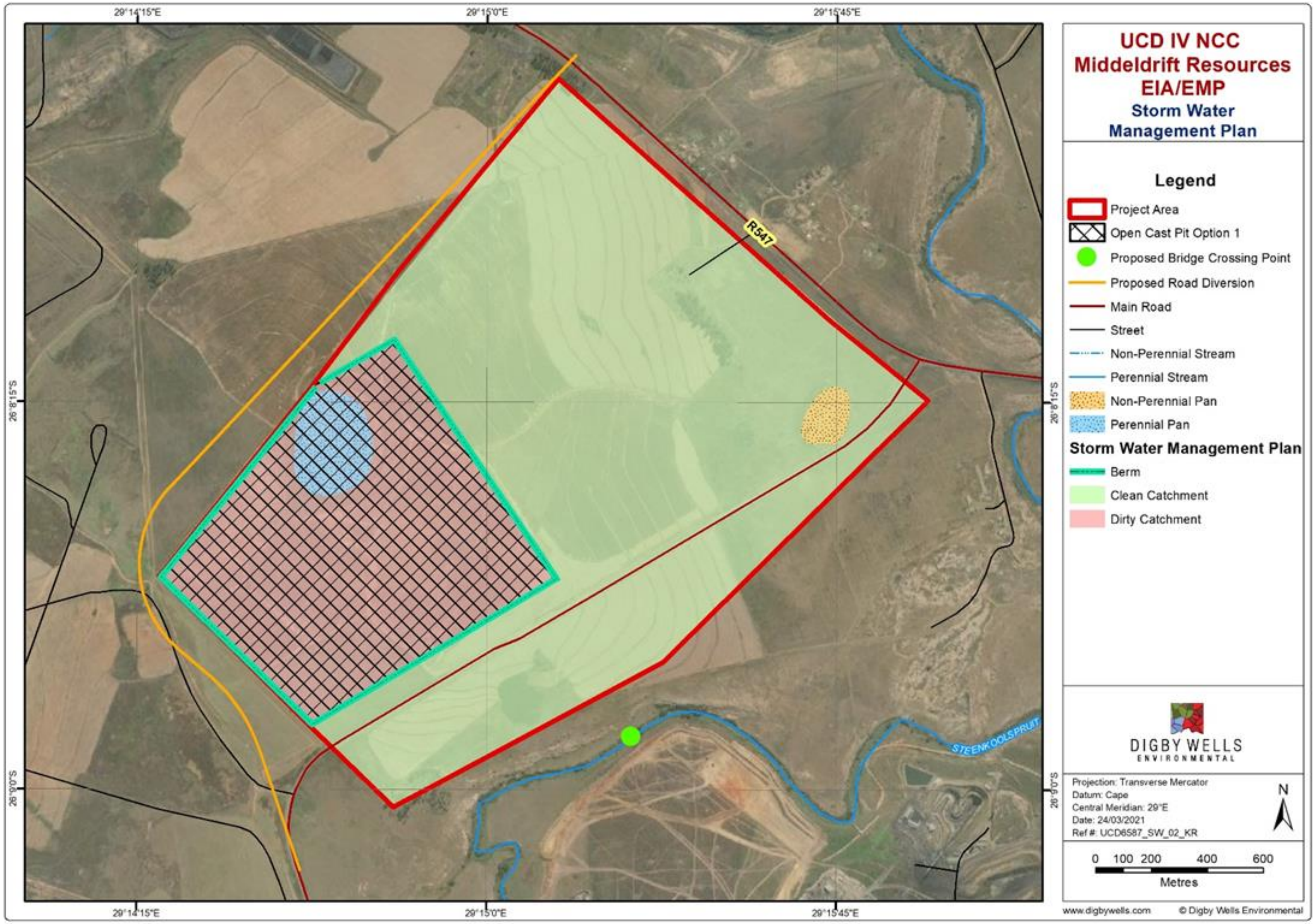


Figure 9-38: Storm water management plan for the proposed new pit at the New Clydesdale Colliery

9.7.4.3. *Floodlines*

The 1:50-year and 1:100-year floodlines indicate that the proposed infrastructure including the Middeldrift opencast pit are outside the flood waterway (Figure 9-37).

9.7.5. Storm Water Management Plan

Storm water management with respect to the proposed Middeldrift opencast pit is shown in Figure 9-38. The SWMP indicates a perimeter berm around the opencast pit, which is considered a dirty catchment. The berm will exclude or divert clean water from the clean water catchment around the pit so that it flows downslope to the Steenkoolspruit. The berm should be constructed to divert runoff depths greater than 1m and to stop a peak-runoff rate of 3.52 m^3/s, on average (Table 9-27).

Table 9-27: Results of the modelled clean catchment around the Middeldrift pit

Description	Slope (%)	Precip. (mm)	Infiltr. (mm)	Runoff Depth (mm)	Runoff Volume (ML)	Peak Runoff (m3/s)	Runoff Coefficient
Clean catchment	0.01	132.23	81.64	100.35	64.56	3.52	0.42

9.7.6. Water Balance

A water balance was compiled for the proposed Middeldrift opencast pit to be integrated into the existing mine-wide water balance at the NCC. Rainfall and evaporation data used to calculate water volumes directly falling into the pit and that evaporating out of the pit were obtained from the WR2012 database and it is presented in Table 9-28 and Table 9-29, respectively.

Table 9-28: Monthly rainfall for quaternary catchment B11E

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
72.08	111.04	109.94	115.86	90.95	75.83	41.80	16.81	7.55	6.48	7.16	22.94

Table 9-29: Monthly potential evaporation for quaternary catchment B11E

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
172.37	162.62	179.09	175.89	146.63	144.71	111.29	93.70	76.11	83.31	110.33	142.95

9.7.6.1. Assumptions and Constants

Constant values and assumptions considered during the water balance development are presented in Table 9-30.

Table 9-30: Assumptions and constants used in the water balance calculations

Description	Value	Unit	Source/comment
MAP	0.682	m	WR2012 database
MAE	1.95	m	WR2012 database
Runoff coefficient	0.4	%	Field observations
Pit runoff surface area	456 000	m^2	Measured from Google Earth
Middeldrift pit surface area	1 045 191	m^2	Measured from layout plan
Dust suppression	88 000	m^3/annum	IWWMP report (Headwaters, 2018)
Groundwater Inflow rate	200	m^3/day	Hydrogeological report (Digby Wells, 2021)
Seepage	1	%	Assumed to be 1% of pit inflows
Pumping from pit to existing PCD2	160	m^3/day	IWWMP report (Headwaters, 2018)

9.7.6.2. Water Balance Results

The annual, monthly and daily average water balances are presented in Figure 9-39 to Figure 9-41 respectively. The annual average water balance indicates a total inflow volume into the Middeldrift Opencast pit of 910 267 m^3/annum emanating from rainfall, runoff and groundwater ingress. A dewatering volume of 58 560 m^3/annum is pumped to Pollution Control Dam 2 (PCD2) situated at the existing NCC operations, while 88 000 m^3/annum is used for dust suppression. There are no water storages that happen at the Middeldrift opencast pit.

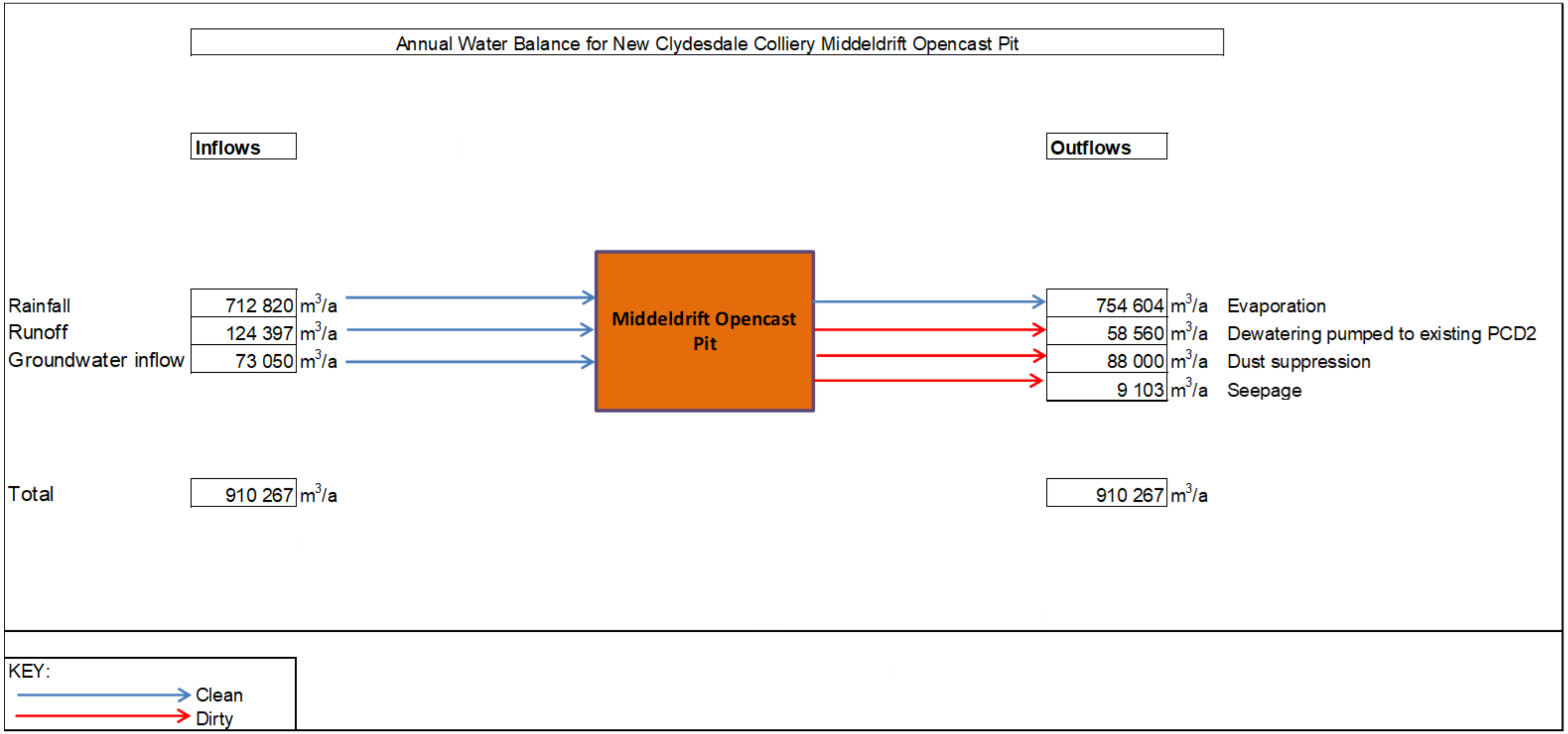


Figure 9-39: Annual average water balance for the Middeldrift Opencast Pit

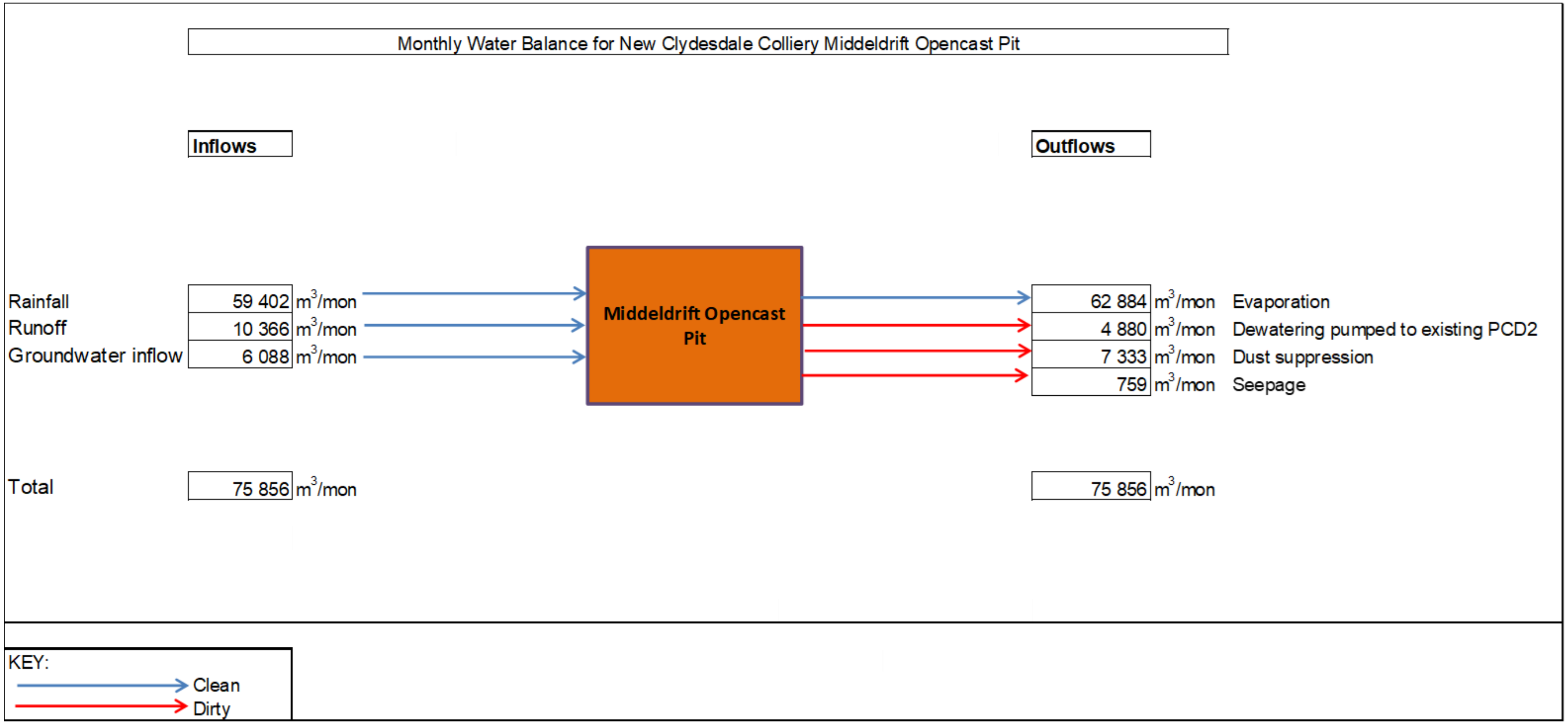


Figure 9-40: Monthly average water balance for the Middeldrift Opencast Pit

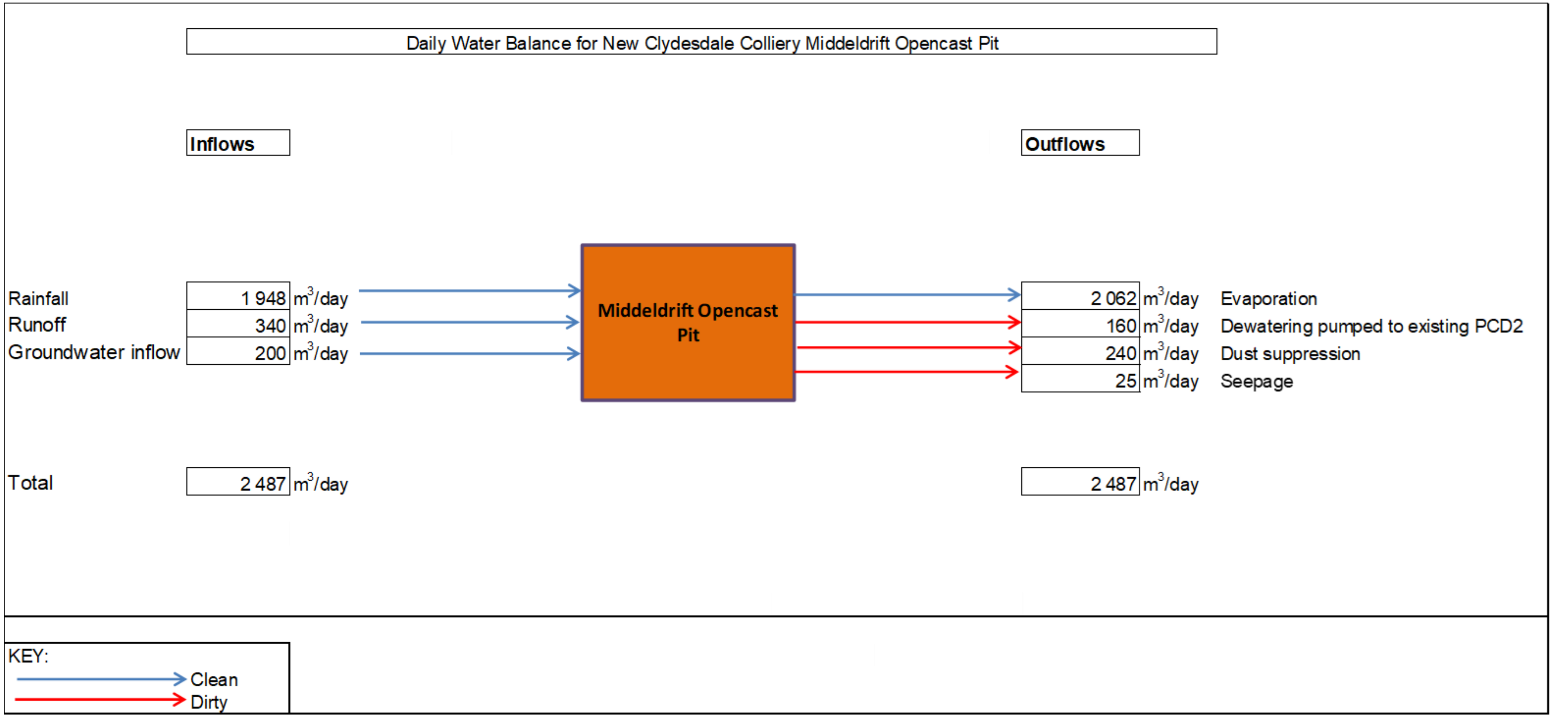


Figure 9-41: Daily average water balance for the Middeldrift Opencast Pit

9.8. Soils, Land Use and Land Capability

The soil, land use and land capability of the study area have been assessed at a desktop level using detailed aerial imagery and standard spatial data. These were confirmed during a rapid site survey. The site survey was used to refine the soil, land use and land capability and to determine the impacts the proposed activities might have on the soil, land use and land capability. The full Soil, Land Use and Land Capability Impact Assessment Report is attached in **Appendix I**.

The results of the assessment are depicted in below. Table 9-31 lists a description of the soil, land use and land capability in the project area. The project area lies on the eastern highveld grass vegetation (Table 9-42) and is largely made up of the Plinthic Catena: Upland Duplex and Margalitic Soils Rare land types (Figure 9-43). The land capability (Figure 9-43) is described as a Class II: arable land with intensive cultivation, while grassland and cultivated land are the most dominant land features in the area (Figure 9-45).

Table 9-31: Baseline Soil, Land Use and Land Capability Characteristics

Characteristics of the Highveld Ecoregion (Kleynhans, Thirion, & Moolman, 2005)		**Plant Species Characteristic of the Eastern Highveld Grassland** (Mucina & Rutherford, 2012)	
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.*
Vegetation Types	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, Hilliardiella oligocephala, Wahlenbergia undulata.*
Low Shrub Species	*Anthospermum rigidum* subsp. *pumilum, Seriphium plumosum.*	Geophytic Herb Species	*Gladiolus crassifolius, Haemanthus humilis subsp. hirsutus, Hypoxis rigidula* var. *pilosissima, Ledebouria ovatifolia.*
Status	Endangered.	Succulent Herb Species	*Aloe ecklonis.*

Land Types and Dominant Soil Forms

Land Type	Soil Form		Geology	Characteristics
Bb4	• Arcadia • Avalon • Estcourt • Glencoe • Glenrosa • Hutton • Katspruit • Kroonstad	• Longlands • Mispah • Rensburg • Sterkspruit • Swartland • Westleigh • Valsrivier	• Shale, sandstone, clay and conglomerate of the Ecca Group, Karoo Sequence; and • Dolerite, occasional felsitic lava of the Rooiberg Group, Transvaal Sequence.	• Dominated by moderately deep to deep well-drained sandy soils on the upper slopes with soils becoming shallower down the slope, increasing in clay content and becoming lower in permeability; • The Hutton and Avalon soil forms usually indicate deep, fertile soils, which are good for agriculture, whereas Mispah soil forms are only slightly permeable due to the high clay content; • Mispah and Glenrosa have a low potential for agriculture due to shallow bedrock, low permeability with a high erosion hazard and a shallow rooting depth; • Upland duplex and margalitic soils are rare; and • Red soils (apedal) are not common in these areas.
Bb5	• Mispah • Hutton • Rensburg • Wasbank • Avalon	• Glencoe • Swartland • Kroonstad • Longlands	• Shale, sandstone, clay, conglomerate, limestone and marl (Ecca Group); • Dolerite; and • Lava, sandstone, conglomerate, siltstone and rhyolite (Loskop Formation).	• Falls within the Plinthic Catena; • Upland duplex and margalitic soils are rare; • Red soils (apedal) are not common in these low-lying areas; and • These soils are usually high in clay content, occur in low lying areas and associated with wetlands.

Land Capability			**Land Use**
Class	Classification	Dominant Limitation Influencing the Physical Suitability for Agricultural Use	Predominantly: • Cultivated Land; and • Grassland. Minor Areas: • Water Area and Wetland; • Thicket/Dense Bush; • Plantation/Woodlot; • Woodland/Open Bush; and • Adjacent Urban Areas.
II	Arable Land – Intensive Cultivation	Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.	
IV	Arable land – Moderate Grazing	Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.	

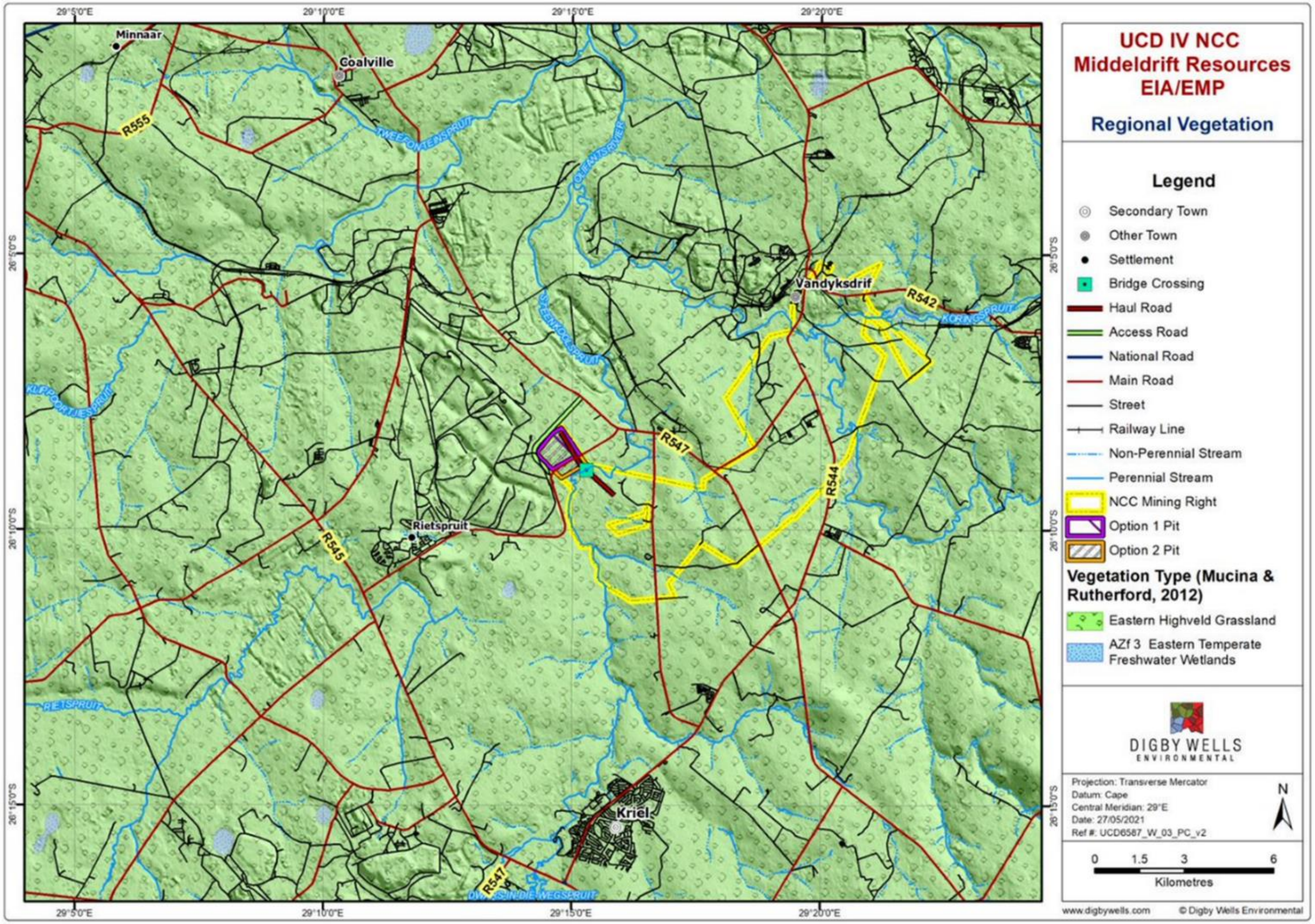


Figure 9-42: Regional Vegetation

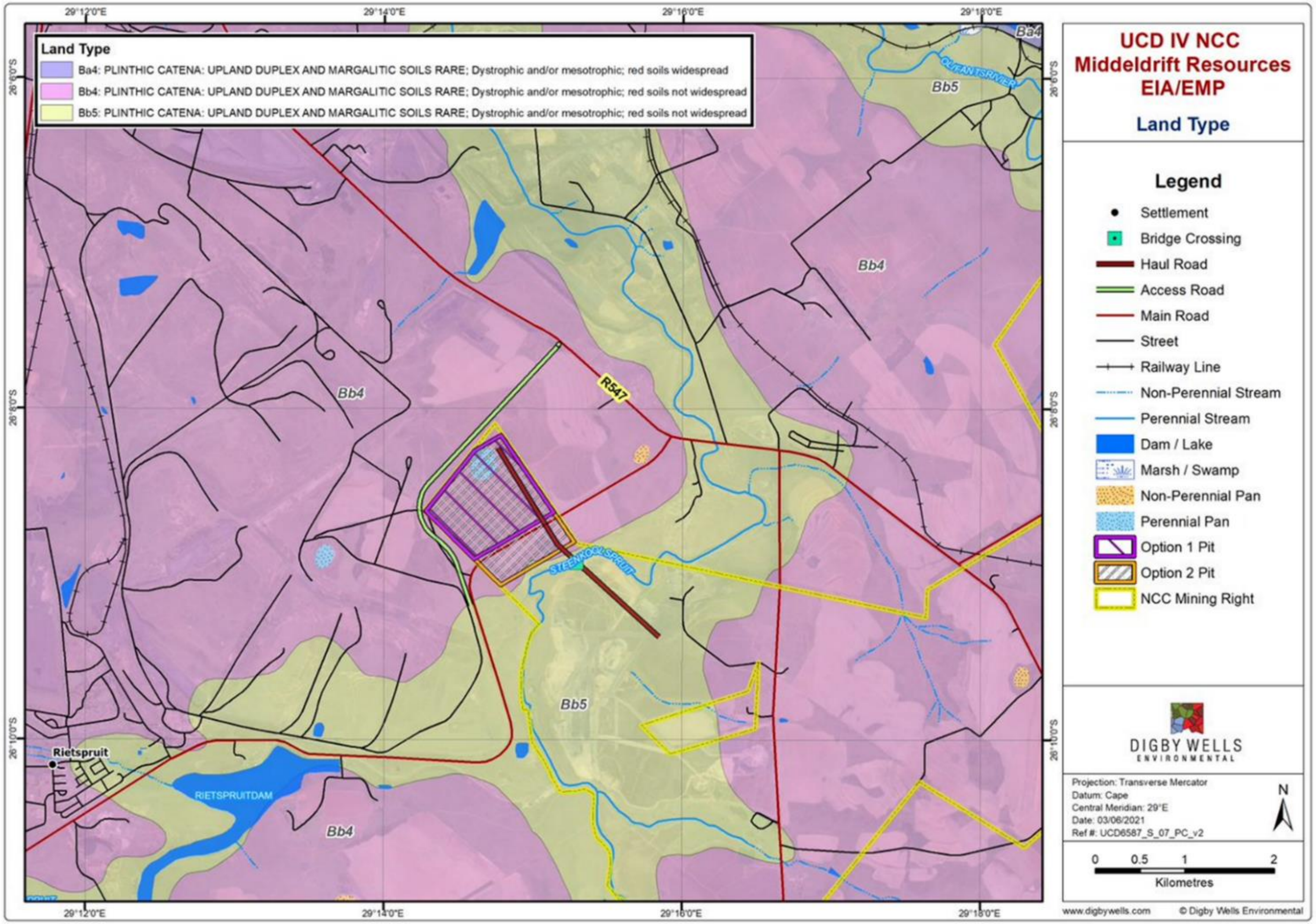


Figure 9-43: Land Types

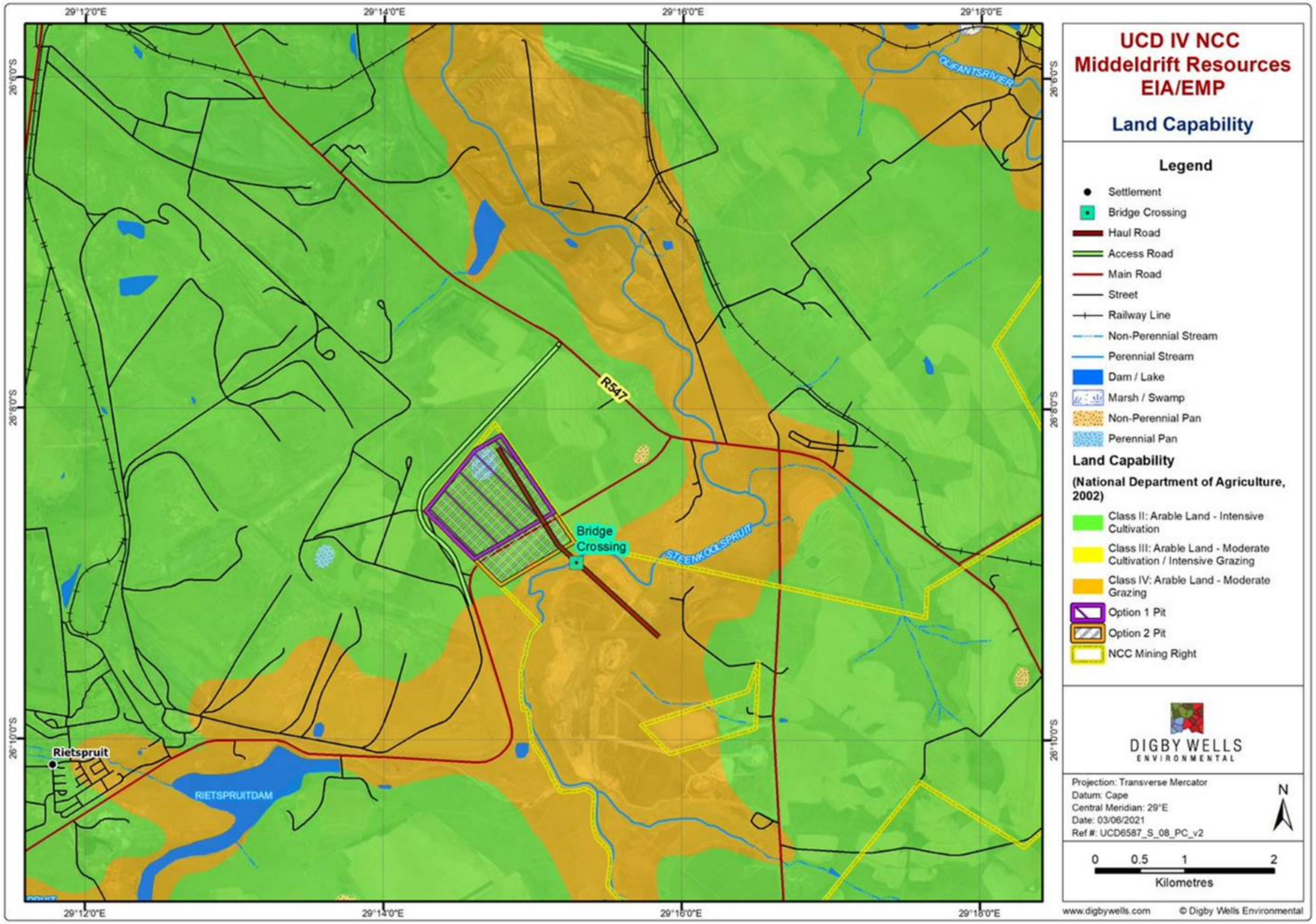


Figure 9-44: Land Capability

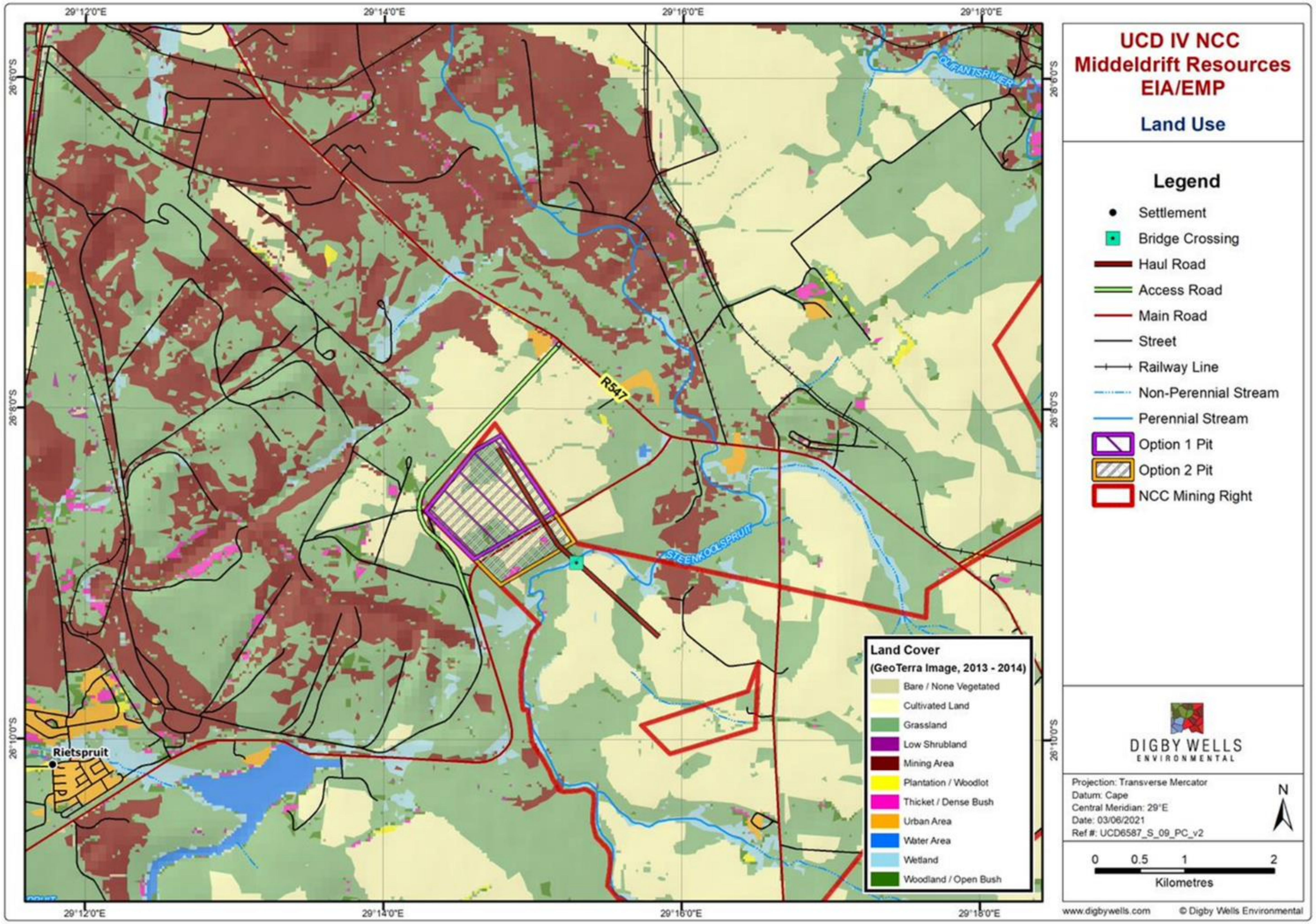


Figure 9-45: Land Use

9.8.1. Soil Forms

The soil forms within the study area were delineated and are illustrated in Figure 9-46. Each soil form together with site photos and a short description area presented in Table 9-32 below.

The following soils were identified within the project area:

- Avalon;
- Cartref/Glenrosa;
- Clovelly;
- Glencoe;
- Glenrosa;
- Katspruit;
- Kroonstad;
- Mispah;
- Pinedene;
- Rensburg; and
- Witbank.

The typical augured soil horizons were identified as Orthic A-horizons, overlying Yellow-brown to Red Apedal B-horizons with a Plinthic B-horizon. The soils were very sandy, deep fertile soils and are generally used for commercial agriculture. Scattered pans were identified on site, with typical soil horizons of Vertic-A overlying G-horizon and E-horizons overlying a G-horizon (Rensburg and Kroonstad soil forms).

The dominant land use of the area is commercial cultivation, indicating the high agricultural potential and land capability of the soils. These deep, sandy soils are generally easily manageable, preferred by farmers and excellent agricultural soils. The low-lying and depressions within the project area showed increased clay content and soil wetness. These soils were identified as wetland soils and are saturated for long periods with a fluctuating water table. The land use in these areas were generally wetlands and used for cattle grazing and perennial grasslands. These soils are somewhat limited for cultivation and highly mobile (high erosion probability).

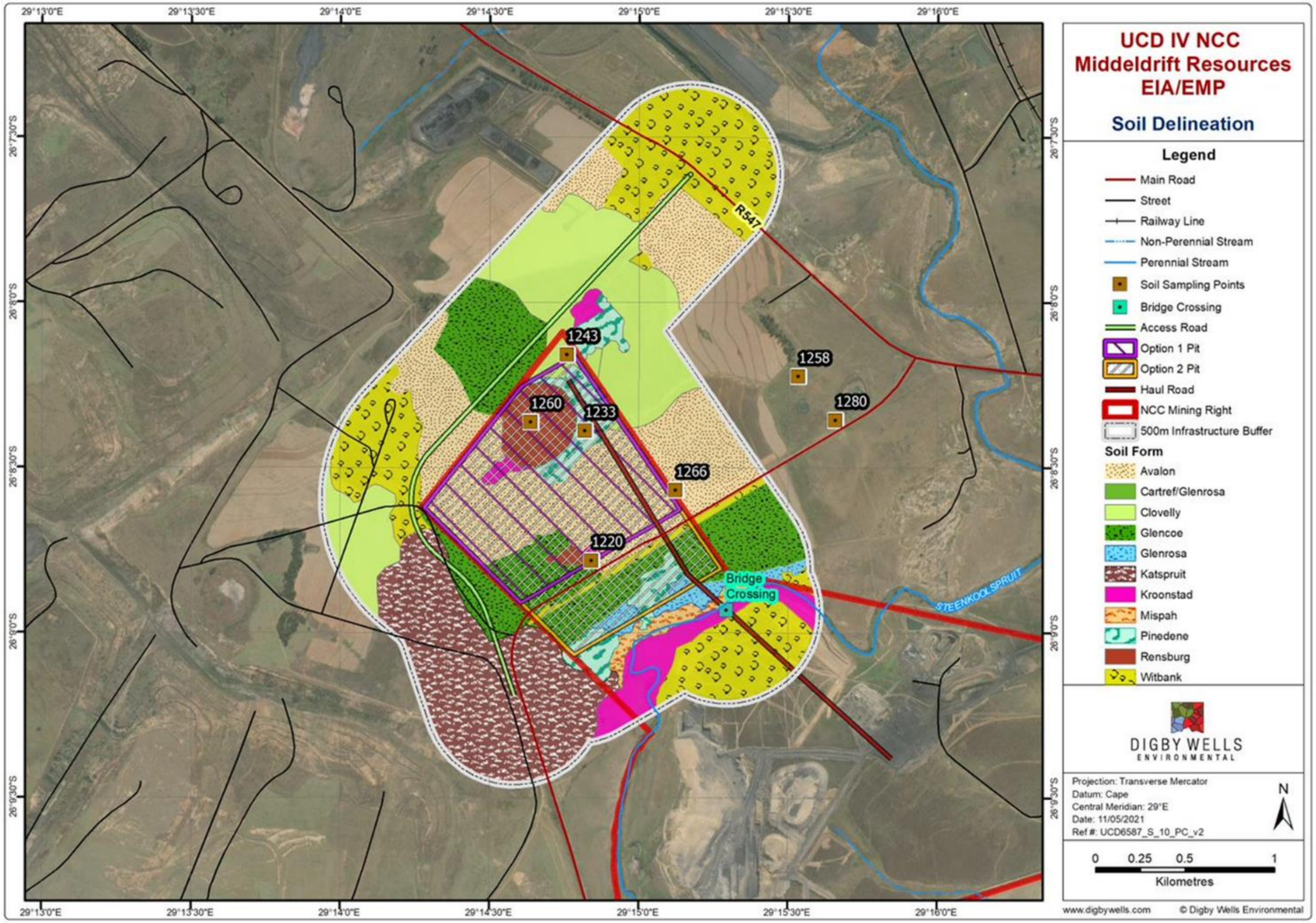


Figure 9-46: Soil Form Delineation and Sample Points

Table 9-32: Soil Forms in the study area

Soil Form	Description (Soil Classification Working Group, 1991))	Observations in the study area	
Avalon → Orthic A → Yellow-brown Apedal → Soft Plinthic	Avalon soils are free draining and chemically active soils with high permeability and leaching potential. Clay, Manganese and iron oxides accumulate with depth under conditions of a fluctuating water table forming localised mottles or soft iron concretions in the soft plinthic B horizon.	Avalon soils in the study area covered large areas, dominantly associated with hillslope seep wetlands and intensively cultivated land. The soils are deep, yellow-brown sandy soils overlying a clayey Plinthic layer. The soil depth varies from 500mm to >1200 mm. Avalon soils are often more fertile than Clovelly soils due to the higher clay contents, absorbing more nutrients and organic material.	
Cartref/Glenrosa → Orthic A → E-horizon → Lithocutanic → Lithocutanic	Cartref soils consist of leached, sandy E-horizons, overlying a weathered hard Lithocutanic layer containing cutans and signs of wetness (mottles). The soils usually overlie a hard, impermeable sandstone layer.	A very small section of the study area consists of Cartref soil form in the east of the project area. The soils are shallow, leached and overly a hard sandstone layer, restricting hand auguring, water movement and root development. Due to the shallow depths, these soils are not cultivated and used for cattle grazing.	
Clovelly → Orthic A → Yellow-brown Apedal → Unspecified	Clovelly soil forms are frequently confused with Hutton soil forms as they share the same characteristics. Clovelly soils have a yellow-brown chroma B-horizon, whereas Hutton soil has a red B-horizon. Both these soil forms have deep, sandy, well-drained characteristics. Yellow-brown Apedal B-horizons form from leached Red Apedal B-horizons and are therefore typically in lower-lying areas, are wetter, have higher permeability potential and lower fertility than red soils. These soils have a high land capability potential and are often intensively cultivated.	Clovelly soils in the study area were dominantly used for intensive cultivation. The soils were deep, sandy, freely drained soils with an unspecified B2 horizon (>1200 mm). The soils formed from the weathering of Sandstone parent material and red-apedal soils in the upper catchment. The soils were deep (>1200 mm), sandy, high permeability and well suited for cultivation. The soils are less susceptible to erosion (when vegetated), drain easily and have a high leachability. The soil has a low capacity to supply nutrients to plants and retain nutrients (CEC). These soils were dominantly cultivated and associated with crests, scarps, and mid-slopes.	
Glencoe → Orthic A → Yellow-brown Apedal → Hard Plinthic	These soils comprise a Yellow-brown Apedal B-horizon overlying a Hard Plinthic layer containing an accumulation of iron-, and manganese oxides. These soils together with their high clay content and restricted rooting depth (usually shallow soils) prevent free drainage and lower the agricultural potential of the soils.	Glencoe soils within the project area were predominantly shallow and had a restricting water, root and auger layer at 600 mm. The Glencoe soils were historically cultivated, had large areas of AIPs, smaller sections of current cultivation and evidence of alterations to the natural hydrology and geomorphology. The topsoil is sandy, freely drained and low in nutrients, overlying a restricted layer, therefore limiting intensive cultivation.	

Soil Form	Description (Soil Classification Working Group, 1991))	Observations in the study area	
Glenrosa → Orthic A → Lithocutanic	Glenrosa soils are shallow sandy soils overlying a Lithocutanic B-horizon containing cutans and signs of wetness (mottles). Glenrosa soils are often confused with Cartref soils. The Lithocutanic horizon merges into the underlying weathering rock (sandstone) with the same general organisation in respect to the colour, structure and consistency.	The Glenrosa soils were associated with shallow soils adjacent to the large floodplain system in the scarp terrain. The soils had some signs of temporary wetness due to springs and water accumulation due to shallow, rocky sandstone outcrops. The soils were dominantly used for cattle grazing and less disturbed by anthropological activities due to the shallow soil depths (~400 mm).	
Katspruit → Orthic A → G-horizon	Katspruit soils are high in clay leading to water accumulation. The restricted water permeability leads to a fluctuating water table and soil wetness for long periods, expressed in the soils as signs of wetness (mottles, clay, gleying). The G-horizon has an accumulation of iron, and manganese oxides, forming mottles. These horizons are saturated for long periods and have noticeable clay accumulation and are often referred to as hydromorphic soils (wetland soils).	Katspruit soils were identified within the Channelled Valley Bottoms and low-lying areas. The soils are high in clay with mottles and gleying within the first 100 mm. The dominant land use for these soils is wetland and used for cattle grazing and cattle watering/dams. These soils have cultivation restrictions due to the low draining potential causing waterlogging conditions, however, are high in organic material and soil fertility.	
Kroonstad → Orthic A → E-horizon → G-horizon	Kroonstad soils are referred to as hydromorphic soils due to waterlogging conditions and permanent wetness. These soils consist of a sandy, leached E-horizon overlying a G-horizon with high clay content and clear signs of wetness (mottles/leaching). The soils are saturated for long periods, has a fluctuating water table and have noticeable clay accumulation in the deeper profile. Kroonstad soils have a perched water table resulting in reducing conditions such as mottling, gleying and leaching. These soils are often sandy loams with high permeability in the upper horizon overlying an impermeable/low-permeable B-horizon.	Kroonstad soils in the project area are associated with hillslope seep wetlands connected to the pans and floodplain system. The soils are seasonal to temporary wet and were often impacted by adjacent cultivation practices. The soils were leached, very sandy in the A-horizon, overlying a very clayey B-horizon with Fe and Mn accumulation. The soils contribute to subsurface water/ interflow into the pans and Channel Valley Bottoms (CVBs). The soil depth varied, however often deeper than 1200 mm.	 

Soil Form	Description (Soil Classification Working Group, 1991))	Observations in the study area	
Mispah → Orthic A → Hard rock	Mispah soils are dominantly shallow with restricting water and rooting depth. The soils often have a shallow water table, high surface runoff and associated with sheetrock wetlands. The A-horizon are highly susceptible to erosion when overgrazed, disturbed and low vegetation cover.	Mispah soils in the project area are very shallow soils overlying hard rock. The soils can easily be confused with Glenrosa soil forms; however, these soils had no B-horizon overlying the hard rock. The soils were delineated in the scarp, adjacent to the floodplain/CVB system. The soil depth did not exceed 150 mm, therefore restricts cultivation and often had low vegetation cover. These areas were less impacted by anthropological activities.	
Pinedene → Orthic A → Yellow-brown Apedal → Unspecified material with signs of wetness	Pinedene soils are generally fairly deep (700 – 1200 mm) 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, the potential for wetland formation and accumulation of nutrients, increasing the soil fertility. These soils are often cultivated and have a high land capability.	Pinedene soils on site were deep (>1200 mm) soils with an unspecified, clayey B-horizon. The soils were sandy, well-drained, and often cultivated due to their high agricultural potential (soil fertility) and easy management rating. Clay increased with depth and often had signs of wetness (mottles) in the deeper horizons, however, were deeper than 500 mm and thus not classified as wetland soils.	
Rensburg → Vertic A → G-horizon	Rensburg soils consist of a Vertic-A horizon with high clay, dark colour and high in organic material. The G-horizon subsoil has a grey or gleyic colour pattern (leached) which at times can be hints of green due to the reduction of iron under permanent or periodic anaerobic conditions and has a firmer consistence than the overlying topsoil and is classified as a wetland soil. These soils are often associated with wetlands and classified as hydrogeomorphic soil.	These soils were augured in the pans and valley bottom wetlands within the project area. The soils had a dark, black, clayey A-horizon (vertic) overlying a sandy-clay-loam, light coloured G-horizon. These soils were permanently saturated with water, well-vegetated and used for cattle grazing. The soils are high in Organic Material (OM) and soil fertility, however restrictions to cultivation due to saturation and waterlogging.	
Witbank → Man-made material	Witbank soils are anthropologically impacted soils. These soils are combined and mixed soils with various properties and pedogenesis. These soils are altered from their natural state and include intensively cultivated land.	Witbank soils were dominant in the study area due to adjacent historical mining and historical and current agropastoral activities. The natural geomorphology of these soils was altered by excavations, compaction, dam building, stockpiling, cultivation and historical infrastructure. Some of these soils were associated with artificial wetness due to compaction, mixing of subsoil and topsoil causing water ponding.	

9.8.2. Soil Chemical and Physical Characteristics

The results of the soil analysis for the seven representative samples taken during the site survey are presented in Table 9-34. As a basis for interpreting the data, Soil Screening Values (SSV) and local soil fertility guidelines are presented in Table 9-33, together with the pH guidelines.

The results highlighted in yellow present values below the SSV and red above the SSV. The pH colours are presented in Table 9-34 below.

Table 9-33: Soil Fertility Guidelines

Guidelines (mg per kg)			Source
Macro Nutrient	**Low**	**High**	
Aluminium (Al)	<10	>50	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)
Boron (B)	<0.5	>1.5	USA Guidelines, (Allison, et al., 1954)
Calcium (Ca)	<200	>3000	South Africa Guidelines, (NEM:WA 2008)
Chlorides (Cl)	-	>12000	South Africa Guidelines, (NEM:WA 2008)
Copper (Cu)	<36.0	>190	Dutch Guidelines, (Dutch VROM, 2000)
F (Fluoride)	-	>200	Canadian Guidelines, (CCME, 2007)
Magnesium (Mg)	<50	>300	South Africa Guidelines, (NEM:WA 2008)
Nickel (Ni)	-	>45	Canadian Guidelines, (CCME, 2007)
Organic Carbon (OC)	< 2 %	>3 %	South Africa Guidelines, (du Preez, Mnkeni, & van Huyssteen, 2010)
Phosphorus (P)	<5	>35	South Africa Guidelines, (NEM:WA 2008)
Potassium (K)	<40	>250	South Africa Guidelines, (NEM:WA 2008)
Sodium (Na)	<50	>200	South Africa Guidelines, (NEM:WA 2008)
Zinc (Zn)	<140	>720	Dutch Guidelines, (Dutch VROM, 2000)
EC	110 (mS/m)	570 (mS/m)	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)
CEC	5%	25%	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)

pH					
Very Acid	**Acid**	**Slightly Acid**	**Neutral**	**Slightly Alkaline**	**Alkaline**
<4	4.1-5.9	6-6.7	6.8-7.2	7.3-8	>8

Table 9-34: Soil Physico-Chemical Properties

Sample ID	pH (KCl)	Electrical Conductivity (EC)	Organic Carbon	Cation Exchange Capacity (CEC)	P (Bray1)	K	Na	Ca	Mg	Fe	Mn	Cu	Zn	Ni	F	Cl	NO_2	NO_3	NH_4	Clay	Sand	Silt	Texture
		mS/m	%	Cmol(+)/kg	mg/kg					mg/l										%			
1	4.28	100	0.59	3.24	7.4	24.7	26.0	109.7	35.3	69.03	0.65	0.60	0.30	0.09	0.24	27.64	0.07	8.60	0.09	4.6	92.8	2.6	Sand
2	4.94	44	0.51	6.20	9.5	207.7	1.8	282.7	97.3	4.63	8.20	0.29	0.63	0.10	0.23	2.71	0.05	54.47	0.06	11.7	83.3	5.0	Loamy Sand
3	5.82	39	0.43	4.85	4.2	81.1	2.1	394.7	39.2	3.64	2.96	0.31	0.50	0.04	0.65	1.15	0.01	1.42	0.05	11.6	76.6	11.8	Sandy Loam
4	4.21	50	1.36	4.58	7.4	41.4	16.9	129.2	29.2	106.10	2.38	0.61	0.87	0.14	0.09	9.89	0.06	1.91	0.07	9.3	88.0	2.7	Loamy Sand
5	6.48	220	1.64	23.90	5.0	862.4	475.0	1766.9	727.5	37.33	79.07	2.33	0.63	0.66	11.40	67.94	0.10	2.91	0.12	59.7	19.8	20.4	Clay
6	6.16	111	0.47	4.25	16.9	56.2	2.0	291.7	77.0	7.00	4.90	0.39	0.85	0.08	0.41	9.35	0.01	192.53	0.05	9.5	85.5	5.0	Loamy Sand
7	5.31	79	0.36	3.59	8.1	34.0	11.4	257.2	28.7	71.54	5.50	0.57	0.47	0.18	0.19	11.20	0.04	0.25	0.07	6.8	90.6	2.6	Sand

9.8.3. Soil Texture

Guidance Note for Soil Texture

The particle size distribution of the soil sampled in the project area was classed into the percentages of sand, silt and clay present. The textural classes were obtained from plotting the three fractions on a textural triangle. The size limits for sand, silt and clay used in the determination of soil texture classes are sand: 2.0 – 0.05 mm, silt: 0.05 – 0.002 mm and clay: < 0.002 mm.

Soil water retention characteristics are strongly affected by soil texture. A higher clay content results in greater water retention. Similarly, the higher the sand fraction, the less water is retained by the soil (Gebregiorgis, 2003). Soil macropores allow a greater volume of water to drain more rapidly than would be expected from a soil that is dominated by clay fractions. Generally, the ideal pore space is between 40 – 60% (NRCS-USDA, 2013).

The bulk density of soil is dependent on the sand-clay-silt ration. The higher the clay content the higher the bulk density. Bulk density represents the mass of dry soil (mass of solids) per unit volume of soil (White, 2003). A low bulk density implies a favourable soil structure for root penetration as it is not compacted (Karuku, *et al.*, 2012). Generally, soils with bulk densities greater than 1.6 g/cm^{-3} are considered as compacted soils (Twum & Nii-Annang, 2015).

The particle size distribution of the soil sampled in the project area was classed into the percentages of sand, silt and clay present. The textural classes were obtained from plotting the three fractions on a textural triangle. The average soil texture in the project area was sand to loamy sand. Soil texture is a direct attribute from the parent material (dominantly sandstone). The following characteristics are related to sandy soils:

- High infiltration and drainage rate;
- High leaching potential; and
- Low soil fertility (Organic Carbon (OC), CEC, EC, pH).

The high clay soils in the large pan contribute to the high fertility of the soils. The higher the clay in the soil, the higher the EC, CEC, Organic Carbon and pH.

Sample Number	Texture Classification
1	Sand
2	Loamy Sand
3	Sandy Loam
4	Loamy Sand
5	Clay
6	Loamy Sand
7	Sand

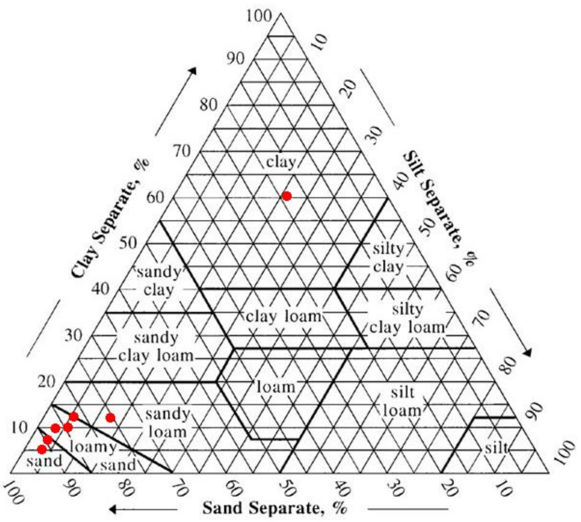


Figure 9-47: Texture Classification

9.8.4. Soil pH

Guidance Note for Soil pH

The measurement of soil acidity is referred to as soil pH. The soil pH is determined in the supernatant liquid of an aqueous suspension of soil after having allowed the sand fraction to settle out of suspension. Soil pH influences soil chemical, physical and biological properties.

The interaction between soil particles, soil solution and dissolved ions have an important role in holding cations such as calcium (Ca^{+2}), magnesium (Mg^{+2}), potassium (K^{+}) and ammonium (NH_4^{+}) in the soil. The cations are important plant nutrients that are taken up by plants from the soil solution. When the concentration of the solution is out of proportion it will directly impact the biology of the soil as well as the growth of the vegetation. When the concentration is increased, by means of adding lime and fertilizers, the nutrient will first be absorbed by the soil particles until dissolved and released into the soil solution for plant availability. When the holding capacity of the soil particles are low (sandy soil), the nutrient will just leach out of the profile, inherently known as infertile soils whereas clayey soils have a much higher holding capacity for nutrient and thus are more fertile (Neina, 2019).

In addition to the cations in the soil is acid ions. The acid ions include hydrogen protons (H^{+}) and aluminium ions (Al^{+3} and $Al(OH)^{+2}$) causes an acidic reaction and therefore lower the pH of the soil solution (Farina & Channon, 1991).

The pH of the soil samples collected ranged from **4.21** to **6.48**, indicating that the soils are **acidic** to **slightly acidic**. The optimal pH for crops ranges between 5.5 and 7.5. However, some crops have adapted to thrive outside the optimal range. The following can be derived from the data:

- Samples 5 and 6 were within the optimal cultivation pH range;
- Samples 5 and 6 were taken within the large pan (Rensburg soil form) and within shallow Avalon soils with high clay and EC;

- Samples 1, 2, 3, 4, 7 were below the optimum agriculture pH and require liming to increase the pH;
- Due to the sandy nature of the dominant soils (Sample 1, 2, 3, 4, 6 and 7), intensive crop production and high rainfall in the vicinity of the project area, the pH tends to decrease over time and require a liming and fertilizer programme to optimise crop production; and
- Soils with a low EC, Magnesium (Mg) and clay content tend to have a lower pH than soils with higher clay and EC.

9.8.5. Exchangeable Cations

Guidance Note for Exchangeable Cations

The higher the CEC value (> 25) the higher the clay and/or OM in the soil. Soils with a high clay and/ or OM content, with a high CEC will have high cation concentrations. Cations are adsorbed by the negatively charged clay and OM particles. Soils with a low CEC (< 5) is usually an indication of sandy soils with low soil fertility and OM. The optimum CEC ranges from 5 to 25 Cmol/kg.

The levels of the basic cations (**Ca**, **Mg**, **K** and **Na**) are determined in soil samples for agronomic purposes through extraction with an ammonium acetate solution. In general, the amounts of exchangeable cations normally follow the same trend as outlined for soil pH and texture. For most soils, cations follow the typical trend **Ca**>**Mg**>**K**>**Na**, **Ca** being the most reactive and **Na** less reactive.

In soil, dispersion and flocculation of soil particles are a chemical phenomenon which is driven by the balance of the exchangeable cations. Excess **Na** and **K** causes dispersion (soil is broken down in very fine particles which is particularly sensitive to erosion), whereas high levels of **Ca** would rather cause flocculation (soil particles adhere to each other to form clusters/flakes or clumps). Dispersion and flocculation have several impacts on soil development and responses which in return affects root development and plant growth (Chibowski, 2011).

The CEC values ranged from **3.24** to **23.90 Cmol/kg**. This is a wide range within the project area, clearly indicating impacts from historical and current land uses. The following can be derived from the data regarding the CEC and the exchangeable cations:

- The CEC for Samples 1, 3, 4, 6 and 7 were below the SSV;
- The Sodium (Na) and Mg in these samples were below the SSV;
- The CEC for Samples 2 and 5 were within the SSV, with adequate Potassium (K), Calcium (Ca) and Mg in Samples 2 and concentrations of K, Na and Mg above the SSV in Sample 5;
- Sample 2 (has slightly a higher clay and loam fraction than the other samples, whereas Sample 5 has a very high clay content (Rensburg soils);
- The low CEC and cations in the dominant soils (all samples, except for Sample 5 taken in the large pan) can be attributed to the sandy nature of the soil (sandstone parent material), low OM, low clay content and intensive cultivation practices; and

- Soils with a low CEC and cations have low soil fertility and require fertilization for optimal crop production.

9.8.6. Phosphorus

Guidance Note for Phosphorus Content

Phosphorus (**P**) is required in plants for root development and promote plant sugars for more efficient ripening of fruits and promote larger flowers. Soil pH and depth are just as important to note as **P** is immobile in soil and will be higher at a depth where there is a free flow of water.

P deficiencies in soil causes low crop production, thin and week stems of plants, stunted growth, and shorter, dark leaves.

Excessive levels of phosphorus in a growth medium are not particularly harmful to plant health, however, may impede the uptake of **Zn** and Iron (**Fe**) even when there are adequate amounts of these nutrients in the material. Excessive levels of **P** are not easily remedied and takes a long time to lower. It is therefore important to avoid fertilisers containing phosphorus, such as NPK and cattle manure as fertiliser. The optimum P in soils for crop production range from 5 to 35 mg/kg.

The P in the samples ranged from **4.2** to **16.9** mg/kg. This is slightly low, and soils will require P-fertilizer for optimum crop production. The following was derived from the data:

- Only Sample 3 had P-values below the SSV. Sample 3 was taken in a maize field and could clarify the low P-level (crop uptake and P-demand);
- P in the other six samples were within the SSV, with the highest concentration in Sample 6;
- The higher concentration in Sample 6 (intensively cultivated land in Clovelly soils) can be attributed to the recent application of P-fertilizer; and
- The slightly low P in Sample 5 (large pan) indicates that the P-demand of the crops in the catchment is high and that the P in the soils are most likely fixed and not easily leached.

9.8.7. Heavy Metals and Potential Harmful Elements

Guidance Note for Heavy Metal Content and Potential Harmful Elements

Heavy metal contamination is a serious form of inorganic pollution which has a long-term negative effect on the natural environment. These heavy metals include **Al, Hg, Cd, Pb, As, Cu, Zn, Mn, Ni, U** and **Se.** To a greater or lesser extent, these elements are toxic to living organisms. **Cd** and **As** are extremely toxic, whereas **B, Cu, Zn** and **Mn** are relatively lower in toxicity to living organisms.

The optimum level of nitrates in soil for commercial crops ranges from 5 to 10 parts per 1 million (ppm). Optimum nitrate level for soil used for corn production is more than 25 ppm.

The heavy metals and potentially harmful elements in all the samples were below the SSV values. This is a good indication that there is currently no inorganic pollution in the project area. The following was derived from the data:

- Copper (Cu), Zink (Zn), Nickle (Ni) and Fluoride (F) were analysed and were all below the SSV in all seven samples;
- Other potential harmful elements, including Chloride (Cl), Nitrite (NO_2), Nitrate (NO_3) and Ammonium (NH_4) were low in all the samples and will not cause harm to crop production; and
- The soils are not impacted by potential harmful elements, nor heavy metals. This baseline data should be used for future soil and water monitoring.

9.8.8. Organic Carbon

Guidance Note for Organic Carbon Content

Soil Organic Carbon indicates organic material content in the soil, therefore soil fertility. Organic Carbon releases nutrients to plants, promotes root development, soil structure, soil health and increases the buffer of the soil against harmful elements. The higher the level of Organic Carbon, the higher the OM and thus the more fertile the soil. Levels above 2 - 3% Organic Carbon are considered moderate to high for soils in South Africa according to du Preez *et al.*, (2010).

The soil Organic Carbon ranged from **0.36** to **1.64** % in the seven soil samples. The Organic Carbon in all the samples were thus below the SSV. The following was derived from the data:

- Sample 7 (pan, outside the project area) had the lowest Organic Carbon and a very sandy texture;
- Sample 5 (pan, inside the project area) had the highest Organic Carbon with the highest clay levels;
- The higher the clay in the soil, the higher the CEC, EC, absorption potential and Organic Carbon; and
- All the samples had a lack of Organic Carbon and organic fertilizer would be required for optimum crop production

9.8.9. Sensitivity

Sensitive areas (areas with a high land capability and suitability) were identified based on the soil delineations, land use and soil chemical and physical analysis (Table 9-35 and Figure 9-48.

Table 9-35: Soil sensitivity

Soil Form	Land Use (Dominant current)	Land Capability (Dominant current)	Land Class	Sensitivity
Avalon	Cultivation	Intensive Cultivation (IC)	I	High
Cartref/ Glenrosa	Cultivation	Moderate Cultivation (MC)	IV	High
Clovelly	Cultivation	IC	I	High
Glencoe	Cultivation	IC	I	High
Glenrosa	Cattle grazing	Moderate Grazing (MG)	VI	Medium
Katspruit	Cattle grazing/ wetland	MG	V	Medium
Kroonstad	Cattle grazing/ wetland	MG	V	Medium
Mispah	Cattle grazing	Light Grazing (LG)	VII	Low
Pinedene	Cultivation/ wetland	IC	III	High
Rensburg	Cattle grazing/ wetland	MG	V	Medium
Witbank	Cattle grazing/ industrial	LG	VII/ VIII	Low

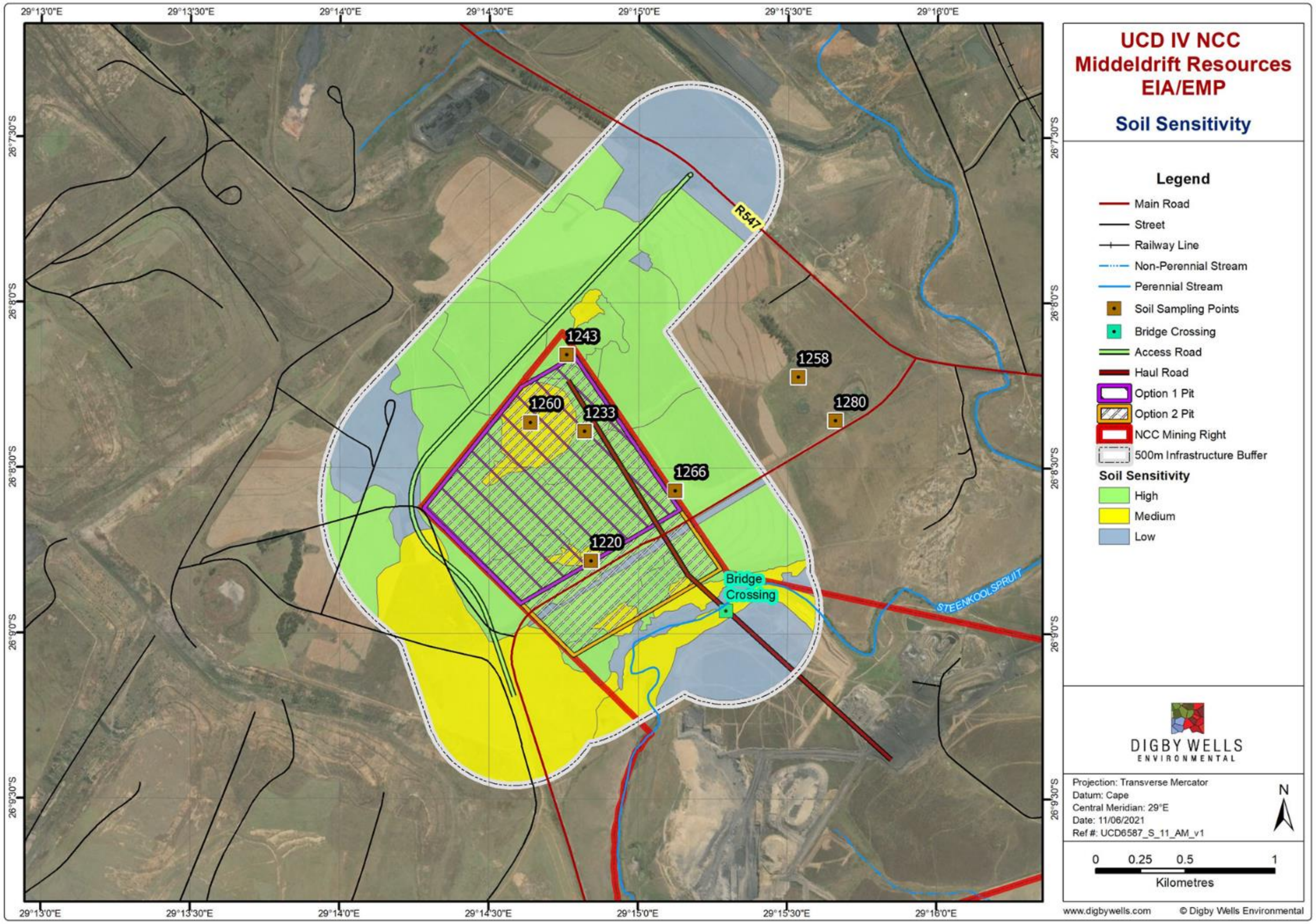


Figure 9-48: Soil sensitivity map

9.9. Hydropedological Assessment

The hydropedological processes in the project area were conducted through desktop assessments and the review of literature. Existing Land Type data was used to obtain generalised soil patterns and terrain types for the proposed project site (See the Soil, Land Use and Land Capability Assessment attached in **Appendix I**).

Hillslopes were delineated according to methods described by (Le Roux, et al., 2011) and the conceptual hillslope hydrological behaviour determined. The hydrological behaviour was based on identified hydrological soil types as described in the Table 9-36 below.

Table 9-36: Hydrological Soil Types of the hillslopes (Adapted from Le Roux *et al*., 2011)

Hydrological Soil Type	Description	Symbol
Recharge	Soils without any morphological indication of saturation. Vertical flow through and out of the profile into the underlying bedrock is the dominant flow direction. These soils can either be shallow on fractured rock with limited contribution to evapotranspiration or deep freely drained soils with significant contribution to evapotranspiration (ET).	
Interflow (A/B)	Duplex soils where the textural discontinuity facilitates build-up of water in the topsoil. The duration of drainable water depends on rate of ET, position in the hillslope (lateral addition/release) and slope (discharge in a predominantly lateral direction).	
Interflow (Soil/Bedrock)	Soils overlying relatively impermeable bedrock. Hydromorphic properties signify temporal build of water on the soil/bedrock interface and slow discharge in a predominantly lateral direction.	
Responsive (Shallow)	Shallow soils overlying relatively impermeable bedrock. Limited storage capacity results in the generation of overland flow after rain events.	
Responsive (Saturated)	Soils with morphological evidence of long periods of saturation. These soils are close to saturation during rainy seasons and promote the generation of overland flow due to saturation excess.	

9.10. Geology Assessment

This section details the regional and local geological settings of the project area.

9.10.1. Regional Geology

Middeldrift is located within the Witbank coalfield, which is within the Karoo Supergroup. All of the known coal deposits in South Africa are hosted in sedimentary rocks of the Karoo Basin, a large foreland basin which developed on the Kaapvaal Craton and filled between the Late Carboniferous and Middle Jurassic periods.

The Karoo Supergroup within the project area comprises the Ecca Group and 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 coal-bearing sandstones and siltstones) rest either conformably on diamictite and associated glaciogenic sediments of probable Dwyka age, or unconformably on basement rocks. The Ecca Group sediments overlie the Dwyka Group. The geology of the project area has been visually represented in Figure 9-50. The geology can also be stratigraphically classified as indicated in Table 9-37.

Table 9-37: Stratigraphy Of The Regional Geology

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

9.10.2. Local Geology

The project area is underlain by formations of the Ecca Group, as shown in Figure 9-50. The site falls on the Witbank coalfield- a succession of sandstone, siltstone and mudstone, containing five coal seams, dipping slightly to the south. The five coal seams numbered No. 1 to No. 5 from the bottom to the top. The coal is contained within a 70 m of lithology.

The distribution of the No. 3, 4 and 5 coal seams are limited by the topography, while the lower seam (No. 1 and 2) distribution is largely controlled by the pre-Karoo topography. The parting thickness between the seams is generally consistent (SRK Consulting. 2016). The coal seams present within the project locality are expected to be similar to the seam thicknesses and depths.

Mining in Middeldrift is proposed to extend to the No. 1A coal seam, with the assumption of a near horizontal dip. The coal seams at the Roodekop mining area are shown in Figure 9-49 below.

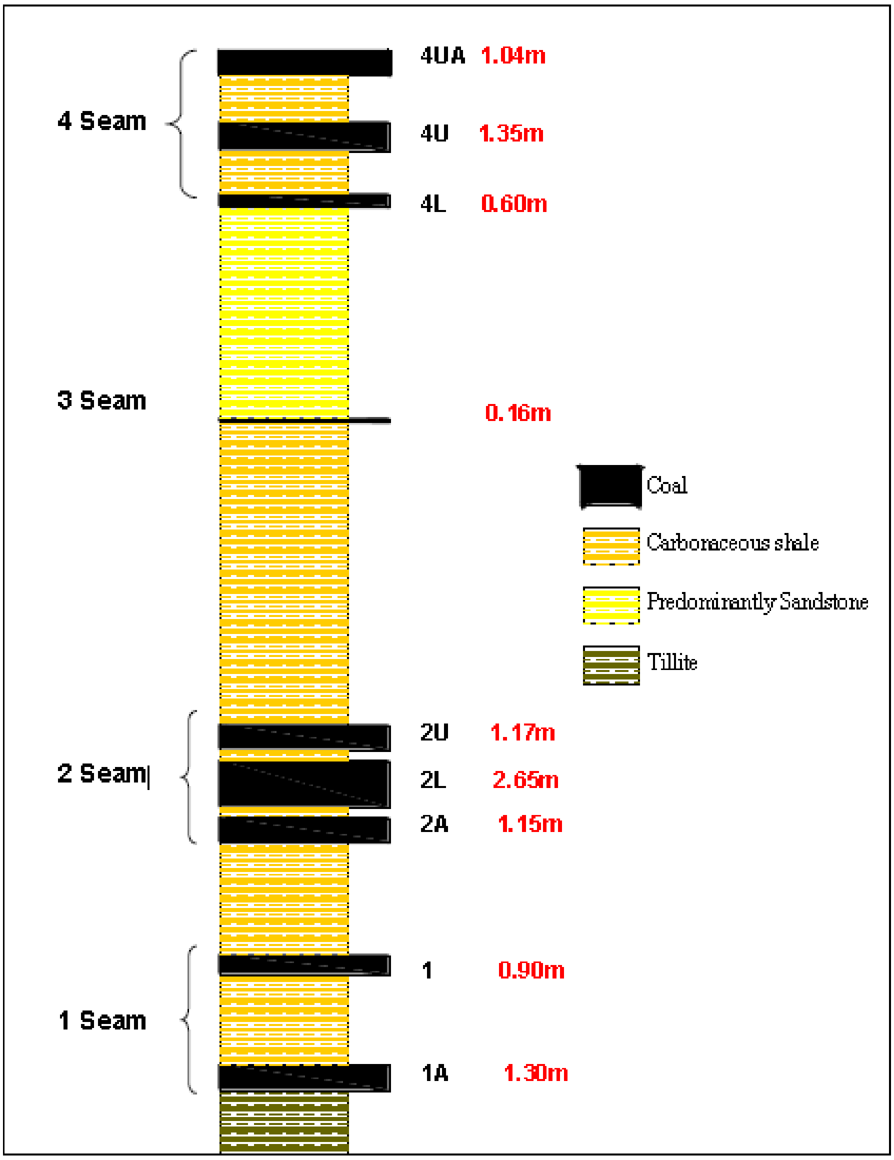


Figure 9-49: Stratigraphic Column for the Roodekop Area (Source: SRK, 2016)

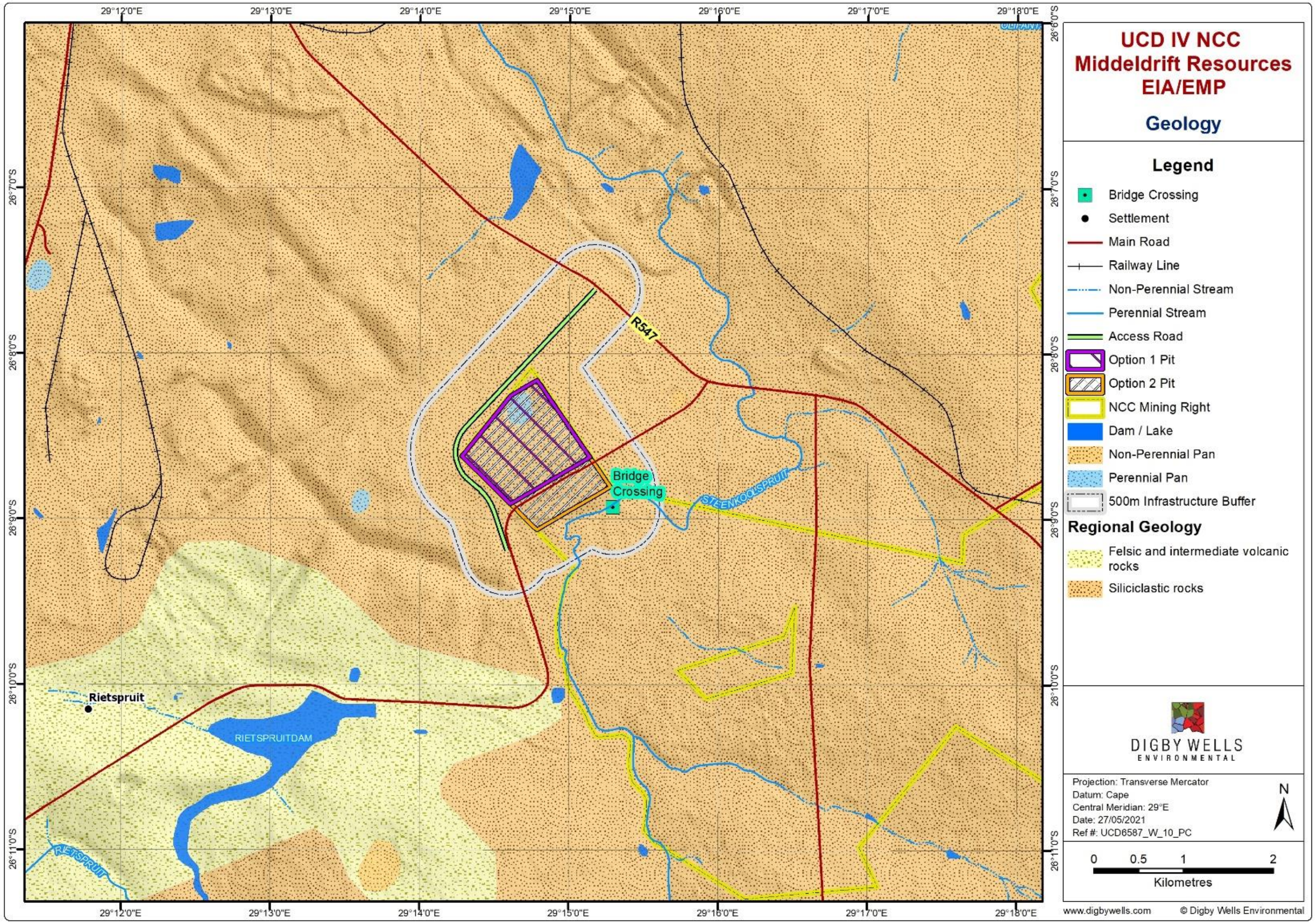


Figure 9-50: Geological Setting of the project area

9.11. Fauna and Flora Assessment

This section will introduce the context of the biodiversity of the Mpumalanga Province and describe the project area in terms of floral and faunal species.

9.11.1. Regional Vegetation

The project area falls within the **Eastern Highveld Grassland (Gm12)** vegetation type as described by Mucina & Rutherford, 2012, as seen in Figure 9-51. The Grassland Biome is one of the nine South African plant Biomes and the second most biodiverse biome in South Africa. The Grassland Biome is situated primarily on the central plateau of South Africa, and the inland areas of Kwa-Zulu Natal and the Eastern Cape provinces. The biome is rich in flora and fauna diversity but is under threat due to persistent agriculture, expansion of mining and industrial activities.

The Eastern Highveld Grassland is characterised by slightly to moderately undulating plains, including some low hills and pan depressions. This vegetation type is considered to be "**Endangered**" on the National List of Threatened Terrestrial Ecosystems and is considered approximately 55% altered. It is considered to be "poorly protected" with only 13% of its' target percentage protected (Lötter, 2015). The primary factor responsible for this status is due to on-going cultivation activities within the area. The vegetation of the landscape is short dense grassland dominated by the usual highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya* etc) (Mucina & Rutherford, 2012).

9.11.2. Floral Species of Conservation Concern

The proposed project area lies within two Quarter Degree Squares (QDS) 2629AA and 2629AB. According to PRECIS several Red Data listed species are expected to be present within the QDS.

The floral species list obtained from the New Plants of Southern Africa (NEWPOSA) has indicated that one SCC may occur within the project area, *Khadia carolinensis,* listed as Vulnerable (VU). Previous studies conducted within close proximity to the project area, by Scientific Aquatic Services (SAS), 2016, identified two SCC. *Crinum macowanii* (Least Concern (LC)) was encountered throughout the wetland habitats. This species is listed as *Declining* by the IUCN and is protected under the Mpumalanga Nature Conservation Act, 1998 (MNCA). Additionally, the likelyhood of occurance for *Habenaria nyikana* would be high, as they have been prevoiusly encountered in that particular region. This species is also protected under the MNCA. The potential SCC that may occur in the in the project area are listed in Table 9-38 below.

Table 9-38: Potential Floral Species of Conservation Concern

Species	Red Data status	SA Endemic
Aloe reitzii var. reitzii	NT	Yes
Argyrolobium longifolium	VU (A2c)	

Species	Red Data status	SA Endemic
Brachystelma minor	VU	Yes
Brachystelma stellatum	Rare	Yes
Crassula setulosa var. deminuta	NE	Yes
Crassula setulosa. var. setulosa	NE	Yes
Cryptocarya transvaalensis	LC	No
Dactylis glomerata	NE	No
Dianthus zeyheri subsp. natalensis	NE	Yes
Disa alticola	VU	Yes
Disa zuluensis	EN	Yes
Eucomis autumnalis subsp. clavata	NE	No
Eucomis vandermerwei	VU	Yes
Graderia linearifolia	VU	Yes
Habenaria barbertoni	NT	Yes
Habenaria nyikana	LC	Yes
Helichrysum aureum. var. argenteum	NE	Yes
Jamesbrittenia macrantha	NT	Yes
Khadia alticola	Rare	Yes
Khadia carolinensis	VU (A3c)	Yes
Lydenburgia cassinoides	NT	Yes
Merwilla natalensis	NT	No
Protea parvula	NT	No
Zantedeschia pentlandii	VU	Yes

EN = Endangered, CR = Critically Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, NYBA = Not yet been assessed

During the wet season survey in February 2021, four floral SCC were recorded during the field assessment. These species are listed under Schedule 11 Protected Plants (Section 69 (1) (a)) of the MNCA (1998). The recorded SCC are listed in Table 9-39 below. These species were located within the identified Wetlands and Rocky Outcrops. Majority of the floral SCC recorded are summer-growing bulbous plants that host a variety of medicinal properties and are usually subjected to illegal harvesting and sold at medicinal plant markets (Notten, 2021). These plants will require permits to authorise the removal of such species as indicated in Section 69 (1) (a) and 70 (1) of Chapter 6 of the MNCA (1998).

Table 9-39: Recorded Floral SCC (2021)

Family	Species	SANBI Red List	MNCA (1998)
Iridaceae	*Gladiolus crassifolius*	Least Concern	Protected
Iridaceae	*Gladiolus dalenii*	Least Concern	Protected
Orchidaceae	*Habenaria filicornis*	Least Concern	Protected
Agapanthaceae	*Agapanthus africanus*	Least Concern	Protected
Amaryllidaceae	*Crinum macowanii*	Least Concern (declining)	Protected

9.11.3. Vegetation Communities

The site assessment in February 2021 concluded that the vegetation habitats delineated within this project area include grasslands, outcrops of sandstone, wetlands and areas which have been modified and transformed from their original state. Three broadly defined habitats have been identified and are discussed in further detail below (see Figure 9-51 below). The project area comprises of Wetland (Moist Grassland and Pan Vegetation), Rocky Outcrops and Transformed habitat units.

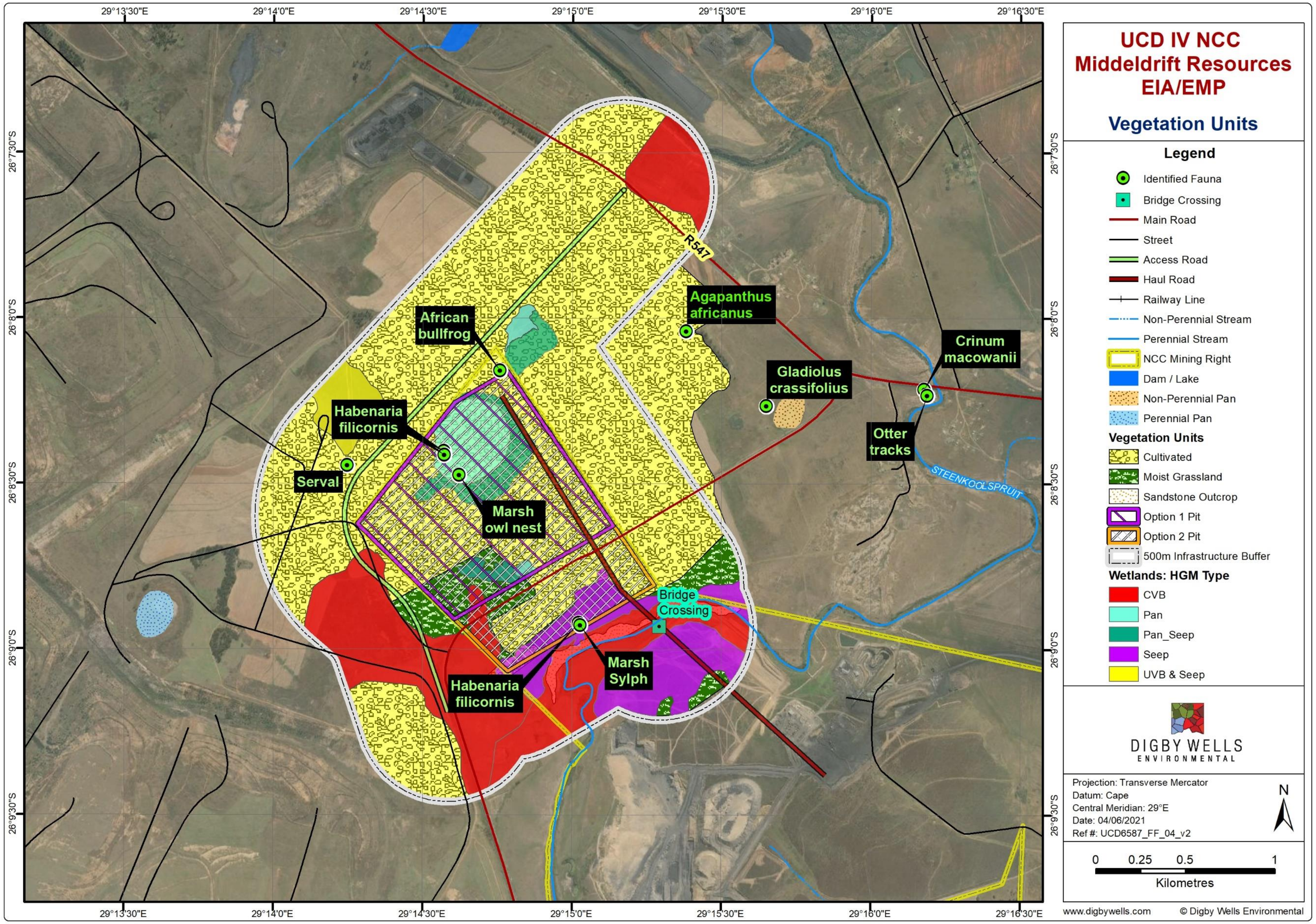


Figure 9-51: Vegetation Units within the project area

9.11.3.1. Rocky Outcrop

Rocky Outcrops are geological features that encompass a wide variety of physical environments such as escarpments, overhangs, and cliffs (Fitzsimons, 2017). They support high levels of species diversity and endemism, and provide stable micro-climates. They provide ecological refuges for colonial species such as seabirds, bats and swifts for ancient lineages. Rocky outcrops provide steppingstone habitats across landscapes and facilitate the movement of migratory bird species and other wide-ranging fauna. As rocky environments are less fertile, steep-sided and less accessible than the surrounding landscapes, they are typically less prone to human disturbances. Nonetheless, rocky outcrops are susceptible to a variety of threats including soil compaction, erosion from livestock and nutrient enrichment and weed invasion. Twenty-five of the 110 floral species were recorded within this unit. Although this unit is not directly within the confines of the project area, its proximity is very near and provides habitat for fauna and flora SCC.

9.11.3.2. Transformed Habitat

For the purpose of this report, transformed land refers to areas that have been changed or disturbed to such an extent that all-natural habitats, biota and ecosystem functions have been fragmented or lost. The transformed areas within the project area were predominantly due to the agricultural practises and cultivation of maise/corn (*Zea mays*) and soybean (*Glycine max*) which constitutes the majority (approximately 260 ha) of the total project area. The current land use practices have completely altered the landscape and has permitted Alien Invasive Plant (AIP) proliferation and loss of sensitive habitats, such as wetlands and the existing natural grassland, namely the Eastern Highveld Grassland (Endangered) (Mucina & Rutherford, 2012).

Previous natural grasslands have been altered and/or transformed and have been replaced by carpets of *Pennisetum clandestinum* and pioneering AIP shrubs, trees and forbs such as *Acacia mearnsii, Populus x canescens Eucalyptus camaldulensis, Datura stramonium, Cirsium vulgare, Solanum sisymbrifolium,* and *Verbena brasiliensis, V. officianalis* can be observed throughout the transformed areas.

Areas which have been transformed still provide habitat to numerous faunal species however due to the nature of terrestrial ecological modification much of the species which exist here are transitional or introduced. The alien vegetation in these areas provide habitat for a number of species which would not usually occur in the project area. Cultivated areas do not necessarily provide shelter for species; however, they do provide abundant food. Small mammal species and avifauna species benefit from these areas.

9.11.4. Fauna

This section represents the results from the field survey conducted during February 2021.

9.11.4.1. Mammals

A total of twelve mammal species were recorded during the infield assessments. The mammal species were encountered and observed throughout the project area within the various habitat units. Various mammals of the Herpestidae (Mongoose) family were observed throughout the numerous wetlands. Tracks of a Water Mongoose were observed in the marshes of the non-perennial Pan adjacent to the R547. Numerous sightings of Black-backed Jackal and Scrub Hare were recorded throughout the project area.

Two mammal SCC were recorded within the project area, namely the Serval and African Clawless Otter, both listed as Near Threatened according to the Regional Red List Assessment of the IUCN. A list of all mammals recorded in the project area is presented in Table 9-39.

Otter tracks were encountered below the bridge of the R547 directly adjacent to the north eastern portion of the project area. Evidently, the Otters are inhabiting the Steenkoolspruit as African Clawless Otters are predominantly aquatic and are seldom found far from permanent water sources. Fresh water is an essential habitat requirement not only for drinking but for rinsing their coats. The African Clawless Otter is predominantly crepuscular, meaning they are mostly active at dawn and dusk. The major threat to the African Clawless Otter is the deterioration of freshwater ecosystems. In South Africa, 84% of the river ecosystems are threatened, while 54% are Critically Endangered (Nel, 2011).

A Serval kitten was encountered adjacent to the proposed road diversion. Servals are found in many protected areas within South Africa and are included on CITES Appendix II and protected under national legislation (TOPS regulations) (SANBI, 2018). It is listed as Least Concern (LC) globally and Near Threatened (NT) nationally on the IUCN Red List. Effective conservation of Serval depends on the conservation of wetlands, particularly wetlands in fragmented landscapes. Wetlands form a micro habitat in a mosaic of farmland for several wetland-dependent species; they are reservoirs of small mammal populations that are major dietary components of Servals. Consequently, if wetlands are protected in a mosaic of farmland use, the landscape may support the persistence of Serval populations.

Table 9-40: Mammals recorded in project area

Family	Species	Common Name	Conservation status
Bovidae	*Sylvicapra grimmia*	Bush Duiker	LC
Canidae	*Canis mesomelas*	Black-backed Jackal	LC
Felidae	***Leptailurus serval***	**Serval**	**NT**
Herpestidae	Atilax paludinosus	Water Mongoose	LC
Herpestidae	*Cynictis penicillate*	Yellow Mongoose	LC

Family	Species	Common Name	Conservation status
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	LC
Leporidae	*Lepus saxatilis*	Scrub Hare	LC
Muridae	*Aethomys namaquensis*	Namaqua Rock Mouse	LC
Muridae	*Gerbilliscus brantsii*	Highveld Gerbil	LC
Muridae	*Otomys angoniensis*	Angoni Vlei Rat	LC
Muridae	*Rhabdomys pumilio*	Four-striped Grass Mouse	LC
Mustelidae	***Aonyx capensis***	**African Clawless Otter**	**NT**

9.11.4.2. Birds

Birds are viewed as good ecological indicators, as their presence or absence tends to represent conditions of a functioning ecosystem. The direct link between bird diversity and land cover portrays a direct indication of the habitats in the area of interest.

Thirty-seven birds were recorded during the field assessment in February 2021. The identified birds are listed in Table 9-41 below. The two pans identified within the region provided ideal habitat for a number of waterbirds including; Ruffs, Grey Herons, Bitterns, White-winged Terns, Reed Cormorant, Yellow-billed Ducks, Red Knobbed Coots and Red-billed Teals.

Two bird SCC were encountered and recorded within the project area, namely the Yellow-billed Stork (Endangered) and Greater Flamingo (Near Threatened). Both species were observed within the pan situated in the north-eastern portion of the project area. During the survey in February 2021, the pan was filled with water and provided habitat for an array of bird life, most notably waterfowl. The two listed bird species are dependent on perennial water bodies for their survival and their ecological requirements are briefly discussed below.

The Yellow-billed Stork is reasonably common at wetlands, yet the species currently breeds at a single site, therefore resulting in a highly restricted (breeding) range in Area of Occupancy (AoO) (Taylor, 2015). In South Africa, there is an Important Birding Area (IBA) in KwaZulu-Natal, at the Nsumo Pan in the Mkuze Game Reserve, where this species reportedly regularly breeds (Bowker, 2012). The AoO in the Nsumo Pan is a mere 2 km^2 in size. Other isolated breeding records include the Engelhardt Dam in the Kruger National Park. The Yellow-billed Stork forage in a diversity of permanent and seasonal wetland habitats, with open shallow water that is generally free of vegetation. Therefore, conservation and preservation of wetland systems is necessary for sustaining the existence of this species within South Africa.

Lastly, the southern African population of the Greater Flamingo has undergone declines of more than 40% over the past three generations (Taylor, 2015). In South Africa, important numbers have been recorded at the following wetlands: Lake St Lucia (KwaZulu-Natal), Leeupan (North West), Kamfers Dam (Northern Cape) and Langebaan Lagoon, Strandfontein Sewage Works and the Berg River Estuary (Western Cape). Rapidly declining water levels reduce food supplies and increase their risk of predation. Conservation of their suitable feeding sites in South Africa is imperative to sustain and support their population. The pans identified within the project area provide suitable foraging sites for the Greater Flamingos.

Table 9-41: Bird species recorded in the project area

Common Name	Species	Conservation Status	Veg Type
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	LC	Wetland
Egyptian Goose	*Alopochen aegyptiaca*	LC	Pan
Red-billed Teal	*Anas erythrorhyna*	LC (Decreasing)	Pan
Cape Shoveler	*Anas smithii*	LC	Pan
Yellow-billed Duck	*Anas undulata*	LC	Pan
Grey Heron	*Ardea cinerea*	LC	Pan
Black-headed Heron	*Ardea melanocephala*	LC	Pan
Marsh Owl	*Asio capensis*	LC	Wetland
White-fronted Plover	*Charadrius marginatus*	LC	Pan
White-winged Tern	*Chlidonias leucopterus*	LC	Pan
Zitting Cisticola	*Cisticola juncidis*	LC	Wetland
White-faced Whistling Duck	*Dendrocygna viduata*	LC	Pan
Black-winged Kite	*Elanus caeruleus*	LC	Wetland
Yellow Bishop	*Euplectes capensis*	LC	Wetland
Southern Red Bishop	*Euplectes orix*	LC	Pan
Long-tailed Widowbird	*Euplectes progne*	LC	Transformed
Red-knobbed Coot	*Fulica cristata*	LC	Pan
African Snipe	*Gallinago nigripennis*	LC	Pan
Black-winged Stilt	*Himantopus himantopus*	LC	Pan
Greater Striped Swallow	*Hirundo cucullata*	LC	Grassland
South African Cliff Swallow	*Hirundo spilodera*	LC	Pan
Little Bittern	*Ixobrychus minutus*	LC	Pan
Reed Cormorant	*Microcarbo africanus*	LC	Pan
Yellow-billed Stork	***Mycteria ibis***	**EN[4]**	**Pan**
Helmeted Guineafowl	*Numida meleagris*	LC	Transformed
Ruff	*Philomachus pugnax*	LC (Decreasing)	Pan

[4] 2015 Regional Status as defined by BildLife South Africa (Taylor, 2015)

Common Name	Species	Conservation Status	Veg Type
Greater Flamingo	***Phoenicopterus roseus***	**NT[4]**	**Pan**
African Spoonbill	*Platalea alba*	LC	Pan
Spur-winged Goose	*Plectropterus gambensis*	LC	Pan
Glossy Ibis	*Plegadis falcinellus*	LC	Pan
Swainson's Spurfowl	*Pternistis swainsonii*	LC	Transformed
Pied Starling	*Spreo bicolor*	LC	Cultivated
Little Grebe	*Tachybabtus ruficollis*	LC (Decreasing)	Pan
Marsh Sandpiper	*Trigna stagnatilis*	LC	Pan
Wood Sandpiper	*Tringa glareola*	LC	Pan
Blacksmith Lapwing	*Vanellus armatus*	LC	Pan
Pin-tailed Whydah	*Vidua macroura*	LC	Grassland

9.11.4.3. Herpetofauna

Herpertofauna is defined as reptiles and amphibians inhabiting a given area. Reptiles are ectothermic (cold-blooded) meaning they are organisms that control body temperature through external means. As a result, reptiles are dependent on environmental heat sources. Due to this, many reptiles regulate their body temperature by basking in the sun, or in warmer areas. Substrate is an important factor determining which habitats are suitable for which species of reptile.

According to Carruthers (2001), a number of factors influence the distribution of amphibians, but because amphibians have porous skin they generally prosper in warm and damp habitats. The presence of suitable habitat (wetland) within the project area provides a number of different species of amphibians.

The brevity of the survey meant that relatively few reptiles were observed compared to that of mammals and birds. During the field assessment, three amphibian species were identified within the wetland and pans, via its call and by direct sightings. The Delalande's River Frog (*Amietia delalandii*), Bubbling Kassina (*Kassina senegalensis*) and the Boettger's Caco (*Cacosternum boettgeri*) (all Least Concern) were recorded within the wetlands (listed in Table 9-42). One amphibian SCC was recorded within the corn fields of the cultivated fields, the Giant Bullfrog (*Pyxicephalus adspersus*).

The Giant Bullfrog is considered to be NT and is the largest amphibian found in Southern Africa. Although the Giant Bullfrog is widely distributed in the atlas region, it occurs in the north eastern region of the Western Cape, central and southern region of the Eastern Cape, eastern section of the Northern Cape, Free State, Gauteng, Limpopo and a few localities in Mpumalanga along the Highveld region. The preferred habitat is also varied but importantly it breeds in seasonal, shallow, grassy pans in flat open areas but also utilises non-permanent wetlands and shallow water on the margins of waterholes and pans which make the pans on site ideal breeding grounds for this species.

Two species of reptile were identified, namely an African Striped Skink (*Trachylepis striata*) and the Common Brown Water Snake (*Lycodonomorphus rufulus*) (both Least Concern). The Skink was encountered basking on the outcrops of the sandstone sheaths. The remaining grassland and wetland habitats provide both hunting sites and shelter for herpetofauna, primarily amphibians colonising the wetlands which in turn attracts reptile predators.

The observed species diversity for both reptiles and amphibians was considerably low. The weather during the field survey was wet and overcast, this may have hindered the presence of herpetofauna (specifically reptile) species within the project area.

Table 9-42: Amphibian species recorded

Family	Species	Common Name	Conservation Status
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	LC
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	LC
Pyxicephalidae	*Amietia delalandii*	Delalande's River Frog	LC
Pyxicephalidae	***Pyxicephalus adspersus***	**Giant African Bullfrog**	**NT**

9.11.4.4. Invertebrates

Invertebrates are the main components of faunal diversity in grasslands, playing substantial roles in ecosystem processes including nutrient cycling and pollination. Grassland invertebrate communities are heavily dependent on plant diversity and production within a given system (Barnett and Facey, 2016). During the field survey in February, a total of 27 invertebrates were observed and are listed in Table 9-43 below. The SCC, Marsh Sylph (*Metisella meninx*), was recorded in the Pan and Seep wetland entering the sheath of exposed sandstone. *M.* meninx is an obligate wetland species and depends on the occurrence of *Leersia hexandra* (Rice Grass), of which has been recorded in majority of the wetland habitats. Henning (2009) states that this species requires unpolluted marsh habitats. The adults tend to roost low down in the wetland vegetation, above the water level – which makes the susceptible to unexpected flooding. Adults rely on nectar to replenish their energy demands, of which has been noted to be obtained from *Verbena bonariensis, V. brasiliensis,* and *Persicaria spp.* (all of which were recorded within the wetland habitats).

Table 9-43: Invertebrate species recorded

Family	Species	Conservation status	Common name
Acrididae	*Locustana pardalina*	LC	Brown Locust
Carabidae	*Lophyra sp.*	LC	Tiger Beetles
Cercopidae	*Locris arithmetica*	LC	Red-spotted Spittle Bug
Coccinellidae	*Henosepilachna bifasciata*	LC	Cucurbit Ladybug
Coenagrionidae	Africallagma glaucum	LC	Swamp Bluet
Coreidae	*Cletus sp.*	LC	Leaffooted bug
Crambidae	*Spoladea recurvalis*	LC	Beet Webworm
Erebidae	*Lacipa nobilis*	LC	Noble Lacipa
Eumenidae	*Parachilus capensis*	LC	
Hesperiidae	***Metisella meninx***	**NT**	**Marsh Sylph**
Libellulidae	*Crocothemis sanguinolenta*	LC	Small Scarlet
Libellulidae	Urothemis assignata	LC	Red Basker
Lycosidae	*Hogna spenceri*	LC	Wolf Spider
Melyridae	*Astylus atromaculatus*	LC	Spotted Maize Beetle
Nymphalidae	*Junonia oenone oenone*	LC	Blue Pansy
Nymphalidae	*Byblia ilithyia*	LC	Spotted Joker
Nymphalidae	*Hypolimnas misippus*	LC	Diadem
Nymphalidae	*Acraea rahira*	LC	Marsh Acraea
Nymphalidae	*Junonia orithya madagascariensis*	LC	Eyed Pansy
Pentatomidae	*Nezara viridula*	LC	Green Vegetable Bug
Pieridae	*Catopsilia florella*	LC	African Migrant
Pieridae	*Eurema brigitta*	LC	Grass Yellow
Pyrgomorphidae	*Dictyophorus spumans*	LC	Koppie Foam Grasshopper
Scarabaeidae	*Tephraea dichroa*	LC	Wild Potato Fruit Chafer
Syrphidae	*Allagrapta fuscotibialis*	LC	Hoverfly
Tettigoniidae	*Conocephalu caudalis*	LC	Meadow Katydid
Tingidae	*Plerochila australis*	LC	Olive Lace Bug

9.11.5. Fauna and Flora Sensitivity Analysis

The sensitivity analysis takes into account all of the desktop data (Mpumalanga C-Plan, Threatened Ecosystems, IBAs and the NPAES), as well as the field data gathered during the site visits. The outcome of this assessment depicts sensitivity ranging from low to high in the project area. High sensitivity was assigned to the Rocky Outcrops and Wetland habitats as they provide habitat for SCC and their irreplaceability as unique biodiversity features. Various habitats within the project area sustain a high diversity of faunal and floral SCC. The drainage and wetland systems are associated with a high ecological sensitivity as they provide refugia and habitat for numerous faunal SCC, promote movement of faunal species and act as corridors and also provide vital ecosystem services. Areas with moderate sensitivity included those that were considered in a natural state with minor anthropogenic disturbances and presence of SCC such as the intact grasslands and moderate rocky slopes. Low sensitivity was assigned to the transformed areas as they have been previously heavily degraded and are proliferated with AIPs. The map below illustrates the areas of concern confined to the project area in Figure 9-52.

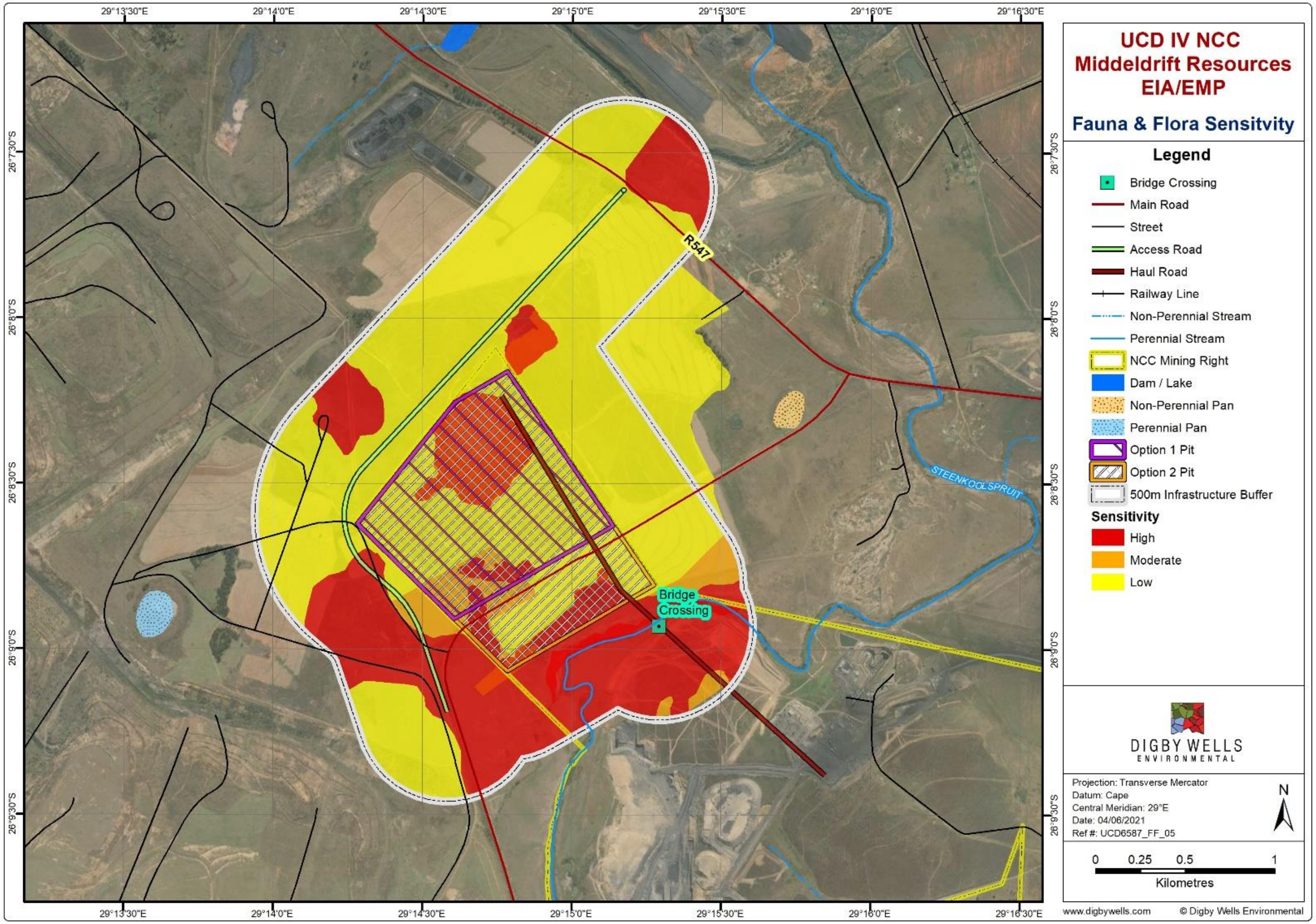


Figure 9-52: Fauna and Flora Sensitivity Map

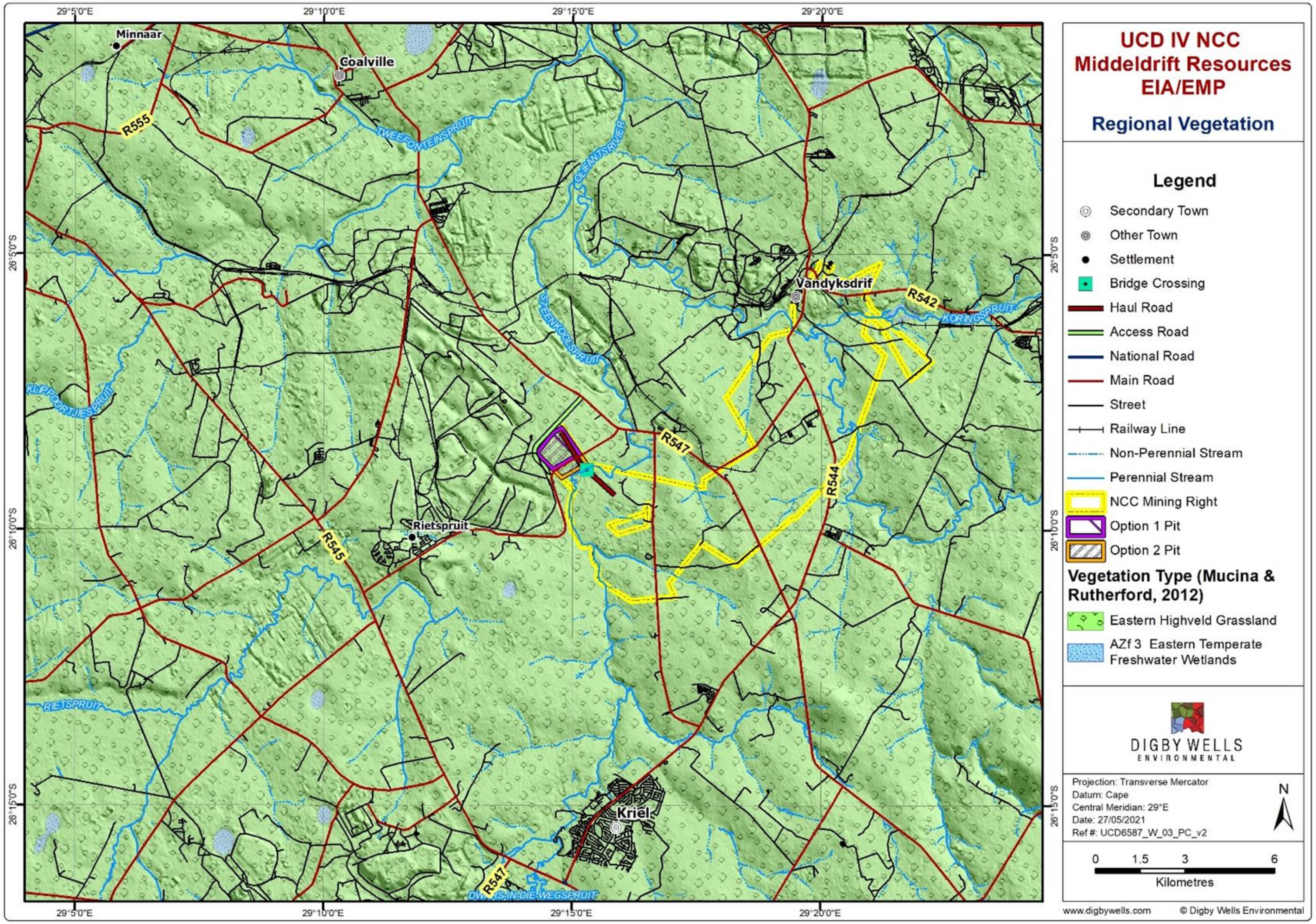


Figure 9-53 Regional Vegetation Type of the project area

9.12. Heritage Impact Assessment

The HIA was conducted based on an understanding of the inter-relation between heritage resources and the greater natural and social environment. The methodology involved a qualitative approach, which is comprehensively described in **Appendix L**. Three study areas were determined, namely:

- Site-specific study area;
- Local study area; and
- Regional study area

9.12.1. Cultural Heritage Baseline Description

The Mpumalanga Province is underlain by valuable geological formations, both in terms of mineral and fossil wealth. Coal is formed through the compression and heat alteration of plant matter. During these processes, alteration happens to such an extent that potential plant fossil remains are no longer recognisable. The shales between the coal horizons, however, have the potential to preserve very good examples of plant fossils (Bamford, Best Practice for Palaeotontological Chance Finds: Proposed Extention into adjacent Block 4 reserve of Syferfontein Mine (Sasol), Mpumalanga, 2014; Environmental Authorisation for the proposed Imvula Mine: Palaeontological Impact Assessment addendum to the Heritage Impact Assessment, 2016). To a lesser extent, the sandstone surface outcrops may also preserve fossil plants. Coal deposits can potentially also include fossils of mammal-like reptiles and mammals, but these are rarely, if ever, preserved with plant fossils.

The greater study area forms part of the Highveld Coalfield, which extends approximately 7 000 km^2 (Johnson, Anhauesser, & Thomas, 2006). The regional and local study areas are predominantly underlain by the Main Karoo Basin, which comprises lithostratigraphic units associated with the Karoo Supergroup. Table 9-44 presents a truncated geological sequence applicable to the regional study area. The specialist Palaeontological Impact Assessment (PIA) report will present the site-specific geological context and the associated palaeontological sensitivities in more detail[5].

The Main Karoo Basin dates to the late Carboniferous to Middle Jurassic Periods, roughly 320 to 145 million years ago (mya). Within the Karoo Supergroup are the sediments of the Ecca Group. These sediments date to the Permian Period and overlie the *Dwyka Formation*. These layers also include significant coal reserves and is the most palaeontologically sensitive unit of the Karoo Supergroup (Johnson, Anhauesser, & Thomas, 2006; Groenewald & Groenewald, 2014). The Ecca Group is well known for its wealth of plant fossils, characterised by the assemblage of *Glossopteris* fossils (a plant species defined through fossil leaves).

[5] The PIA study has not been completed at the time of compiling this HIA report and will be attached to the report and SAHRA case as an addendum.

The Ecca Group includes three formations:

- The *Pietermaritzburg Formation*, which is of moderate palaeontological sensitivity. This formation rarely forms good outcrops and fossils are rare and difficult to find;
- The *Vryheid Formation*, which is the main coal-producing formation in South Africa. This formation has produced a number of fossils, including extensive *Glossopteris* fossil assemblages. Trace fossils, rare insects, possible conchostracans (bivalve crustaceans and shrimp clams, which are still extant), non-marine bivalves and fish scales. This formation is of very high palaeosensitivity; and
- The *Volksrust Formation*: a monotonous sequence of grey shale. Fossils are significant but rare and include temnospondyl amphibian remains, invertebrates and minor coal with plant remains, petrified wood and trace fossils assemblages (Groenewald & Groenewald, 2014).

The *Vryheid Formation* is the predominant geographical present in proximity to the project area. As indicated above, this feature is known for its wealth of plant fossils. These include fossils of *Breytenia*. These fossils are extremely rare, comprising only four known instances, one of which is available for research. The other three examples were identified during site inspections for a coal mine approximately 50 km away from the project area.

Table 9-44: Geological Sequence and Palaeontological Sensitivity of the Local Study Area

Eon	Era	Period	Mya	Lithographic Units			Significance	Fossils
				Supergroup	Group	Formation		
Phanerozoic	Palaeozoic	Permian	300	Karoo Supergroup	Ecca Group	Volksrust	High	The Volksrust Formation comprises of trace fossils, rare temnospondyl amphibian remains, invertebrates (bivalves, insects), minor coals with plant remains, petrified wood, organic microfossils (acritarchs), and low-diversity marine to non-marine trace fossil assemblages.
						Vryheid	Very-high	Abundant plant fossils of *Glossopteris* and other plants. Trace fossils. The reptile Mesosaurus has been found in the southern part of the Karoo Basin. Rich fossil plant assemblages of the Permian *Glossopteris* flora (lycopods, rare ferns and horsetails, abundant glossopterids, cordaitaleans, conifers, ginkgoaleans), rare fossil wood, diverse palynomorphs. Abundant, low diversity trace fossils, rare insects, possible conchostracans, non-marine bivalves, fish scales.

Table 9-45 presents an overview of the broad timeframes for the major periods of the past in Mpumalanga. Figure 9-54 presents a summary of the heritage resources identified within the larger study area. The figure presents the relative abundance of these heritage resources as grouped by the periods listed in Figure 9-55.

Table 9-45: Archaeological Periods in Mpumalanga

The Stone Age	Earlier Stone Age (ESA)	2 mya to 250 thousand years ago (kya)
	Middle Stone Age (MSA)	250 kya to 20 kya
	Later Stone Age (LSA)	20 kya to 500 CE (Common Era[6])
There appears to be a gap in the record in Mpumalanga between approximately 7000 and 2000 BCE.		
Farming Communities	Early Farming communities (EFC)	500 to 1400 CE
	Late Farming Communities (LFC)	1100 to 1800 CE
Historical Period[7]	-	1500 CE to 1850 (Behrens & Swanepoel, 2008)
Adapted from Esterhuysen & Smith (Stories in stone, 2007)		

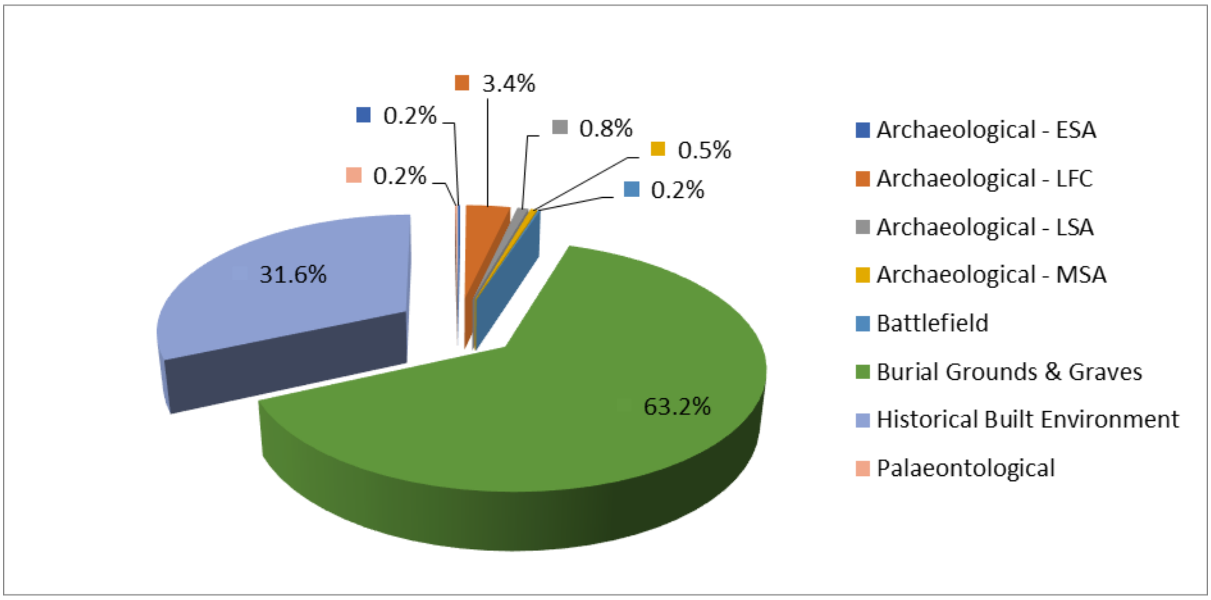


Figure 9-54: Heritage Resources Identified within the Greater Study Area

[6] Common Era (CE) refers to the same period as *Anno Domini* ("In the year of our Lord", referred to as AD): i.e., the time after the accepted year of the birth of Jesus Christ and which forms the basis of the Julian and Gregorian calendars. Years before this time are referred to as 'Before Christ' (BC) or, here, BCE (Before Common Era).

[7] The author acknowledges that in southern Africa, especially in Mpumalanga, the last 500 years represents a formative period that is marked by enormous internal economic invention and political experimentation that shaped the cultural contours and categories of modern identities outside of European contact. This period is currently not well documented and is being explored through the 500 Year Initiative (Behrens & Swanepoel, 2008).

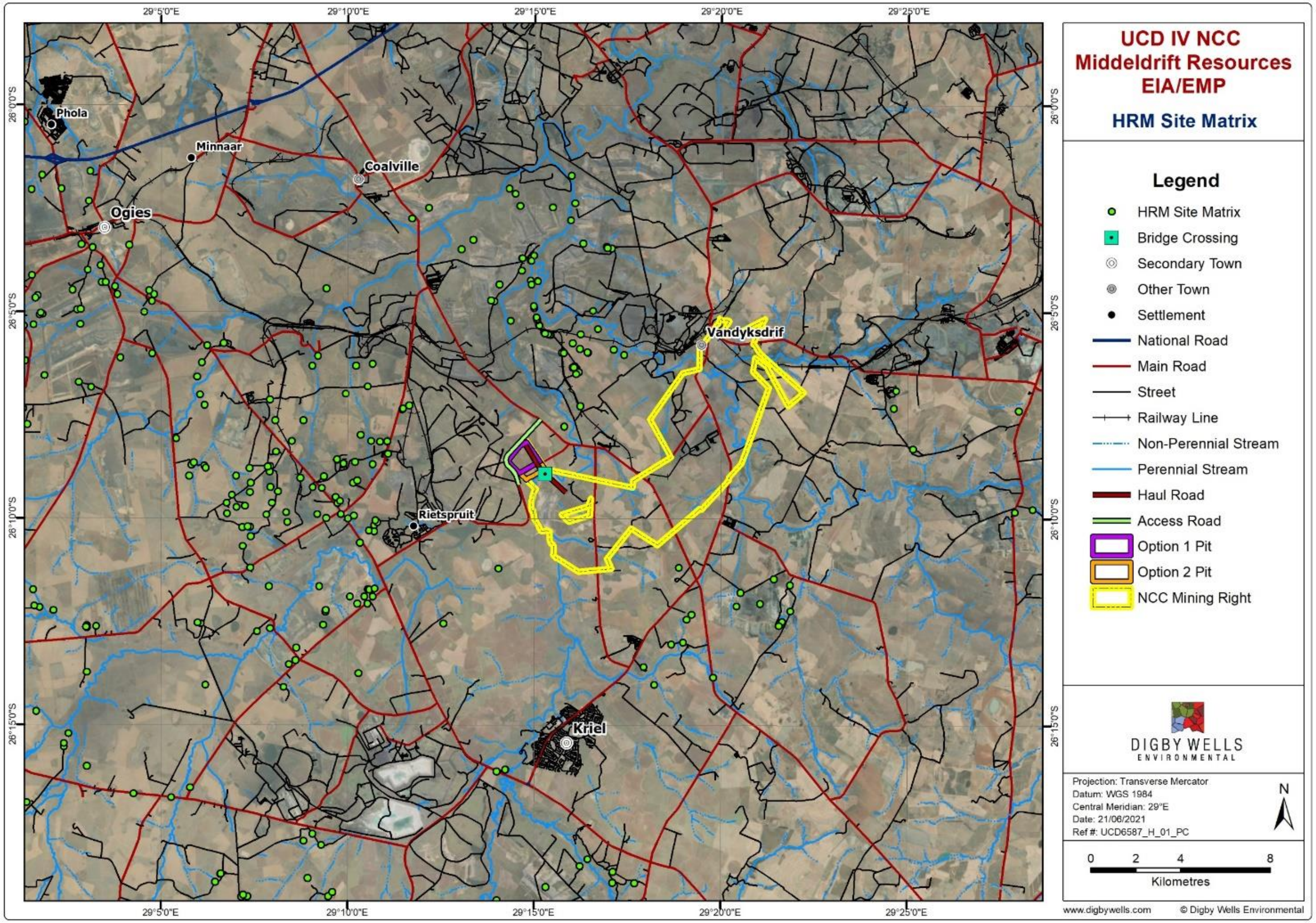


Figure 9-55: Distribution of Recorded Cultural Resources in the greater study area

In total, 589 heritage resources were identified within the regional, local and site-specific study areas. Within the areas under consideration, the predominant tangible heritage resources demonstrate affiliations with the historical period, including the historical built environment and burial grounds and graves. This notwithstanding, expressions of the Stone Age, the Farming Community Period, historical battlegrounds, and palaeontological resources have also been recorded in the regional study area.

The Stone Age of southern Africa is divided into three broad phases: the ESA, MSA and LSA. These phases are defined according to the various hominid species and the lithic tools and associated materials they created through time.

The ESA period occurred between 2 mya and 250 kya and comprised predominantly of large hand axes and cleavers made of coarse-grained materials (Esterhuysen & Smith, 2007). This period is associated with *Australopithecus* and early *Homo* hominid species. Within the reviewed data, one example of ESA lithics was identified, which comprised a low-density artefact scatter (Huffman, 1999). This represents 0.2% of the data set.

The MSA dates between approximately 300 kya and 20 kya. The early MSA lithic industries are characterised by high proportions of minimally modified blades, created using the Levallois technique, the use of good quality raw material and the use of bone tools, ochre, and pendants (Clark, 1982; Deacon & Deacon, 1999). These tools were made and used by archaic *Homo sapiens.* The review of available data included 3 records of expressions of MSAS (0.5% of the total identified heritage resources). These include low- and medium-density surface scatters (Fourie, Steyn, Birkholtz, & Salomon, 2000; du Piesanie & Nel, Environmental Authorisation for the Proposed Imvula Coal Mine: Heritage Impact Assessment Report, 2016b).

The LSA dates from approximately 40 kya to the historical period. LSA lithics are specialised, (i.e., specific tools each have specific uses) (Mitchell, 2002). Assemblages from this period commonly include diagnostic tools such as scrapers and segments. Assemblages may include bone points as well. In southern Africa, the LSA is closely associated with hunter-gatherers. The San (including hunter-gatherer, Basarwa and Bathwa groups) are generally accepted as the first inhabitants of southern Africa (Makhura, 2007).

The review of available data included few expressions of the LSA (5 records or 0.8% of the total identified heritage resources). Within the regional study area, expressions of the LSA include:

- Isolated artefacts and low-density scatters of lithic accumulations (de Jong, 2006; Karodia, Higgit, du Piesanie, & Nel, 2013);
- A rock shelter with deposit and artefacts (Fourie, Steyn, Birkholtz, & Salomon, 2000); and
- Rock art (du Piesanie & Nel, Proposed Development of an Underground Coal Mine and Associated Infrastructure near Hendrina, Mpumalanga, 2016a).

In Mpumalanga, three rock art painting traditions occur and are associated with cultural groups. These traditions are widely dispersed and include:

- Fine line painting associated with autochthonous LSA hunter-gatherer groups (Eastwood, Van Schalkwyk, & Smith, 2002);
- Finger paintings associated with the later arrival of pastoralists (Smith & Ouzman, 2004; Eastwood *et al*., 2002; Smith & Zubieta, 2007); and
- Finger paintings associated with much later, possibly historic, farming communities. No expressions of this tradition are known to occur within the study area under consideration.

The San were later followed by the various peoples of the Farming Community, including ancestors of modern Sotho-Tswana and Nguni peoples (Makhura, 2007). This period correlates to the movements of Bantu-speaking agro-pastoralists moving into southern Africa. Farming Community settlements are identified through stonewalling and secondary tangible surface indicators, such as ceramics and evidence for domesticated animals, i.e., dung deposits or faunal remains.

The Farming Community Period is divided into two phases: the EFC and the LFC. No material associated with the EFC was identified within the broader study area. The LFC resources accounted for 20 (or 3.4%) of the identified heritage resources in the regional study area. The identified LFC heritage resources include:

- Structural sites, including stone walling or structural remains (ruins of homesteads or circular stone structures) (Fourie *et al*., 2000; van Schalkwyk, 2007; Pelser & van Vollenhoven, 2008; Karodia *et al*., 2013; Higgit *et al*., 2014; Karodia & Nel, 2014); and
- Low density surface scatters (de Jong, 2006; Karodia *et al*., 2013).

The historical period is commonly regarded as the period characterised by contact between Europeans and Bantu-speaking African groups and the written records associated with this interaction. However, the division between the LFC and historical period is largely artificial, as there is a large amount of overlap between the two.

Throughout the transitions between the LFC and the historical period (and throughout the historical period itself), migration, population growth, climatic variation and trade to the east significantly impacted the Pedi, Koni and other groups on the Mpumalanga Highveld. The rise of power blocs, including violent displacement and political centralisation, characterised this time (Makhura, 2007). Within this region, the Pedi developed a system of centralisation where subordinate communities could retain their independence in exchange for tribute in various forms. The Pedi grew to become the strongest power in the north-east, amongst the escalating conflict and intensifying violence (Delius *et al*., 2014).

The Mfecane (or the Difaqane as it is known north of the Orange River) is one example of the overlap between the LFC and the historical period. These terms refer to a period of violence and unrest between approximately 1817 to 1826 AD (Landau, 2010). Many aspects of the

Mfecane/Difaqane have been debated and challenged, but the traditional understanding of the period is that Mzilikazi and his Ndebele group were pushed out of their territory by the Zulu group led by Shaka. This displacement had a knock-on effect, as multiple groups were subsequently displaced to the north and the west. A drought during this time exacerbated the instability and increased the pressure on food supplies, which were already running low.

Adding to the instability and power struggles were the European settlers, traders, missionaries, and travellers now moving into the interior (Landau, 2010). The Mfecane/Difaqane was characterised by unprecedented (at least within the records of the Europeans travelling within southern Africa) social and political mobilisation and violence across the Highveld as individuals sought personal and food security. As a result, the Mpumalanga Highveld was vulnerable to intrusive groups including the Swazi and the Voortrekkers.

Groups of Afrikaners initiated a move from the Cape to the interior to establish an independent state in approximately 1835, in reaction to increased British liberalism and the abolishment of slavery and pass laws. The migration of these Voortrekkers is commonly referred to as the Great Trek (or Groot Trek) and it started with the first group, the Robert Schoon Party, in 1836. The first permanent settlement that was established as a result of this movement was Ohrigstad in 1845 – the Voortrekkers at this time were intruding into an already volatile interior and exacerbated the strife in this area, frequently skirmishing with remnant Pedi, Ndzundza Ndebele and Kopa groups (Delius & Cope, 2007; Voortrekkers, 2014).

In 1852, Voortrekker and British representatives signed the Sand River Convention into effect; the convention acknowledged Trekboer independence and officially established the Zuid-Afrikaansche Republiek (ZAR). ZAR independence allowed for land to be distributed to its citizens, though the demarcation of farms and the issuing of title deeds. The Trekboers continued their violent encounters with the smaller groups in this region, armed with their perceived right to land under the ZAR. These conflicts resulted in a Trekboer-Swazi alliance: the Swazi besieged and destroyed the Kopa and orchestrated assaults against the Ndzundza Ndebele. The Ndzundza Ndebele remained undefeated but came to a compromise with the Trekboers where land would be leased by the Trekboers through a system of tribute (Delius & Cope, 2007; Voortrekkers, 2014).

The Trekboers (now farmers) discovered and exploited the Highveld Coalfields soon after settling in the area. The Boers initially used the coal as a domestic resource; however, the discovery of gold in the Witwatersrand in 1886 created an enormous demand for coal (Brodie, 2008; Pistorius, 2008; 2008b). This increase in the demand for coal drove the commercial exploitation of the coal, until the industry was put on hold by the outbreak of war.

The South African War of 1899-1902 (also referred to as the Second Anglo-Boer War) officially started on October 9th, 1899. The war was the result of building tensions and conflicting political agendas between the Trekboers and the British. There are multiple notable battles associated with the South African War within the regional study area, one of which is the Battle of Bakenlaagte (October 30th, 1901). A battlefield relating to this event has been recorded within the greater study area.

Lieutenant Colonel George Benson's No. 3 Flying Column moved from the farm Syferfontein, marching north-west to the Bakenlaagte farmstead, where they intended to camp. The advance guard reached the farmstead and set up the camp, but by midday, the rear-guard had been hampered by unfavourable weather and were still some distance away from the farm. General Botha of the Boer commando and his 800 reinforcements planned to attack Benson's Column and this division of the force provided the Boers with an advantage. Outnumbered four to one, the Boers decimated the rear-guard in a gun battle that lasted just 20 minutes; but the attack did allow the main column to deploy and set up a defensive perimeter. This perimeter prevented the Boers from capturing the main column as they had envisaged, and the Boers left with what spoils they could. The British transported their 134 wounded to the entrenched camp during the night (Pakenham, 1979; Willsworth, 2006; Wessels, 2010; von der Heyde, 2013). British losses included at least 66 dead, 120 were taken prisoner and the loss of two British guns. Boer casualties included at least 52 who were killed or wounded (Wessels, 2010)

Other important events associated with the South African War in the broader area include:

- The Battle of Lake Chrissie (6 February 1901);
- Trigaardsfontein (10 December 1901),
- Klippan (18 February 1902); and
- Boschmanskop (1 April 1904) (Van Vollenhoven, 2012).

Historical heritage resources associated with the early settlement of these groups in the region make up the large majority of the identified heritage resources in the area under consideration. Burial grounds and graves account for 372 records (63.2% of the identified heritage resources) and historical built environment resources account for 186 records (31.6%).

Historical resources are represented as:

- The Bakenlaagte battlefield referred to above (Van Vollenhoven, 2012a; Hardwick & du Piesanie, 2018);
- Burial grounds and graves, ranging from single burials to graveyards containing over one hundred individuals (van Schalkwyk, 1997a 1997b, 2002a, 2002b; Huffman 1999, Fourie *et al*., 2000, 2012; Pistorius, 2004a, 2004b, 2008, 2011, 2012, 2013a, 2014, 2015, 2016; de Jong, 2006, 2007; Pelser & van Vollenhoven, 2008, Fourie, 2008 2009; Birkholtz, 2011, 2013; Fourie & Hutton, 2012; Higgit *et al*., 2013; Karodia *et a*l., 2013; Higgitt *et al*., 2014; Karodia & Nel, 2014; van Vollenhoven & du Bruyn, 2014; van Vollenhoven, 2012a, 2012b, 2015a, 2015b; van der Walt, 2015; du Piesanie & Nel, 2016b; Coetzee & Fivaz, 2017; Hardwick & du Piesanie, 2018); and
- Historical built environment resources, such as structural remains (stonewall structures, homesteads, farmhouses and functional structures) and structural complexes; (Huffman & Calabrese, 1996; van Schalkwyk, 1997a 1997b, 2002a, 2002b; Huffman 1999, Pistorius, 2008, 2011, 2012, 2016; de Jong, 2006, 2007; Pelser & van Vollenhoven, 2008, Fourie, 2008 2009; Fourie & Hutton, 2012;

Birkholtz, 2013; Higgit *et al*., 2013; Karodia *et al*., 2013; Pelser, 2013; Higgit *et al*., 2014; Karodia & Nel, 2014; van Vollenhoven, 2012a; 2015a, du Piesanie & Nel, 2016a; 2016b; Coetzee & Fivaz, 2017; Hardwick & du Piesanie, 2018).

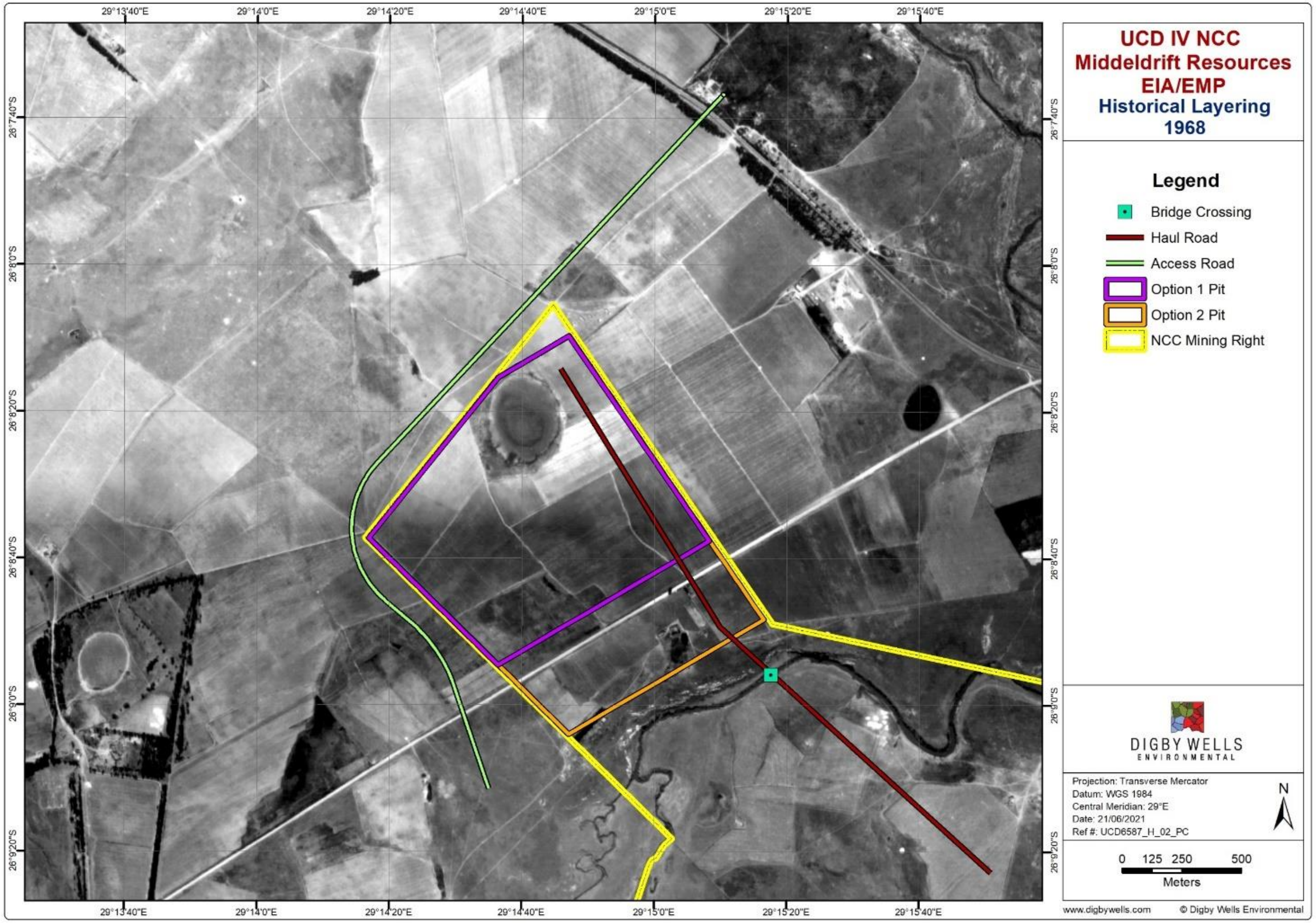


Figure 9-56: Historical Layering if New Clydesdale Colliery Mining Right

9.12.2. Results from the Pre-disturbance Survey

The following sections describe the observations made during the survey and the outcomes of the survey.

9.12.2.1. Existing Environment

The project area has been disturbed through anthropogenic activity, specifically related to farming activities. A large portion of the project area consists of cultivated fields and informal roads between the fields. Natural pans cover a significant portion of the project area. The present environment is illustrated in Figure 9-57.

Parts of the project area had been disturbed through animal activity. Burrows were inspected for the presence of any archaeological materials.

Mining activities occur on the adjacent property.

Figure 9-57: Current state of the environment during the pre-disturbance survey

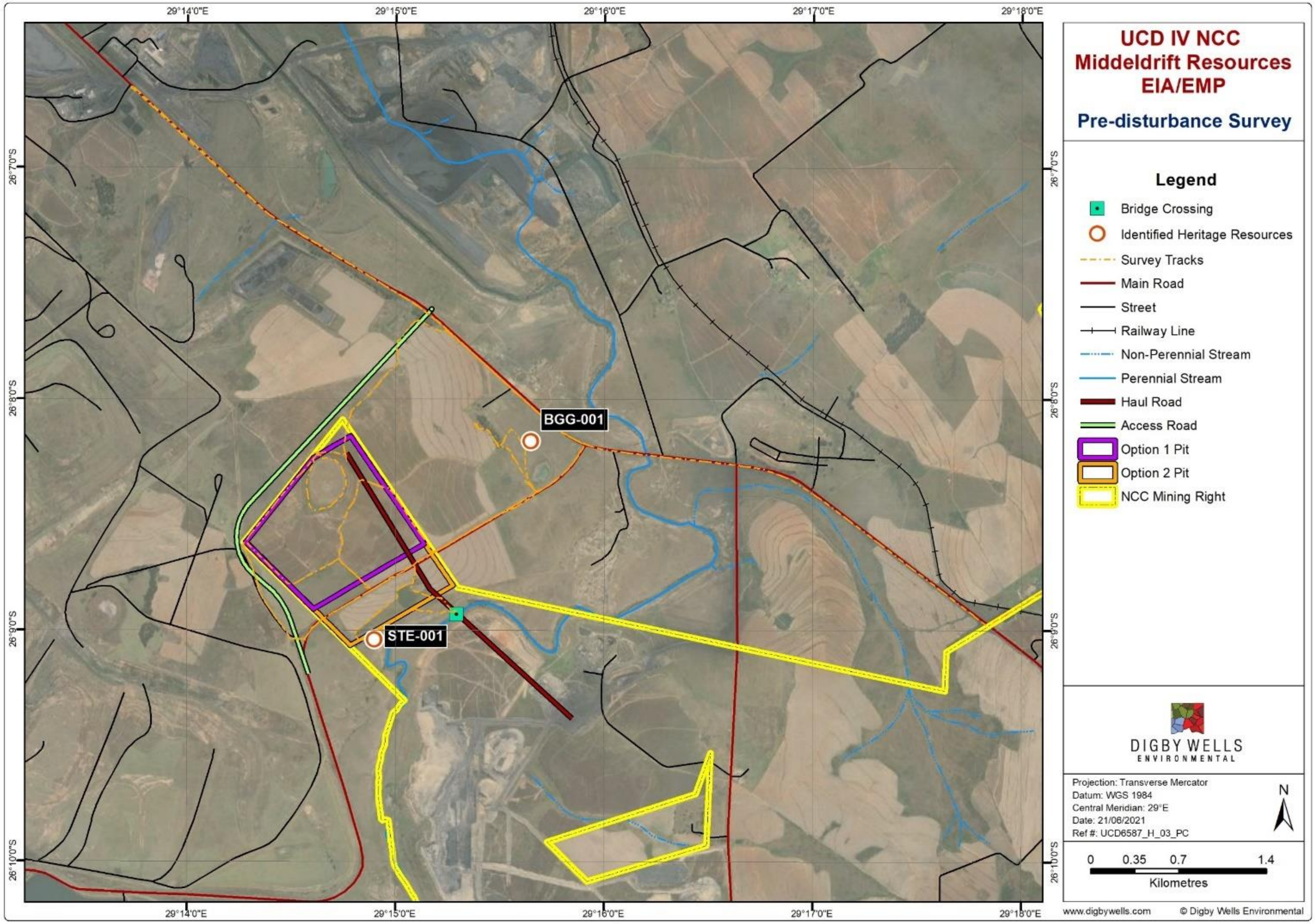


Figure 9-58: Pre-disturbance Survey GPS Tracklog and Identified Cultural Heritage Resources

9.12.2.2. Identified Heritage Resources

Table 9-46 includes descriptions of the heritage resources identified during the pre-disturbance and ground-truthing surveys. Figure 9-59 below presents photographs of heritage resources identified during the pre-disturbance survey and conditions at the time of the survey. Figure 9-60 presents the spatial distribution of these sites and includes the tracks, indicating the areas that were surveyed.

A preliminary assessment of the Genealogical Society of South Africa (Google Earth Cemetery Initiative, 2011) database did not indicate additional burial grounds are known to exist within the project area.

Table 9-46: Heritage Resources identified through the Pre-Disturbance Survey

Site Name	Description
BGG-001	Burial ground including several graves identified by upright stones serving as headstones. The burial ground is not demarcated by a fence. *This heritage resource was identified by the wetland specialist and was not inspected by the heritage specialist.*
STE-001	Remains of what appears to be a one-roomed structure with no internal divisions. The wall has a dog-legged corner. The wall is made of stone with cement / plaster in between the stones. The walls are in varying stages of collapse, from standing above head height to total collapse. The structure does not have a roof, doors, or windows. The structure is surrounded by a dense stand of trees. No debris, midden or material culture associated with the structure is visible.

Structural remains at STE-001

Structural remains at STE-001

Figure 9-59: Select Heritage Resources Identified through the Pre-Disturbance Survey

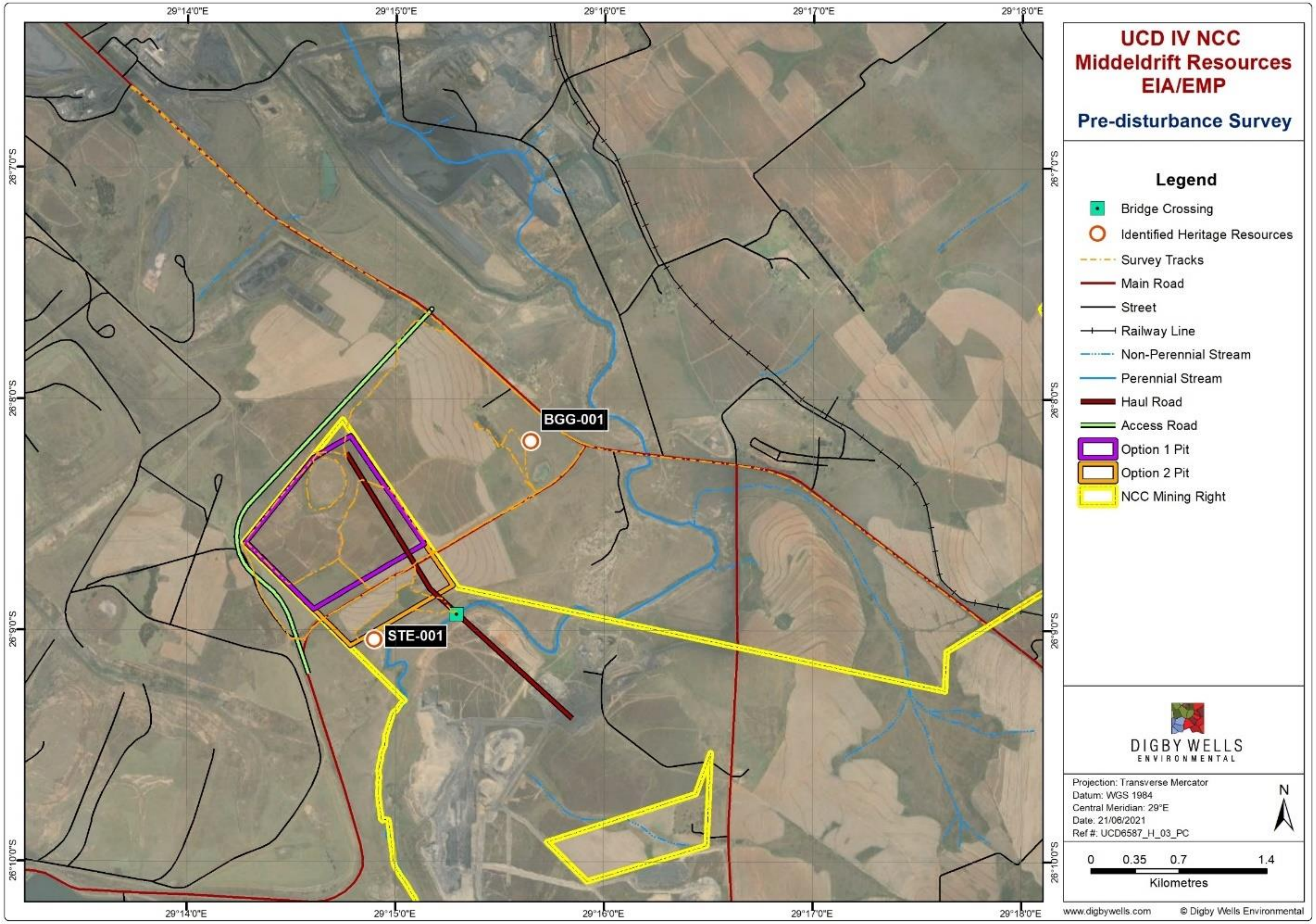


Figure 9-60: Results from the Pre-disturbance Survey

9.13. Socio-economic Setting

The project is located within ELM of the NDM in the Mpumalanga Province. This section presents a brief summary of the demographic statistics relevant to the potential socio-economic benefit derived from the project, informed by data collected during the 2016 Community Survey (Statistics South Africa, 2011). Wazimap (Wazimap, 2017) has adjusted these data to conform with the updated ward and municipality boundaries which were altered ahead of the 2016 Municipal Elections (Open Up, 2017). These data are supplemented by information included in the Integrated Development Plan (IDP) for the Victor Khanye Local Municipality (VKLM) (2017-2021 Draft Integrated Development Plan: 2020/21 Review, 2020).

As of the 2011 Census, Mpumalanga province had a population of 4 039 939, which accounts for approximately 7.8% of the national population (Wazimap, 2017). The province includes three district municipalities, of which the NDM is neither the largest nor the smallest in terms of population.

Employment Status of the Populations within the study area presents an overview of the employment status of the populations within the regional study area.

Table 9-47: Employment Status of the Populations within the study area

Employment Statistics (Census 2011)	Ward		ELM		NDM	
	No.	%	No.	%	No.	%
Total Population					1 308 129	-
Working Age (18-64)					796 693	60.9
Employed					355 478	27.2
Discouraged Work Seeker					42 554	3.3
Unemployed					152 250	11.6
Other not economically active					319 641	24.4

Adapted from Wazimap (Wazimap, 2017)

9.14. Air Quality Assessment

The baseline assessment examines the project area and immediate surroundings, the sensitive receptors likely to be impacted, the meteorology and the exiting background air quality of the project area.

In the immediate vicinity, several farm homesteads with animal husbandry and mechanised crop farming (i.e. maize) are observed, coupled with mining activities these represent the dominant land-use types (Google Earth® Pro V.7.3 (June 6, 2021)).

Figure 9-61 shows the project area, surrounding sensitive receptor and dust monitoring locations. According to the USEPA (2016), a sensitive receptor encompasses but is not limited to "*hospitals, schools, daycare facilities, elderly housing, and convalescent facilities. The* *aforementioned are locations where the occupants are more susceptible to airborne pollutants" if exposed*.

Ambient air quality records measured onsite, south of Middeldrift were used to assess the baseline air quality. This is limited to dustfall measurements only, with no site-specific records for particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}) and 2.5 microns ($PM_{2.5}$) and gases, such as sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO).

9.14.1. Dustfall

Data from a network of four dust monitoring locations operated by Rayten Engineering Solutions (Pty) Ltd (hereafter referred to as "Rayten") was used to assess the background scenario. These sites were designated as DR-001, DR-002, DR-003, and DR-004, and classified as non-residential. The data covered the period from January 2019 to October 2020 (Figure 9-62 and Figure 9-63).

The dustfall rates were compared with the South African *Dust standards* (GN R 827 of 1 November 2013) for compliance. A summary of the results is presented below:

- With the sites classified as non-residential, no exceedance of the non-residential limit of 1 200 mg/m^2/d was recorded in 2019; and
- In 2020, site DR-003 recorded two exceedances of the non-residential limit in sequential months – August and September 2020. It was assumed that a localised dust-generating event resulted in the exceedances measured since the other sites were below the limit value.

Considering the distance of the monitoring locations from the project area, it is recommended that additional monitoring sites be commissioned once mining of Middeldrift commences.

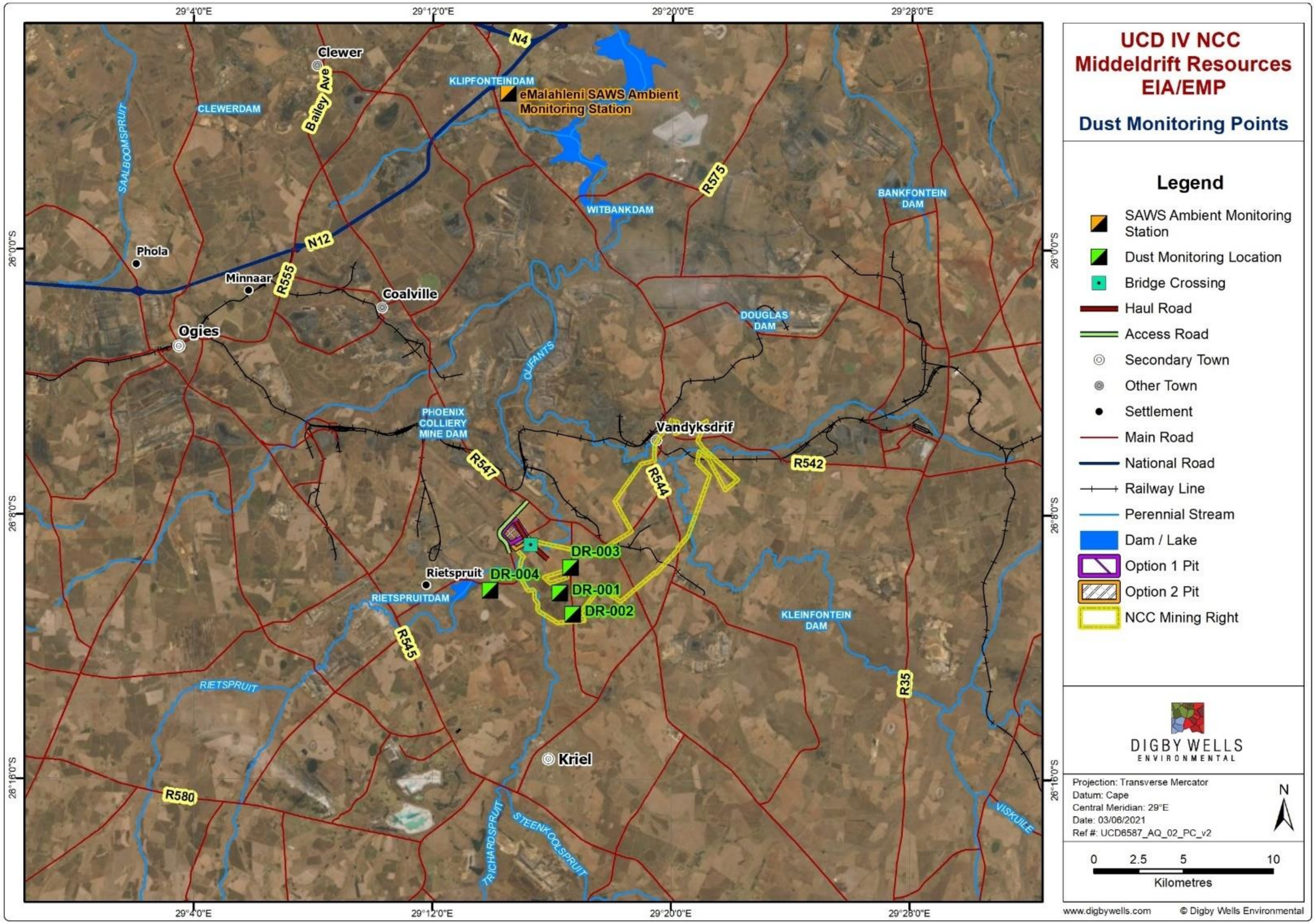
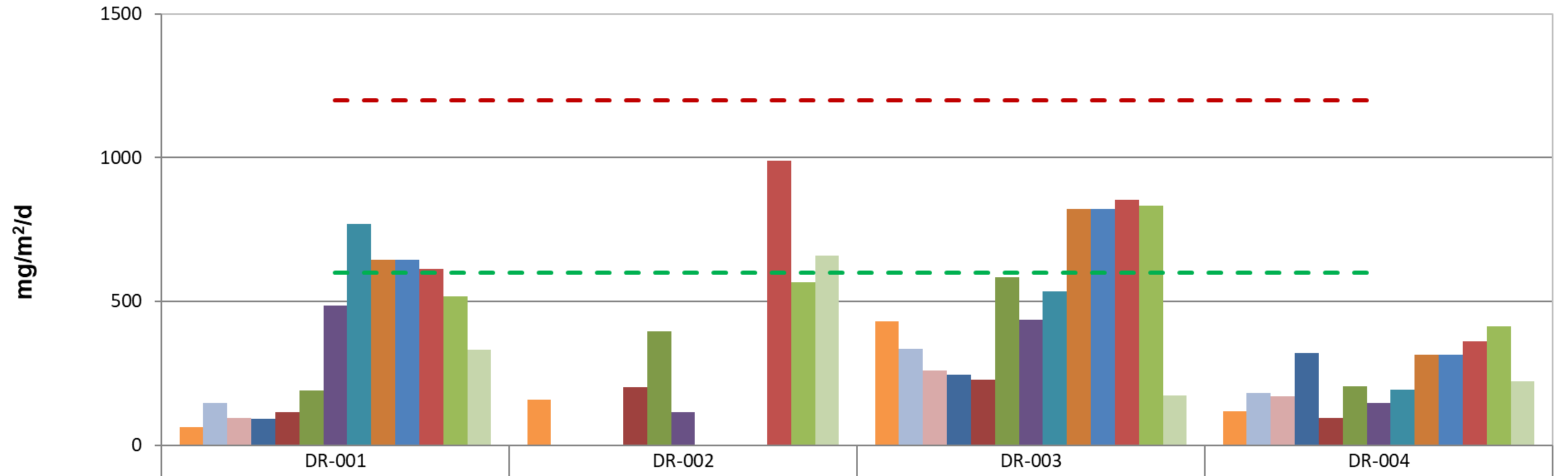
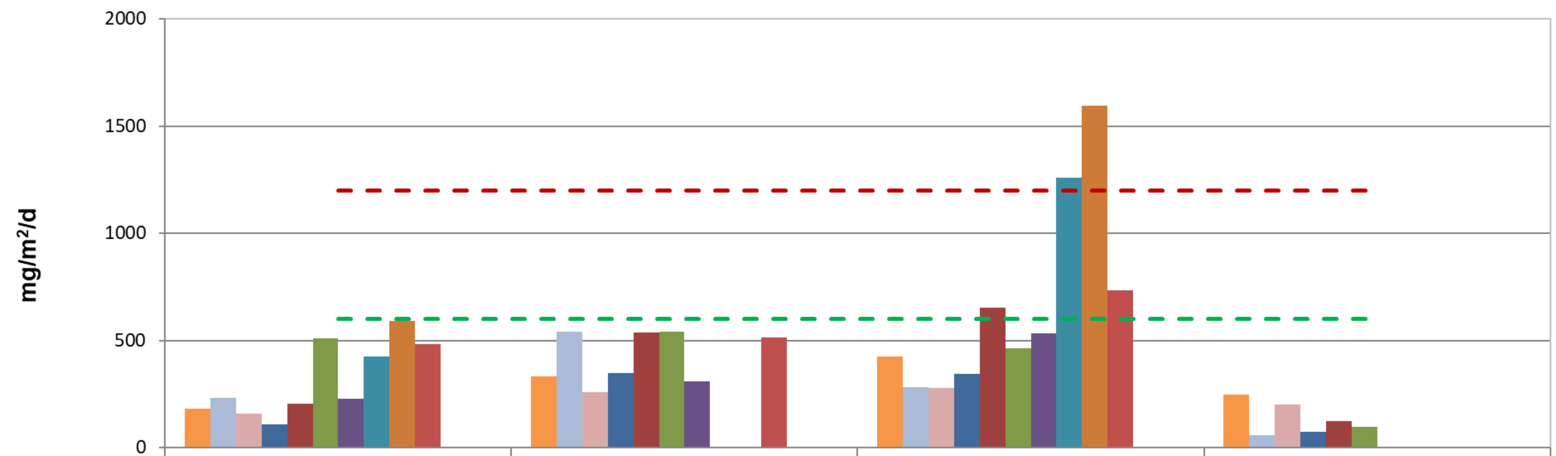


Figure 9-61: Project Area with Surrounding Receptors and Dust Monitoring Locations



	DR-001	DR-002	DR-003	DR-004
Jan-19	62	158	430	117
Feb-19	146	0	336	183
Mar-19	96	0	259	169
Apr-19	92	0	245	322
May-19	114	201	228	96
Jun-19	191	395	583	205
Jul-19	486	116	437	148
Aug-19	770	0	536	193
Sep-19	646	0	822	316
Sep-19	646	0	822	316
Oct-19	613	989	853	362
Nov-19	519	566	833	412
Dec-19	332	660	174	223
Residential Limit	600	600	600	600
Industrial Limit	1200	1200	1200	1200

Figure 9-62: Dustfall Measurements (Rayten, 2019)



	DR-001	DR-002	DR-003	DR-004
Jan-20	182	333	423	246
Feb-20	232	542	283	58
Mar-20	158	257	278	202
Apr-20	107	346	344	73
May-20	203	535	651	122
Jun-20	510	542	462	98
Jul-20	227	309	532	0
Aug-20	426	0	1259	0
Sep-20	589	0	1594	
Oct-20	482	513	735	0
Nov-20				
Dec-20				
Residential Limit	600	600	600	600
Industrial Limit	1200	1200	1200	1200

Figure 9-63: Dustfall Measurements (Rayten, 2020)

The baseline results of the Air Quality Assessment are presented below. The approach used is comprehensively defined in **Appendix M**.

9.14.2. Baseline Results

The meteorology of the project area was assessed with three years' worth of data. The prevailing winds are from the northeast (10.5%) and north northwest (9.1%) respectively. Secondary contributions are from the northwest (8.4%) and east northeast (8.7%).

The average wind speed at the project area is 3.1 m/s and calm conditions (<0.5 m/s) occurred for some 5.2% of the time. Wind speed capable of causing wind erosion i.e. ≥5.4 m/s occurred for about 6.7% of the time. This equates to about 25 days in a year. Based on the statistics, twelve days in spring, seven days in winter, six days in summer, and two days in autumn experienced wind speed greater than 5.4 m/s.

The dustfall rates measured in the proposed project area from a network of four monitoring locations, designated as non-residential, recorded just two exceedances at DR-003. The latter was non-compliant as these exceedances occurred in sequential months (August 2020 and September 2020). In general, more than 97th percentile of the dustfall records measured were below the limit values of 1 200 mg/m^2/d.

9.14.3. Dispersion Model Simulation Results

The model results consist of a graphical presentation of Ground Level Concentrations (GLC) (in a unit of µg/m^3) for the different pollutants, and for dust deposition rates (mg/m^2/d). The daily averages were calculated as the 4th highest value (99th percentile). Annual averages were shown as the 1st highest value (100th percentile).

9.14.4. Isopleth Plots and Evaluation of Results

This section details the results from the dispersion model that was conducted for particulate matter emissions associated with $PM_{2.5}$, PM_{10} and dustfall from this project.

9.14.4.1. Predicted GLC of $PM_{2.5}$

The predicted GLC of $PM_{2.5}$ over a 24-hour averaging period for the operational phase returned simulation isopleths that are shown in Figure 9-64 ($PM_{2.5}$ daily) and Figure 9-65 ($PM_{2.5}$ annual).

The model simulations show the worst-case scenario (assuming no mitigation measures were put in place). The areas where the exceedance of the 24-hour standard of 40 µg/m³ will occur are confined within the project area (Figure 9-64) and along the haul road. The predicted GLCs at the sensitive receptors (DR-001 to DR-004) were lower than the daily standard (see Table 9-48). The predicted annual GLC of $PM_{2.5}$ did not exceed the regulatory standard 40 µg/m³ within the project area and at the selected receptors (Table 9-48).

9.14.4.2. Predicted GLC of PM_{10}

The predicted GLC of PM_{10} over a 24-hour averaging period returned simulation isopleths shown in Figure 9-66 (PM_{10} daily) and Figure 9-67 (PM_{10} annual).

The areas where the 24-hour standard of 75 µg/m³ are likely to be exceeded are within the project area and along the haul road. This can be seen in Figure 9-66 below. The predicted GLCs at the sensitive receptors (DR-001 to DR-004) were lower than the daily standard (see Table 9-48). The predicted annual isopleth showed that areas where exceedance will occur are confined to within the project area (Figure 9-67).

Predicted Dustfall Rates

The predicted dustfall rates are shown in (Figure 75) (with mitigation and without mitigation). The predicted dustfall rates confirmed that exceedances of the non-residential limit of 1,200 mg/m^2/d will occur. However, these exceedances will be mostly within the project area. With mitigation or without mitigation measures in place, the operational phase of the project will not result in the exceedance of the non-residential limit at the selected sensitive receptors (Table 9-48).

Table 9-48: Predicted Concentrations of PM_{25} and Dust Deposition Rates at Selected Sensitive Receptors

Pollutants	Averaging Period	South Africa Air Quality Standard (µg/m³)	Predicted Ground Level Concentration (µg/m³)			
			DR-001	DR-002	DR-003	DR-004
$PM_{2.5}$ (No Mitigation)	Daily	40[(1)]	2.1	1.5	1.9	4.7
	Annual	20[(1)]	0.19	0.10	0.14	0.45
PM_{10} (No Mitigation)	Daily	75[(1)]	13.5	9.3	12.5	27.1
	Annual	40[(1)]	1.2	0.7	0.9	2.9
Dust Deposition Rates (mg/m²/day)						
Dust (No Mitigation)	Monthly	Non-residential (1200[(2)])	142	70	257	106
Dust (With Mitigation)			38	19	69	29

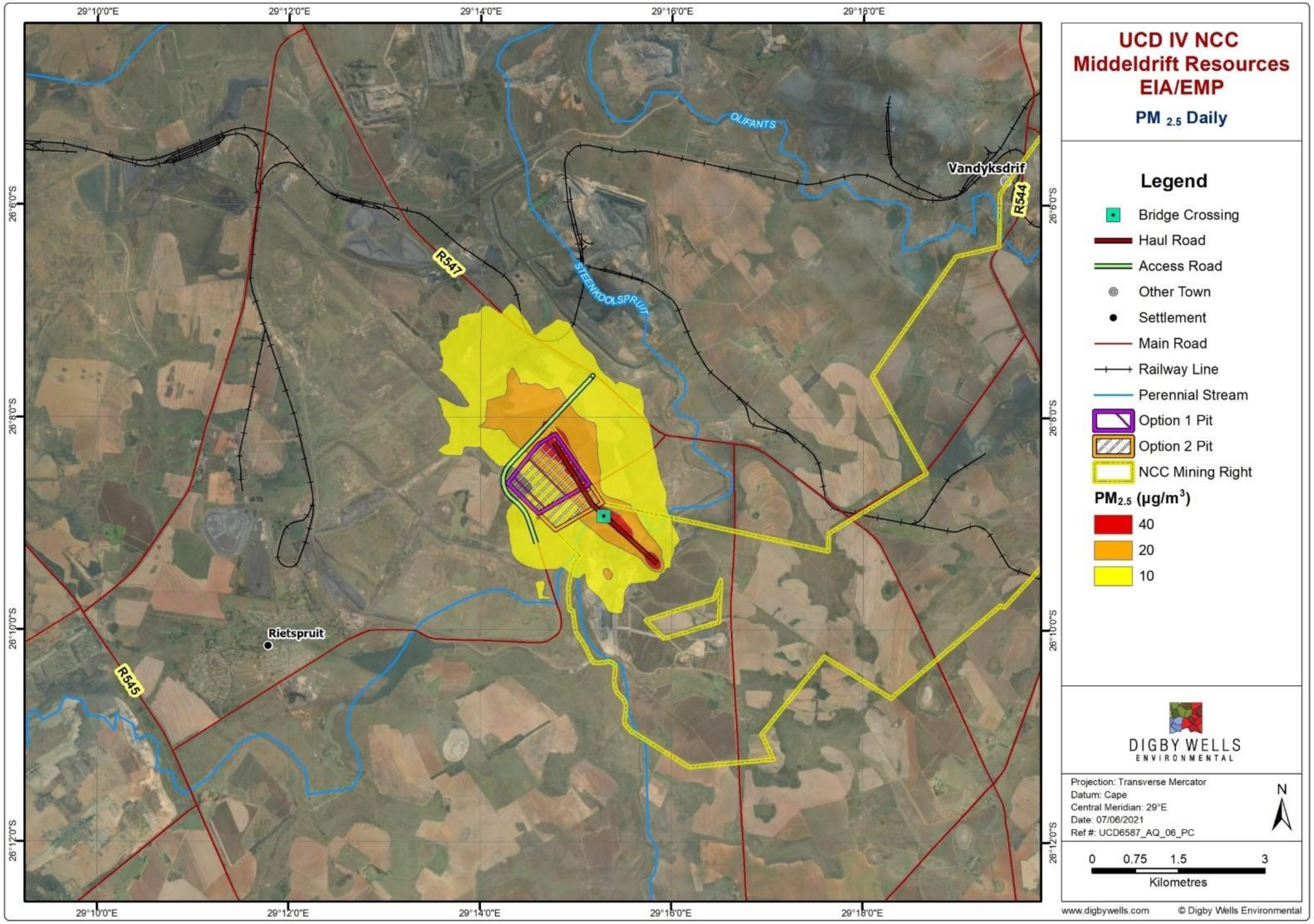


Figure 9-64: Predicted 1st highest (100th percentile) Annual PM2.5 Annual Concentration (ug/m³)

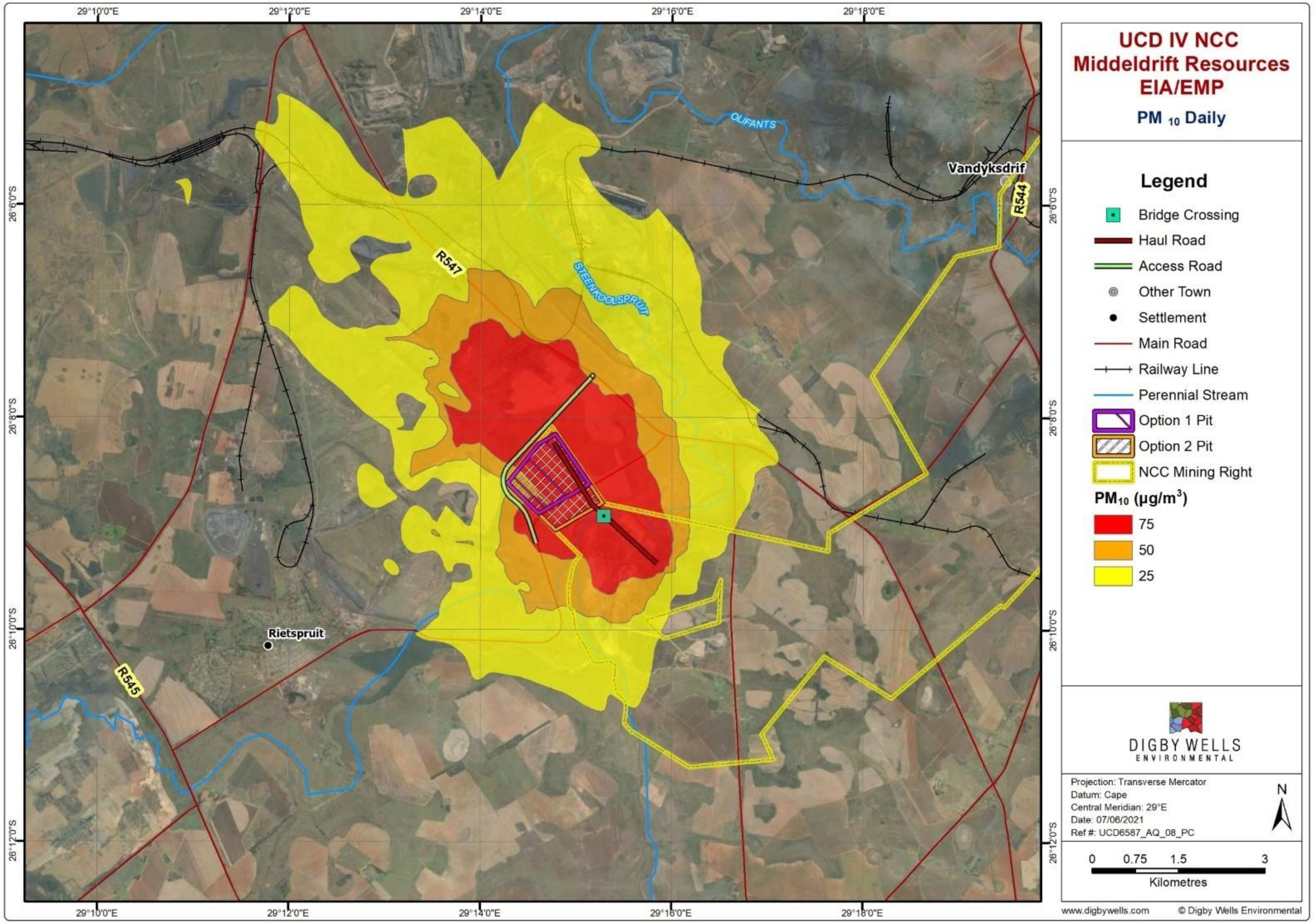


Figure 9-65: Predicted 4th highest (99th percentile) daily PM_{10} Concentrations (ug/m^3)

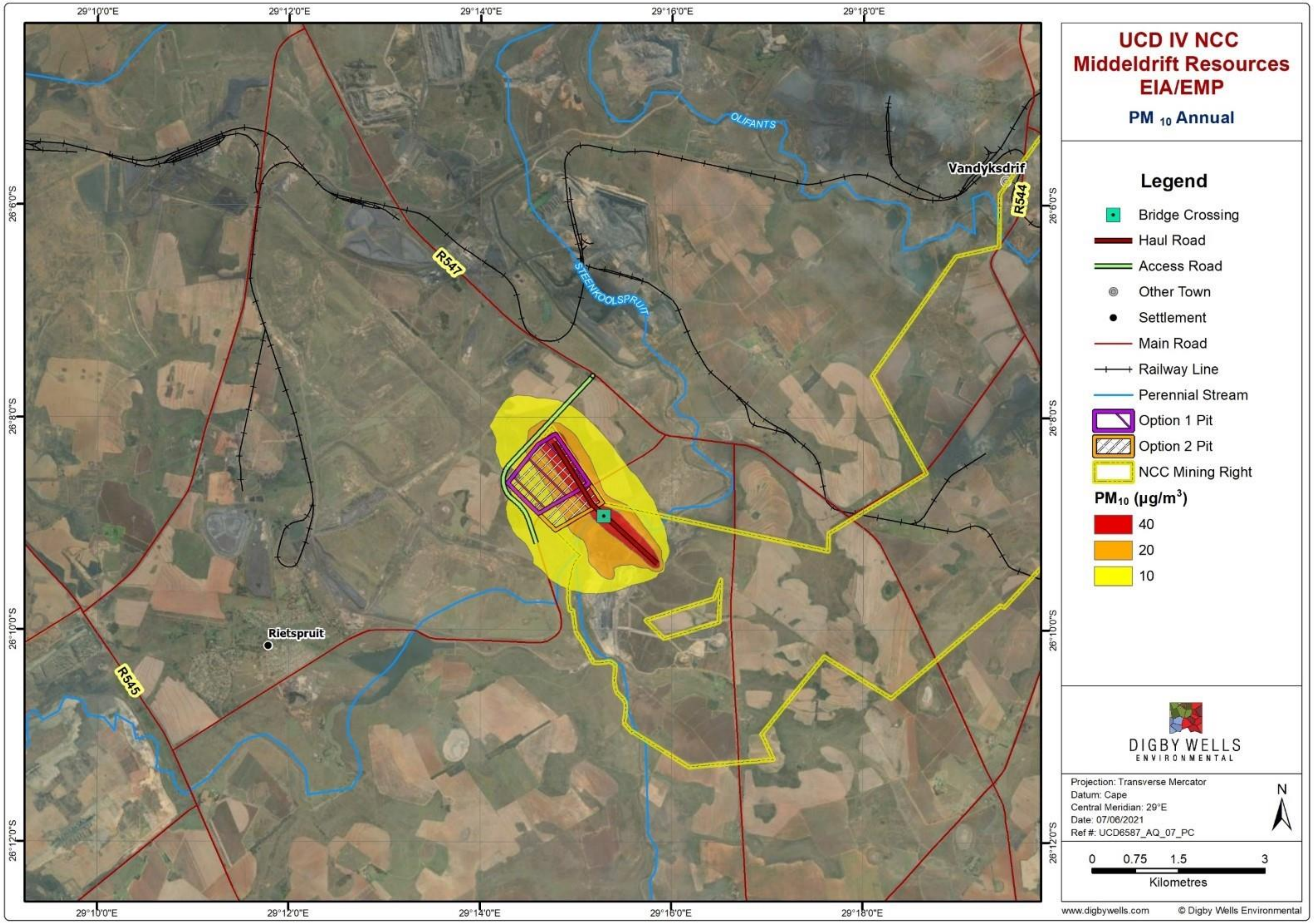


Figure 9-66: Predicted 1st highest (100th percentile) Annual PM_{10} Concentration (ug/m^3)

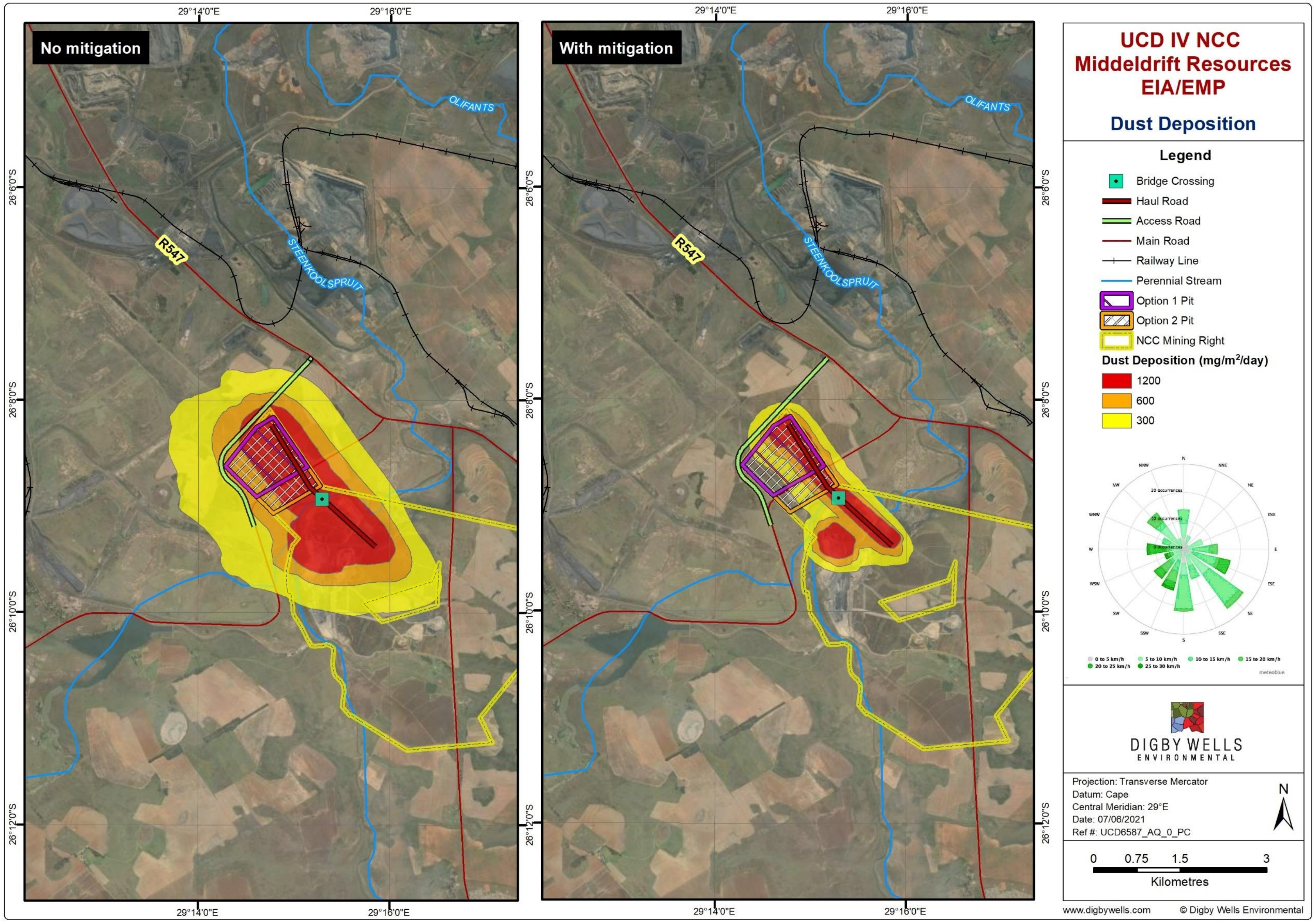


Figure 9-67 Predicted (100th percentile) Monthly TSP Deposition Rates (mg/m²/day) With and Without Mitigation)

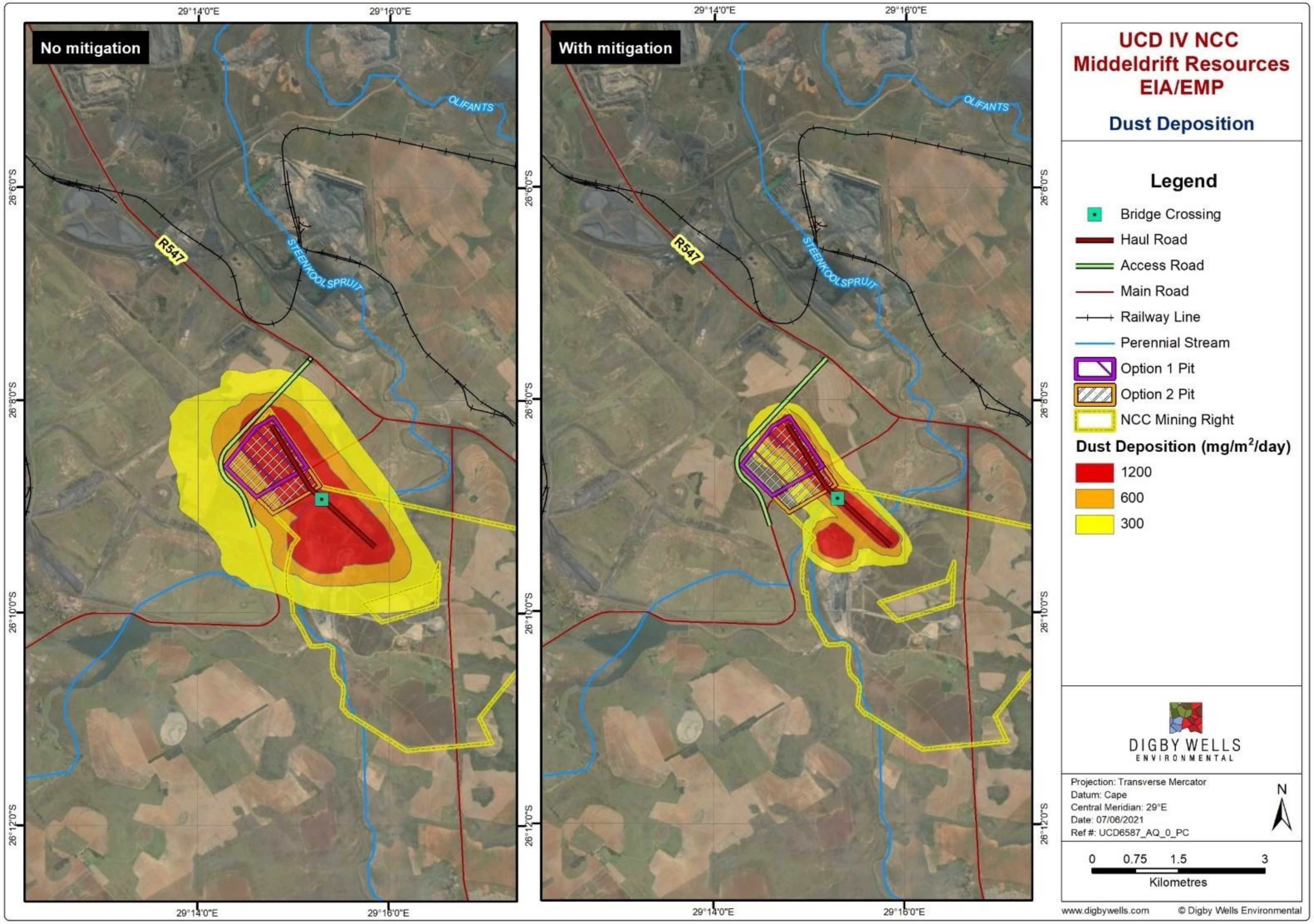


Figure 9-68: Predicted (100th percentile) Monthly TSP Deposition Rates ($mg/m^2/day$) With and Mitigation

9.15. Closure Cost Assessment

The closure costing review and update was determined based on the following Terms of Reference:

- Conduct a GIS based analysis to assess the volume of backfill material required for the final void at closure, assuming Option 2 as the go-ahead option (source file: DEM_Bottom_Seam_clip_cape27.prj);
- Input the outputs from the above work into the closure cost model;
- Develop closure measures for backfill and rehabilitation of the open pit (for Option 2);
- Assign third-party contractor rates (sourced from the Digby Wells unit rates data base) to the allocated closure measures applied; and
- Compile a succinct closure costing report describing the project outcomes.

The methodology is based on the following reports and supporting information:

- Proposed Environmental Regulatory Process for the Middeldrift Resources Within the Existing New Clydesdale Colliery Mining Right, Situated in the Magisterial District of Nkangala, Mpumalanga Province, Final Scoping Report – Digby Wells (March 2021);
- New Clydesdale Colliery Middeldrift Resources, Soil, Land Use and Land Capability Impact Assessment – Digby Wells (May 2021);
- New Clydesdale Colliery Mining Works Programme – Universal Coal (September 2016); and
- DEM_Bottom_Seam_clip_cape27.prj.

9.15.1. General Assumptions and Exclusions

The following assumptions and exclusions were applied in the Closure Cost Assessment (CCA):

- The closure costing addresses decommissioning, demolition, surface rehabilitation, the final closure and monitoring and corrective action of the site. Aspects that are not addressed in this costing include staffing, separation packages, retraining or reskilling, etc.;
- It is assumed that third party contractors would be commissioned to establish on site [Preliminary and General (P&Gs) costs included] and implement the mass earth works, demolition, site clean-up, related rehabilitation work and the post-rehabilitation monitoring and maintenance;
- The CCA has been undertaken for the LoM situation only (i.e. for scheduled closure in 2038, as per Option 2) since the immediate closure costs are currently not applicable due to the greenfields nature of the project;
- All quantities applied in the CCA were supplied and/or derived from information supplied by Universal Coal;

- No landform modelling was undertaken as part of this assessment;
- No legal due diligence was done as part of this assessment;
- The closure costing is based on the information provided by Universal Coal;
- The P&G costs are applied as a percentage of the total (12%). If the current amendments to the Financial Provisioning Regulations, 2015 (as amended) circulated for comment are promulgated, this figure will likely require an increase to ensure alignment with industry standards;
- A contingency of 10% has been applied in the CCA. The contingency considers price fluctuations regarding plant hire, fuel prices, possible omissions and uncertainties in the cost estimate;
- The closure cost estimate is exclusive of VAT; and
- Allowance for post-closure water treatment associated with the development of the open pit is not included in this CCA, and it is noted that the inclusion of this costs would result in a significant increase in the closure liability. Should the project go ahead, it is recommended that these costs be assessed and included for financial provisioning.

9.16. Traffic Assessment

9.16.1. Surrounding Road Network and Traffic Flow

The following roads are relevant to the study area, namely the R547 which functions as a Regional Distributor (Class 3) and falls under the jurisdiction of Mpumalanga Department of Public Works, Roads and Transport (MDPWRT). This newly surfaced road (within the study area) is a single carriageway road with one lane per direction of about 3.7m wide. This road has gravel shoulders on both sides of 1.5 m to 1.6 m wide. This road has superelevation where the new intersection with the D1651 is proposed. Note that the R547 is closed to the north. Manually undertaken traffic counts indicate that this road carries traffic volumes of between 155 vph and 170 vph per direction during the weekday morning (AM) and afternoon (PM) peak hours

Figure 9-69: R547 where the new intersection is proposed (looking south east)

Figure 9-70: R547 where the new intersection is proposed (looking north west)

9.16.1.1. District Road D1651:

This road functions as a District Collector (Class 4) road and falls under the jurisdiction of Mpumalanga Department of Public Works, Roads and Transport (MDPWRT). This section of District Road D1651, links the R545 to the south west with the R547 to the north west, running past the Rietspruit Dam and various coal mines. This road currently has a T-Junction intersection with the R547 with the latter having the right-of-way.

The D1651 is proposed to be re-aligned (diverted) as shown on **Drawing No. 21017/KP/01** (**Appendix O**) by means of a newly proposed T-junction as shown on **Drawing No. 21017/ID/01** (**Appendix O**). Traffic counts indicate that this road carries less than 50 vph during the weekday peak hours in both directions.

Figure: 9-71 D1651

9.16.1.2. Future Road Network

According to information provided to EDL Engineers (Pty) Ltd, no new roads or alignment changes are planned for the study area, other than the proposed diversion of the D1651 and its new intersection with the R547, as discussed in this report.

9.16.1.3. Existing Traffic Flows

Given the type and extent of the proposed expansion and road diversion, the study area was defined to include one key intersection-and one link count along the R547 as required by South Africa Committee of Transport Officials (COTO) TMH and was analysed using Signalized Intersection Design and Research Aid (SIDRA). Weekday Morning and Weekday Afternoon Traffic Counts were therefore carried out during the Weekday Morning (AM) and Weekday

Afternoon (PM) commuter peak periods, in March of 2021, at the following identified intersection and road:

- Key Intersection / road: Current intersection of the D1651 & R547; and
- R547 (Future position of the intersection of D1651 & R547).

The existing Weekday Morning (AM) and Weekday Afternoon (PM) peak hour traffic volumes at the above-mentioned key intersection and road are summarised in Figure 2 of **Appendix O**.

9.16.1.4. Projected Future Traffic Flows

It is required to determine the future 5-year horizon traffic by applying an annual growth rate to the existing traffic. As the area is slowly densifying and the growth (although lower than in previous years due to slow / negative economic factors) is expected to be positive going forward, a maximum average growth rate of 3% / annum was adopted and applied to the existing 2021 peak hour traffic counts.

9.16.2. Proposed Expansion and Diversion

The following sub-chapters are relevant with respect to the proposed expansion of the existing colliery and the subsequent diversion of District Road D1651.

9.16.2.1. Proposed Expansion

The existing NCC is proposed to expand to the west, and north, ultimately planning to mine where the existing portion of the D1651, in question, is situated. To allow for the expansion of the colliery, it was proposed that this portion of the D1651 be re-aligned to accommodate the expansion of the colliery.

9.16.2.2. Proposed Diversion of District Road D1651

Considering drawing **21017/KP/01** in **Appendix P** and horizontal alignment, the diversion of District Road D1651 is approximately 3.4 km long and is proposed to be surfaced and have lane widths of 3.7 m (7.4 m wide in total), gravel shoulders of 1.5m wide, minimum horizontal curves of 400 m and a design speed of 80 km/h. Regarding vertical alignment, the road is proposed to follow the existing topography present in the area. It is proposed to intersect the R547 by means of a T-Junction intersection, about 1.6 km to the north east of where the existing intersection is situated. Please refer to **Drawing No. 21017/ID/01** in **Appendix O** for more details regarding the proposed intersection.

9.16.2.3. Sight Distance

The proposed diversion (See **Drawing 21017/KP/01** in **Appendix O)** of the D1651 is relatively flat, with average slopes along its length of less than ±3%. Where the new intersection is proposed, the R547 is also flat and straight to the north west and south east with superelevation on the large radius bend where the D1561 is proposed to intersect it. Concluding a site visit it can be said that the Shoulder and Stopping Sight Distances to either side is much more than the required 300 m and is more than adequate for the purpose of this road and proposed intersection, with a speed limit of 100 km/h. It is however proposed that the trees next to where the new intersection is to be constructed, be cut off to ensure no obstruction in the available sight distance, at the new T-Junction intersection.

9.16.2.4. *Access Spacing*

On the R547, the nearest T-Junction / access, is situated about 2.7 km to the south east of the proposed intersection, and 3.0km to the north west of the proposed intersection, concluding that the proposed access spacing on the R547 is acceptable for a rural class 3 road, being more than 1.6 km to either side where the new intersection is proposed, as per the standards set out in the TRH26 document.

9.16.2.5. *Latent Rights*

No latent rights or latent rights upgrades were considered for the study area.

9.16.3. Traffic Impact, Future Traffic & Capacity Analyses

9.16.3.1. *Future Traffic Flow*

The future traffic flow was calculated with a compounding growth factor of 3.0% per annum and was based on the background traffic from the existing 2021 counts. Figure 3 in **Appendix O** shows the existing 2021 peak hour traffic plus estimated diverted traffic. Figure 4 in **Appendix O** shows the future 2026 background peak hour traffic plus the estimated diverted traffic.

9.16.3.2. *Traffic Impact & Capacity Analysis*

To determine the expected traffic impact of the proposed re-alignment (diversion) of the D1651, capacity analyses were carried out by using SIDRA 9, a well-known traffic engineering software package. The following intersection and road were analysed:

- Key Intersection / road: Current intersection of the D1651 & R547 (Future position of the intersection of D1651 & R547)

The following scenarios were analysed at the above-mentioned key intersection(s), namely:

- Existing 2021 Weekday Morning (AM) and Weekday Afternoon (PM) peak hour without the diverted traffic (as per Figure 2 in **Appendix O**).
- Existing 2021 Weekday Morning (AM) and Weekday Afternoon (PM) peak hour with diverted traffic (as per Figure 3 in **Appendix O**).
- Future 2026 Background Weekday Morning (AM) and Weekday Afternoon (PM) peak hour with diverted traffic (as per Figure 4 in **Appendix O**).

The SIDRA results are described in Section 5.3 of **Appendix O**.

10. Description of current land uses

Current land uses in the project area include farming, coal mining and power generation facilities just to name a few. Other land uses in the area are described in Section 9.7.2 and displayed in Figure 9-45.

10.1. Specific environmental features and infrastructure on site

The infrastructure on site is displayed in Figure 4-1 above. Proposed infrastructure includes opencast mining through a pan, diversion of the current district road D1651, construction of a new road linked to the diversion as well a bridge crossing over the Steenkoolspruit.

Specific environmental features on site include wetlands (See Figure 9-10), groundwater indicators (Figure 9-16 and Figure 9-18), surface water (Figure 9-34), sensitive soils (Figure 9-48) and moderate to highly sensitive fauna and flora as indicated in Figure 9-48.

10.2. Environmental and current land use map

Please refer to the figures referenced in Section 10 above and Figure 9-45.

11. Impacts and risks identified

The specialist studies listed in Table 8-1 guided the EIA Process. The findings of the studies were used to identify the impacts and risks the proposed project may impose on the receiving environment. The impacts were assessed through all phases of the project, including the operational, closure and /decommissioning or rehabilitation phases.

11.1. Impact assessment process

The EIA Process was conducted in two phases as defined in the EIA Regulations, 2014 (as amended):

- **Phase 1**: Scoping- the objectives of the Scoping Phase were achieved by developing the environmental screening tool developed by the DFFE. The tool aided in identifying environmental sensitivities in the project area and required specialist input.
    - Site visits were also conducted to get an overview of the environmental attributes on site.
    - Desktop level studies were undertaken to define the environmental baseline conditions at Scoping Level.
- **Phase 2: EIA** – the environmental baseline conditions of the project area were defined through different specialist studies and the impact assessment methodology described below.

11.2. Impact Assessment Methodology

The process followed to determine the significance, probability, and duration of the impacts identified in Section 17 is described in this section. The impacts were assessed using the methodology outlined in the EIA Regulations Guideline Document published by the Department of Environmental Affairs and Tourism (DEAT, 2002). According to the guidelines:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

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

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

The matrix calculates the rating out of 147, whereby intensity, extent, duration and probability are each rated out of seven as indicated in Table 11-2. 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 has been applied; post-mitigation is referred to as the residual impact. The significance of an impact is determined and categorised into one of seven categories (The descriptions of the significance ratings are presented in Table 11-4.

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.

Significance is determined using occurrence and severity which are sub-divided according to the table below:

Table 11-1 Significance Assessment Aspects

Occurrence	**Severity**
Probability of occurrence	Scale/extent of impact
0-None	0-None
1-Improbable	1-Site only
2-Low probability	2-Local
3-Medium probability	3-Regional
4- Highly probable	4-National
5- Definite/do not know	5-International
Duration of occurrence	Magnitude (severity) of impact
1-Immediate	2-Minor
2-Short-term (0-7 years) (impact stops with operational life of project/activity)	4-Low
3-Medium-term (8-15 years)	6-Moderate
4-Long-term	8-High
5-Permanent	10-Very high/do not know
1-Immediate	2-Minor

The formula below is then used to determine the significance of each identified impact:

SP (significance points) = (magnitude + duration + scale) × probability

Table 11-2: Impact Assessment Parameter Ratings

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or **highly** sensitive environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Serious loss and/or damage to physical or biological resources or **highly** sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or **moderately** sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	Moderate loss and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
2	**Minor loss and/or effects** to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 11-3: Probability/Consequence Matrix

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

Table 11-4: 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) (-)

12. The positive and negative impacts of the proposed activity

The positive and negative impacts of the proposed project are depicted below. Most of the impacts are largely negative as indicated in Table 12-1 below.

Table 12-1: Positive and negative impacts of the proposed project

Project Phase	Environmental Impact	Impact status (Positive/Negative)
Wetlands		
Construction	Direct loss of 224.35 ha wetlands: • Loss of habitat and biodiversity; • Erosions and sedimentation of adjacent wetlands and water courses; • Water quality contamination and deterioration; • Increased runoff from hardened surfaces; • Decreased water supply to the wetlands systems; and • Change in habitat and potential change in species composition.	Negative
Operational	Impacts to downstream and adjacent wetlands and watercourses: • Loss of habitat and biodiversity; • Erosions and sedimentation; • Water and soil quality contamination and deterioration; • Increased runoff and flow from hardened surfaces; • Dewatering of wetland adjacent and downstream to the project area (Steenkoolspruit CVB); and • Change in habitat and potential change in species composition.	Negative
Rehabilitation	Impacts to downstream and adjacent wetlands and watercourses: • Erosion and sedimentation; • Increased AIPs; • Change in habitat and potential change in species composition; and • Soil and water contamination due to decanting and the groundwater contamination plume.	Negative
Aquatics		
Construction	• Increase in surface runoff, erosion and subsequently sedimentation; • Channel and bank modifications; • Alteration of the aquatic habitats; • Potential mobilisation of pollutants entering the associated watercourses; • Alteration of the physio-chemistry of water, deterring water quality sensitive biota; and • Sedimentation and water quality deterioration.	Negative

Project Phase	Environmental Impact	Impact status (Positive/Negative)
Operational	• Increase in flow rates, sediment input, erosion and contaminants in the associated watercourses; and • Alteration of the physio-chemistry of water, deterring water quality sensitive biota.	Negative
Rehabilitation	• Potential mobilisation of pollutants entering the associated watercourses during hauling of backfilling material; • Alteration of the physio-chemistry of water, deterring water quality sensitive biota; and • Deterioration in water chemistry and ecological condition.	Negative
Groundwater		
Construction	• Site contamination of groundwater due to hydrocarbon spillages and leaks from construction vehicles; and • Small scale dewatering during stripping of topsoil and softs.	Negative
Operational	• Due to active mine dewatering required to ensure dry working conditions in the open pit, certain groundwater volumes will be extracted from the open pit, limiting the groundwater resource; • Active mine dewatering will be required to ensure dry working conditions in the open pit. The dewatering will cause ground levels to be drawn down in the vicinity of the mining area; and • Due to AMD taking place within the open pit, potential groundwater contamination with sulphate and a lower pH could occur, which would have an impact on the groundwater quality.	Negative
Post-closure	• Due to AMD taking place within the backfilled open pit, potential groundwater contamination with sulphate and a lower pH could occur, which would have an impact on the groundwater quality; • If groundwater levels within the pit recover to elevations higher than surface elevations, this water may then flow from the backfilled open pit areas and cause groundwater contamination down gradient of the mine; and • Due to the dewatering activities during the operational phase, groundwater levels surrounding Middeldrift pit will be subdued at the start of the post-closure phase, after it will gradually recover towards pre-mining levels.	Negative
Surface water		
Construction	• Sedimentation and siltation of water sources due to increased soil erosion leading to reduced water quality; and • Reduced surface water quality due to contamination from hydrocarbon waste.	Negative
Operational	• Sedimentation and siltation of water sources due to increased soil erosion leading to reduced water quality; • Contamination of surface water resources leading to deteriorated water quality; and • Reduced catchment runoff and reduction of streamflow regime in the Steenkoolspruit.	Negative/Positive

Project Phase	Environmental Impact	Impact status (Positive/Negative)
Decommissioning	• Sedimentation and siltation of watercourses subsequently affecting water quality and flow of streams; • Contamination of water resources due to chemical contamination such as hydrocarbons as result of mishandling; • Contamination of water resources from decant of AMD at low-lying riverine areas; and • Allowing free drainage and possible increase of streamflow regimes.	Negative
Soils, Land use and Land capability		
Construction	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	Negative
Operational	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential	Negative
Rehabilitation	• Soil compaction; • Soil erosion; • Sedimentation; and • Topsoil degradation.	Negative
Hydropedological		
Construction	• The mining of a pan will lead to loss of a water resource through disruption of flow paths; • Sedimentation and siltation of watercourses due to increased soil erosion leading to reduced water quality; and • Alteration of channel geometry at crossings resulting in fluvial erosion and reduced flow regime.	Negative
Operational	• Runoff and rainfall interception by the opencast pit will affect the availability of water resources for downstream water users; • Disruption of water flow paths will likely reduce the quantity of water reporting to the Steenkoolspruit thereby affecting the availability of water for downstream water users; and • Allowance for free drainage and increase in runoff yield supporting desired post-mining land use.	Negative

Project Phase	Environmental Impact	Impact status (Positive/Negative)
Decommissioning	• Sedimentation and siltation of nearby watercourses leading to reduced water quality; • Allowance for free drainage and increase in runoff yield supporting desired post-mining land use; and • Contamination of soil and water resources from potential decant of AMD and movement of contamination plume due to the re-watering of the backfilled pit.	Negative
Fauna and Flora		
Construction	• Removal of all vegetation within the development footprint, permits the loss of vegetation and habitat communities (including fauna and flora SCC), biodiversity and ecosystem services; and soil compaction, increased runoff and soil erosion; • Fragmentation, edge effects and degradation to the ecosystem; • Decline in habitat quality for biodiversity and SCC; • Vegetation removal, dust pollution, soil erosion, compaction, sedimentation and AIP proliferation and faunal casualties; • Increased vehicle movement promoting potential faunal causalities; and • Low vegetation growth. If stockpiles unvegetated, potential erosion and spontaneous combustion.	Negative
Operational	• Loss of habitat integrity and damage to surrounding ecosystem services (such as freshwater courses and wetlands); • Increased risk of dust pollution inundating surrounding undisturbed vegetation; • Risk of erosion of the stockpiles; • Risk of AIP proliferation; • Loss of biodiversity and sensitive fauna and flora; • Removal of vegetation, habitats and increased soil erosion, soil contamination and compaction; • Increased faunal casualties (roadkill); and • Increased erosion and sedimentation decreasing vegetation cover.	Negative
Decommissioning	• Disturbance of soils and subsequent erosion by wind, and water; • Increased vehicle movement in the area, increasing soil erosion and habitat destruction; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the surrounding grounds; and	Negative
Heritage		
Construction	• Damage to or destruction of tangible cultural heritage.	Negative
Operational	• Damage to or destruction of tangible cultural heritage.	Negative

Project Phase	Environmental Impact	Impact status (Positive/Negative)
Decommissioning	• No impact to the cultural heritage landscape, given the nature of the proposed activities and the location of identified heritage resources in relation to the proposed Project infrastructure; and • Should any infrastructure intended for demolition increase in age to older than 60 years during the Project lifecycle, the structure must be considered a heritage structure. Any alterations to these structures will be subject to a NHRA Section 34 permit application process	Negative
Air Quality		
Construction	• Reduction in ambient air quality.	Negative
Operational	• Dust generation and reduction in ambient air quality.	Negative
Decommissioning	• Dust generation and reduction in ambient air quality.	Negative
Traffic		
Operational	The intersection of D1651 & R547 currently operates at a worst-case Level of Service (LOS) A with an average delay of 9.1 seconds. With the implementation of the proposed diversion and the additional estimated 5-year traffic growth, this intersection will have a worst-case Level of Service of (LOS) A, with a longer average delay of 9.4 seconds. The intersection will still operate at acceptable conditions (good Levels of Service and Avg. Delays) and it can be concluded that this intersection will operate acceptably with a geometric layout as set out within this report and shown on Drawing No. 21017/ID/01	Negative
Socio-economic		
Construction, Operational and Decommissioning	• Job creation • Skills development • Local and National Economic Development	Positive
Construction, Operational and Decommissioning	• Nuisance Noise • Air quality discharges • Traffic disturbances • Disturbances to natural environment.	Negative

13. The possible mitigation measures and level of risk

Please refer to Section 35.8.1 and Table 35-1.

14. Motivation where no alternative sites were considered

As mentioned in Section 7 above. No alternative sites were considered since the proposed activity will take place within the NCC's existing MRA **(MR Ref. No. MP30/5/1/2/2/492MR).** Mining of Middeldrift will form part of the existing mining operations at NCC, continuing for a period of at least 17 years depending on the road diversion approval.

15. Statement motivating the alternative development location within the overall site

No alternative development location was considered since the Middeldrift reserves occur in the preferred location, which is in the boundaries of the MRA.

16. Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site

The impact assessment process has been described in Section 11.1 above. The process was conducted in terms of the NEMA requirements, where a Scoping and EIA Process took place. Desktop studies aided the findings of the Scoping Process, while specialist input, which included monitoring results and site surveys aided the EIA Phase. '

The PPP carried out in terms of Regulation 41 of the EIA Regulations, 2014 (as amended) also guided the EIA phase. Findings of the EIA Process are comprehensively described in the section that follows.

17. Environmental Impact Assessment

The concept of sustainability is generally defined as development that meets the needs of current generations without compromising those of future generations. The principles of sustainability are embedded in the NEMA, which is guiding legislation for the EIA Process. The EIA Process for the project has been conducted in terms of requirements of the EIA Regulations, 2014 (as amended) and the MPRDA.

The findings of the EIA Process are documented in the EMPr attached in **Section B** of this report. The EMPr describes measures to mitigate the identified impacts, including **avoidance, minimisation, rehabilitation** and **offsetting** residual, unavoidable impacts.

17.1. Project Phases and Activities

The impact assessment process considered impacts for the following phases of the project:

- Construction

- Operational; and
- Decommissioning/Rehabilitation.

17.1.1. Construction Phase

Construction Phase activities include:

- Site/vegetation clearance;
- Contractor laydown yard;
- Access and haul road construction; and
- Topsoil stockpiling.

17.1.2. Operational Phase

Activities to be undertaken in project operation include:

- Open pit establishment;
- Removal of rock (blasting);
- Stockpiling (i.e., soils) establishment and operation; and
- Operation of the open pit workings.

17.1.3. Decommissioning and Closure

During decommissioning and closure, the following activities will be conducted:

- 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.

The assessment of each identified potentially significant impact and risk associated with the project phases mentioned above are described below. The assessment was conducted using the methodology detailed in Section 11.2. and details the impacts prior and after to mitigation.

17.2. Wetland Assessment

The results of the Wetland Assessment are displayed in Table 17-1 (Interactions and impacts of activity) and Table 17-2 below (Pre-mitigation impact ratings). It is observed that the proposed project will significantly impact on the wetland environment prior to mitigation and may have minor impacts post-mitigation. The impacts resulting from the bridge construction and decommissioning are highly significant and may result in sedimentation and water quality deterioration as well as habitat deterioration of watercourses.

Table 17-1: Wetland Impact Assessment

Project Phase	Project Activity	Impact	Description
Construction Phase	Site/vegetation clearance Contractor laydown yard Access and haul road construction Topsoil stockpiling	• Direct loss of 224.35 ha wetlands; • Loss of habitat and biodiversity; • Erosions and sedimentation of adjacent wetlands and water courses; • Water quality contamination and deterioration; • Increased runoff from hardened surfaces; • Decreased water supply to the wetlands systems; and • Change in habitat and potential change in species composition.	The site clearance, removal of vegetation, soil stripping and stockpiling will result in the complete loss of wetlands. This will also alter the hydrological regime and flow of water to adjacent and downstream wetlands and watercourses. This could contribute to further loss of wetlands adjacent and downstream of the site, referred to as indirect loss. Increased flow velocity from hardened surfaces and concentrated streams may increase the erosion risk of adjacent wetlands and along with the excess soil cause sedimentation of water resources. Soil stockpiles may erode and cause sedimentation of downstream and adjacent wetlands and water courses. Construction of haul roads will result in complete loss of some wetlands within the project area as well as soil compaction, increased surface runoff and increased risk of erosion, contamination and sedimentation of the wetlands downstream and adjacent of the site. During construction, spills from machinery may occur which will in effect contaminate the downstream wetlands and affect the biodiversity directly. The contamination of water resources will result in the deterioration of water quality which will cause a loss of aquatic faunal species, terrestrial faunal species and vegetation.

Operational Phase	Open pit establishment
	Removal of rock (blasting)
	Stockpiling (i.e., soils) establishment and operation
	Operation of the open pit workings
		• Impacts to downstream and adjacent wetlands and watercourses:
		  ◦ Loss of habitat and biodiversity;
		  ◦ Erosions and sedimentation;
		  ◦ Water and soil quality contamination and deterioration;
		  ◦ Increased runoff and flow from hardened surfaces;
		  ◦ Dewatering of wetland adjacent and downstream to the project area (Steenkoolspruit CVB); and
		  ◦ Change in habitat and potential change in species composition.
			As the wetlands within the project area will completely be removed/mined, there will be no additional impacts to the wetlands in the project area, however, activities in the project area may lead to secondary impacts to downstream and adjacent wetlands.
			The operation of the mine will result in exposed surfaces for prolonged periods and the generation of loose soil and contaminated material which may be washed to downstream wetlands and water courses that may lead to sedimentation and contamination. The exposed surfaces will have no ability to slow water flow and as such may cause an altered or elevated water flow to the wetland areas which may prompt the onset of erosion in wetland areas. Furthermore, contaminated water from the mine, may spill which may potentially be washed down to the adjacent and downstream wetlands and contaminate the wetlands/soil/water.
			It is not expected that the hydrology of the wetlands within the project area be impacted upon, except for the Steenkoolspruit (CVB) that will lose 34 % - 41 % (option 1 and 2 respectively) baseflow during the LoM, however will recover to near pre-mining volumes post-closure.

Rehabilitation Phase	Rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation
	Post-closure monitoring and rehabilitation
		• Impacts to downstream and adjacent wetlands and watercourses:
		  ◦ Erosion and sedimentation;
		  ◦ Increased AIPs;
		  ◦ Change in habitat and potential change in species composition; and
		  ◦ Soil and water contamination due to decanting and the groundwater contamination plume.
			Rehabilitation of the project area may lead to exposed areas that could lead to erosion and sedimentation. This will impact wetlands downstream and adjacent of the project area.
			Sedimentation will lead to habitat and biodiversity loss and decreased overall wetland health. The activities that will be performed during the final rehabilitation will entail the movement of material, shaping of the topography and soil spreading and will include the establishment of vegetation on exposed surfaces. The movement of material and large areas of exposed surfaces could result in erosion, sedimentation, change in species composition and increase in AIPs.
			Dewatering is expected during the LoM of the CVB (Steenkoolspruit) only, however, the water levels are expected to restore after the Closure phase. The largest impact to the CVB (Steenkoolspruit) after LoM will be decanting and groundwater contamination if not managed and mitigated. This will impact the wetland health and integrity and lead to degradation of water quality. Post-closure impacts are mainly contamination and decanting towards the Steenkoolspruit (CVB) which will have major impacts on the wetland health and integrity if not mitigated and proper rehabilitation placements are done.

Table 17-2: Pre-mitigation impact ratings

Pre-Mitigation Rating								
Project Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
Construction Phase	Site/vegetation clearance	**Direct loss** of **224.35 ha** wetlands Impacts include: • Loss of habitat and biodiversity; • Erosions and sedimentation of adjacent wetlands and water courses; • Water quality contamination and deterioration; • Increased runoff from hardened surfaces; • Decreased water supply to wetlands systems (Steenkoolspruit CVB); and • Change in habitat and potential change in species composition.	Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Contractor laydown yard		Beyond Project Life (6)	Local (3)	Serious Loss (4)	Almost Certain (6)	Negative	Moderate - 78
	Access and haul road construction		Beyond Project Life (6)	Municipal Area (4)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 96
	Topsoil stockpiling		Beyond Project Life (6)	Region (5)	Serious Loss (5)	Almost Certain (6)	Negative	Moderate - 96
Operational Phase	Open pit establishment	**Direct loss** of **224.35 ha** wetlands Impacts to downstream and adjacent wetlands and watercourses: • Decreased water supply to the Steenkoolspruit (CVB) and downstream water courses due to drawdown from the cone of depression, as well as contamination from the contamination plume caused by the proposed activities; • Loss of habitat and biodiversity; • Erosions and sedimentation; • Water and soil quality contamination and deterioration; • Increased runoff and flow from hardened surfaces; • Change in habitat and potential change in species composition	Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Removal of rock (blasting)		Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Stockpiling (i.e., soils, and ROM) establishment and operation		Beyond Project Life (6)	Region (5)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 102
	Operation of the open pit workings		Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133

Rehabilitation Phase	Rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation	• Impacts to downstream and adjacent wetlands and watercourses:
		  ◦ Erosion and sedimentation;
		  ◦ Increased AIPs;
		  ◦ Change in habitat and potential change in species composition; and
		  ◦ Dewatering and contamination due to the contamination plume towards the Steenkoolspruit (CVB).
			Beyond Project Life (6)	Local (3)	Minor loss (2)	Probable (4)	Negative	Minor -44

	Post-closure monitoring and rehabilitation		Beyond Project Life (6)	Region (5)	Irreplaceable Loss (7)	Likely (5)	Negative	Moderate -90

17.3. Aquatics Assessment

The assessment of the Aquatic Environment is presented in phases. The assessment identifies impacts associated with the **Construction Phase**, **Road Construction**, **Bridge Construction** and then **Operational** and **Closure Phases**. The impacts associated with the Construction Phase are presented in Table 17-3 below.

Table 17-3: Construction Phase Impacts

Interaction	Impact
Soil disturbance and vegetation clearance for establishment of mining and linear infrastructure	Increase in surface runoff, erosion and subsequently sedimentation; Channel and bank modifications; and Alteration of the aquatic habitats.
Diesel storage and explosives magazine.	Potential mobilisation of pollutants entering the associated watercourses; and Alteration of the physio-chemistry of water, deterring water quality sensitive biota.
Construction of access roads and haul roads.	
Stockpiling of soils, rock dump and discard dump establishment.	

The **road construction** impact ratings are depicted in Table 17-4. The significance rating of the sedimentation and water quality deterioration associated with the road construction before mitigation is minor, and negative with the correct mitigation measures. All mitigation measures are detailed in the EMPr (Section B).

Table 17-4: Road Construction Impacts

Dimension	Rating	Motivation	Significance
Activity and Interaction: Site clearance and construction of proposed infrastructure in proximity to the watercourses.			
Impact Description: Sedimentation and water quality deterioration			
Prior to Mitigation/Management			
Duration	Project life (5)	Once vegetation is cleared for infrastructure, no revegetation will occur until project closure.	Minor (negative) – 36
Extent	Local (3)	Based on the distance between the proposed road and the Steenkoolspruit, the extent of the impact is expected to extend to the immediate surroundings.	

Dimension	Rating	Motivation	Significance
Intensity x type of impact	Moderately high - Negative (-4)	During periods of high rainfall, runoff from the road construction will impact on the biophysical characteristics within the Steenkoolspruit.	
Probability	Unlikely (3)	Based on the distance between the proposed road and the Steenkoolspruit, Biological and physical resources within the Steenkoolspruit are only expected to be impacted during periods of high rainfall.	
Nature	Negative		
Post-Mitigation			
Duration	Project Life (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	Limited (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	Minor - Negative (-2)	If mitigation measures are all incorporated for the road construction, the intensity of the impact should be low.	
Probability	Unlikely (3)	The likelihood of the impact occurring at the Steenkoolspruit and surrounding watercourses is reduced by the mitigation actions and should only result in extreme cases or unexpected rainfall events.	
Nature	Negative		

The construction of a bridge over the Steenkoolspruit River will significantly influence sedimentation and water quality deterioration. The impacts may be moderate with mitigation (Table 17-5).

Table 17-5: Bridge Construction Impacts

Dimension	Rating	Motivation	Significance
Activity and Interaction: Construction of the proposed bridge over the Steenkoolspruit.			
Impact Description: Sedimentation and water quality deterioration			
Prior to Mitigation/Management			
Duration	Project life (5)	Once vegetation is cleared for infrastructure, no revegetation will occur until project closure.	Major (negative) – 112
Extent	Catchment (4)	The bridge construction will have a direct impact on the biophysical characteristics of the Steenkoolspruit and downstream reaches, potentially extending to the larger catchment area.	
Intensity x type of impact	Extremely high - Negative (-7)	The construction of the bridge is expected to impact on the immediate riparian and instream areas, affecting biological and physical resources within the Steenkoolspruit and downstream reaches.	
Probability	Definite (7)	Due to the proximity of the proposed bridge construction to the Steenkoolspruit, the impact is definite.	
Nature	Negative		
Post-Mitigation			
Duration	Project Life (5)	Once vegetation is cleared for infrastructure, no revegetation will occur until the closure phase of the Project or removal of the infrastructure.	Moderate (negative) – 105
Extent	Catchment (4)	Construction of the bridge will Impact on the Steenkoolspruit and further downstream reaches.	
Intensity x type of impact	Very high - Negative (-6)	If periods of high rainfall are prevented, the extent to which the impacts stretch further downstream will be slightly reduced.	

Dimension	Rating	Motivation	Significance
Probability	Definite (7)	Due to the proximity of the proposed bridge construction to the Steenkoolspruit, the impact is definite.	
Nature	Negative		

The impacts and significant rating for the **Operational Phase** of the project are indicated below.

Table 17-6: Impacts associated with the Operational Phase of the project

Dimension	Rating	Motivation	Significance
Activity and Interaction: 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			
Prior to Mitigation/Management			
Duration	Project Life (5)	It is predicted that contaminant input will continue throughout the life of the Project whenever rainfall events occur.	Minor (negative) – 65
Extent	Local (3)	Due to the impacts that the surrounding mining activities have on the catchment, impacts associated with the proposed Project are expected to significantly impact on the local surroundings only	
Intensity x type of impact	High - Negative (-5)	Runoff, seepage and or leakage into watercourses is expected to impact functioning of the aquatic ecosystems.	
Probability	Likely (5)	The impact is likely to occur throughout the life of the Project but limited due to periodic rainfall events.	
Nature	Negative		
Post-Mitigation			
Duration	Project Life (5)	Runoff will continue throughout the Project life.	Negligible (negative) – 21

Dimension	Rating	Motivation	Significance
Extent	Very limited (1)	Runoff will most likely be largely restricted and captured after mitigation.	
Intensity x type of impact	Minimal to no loss - Negative (-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	Unlikely (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 are not maintained.	
Nature	Negative		

The use of heavy machinery for backfilling may potentially impact on the water quality and habitat deterioration of affected watercourses. The impacts are however negligible with mitigation.

Table 17-7: Impacts associated with closure and rehabilitation

Dimension	Rating	Motivation	Significance
Activity and Interaction: Backfilling of the pit and associated activities near and within drainage lines			
Impact Description: Water quality and habitat deterioration of watercourses in contact with heavy machinery and receiving runoff and decant from surface workings			
Prior to Mitigation/Management			
Duration	Beyond project life (6)	Impacts associated with decanting and AMD will occur beyond the project life.	Moderate (negative) – 90
Extent	Catchment (4)	Based on the proximity of the proposed Project to the Steenkoolspruit, the extent of runoff and decant is expected to extend to the respective catchment.	

Dimension	Rating	Motivation	Significance
Intensity x type of impact	High - Negative (-5)	Runoff into watercourses is expected to result in erosion, increased sedimentation and contamination impacting functioning of the aquatic ecosystems.	
Probability	Highly likely (6)	The impact is highly likely to occur throughout the Decommissioning Phase and beyond.	
Nature	Negative		
Post-Mitigation			
Duration	Medium Term (3)	Impacts will persist throughout the Decommissioning Phase until rehabilitation activities are complete.	Negligible (negative) – 15
Extent	Very limited (1)	If mitigation measures are adhered to and decant is treated for AMD, runoff is expected to be restricted to the mitigation structures.	
Intensity x type of impact	Minimal to no loss - Negative (-1)	If mitigation measures are all incorporated for the Project, the intensity of the impact should decrease notably especially after rehabilitation.	
Probability	Unlikely (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 are not maintained.	
Nature	Negative		

17.4. Groundwater Assessment

Findings of the groundwater assessment are displayed in Table 17-8 to Table 17-15. The impacts identified include:

- Site contamination of groundwater due to hydrocarbon spillages and leaks from construction vehicles;
- Small scale dewatering during stripping of topsoil and softs;
- Active mine dewatering will be required to ensure dry working conditions in the open pit. The dewatering will cause ground levels to be drawn down in the vicinity of the mining area; and are further substantiated as follows:

- Due to AMD taking place within the open pit, potential groundwater contamination with sulphate and a lower pH could occur, which would have an impact on the groundwater quality;
- If groundwater levels within the pit recover to elevations higher than surface elevations, this water may then flow from the backfilled open pit areas and cause groundwater contamination down gradient of the mine; and
- Due to active mine dewatering required to ensure dry working conditions in the open pit, certain groundwater volumes will be extracted from the open pit, limiting the groundwater resource.

The significance of these impacts ranges largely between minor to negligible post and prior mitigation. The decanting procedures associated with the Operational Phase are moderate post mitigation.

Table 17-8: Construction Phase impacts (Spillages)

Dimension	Rating	Motivation	Significance
Activity and Interaction: Fuel storage, construction vehicles causing potential groundwater contamination			
Impact Description: site contamination of groundwater due to hydrocarbon spillages and leaks from construction vehicles.			
Prior to Mitigation/Management			
Duration	1	Any occurrence could be reversed within a months' time.	Negligible (negative) -10
Extent	1	Impacts will be limited to specific isolated parts of the site.	
Intensity	2	Expected minor impacts on the biological or physical environment; damage can be rehabilitated internally.	
Probability	3	There is a possibility of this impact to occur.	
Nature	Negative		
Mitigation/Management Actions			
• Regular service of vehicles in designated repair bays. • Refueling of vehicles only in designated areas.			
Post-Mitigation			

Dimension	Rating	Motivation	Significance
Duration	1	Any occurrence could be reversed within a months' time.	Negligible (negative) -6
Extent	1	Impacts will be limited to specific isolated parts of the site.	
Intensity	2	Expected minor impacts on the biological or physical environment; damage can be rehabilitated internally.	
Probability	1	With mitigation measures in place it is not expected to happen.	
Nature	Negative		

Table 17-9: Construction Phase Impacts (Stripping)

Dimension	Rating	Motivation	Significance
Mine dewatering causing groundwater level drawdown			
Impact Description: Small scale dewatering during stripping of topsoil and softs.			
Prior to Mitigation/Management			
Duration	1	Any occurrence could be reversed within a months' time.	Negligible (negative) -8
Extent	1	Impacts will be limited to specific isolated parts of the site.	
Intensity	2	Expected minor impacts on the biological or physical environment; damage can be rehabilitated internally.	
Probability	2	There is a possibility of this impact to occur if the box cuts or the stripping goes to below the groundwater table.	
Nature	Negative		
Mitigation/Management Actions			

Dimension	Rating	Motivation	Significance
• Keep the stripping time as short as possible. • If the groundwater level is intercepted, the extent and depth of the stripping areas should be as minimal as possible.			
Post-Mitigation			
Duration	1	Any occurrence could be reversed within a months' time.	Negligible (negative) -6
Extent	1	Impacts will be limited to specific isolated parts of the site.	
Intensity	2	Expected minor impacts on the biological or physical environment; damage can be rehabilitated internally.	
Probability	1	Expected not to happen if box cut and stripping depth can be limited.	
Nature	Negative		

Table 17-10: Operational Phase Impacts– Groundwater Drawdown

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 pit. The dewatering will cause ground levels to be drawn down in the vicinity of the mining area.			
Prior to Mitigation/Management			
Duration	6	Expected for LoM.	Minor (negative) -42
Extent	2	Limited to Middeldrift open pit and surroundings.	
Intensity	3	Moderate, operational effects.	
Probability	6	It is likely that this impact will occur.	
Nature	Negative		
Mitigation/Management Actions			

Dimension	Rating	Motivation	Significance
• 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 pit should stop should as soon as the mining activities cease. • Groundwater levels surrounding the open pit 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) -39
Extent	2	Limited to Middeldrift pit and surroundings.	
Intensity	3	Moderate, operational effects .	
Probability	6	It is likely that this impact will occur.	
Nature	Negative		

Table 17-11: Operational Phase Impacts – 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 pit, certain groundwater volumes will be extracted from the open pit, limiting the groundwater resource.			
Prior to Mitigation/Management			
Duration	6	Expected for LoM and a short period post-closure.	Minor (negative) -36
Extent	2	Limited to Middeldrift open pit and surroundings.	
Intensity	3	Moderate, operational effects.	
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.			

Dimension	Rating	Motivation	Significance
• Dewatering of the open pit should stop should as soon as the mining activities cease. • 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) -33
Extent	2	Limited to Middeldrift pit and surroundings.	
Intensity	3	Moderate, operational effects .	
Probability	4	It is probable that this impact will occur.	
Nature	Negative		

Table 17-12: Operational Phase Impacts– Groundwater Quality

Dimension	Rating	Motivation	Significance
Activity and Interaction: AMD formation in the open pit causing groundwater contamination			
Impact Description: Due to AMD taking place within the open pit, potential groundwater contamination with sulphate and a lower pH could occur, which would have an impact on the groundwater quality.			
Prior to Mitigation/Management			
Duration	6	Expected for LoM and post-closure.	Negligible (negative) -22
Extent	2	Limited to Middeldrift open pit and surroundings.	
Intensity	2	Negligible effects due to drawdown cone preventing contaminants from spreading.	
Probability	3	With current limited data available and based on previous experience 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 open pit should continue during LoM. • Groundwater levels surrounding the mine void should be monitored on a regular basis during LoM to verify the extent of the cone of drawdown.			

Dimension	Rating	Motivation	Significance
Post-Mitigation			
Duration	5	Expected for LoM.	Negligible (negative) -18
Extent	2	Limited to Middeldrift open pit and surroundings.	
Intensity	2	Negligible effects due to drawdown cone preventing contaminants from spreading.	
Probability	2	With current limited data available and based on previous experience this impact is likely to occur but reduced with mitigations in place.	
Nature	Negative		

Table 17-13: Post-Closure Phase Impacts – Groundwater Quality

Dimension	Rating	Motivation	Significance
Activity and Interaction: AMD in open pit causing groundwater contamination			
Impact Description: Due to AMD taking place within the backfilled open pit, potential groundwater contamination with sulphate and a lower pH could occur, which would have an impact on the groundwater quality.			
Prior to Mitigation/Management			
Duration	7	The impact will remain long after the life of the Project. The impacts are irreversible.	Moderate (negative) -90
Extent	2	Limited to Middeldrift open pit and surroundings.	
Intensity	6	Serious impact on expected on ecosystems and drainage lines within the contaminant plume.	
Probability	6	This impact will likely occur.	
Nature	Negative		
Mitigation/Management Actions			
• Dewatering of the pit should cease as soon as possible after mining activities are completed to allow for groundwater level recovery. • Rehabilitation of the pit to reduce infiltration of rainwater. • Clean water and runoff should be diverted where possible towards the rehabilitated pit as fast as possible after mining has stopped. • Groundwater quality should be frequently sampled to establish if a contaminant plume will migrate.			

Dimension	Rating	Motivation	Significance
Post-Mitigation			
Duration	7	The impact will remain long after the life of the Project. The impacts are however mitigated in duration if proposed mitigation of faster flooding is implemented.	Moderate (negative) -75
Extent	2	Limited to Middeldrift open pit and surroundings.	
Intensity	5	Serious impact on expected on ecosystems and drainage lines within the contaminant plume.	
Probability	6	This impact will likely occur.	
Nature	Negative		

Table 17-14: Post Closure Impacts – Decant

Dimension	Rating	Motivation	Significance
Activity and Interaction: Mine decant causing contamination of groundwater			
Impact Description: If groundwater levels within the pit recover to elevations higher than surface elevations, this water may then flow from the backfilled open pit areas and cause groundwater contamination down gradient of the mine.			
Prior to Mitigation/Management			
Duration	7	The impact will remain long after the life of the Project. The impacts are irreversible.	Moderate (negative) -84
Extent	2	Decant points and downgradient.	
Intensity	6	Serious impact on ecosystems within the contaminant plume.	
Probability	5	This impact may occur.	
Nature	Negative		
Mitigation/Management Actions			
• Groundwater level recovery in the rehabilitated open pit should be frequently monitored to create stage curves and predict the final water recovery level. • Rehabilitation of the pit 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.			

Dimension	Rating	Motivation	Significance
Post-Mitigation			
Duration	6	The impact will remain long after the life of the Project. The impacts are irreversible.	Minor (negative) -60
Extent	2	Limited to the site only.	
Intensity	6	Serious impact on ecosystems within the contaminant plume.	
Probability	2	This impact is unlikely to happen.	
Nature	Negative		

Table 17-15: Post-Closure Phase Impacts– Groundwater 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 Middeldrift pit will be subdued at the start of the post-closure phase, after it will gradually recover towards pre-mining levels.			
Prior to Mitigation/Management			
Duration	6	Reduced groundwater levels will be fully recovered within 90-120 years, no groundwater users to be impacted. Baseflow volume is minor.	Minor (negative) - 42
Extent	2	Limited to Middeldrift open pit and surroundings.	
Intensity	3	Moderate, short-term effects are expected.	
Probability	6	This impact is likely to occur.	
Nature	Negative		
Mitigation/Management Actions			

Dimension	Rating	Motivation	Significance
• Dewatering of the open pit 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. • Clean water and runoff should be diverted where possible towards the open pit to flood areas as fast as possible after mining has stopped.			
Post-Mitigation			
Duration	5	Reduced groundwater levels will be fully recovered within 90-120 years, no groundwater users to be impacted. Baseflow volume is minor.	Minor (negative) - 39
Extent	2	Limited to Middeldrift open pit and surroundings.	
Intensity	3	Moderate, short-term effects are expected.	
Probability	6	This impact is likely to occur.	
Nature	Negative		

17.5. Surface Water Assessment

The impacts imposed on the surface water environment are presented in this section. Most of the impacts, from the construction to the decommissioning phases are rated as moderate negative impacts. These impacts may have major or usually long-term changes to the natural environment.

17.5.1. Impacts associated with the Construction Phase

Construction Phase impacts include sedimentation and siltation as well as reduced water quality. These impacts are moderate before mitigation, and acceptable post mitigation.

Table 17-16: Surface water: Impact Significance Rating for Construction Phase

Dimensions	Rating	Motivation	Significance
Impact: Sedimentation and siltation of water sources due to increased soil erosion leading to reduced water quality			
Duration	5	The impact will likely occur during construction and decommissioning phases.	90-Moderate (Negative)

Dimensions	Rating	Motivation	Significance
Intensity	5	The impact will have serious, long-term impact on the ecosystem.	
Spatial scale	5	The impacts will go beyond the specified project area.	
Probability	6	It is highly probable that it will occur.	
Post-mitigation			
Duration	5	The impact will likely occur throughout the project's life.	36-Negligible (negative)
Intensity	2	The impacts will have minor effects on water resources.	
Spatial scale	2	The impacts will be limited to the project site.	
Probability	4	Probable: Has occurred here or elsewhere and could therefore occur.	

The reduction of water quality due to hydrocarbon contamination is anticipated to be moderate before mitigation and negligible post mitigation (Table 17-17).

Table 17-17 Surface water: Reduced surface water quality

Dimensions	Rating	Motivation	Significance
Impact Description: Reduced surface water quality due to contamination from hydrocarbon waste			
Duration	6	The impact will occur beyond the project life.	76-Moderate (Negative)
Intensity	7	The impact will have serious, long-term impact on water resources and the aquatic ecosystem.	
Spatial scale	6	The impacts will go beyond the project area, it will also affect areas downstream.	
Probability	4	There is high possibility of the impacts occurring.	
Post-mitigation			
Duration	4	The impacts will occur only during the life the project.	36-Negligible (negative)
Intensity	3	The intensity of the impacts will be at minimum.	

Dimensions	Rating	Motivation	Significance
Spatial scale	2	The impacts will be felt mostly around the project area.	
Probability	4	Probable: Has occurred here or elsewhere and could therefore occur.	

17.5.2. Impacts associated with the Operational Phase

The impacts associated with the Operational Phase are almost similar to those of the Construction Phase, accept that reduced catchment runoff and reduction of streamflow regime in the Steenkoolspruit River is assessed as a minor impact.

Table 17-18: Surface water: Impact Significance Rating for Operational Phase

Dimensions	Rating	Motivation	Significance
Impact: Sedimentation and siltation of water sources due to increased soil erosion leading to reduced water quality			
Duration	5	The impact will likely occur during construction and decommissioning phases.	90-Moderate (Negative)
Intensity	5	The impact will have serious, long-term impact on the ecosystem.	
Spatial scale	5	The impacts will go beyond the specified project area.	
Probability	6	It is highly probable that it will occur.	
Post-mitigation			
Duration	5	The impact will likely occur throughout the project’s life.	36-Negligible (negative)
Intensity	2	The impacts will have minor effects on water resources.	
Spatial scale	2	The impacts will be limited to the project site.	
Probability	4	Probable: Has occurred here or elsewhere and could therefore occur.	

The impact of hydrocarbon spills on surface water quality is anticipated to be moderate and will occur beyond the project life (Table 17-19).

Table 17-19 Surface water: Reduced water quality due to hydrocarbon waste

Dimensions	Rating	Motivation	Significance
Impact Description: Reduced surface water quality due to contamination from hydrocarbon waste			
Duration	6	The impact will occur beyond the project life.	95-Moderate (Negative)
Intensity	7	The impact will have serious, long-term impact on water resources and the aquatic ecosystem.	
Spatial scale	6	The impacts will go beyond the project area, it will also affect areas downstream.	
Probability	5	Project Life: The impact will cease after the operational life span of the Project.	
Post-mitigation			
Duration	4	The impacts will be long-term during the course of the project.	36-Negligible (negative)
Intensity	3	The intensity of the impacts will be at minimum.	
Spatial scale	2	The impacts will be felt mostly around the project area.	
Probability	4	Probable: Has occurred here or elsewhere and could therefore occur.	

Reduced catchment runoff and the streamflow regime reduction of the Steenkoolspruit River is anticipated to be minor without mitigation (Table 17-20).

Table 17-20 Surface water: Reduced catchment runoff and reduction of streamflow regime

Dimensions	Rating	Motivation	Significance
Impact: Reduced catchment runoff and reduction of streamflow regime in the Steenkoolspruit			
Duration	5	Impacts will occur for the lifespan of the project.	70-Minor (Negative)
Intensity	4	The impact will affect the availability of freshwater resources therefore affecting habitats.	
Spatial scale	5	Impacts will be felt downstream mostly.	
Probability	5	The impacts will likely take place.	

Dimensions	Rating	Motivation	Significance
Post-mitigation			
Duration	5	Impacts will occur during the project's life span.	36-Negligible (Negative)
Intensity	2	Limited impacts on the water resources and minimum damage to habitats.	
Spatial scale	2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	
Probability	4	The impact will highly occur during extreme circumstances.	

17.5.3. Impacts associated with the Decommissioning/Rehabilitation Phase

Allowing free drainage and possible increase of streamflow regimes is assessed a positive impact which is beneficial and may result in positive change.

AMD decant into surface water resources and sedimentation and siltation of water sources (may affect the water quality and flow of streams) are the most significant impacts assessed on the water environment prior to mitigation.

Table 17-21 : Impact Significance Rating for the Decommissioning Phase

Dimensions	Rating	Motivation	Significance
Impact: Sedimentation and siltation of water sources therefore affecting water quality and flow of streams			
Duration	6	Beyond Project Life: The impact will remain for some time after the life of a Project.	78-Moderate (negative)
Intensity	4	The impacts will affect the flow and quality of streams thereby endangering the aquatic environment.	
Spatial scale	3	The impact will affect areas beyond the project area.	
Probability	6	The impact is highly likely to take place.	
Post-Mitigation			
Duration	2	The impact will only be limited during the specified phase after mitigation measures.	28-Negligible (Negative)
Intensity	2	There will be minor and manageable impacts on water resources and the environment.	

Dimensions	Rating	Motivation	Significance
Spatial scale	3	Local: Extending across the site and to nearby settlements.	
Probability	4	The chances of the impact occurring are low, unless its extreme events.	

The contamination of water resources by hydrocarbons is anticipated to be minor, but negligible post mitigation (Table 17-22).

Table 17-22 Surface water: Surface water resource contamination

Dimensions	Rating	Motivation	Significance
Impact: Contamination of water resources due to hydrocarbon waste			
Duration	4	The impacts of chemical contamination will occur beyond the specified phase.	66- Minor (Negative)
Intensity	4	The impacts will moderately affect the quality of water resources thereby affecting the aquatic environments downstream of the project area.	
Spatial scale	3	The impacts may be felt downstream of the project area.	
Probability	6	There are high chances of the impact occurring.	
Post-Mitigation			
Duration	4	The impacts may occur for a long term, 6 – 15 years.	36- Negligible (Negative)
Intensity	3	Minor effects on ecosystems will occur and will be reversible internally or with minimal assistance from external experts.	
Spatial scale	2	The impact will be localised within the project area.	
Probability	4	The impact will probably occur.	

Allowing free drainage and increasing streamflow regimes is anticipated to have positive impacts since it will sustain aquatic systems (Table 17-23).

Table 17-23 Surface water: Allowing free drainage and possible increase in streamflow regimes

Dimensions	Rating	Motivation	Significance
Impact: Allowing free drainage and possible increase of streamflow regimes			
Duration	7	The positive impact will last long after the project life .	126+ Major (Positive)
Intensity	6	Streamflow regimes will likely increase and aquatic ecosystems will be sustained, hence, beneficial to the environment.	
Spatial scale	5	The impacts will go beyond the project area to downstream water users.	
Probability	7	The impact will definitely take place .	

The impacts of acid mine drainage on water resources is anticipated to be moderate and minor with the implementation of appropriate mitigation measures (Table 17-24).

Table 17-24 Surface water: Contamination from Acid Mine Drainage

Dimension	Rating	Motivation	Significance
Impact: Water contamination from Acid Mine Drainage decant into surface water resources			
Duration	7	The impact will likely 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.	
Post-mitigation			
Duration	6	The impact will occur beyond the LoM.	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	

17.6. Soils, Land Use and Land Capability Assessment

The impact assessment results of the Soils, Land Use and Land Capability are depicted in the tables below. Table 17-25 shows how the impacts identified will interact with the activities along the Construction, Operational and Rehabilitation Phases. The Soils, Land Use and Land Capability environment has been described as sensitive (Refer to Section 9.8) (Figure 9-48). It can therefore be seen (Table 17-26) that the pre-mitigation impacts are largely long-term with a high significance prior to mitigation.

Table 17-25: Interactions and Impacts of Activity

Project Phase	Project Activity	Impact	Description
Construction Phase	Site/vegetation clearance Contractor laydown yard Access and haul road construction Topsoil stockpiling	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	During site clearing, vegetation will be removed along with topsoil. When soil is removed, the physical and chemical properties may change, and the soils can degrade and change from high land capability to low land capability/ industrial. When the organic material is removed, either by the clearing of an area for the development of infrastructure or by erosion; the soil fertility status can reduce and may result in soil acidification. Vehicles and machinery can lead to soil compaction, increased surface runoff, erosion and loss of vegetation and OM. This can reduce the infiltration rate, and the ability for plant roots and water to penetrate the soil. Once the soil is eroded it can reduce the overall soil depth, soil fertility rate, and as a result the land capability. If the topsoil and subsoil are excavated and stockpiled as one unit, the topsoil's seed bank and natural fertility balance can be diluted. This can affect the regrowth of vegetation using the stockpiled topsoil. Soils should therefore be handled with care from the construction phase through to the decommissioning phase. When usable soil is disturbed, compacted, or eroded, the soil profile can be compromised and its ability to function as a growth medium can be restricted. The sandy soils in the Project Area can be particularly vulnerable to wind and water erosion when exposed during site clearance and stockpiling. An intact vegetation cover is needed to reduce impact from raindrops on the soil, slows down surface run-off, filters sediment and binds the soil together for more stability. The potential for chemical pollution and soil contamination exists during site preparation and construction when spills or leaks of fuels, oils and lubricants from construction or operational vehicles or machinery occur. Fluids used for vehicles and machinery may spill during filling or direct leakage.
Operational Phase	Open pit establishment Removal of rock (blasting) Stockpiling (i.e., soils) establishment and operation Operation of the open pit workings	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	Various unplanned and residual impacts to the remaining and adjacent soils might occur, including soil pollution/contamination, erosion, compaction and loss of soils and land capability. Impacts may include changes to the natural soil physical, chemical and biological activities which changes the land use and capability. Drilling, blasting, dumping of waste rock and crushing of RoM, contamination and sedimentation might occur and the possible impact the remaining and adjacent soils and land. When stockpiles, spills and the overall infrastructure are not well maintained, the soil contamination plume might increase, increasing a much larger area than anticipated. Erosion may occur and result in sedimentation and changes to the adjacent land uses, such as wetlands downstream and adjacent to the project area. The area of chemical contamination dependent on the size of the spill and the permeability/infiltration rate of the soil. Contaminants transported by water into the soils can rapidly infiltrate into sandy soils which are dominant across the project area. If heavy vehicles and machinery are not confined to the permanent roads, widespread erosion may take place. Land capability and productivity will be lost within the Project Area.
Rehabilitation Phase	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation	• Soil compaction; • Soil erosion; • Sedimentation; and • Topsoil degradation.	Rehabilitation of the project area will entail backfilling, landscaping and reshaping, placing of topsoil, and revegetation. Even though rehabilitation of the area might have a positive result on the soil, land use and land capability (i.e., restoring soils, change the land capability from industrial back to wildlife, cattle grazing or arable land), several impacts might occur during the rehabilitation phase. During backfilling and placing of topsoil, soils might get compacted and eroded, losing effective rooting depth, water and root penetration, water holding capacity and soil fertility. The movement of heavy machinery on the soil surface could lead to compaction, which reduces

Project Phase	Project Activity	Impact	Description
	Post-closure monitoring and rehabilitation		the vegetation's ability to grow and as a result erosion. Soils might be lost due to erosion from unprotected surfaces. The loss of usable soil as a resource is a serious impact as the natural regeneration of a few millimetres of usable soil takes hundreds of years. Rehabilitation activities will cover the extent of the infrastructure footprint areas and will include ripping, spreading of overburden and topsoil and establishment of vegetation. The first phase of the rehabilitation plan (demolishing of infrastructure) might have a negative effect on the soil, land use and land capability, however, when rehabilitation of these areas commence, the soil, land use and land capability status will increase and have a positive effect. Ideally, the post-mining land capability should be Agriculture.

Table 17-26: Pre-Mitigation Impact Ratings

Pre-Mitigation Rating								
Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
Construction Phase	Site/vegetation clearance	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Contractor laydown yard		Beyond Project Life (6)	Local (3)	Serious Loss (5)	Almost Certain (6)	Negative	Moderate - 84
	Access and haul road construction		Beyond Project Life (6)	Local (3)	Serious Loss (5)	Almost Certain (6)	Negative	Moderate - 84
	Topsoil stockpiling		Permanent (7)	Local (3)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 96
Operational Phase	Open pit establishment	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Removal of rock (blasting)		Permanent (7)	Municipal Area (4)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 126
	Stockpiling (i.e., soils, and ROM) establishment and operation		Beyond Project Life (6)	Local (3)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 90
	Operation of the open pit workings		Beyond Project Life (6)	Municipal Area (4)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 96
Rehabilitation Phase	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation	• Soil compaction; • Soil erosion; • Sedimentation; and • Topsoil degradation.	Project Life (5)	Local (3)	Moderate loss (3)	Probable (4)	Negative	Minor -44
	Post-closure monitoring and rehabilitation		Medium Term (3)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -21

Table 17-27: Post-Mitigation Impact Ratings

Prior Mitigation Rating								
Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
Construction Phase	Site/vegetation clearance	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soils, however other impacts, such as contamination, compaction and erosion will be Minor. Impacts after mitigation on site and the adjacent areas include: • Erosion; • Sedimentation; • Compaction and increased runoff; and • Mixing of subsoil and topsoil (low rehabilitation success).	Permanent (7)	Municipal Area (4)	Irreplaceable Loss (6)	Definite (7)	Negative	Major - 119
Construction Phase	Contractor laydown yard	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soils, however other impacts, such as contamination, compaction and erosion will be Minor. Impacts after mitigation on site and the adjacent areas include: • Erosion; • Sedimentation; • Compaction and increased runoff; and • Mixing of subsoil and topsoil (low rehabilitation success).	Project Life (5)	Limited (2)	Serious Loss (4)	Likely (5)	Negative	Minor - 55
Construction Phase	Access and haul road construction	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soils, however other impacts, such as contamination, compaction and erosion will be Minor. Impacts after mitigation on site and the adjacent areas include: • Erosion; • Sedimentation; • Compaction and increased runoff; and • Mixing of subsoil and topsoil (low rehabilitation success).	Project Life (5)	Local (3)	Serious Loss (5)	Almost Certain (6)	Negative	Moderate - 84
Construction Phase	Topsoil stockpiling	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soils, however other impacts, such as contamination, compaction and erosion will be Minor. Impacts after mitigation on site and the adjacent areas include: • Erosion; • Sedimentation; • Compaction and increased runoff; and • Mixing of subsoil and topsoil (low rehabilitation success).	Permanent (7)	Limited (2)	Serious Loss (5)	Probable (4)	Negative	Minor - 56
Operational Phase	Open pit establishment	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soil and land capability, however other impacts, such as contamination and compaction will be Minor.	Permanent (7)	Municipal Area (4)	Irreplaceable Loss (6)	Definite (7)	Negative	Major - 119
Operational Phase	Removal of rock (blasting)	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soil and land capability, however other impacts, such as contamination and compaction will be Minor.	Permanent (7)	Local (3)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 96
Operational Phase	Stockpiling (i.e., soils, and ROM) establishment and operation	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soil and land capability, however other impacts, such as contamination and compaction will be Minor.	Project Life (5)	Limited (2)	Serious Loss (4)	Probable (4)	Negative	Minor - 44
Operational Phase	Operation of the open pit workings	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soil and land capability, however other impacts, such as contamination and compaction will be Minor.	Project Life (5)	Local (3)	Serious Loss (5)	Likely (5)	Negative	Minor - 65
Rehabilitation Phase	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation	Impacts from rehabilitation and monitoring are negligible when mitigation is followed. The impact that might however arise over time include: • Erosion when areas are not revegetated instantly; • Low rehabilitation success; • Decreased land capability; • Compaction; and • Spreading of AIPs.	Long Term (4)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -24
Rehabilitation Phase	Post-closure monitoring and rehabilitation	Impacts from rehabilitation and monitoring are negligible when mitigation is followed. The impact that might however arise over time include: • Erosion when areas are not revegetated instantly; • Low rehabilitation success; • Decreased land capability; • Compaction; and • Spreading of AIPs.	Short Term (2)	Very Limited (1)	Minimal to no loss (1)	Highly Unlikely (1)	Negative	Negligible -4

17.7. Hydropedology Assessment

The Hydropedology Assessment identified the following impacts:

- Loss of a water resource resulting from mining through pan thereby disrupting water flow paths;
- Sedimentation and siltation of watercourses due to increased soil erosion leading to reduced water quality;
- Alteration of channel geometry at crossings resulting in fluvial erosion and reduced flow regime;
- Alteration of channel geometry at crossings resulting in fluvial erosion and reduced flow regime; and
- Runoff and rainfall interception by the opencast pit will affect the availability of water resources for downstream water users.

The significance of these impacts is rated in the tables below.

17.7.1. Construction Phase Impacts

Mining through the pan will negatively affect water resources, the impacts are however negligible with mitigation (Table 17-28).

Table 17-28 Loss of water resource from mining through pan

Dimension	Rating	Motivation	Significance
Impact: Loss of a water resource resulting from mining through pan thereby disrupting water flow paths			
Duration	6	The impact will remain for some time after the life of the project.	90- Moderate (negative)
Intensity	6	Significant impact on highly values species, habitat or ecosystem.	
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.	
Post-mitigation			
Duration	6	The impact will remain for some time after the life of the project even if the mitigation measures are applied.	65- Minor (negative)
Intensity	4	Serious medium-term effects on biological or physical environment are expected if the proposed mitigation measures are implemented.	

Dimension	Rating	Motivation	Significance
Spatial scale	3	With proper management, the impact will extend to the immediate downstream of the site and nearby settlements.	
Probability	5	There is a possibility that the impact will occur.	

Increased soil erosion may result in sedimentation and siltation which may reduce water quality. This impact is rated moderate and will become negative with mitigation (Table 17-29).

Table 17-29 Sedimentation and siltation of watercourses

Dimensions	Rating	Motivation	Significance
Impact: Sedimentation and siltation of watercourses due to increased soil erosion leading to reduced water quality			
Duration	5	The impact will likely occur during construction and decommissioning phases.	-90 Moderate (Negative)
Intensity	5	The impact will have serious, long-term impact on the ecosystem.	
Spatial scale	5	The impacts will go beyond the specified project area.	
Probability	6	It highly possible that it will occur.	
Post-mitigation			
Duration	5	The impact will likely occur throughout the project's life.	18-Negligible (negative)
Intensity	2	The impacts will have minor effects on water resources.	
Spatial scale	2	The impacts will be limited to the project site.	
Probability	2	The possibility of the impact occurring will be reduced due to the implemented mitigation measures.	

The alteration of channel geometry at crossings will have negative implications but mitigation will yield minor impacts (Table 17-30).

Table 17-30 Alteration of channel geometry at crossings

Dimension	Rating	Motivation	Significance
Impact: Alteration of channel geometry at crossings resulting in fluvial erosion and reduced flow regime			
Duration	6	The impact will likely remain for some time after the life of the project.	98 - Moderate (negative)
Intensity	5	This may cause very serious, long-term impacts on the water quality and the ecosystem functionality for downstream users.	
Spatial scale	3	The impacts will be localized extending across the site and to downstream reaches.	
Probability	7	Certain/ Definite: There are sound scientific reasons to expect that the impact will definitely occur.	
Post-mitigation			
Duration	5	The impact will likely occur for the life of the project.	63-Minor (negative)
Intensity	2	With proper management the impact will have low intensity.	
Spatial scale	2	With proper management, the impact will be localized to sites where incidents occur.	
Probability	7	Certain/ Definite: There are sound scientific reasons to expect that the impact will definitely occur.	

17.7.2. Operational Phase Impacts

The opencast pit will potentially result in rainfall and rainfall interception. This impact is rated as minor before and after mitigation (Table 17-31).

Table 17-31 Runoff and rainfall interception by opencast pit

Dimensions	Rating	Motivation	Significance
Impact: Runoff and rainfall interception by the opencast pit will affect the availability of water resources for downstream water users			
Duration	5	Impacts will cease after the operational phase.	-84 Minor (Negative)
Intensity	4	Serious medium-term environmental effects. Environmental damage can be reversed in less than a year.	
Spatial scale	3	Impacts will be localised but will likely be felt downstream mostly.	
Probability	7	Certain/ Definite: There are sound scientific reasons to expect that the impact will definitely occur.	
Post-mitigation			
Duration	5	Impacts will occur during the project's life span.	-54 Minor (Negative)
Intensity	2	Limited impacts on the water resources and minimum damage to habitats.	
Spatial scale	2	The impacts will be restricted around the project site after the mitigation measures are implemented.	
Probability	6	Almost certain/Highly probable that the impact will occur.	

The reduction of water quantity due to the disruption of water flow paths (Table 17-32) cannot be mitigated. The management approach should however yield positive impacts on post-mining land use.

Table 17-32 Water quantity reduction due to disruption of water flow paths

Dimension	Rating	Motivation	Significance
Impact: Disruption of water flow paths will likely reduce the quantity of water reporting to the Steenkoolspruit thereby affecting the availability of water for downstream water users			
Duration	7	The impact will occur during the operation phase and even post-closure.	-105 Minor

Dimension	Rating	Motivation	Significance
Intensity	5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate.	(negative)
Spatial scale	3	The impact may extend across the site and to nearby settlements.	
Probability	7	It is likely that the impact will occur.	
Post Mitigation			
There are no mitigation measures to prevent this impact from occurring. With concurrent rehabilitation, the restoration of flows into the receiving waterbodies may be achieved, but the dominant flow paths will be permanently altered. The management approach to manage this impact is to ensure that the rehabilitation will benefit the planned post-mining land use as much as practically possible.			

The allowance for free drainage and increase in runoff yield is a highly probable impact with positive benefits on both the site and nearby communities (Table 17-33).

Table 17-33 Allowance for free drainage and increase in runoff yield

Dimension	Rating	Motivation	Significance
Impact: Allowance for free drainage and increase in runoff yield supporting desired post-mining land use			
Duration	7	Permanent benefits are anticipated once rehabilitation has been undertaken.	84 + Moderate (positive)
Intensity	4	The impacts may take some time to be evident but will be ongoing after the initial benefits of recharging are realized.	
Spatial scale	3	The extent of the benefits will be across the site and to nearby settlements.	
Probability	6	The impact is highly probable.	

17.7.3. Decommissioning and Closure Phase

Water quality may potentially be affected due to sedimentation and siltation. This impact is rated as moderate without mitigation but may become negative post mitigation.

Table 17-34 Sedimentation and siltation due to increased erosion

Dimensions	Rating	Motivation	Significance
Impact: Sedimentation and siltation of watercourses due to increased soil erosion leading to reduced water quality			
Duration	5	The impact will likely occur during construction and decommissioning phases.	-90 Moderate (Negative)
Intensity	5	The impact will have serious, long-term impact on the ecosystem.	
Spatial scale	5	The impacts will go beyond the specified project area.	
Probability	6	It highly possible that it will occur.	
Post-mitigation			
Duration	5	The impact will likely occur throughout the project's life.	18-Negligible (negative)
Intensity	2	The impacts will have minor effects on water resources.	
Spatial scale	2	The impacts will be limited to the project site.	
Probability	2	The possibility of the impact occurring will be reduced due to the implemented mitigation measures.	

Post-mining land use is likely to be positively influenced due to the allowance for free drainage and increase in runoff (Table 17-35).

Table 17-35 Allowance for free drainage and increase in runoff yield

Dimension	Rating	Motivation	Significance
Impact: Allowance for free drainage and increase in runoff yield supporting desired post-mining land use			
Duration	7	Permanent benefits are anticipated once rehabilitation has been undertaken.	84 + Moderate (positive)

Dimension	Rating	Motivation	Significance
Intensity	4	The impacts may take some time to be evident but will be ongoing after the initial benefits of recharging are realised.	
Spatial scale	3	The extent of the benefits will be across the site and to nearby settlements.	
Probability	6	The impact is highly probable.	

The significance of the decant of AMD on soil and water resources is moderate and maybe minor post mitigation (Table 17-36).

Table 17-36 Soil and water resource contamination

Dimensions	Rating	Motivation	Significance
Impact: Contamination of soil and water resources from potential decant of AMD and movement of contamination plume due to the re-watering of the backfilled pit			
Duration	7	The impact will potentially persist long after the project ceases.	-119 Major (Negative)
Intensity	6	The impact will have significant impacts on water resources and the environment.	
Spatial scale	4	The impacts will be felt around the mining area and immediate downstream of the project site.	
Probability	7	There is a high probability that this impact will take place.	
Post-Mitigation			
Duration	7	The impacts can occur long after mining operations have ceased and can persist for a few years.	-98 Minor (Negative)
Intensity	4	The impacts will have serious effects on the environment, however, with proper management the adverse effects will be relatively low.	
Spatial scale	3	Municipal Area: Will affect the whole municipal area.	
Probability	7	The impact will occur.	

17.8. Fauna and Flora Assessment

The impacts assessed for the fauna and flora environment generally have high significance, before and after mitigation. The tables below indicate that construction activities associated with the proposed project may result in the removal of vegetation which may cause loss of biodiversity and faunal habitat.

The Operational Phase impacts are also highly significant and include the maintenance of haul roads and the use of heavy machinery.

Some positive impacts are identified during the decommissioning phase, these include revegetation and profiling, as well as other mitigation such as monitoring and rehabilitation.

17.8.1. Construction Phase Impacts

The significance of the impacts of the construction phase on fauna and flora is largely major without mitigation. The mitigation measures stipulated below (Table 17-37) will therefore need to be implemented to ensure minimal impact on flora and fauna during the construction phase.

Table 17-37 Construction Phase Impacts on Fauna and Flora

Activity, and Interaction: Removal of vegetation / topsoil for establishment of open cast mining and linear infrastructure			
Impact Description: • Loss of plant communities and sensitive landscapes including floral SCC and pan vegetation; • Loss of biodiversity; • Increased erosion; • Potential for AIP proliferation; • Loss of faunal habitat including faunal SCC.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact of the vegetation clearance will occur during the life of the project, although reduced during the decommissioning phase.	Major (negative) - 133
Extent	3	Vegetation removal will occur within the pit areas , proposed roads and construction of bridge.	
Severity	6	Serious loss of the vegetation communities (including grassland and wetlands) limiting ecosystem functioning .	
Probability	7	Definite probability of vegetation clearing particularly in the pit areas, proposed roads and construction of bridge.	

Nature	Negative		
Mitigation measures			
• Keep site clearing to a minimal, and restrict vehicle movement to dedicated areas, outside of wetlands and ridges; • Keep site clearing and impacts within the MRA; • Alien plant management strategy should be implemented; • Make use of existing roads to encourage minimal impacts/footprint; • Avoid sensitive areas such as rocky outcrops and wetlands (See Sensitivity Map, Figure 9-52. The footprint of the mine should be as compact as possible from a design point of view; and • Adhere to 100 m protective buffers around pans.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will occur beyond project life, specifically during the construction, and operational phases.	Moderate (negative) - 77
Extent	3	Vegetation removal is limited only to the pit areas , proposed roads and construction of bridge.	
Intensity	3	Moderate loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	7	There is a definite probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
Activity, and Interaction: Stockpile and dumping of waste material			
Impact Description: • Heavy machinery utilised increasing vehicle movement in the area, increasing soil compaction, habitat disturbances and vegetation removal; • Natural vegetation will be removed, damaged and fragmented promoting edge effects and AIP proliferation; and • Increased soil compaction and erosion.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact of habitat fragmentation and loss of fauna and flora will occur during and after the life of the project.	Moderate (negative) - 105

Extent	4	This fragmentation will only occur within the impacted area and its near surroundings.	
Intensity	5	If not mitigated, once the resources have been lost from the landscape it can be difficult to recover and restore.	
Probability	7	Site clearance has to take place for construction of the various infrastructures which will encourage the fragmentation and loss of fauna and flora and AIP proliferation.	
Nature	Negative		
Mitigation measures			
• Restoration and rehabilitation of removed vegetation and SCC during rehab phase; • Construction must be kept within the infrastructure footprint area, to reduce fragmentation as much as possible; • No establishment of rubble piles; • Alien invasive plants should be continuously monitored and controlled throughout the life of the mine and thereafter; and • Corridors (infrastructure and ecological) set aside within the mine area would mitigate fragmentation substantially, especially if this could be managed with the community over an extended period of time.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact will occur during the life of the project.	Minor (negative) - 60
Extent	3	Loss of fauna and flora and habitat degradation is extending only as far as the development area.	
Intensity	3	Moderate loss, and/or effects to biological or physical resources or moderate sensitive environments, affecting ecosystem functioning.	
Probability	6	High probability that the impact will continue to occur.	
Nature	Negative		
Activity, and Interaction: Access and haul roads construction			

Impact Description: • Removal of vegetation and basal layer; • Increased proliferation of AIPs; • Adhere to health and safety protocols within the operations of the mine and adhere to speed limits to minimise faunal casualties; • Increased faunal casualties; and • Increased dust pollution.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact of haul roads will extend beyond the life of the project.	Moderate (negative) - 91
Extent	3	Loss of fauna and flora will only occur within the impacted area and its near surroundings.	
Intensity	4	If not mitigated serious loss will occur to the moderately sensitive environment.	
Probability	6	Site clearance has to take place for construction of the access and haul roads, so vegetation removal is inevitable.	
Nature	Negative		
Mitigation measures			
• Keep site clearing to a minimum; • 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; • Staff of the mine must adhere to policies within the operation of the mine, such as adhering to designated speed limits; • Restoration and rehabilitation of any removed vegetation and SCC should occur during the rehab phase; and • AIPs should be continuously monitored and controlled throughout the life of the mine and thereafter.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impacts will occur during the life of the project.	Minor (negative) - 54
Extent	3	Loss of fauna and flora is limited only to the footprint of the access and haul roads, exposed areas due to mitigation measures being implemented, such as limit vehicle movement, and restrict movement to specific sites.	

Intensity	3	Moderate loss, and/or effects to biological or physical resources or moderately sensitive environments, limiting ecosystem functioning.	
Probability	6	High probability that the impact will continue to occur.	
Nature	Negative		

17.8.2. Operational Phase Impacts

The operational phase will mostly have minor impacts on fauna and flora. The impacts of infrastructure (e.g. stockpile area) will however be major without mitigation (Table 17-38).

Table 17-38: Impacts associated with the Operational Phase

Activity, and Interaction: Infrastructure area containing stockpile areas			
Impacts: • Loss of habitat integrity and damage to surrounding ecosystem services (such as freshwater courses and wetlands); • Increased risk of dust pollution inundating surrounding undisturbed vegetation; • Rick of erosion of the stockpiles; • Risk of AIP proliferation; and • Loss of biodiversity and sensitive fauna and flora.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will occur during the life of the Project and will cease after the operational life span.	Minor (negative) - 72
Extent	3	Impacts will extend as far as the development site area	
Intensity	4	Serious environmental effects. These activities will result in modification of the landscape and loss of fauna and flora.	
Probability	6	There is a high probability.	
Nature	Negative		
Mitigation measures			
• Monitoring of alien invasive sprawl during the operation is recommended as the surrounding vegetation is relatively intact and free from alien invasive plants. • Monitor dust pollution. • Vegetate stockpiles to prevent soil loss, leachate, organic material loss, erosion, and sedimentation.			

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	Impacts can be reversed with adequate management	Minor (negative) -
Extent	3	Impact extending as far as the development site area.	
Intensity	2	Minor loss and damage to fauna and flora and habitats if mitigation measures are not adhered to.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		

Activity, and Interaction: Maintenance of haul roads, machinery, and stormwater management infrastructure and stockpile areas.
Impacts: • Removal of vegetation, habitats and increased soil erosion, soil contamination and compaction; • Removal of soil and vegetation, increased faunal casualties (roadkill); • Increased erosion and sedimentation decreasing vegetation cover; • Destruction of vegetation and habitat, dust pollution, and AIP proliferation; • Adhere to health and safety protocols within the operations of the mine and adhere to speed limits to minimise faunal casualties; • Increased vehicle movement in the area, increasing soil compaction, and runoff potential; and • Unexpected changes in the topography and overall habitats.

Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will occur during the life of the project and result in permanent changes to the landscape and habitats.	Moderate negative (-91)
Extent	3	Impacts will extend as far as the development site area.	
Intensity	4	Serious environmental effects. These activities will result in modification of the landscape and loss of fauna and flora.	
Probability	7	The probability is very high.	
Nature	Negative		

Mitigation measures			
• Monitoring of alien invasive sprawl during the operation is recommended as the surrounding vegetation is relatively intact and free from alien invasive plants. • Ensure no loss of faunal SCC by activating anti-poaching units that will be incorporated during the mine life cycle. • Monitor dust pollution. • Keep sight clearing to a minimal and restrict vehicle movement to dedicated areas outside of wetlands (pans). • Vegetate stockpiles to prevent soil loss, organic material loss, erosion, and sedimentation.			
Post-Mitigation			
Duration	4	The impact will occur on a long-term basis, specifically during the construction, and operational phases.	Minor negative (-40)
Extent	3	Removal of vegetation, soil stripping and stockpiling is limited only to current mine areas, provided that mitigation measures are implemented.	
Intensity	3	Moderate loss and damage to fauna and flora and habitats if mitigation measures are not adhered to.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
Activity, and Interaction: Removal of rock(blasting) and concurrent rehabilitation as mining progresses			
Impacts: • Removal of vegetation, habitats and increased soil erosion and compaction; • Destruction of and changes to the habitats; • Increased dust pollution due to erosion and vehicular activity; • Risk of AIP proliferation; • Habitat removal; • Increased faunal casualties; • Loss of habitat integrity and ecosystem services; and • Loss of biodiversity and sensitive fauna and flora.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**

Duration	5	The impact will occur during the life of the project and result in permanent changes to the landscape and habitats.	Minor Negative (- 84)
Extent	3	Impacts will extend as far as the development site area.	
Intensity	5	These activities will result in modification of the landscape and loss of fauna and flora.	
Probability	6	The probability is very high	
Nature	Negative		
Mitigation measures			
• Monitoring of AIP sprawl during the operation is recommended as the surrounding vegetation is relatively intact and free from AIPs'; • Ensure no loss of faunal SCC by activating anti-poaching units that will be incorporated during the mine life cycle; • Monitor dust pollution; • Keep sight clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans); • Explosives for the blasting must be stored in an approved tamper-proof explosive storage unit; and • Vegetate stockpiles to prevent soil loss, organic material loss, erosion and sedimentation.			
Post-Mitigation			
Duration	5	The impact will occur on a long-term basis, specifically during the construction, and operational phases.	Negligible Negative (- 30)
Extent	3	Removal of vegetation, soil stripping and stockpiling is limited only to current mine areas, provided that mitigation measures are implemented.	
Intensity	2	Moderate loss and damage to fauna and flora and habitats if mitigation measures are not adhered to.	
Probability	3	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
Activity, and Interaction: Use of hydrocarbons on site for vehicle use			

Impacts:

- Potential leaking or spillage of hydrocarbons form vehicle use in the project area; and
- Contamination of soil, water and surrounding areas / habitats (pan vegetation) from hydrocarbon waste/spills (lubricants, oil, explosives and fuels).

Prior Mitigation

Dimension	Rating	Motivation	Significance
Duration	3	The impact will occur during the life of the project, although reduced during the decommissioning phase	Minor Negative (- 60)
Extent	3	Contamination may occur in areas where high vehicle or machinery activities will take place.	
Intensity	4	Could be serious if leaks are detected in the sensitive water systems on site.	
Probability	6	The probability is very high.	
Nature	Negative		

Mitigation measures

- All spills should be immediately cleaned up, and treated accordingly; and
- Refueling must take place on a bunded surface area away from sensitive habitats such as the pan vegetation to prevent the ingress of hydrocarbons into the topsoil.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	5	The impact will occur on a long-term basis, specifically during the construction, and operational phases.	Negligible Negative (- 30)
Extent	3	Spillage and contamination is limited only to storage areas, provided that management measures are implemented	
Intensity	2	Short - term environmental effects due to prevention measures and rehabilitation.	
Probability	3	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		

17.8.3. Decommissioning Phase Impacts

The impacts of the decommissioning phase are rated as mostly minor without mitigation (Table 17-39) and negligible with mitigation.

Table 17-39: Impacts of the decommissioning phase

Activity and Interaction: Movement of vehicles and heavy machinery			
Impact Description: • Compaction of soil; • Potential faunal casualties; • Increased runoff potential; and • Increased erosion and decline in revegetation potential.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	3	Impacts can be managed during the decommissioning phase.	Minor (negative) - 55
Extent	3	Impacts will be localised within the operational pits and roads	
Intensity	4	Erosion and decline in vegetation due to increased runoff from compacted areas.	
Probability	5	Movement of vehicles and heavy mine machinery will result in soil compaction and possible faunal casualties.	
Nature	Negative		
Mitigation measures			
• Rehabilitate the compacted, eroded areas by deep ripping to loosen the soil and revegetate the area as soon as possible; • Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs; • Adhere to health and safety protocols within the operations of the mine and adhere to speed limits to minimise faunal casualties; and • Only designated access routes are to be used to reduce any unnecessary compaction.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact will occur on a small scale, specifically during rehabilitation and monitoring.	Negligible (negative) - 32
Extent	2	The impact is limited only to specific areas, provided that mitigation measures are implemented.	

Intensity	2	Minor loss, and/or effects to biological or physical resources not affecting ecosystem functioning.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
Activity, and Interaction: Demolition of infrastructure and preparation for rehabilitation of affected areas			
Impact Description: • Disturbance of soils, and subsequent erosion by wind and water; • Increased vehicle movement in the area, increasing soil erosion and habitat destruction; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the surrounding grounds; • AIP proliferation; and • Unexpected changes in topography and landscape.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impacts will remain for some time after the life of a Project.	Minor (negative) - 65
Extent	3	Impacts will be localised as far as the extent of the development.	
Intensity	4	Serious medium-term environmental effects.	
Probability	5	The impact may likely occur.	
Nature	Negative		
Mitigation measures			
• Continue with concurrent Rehabilitation, begin with stockpiles, bare grounds and dumps, implement rehabilitation measures; • Address eroded and compacted areas by deep ripping to loosen the soil, and revegetate the area as soon as possible to prevent AIP sprawl; • Inventory of hazardous waste materials stored on-site should be compiled and complete removal arranged; and • Only designated access routes are to be used to reduce any unnecessary compaction.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**

Duration	2	The impact will be less than a year if rehabilitation measures are implemented correctly.	Negligible (negative) - 24
Extent	2	The impact will be limited to the site due to the implementation of mitigation measures.	
Intensity	2	Minor effects on the biological or physical environment. Environmental damage can be rehabilitated internally with/ without the help of external consultants.	
Probability	4	The impact can occur.	
Nature	Negative		
Activity, and Interaction: Rehabilitation – re-vegetation and profiling of the land.			
Impact Description: • Exposure of soils, and subsequent compaction, erosion, and sedimentation; • Soil compaction, and increased runoff potential due to vehicle movement during rehabilitation programs; • AIP proliferation; • Loss of organic material, basal layer and vegetation cover; and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of soil.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impacts caused during the rehabilitation activities will have a long-lasting effect if not managed.	Minor negative (-56)
Extent	4	The impact could spread beyond the local development boundaries due to the ability of degraded landscape or alien invasive species impacting the area.	
Intensity	5	These impacts have serious implications to the revival of the disturbed areas.	
Probability	5	These are commonly observed impacts for the rehabilitation phase.	
Nature	Negative		
Mitigation measures			

• During the decommissioning phase, rehabilitation must start as soon as possible and preferably in the growing season (October to February) to ensure adequate plant recruitment; • Address eroded and 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 complete removal arranged; and • Only designated access routes are to be used to reduce any unnecessary compaction.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will be less than a year if rehabilitation measures are implemented correctly.	Positive Impact 66
Extent	3	The impact will be limited to the site due to the implementation of mitigation measures.	
Intensity	2	Minor effects on the biological or physical environment. Environmental damage can be rehabilitated internally with/ without the help of external consultants.	
Probability	6	The impact can occur.	
Nature	Positive		
Activity, and Interaction: Post-closure monitoring and rehabilitation			
Impact Description: • Minimal negative impacts on the environment; • Activities involve the rehabilitation processes of reprofiling the soils and re-vegetation thereafter; • Impacts include the possibility of erosion and sedimentation; • Proliferation of AIPs; and • Change in the habitat and species composition.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	7	The impact will be permanent.	Negligible (negative) 30
Extent	1	Limited to isolated sections of the Project Area.	
Intensity	4	Moderate loss, and/or effects to biological or physical resources or low sensitive environments, limiting ecosystem functioning.	

Probability	5	Likely: The impact may occur. <65% probability.	
Nature	Negative		
Mitigation measures			
• During the decommissioning phase, rehabilitation must start as soon as possible and preferably in the growing season (October to February) to ensure adequate plant recruitment; • Stockpiles, open pits and dumps are to be rehabilitated; • Ensure sufficient irrigation and fertilizing of newly planted vegetation to facilitate rapid establishment; and • Replant with species identified within each vegetation community.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Positive Impact 66
Extent	3	Local area will be affected.	
Intensity	2	Low positive impact.	
Probability	6	Almost certain with a high probability that the impact will occur.	
Nature	Positive		

17.9. Heritage Assessment

The heritage study identified new heritage resources in the project area, and these are assessed as culturally significant due to the changes that the proposed project may impose on the heritage environment.

17.9.1. Cultural Significance of the Identified Landscape

Impacts on burial sites or graves are assessed as highly culturally significant while impacts on the historical built environment are negligible, meaning that the impacts are acceptable with mitigation.

Table 17-40: Cultural Significance and Field Ratings of Newly Identified Heritage Resources within the Project Area

Map ID	Type	Description	Cultural Significance	Recommended Field Rating
BGG-001	Burial / grave	Burial ground including several graves identified by upright stones serving as headstones. The burial ground is not demarcated by a fence.	**Very High**	**Grade III A**
STE-001	Historical Built Environment	Remains of what appears to be a one-roomed structure with no internal divisions. The wall has a dog-legged corner. The wall is made of stone with cement / plaster in between the stones. The walls are in varying stages of collapse, from standing above head height to total collapse. The structure does not have a roof, doors, or windows. The structure is surrounded by a dense stand of trees. No debris, midden or material culture associated with the structure is visible.	**Negligible**	**General Protection IV C**

17.9.2. Construction and Operational Phase Impacts

A majority of the impacts assessed for the construction and operational phases of the project are major prior to mitigation. With the implementation of mitigation measures, positive impacts are anticipated, including the conservation of the cultural heritage environment (See Table 17-41 to Table 17-43).

Table 17-41: Impacts on Cultural Heritage with Very High Cultural Significance and a Grade III A Field Rating

Dimension	Rating	Motivation	Significance
Cultural Heritage - Very High Cultural Significance - Grade IIIA (BGG-001)			
Impact Description: Cultural heritage whose cultural significance is designated as very high are highly susceptible to changes that may result from any project-induces activities. This could range from loss of or restricted access, physical damage, or destruction, to the degradation of the cultural significance of the resource.			

Dimension	Rating	Motivation	Significance
Prior to Mitigation/Management			
Duration	7	Physical impacts on tangible cultural heritage resources are generally permanent as it affects the integrity of their fabric and cultural significance.	Major (negative) - 112
Extent	2	Physical impacts on tangible cultural heritage resources are generally limited to specific sites or aspects of cultural heritage. However, the rarity and cultural significance of every identified individual cultural heritage resource can extend the spatial impact up to international levels. Impacts on burial grounds pose specific risk for wider ranging social impacts.	
Intensity	7	Any impact on any cultural heritage with very high significance is irreparable.	
Probability	7	Without adequate mitigation impacts on cultural heritage are known to definitely occur.	
Nature	Negative		
Mitigation/Management Actions			
Project design must change to avoid all negative changes to identified tangible cultural heritage and ensure their continued in situ conservation.			
Where impacts cannot be avoided, mitigation *of* tangible cultural heritage will be required that may include relocation.			
Post-Mitigation			
Duration	7	Applying mitigation measures can generally maintain the cultural significance and integrity of cultural heritage resources.	Major (positive) 112
Extent	3	Applying mitigation measures ensures the continued conservation of the cultural significance of other similar cultural heritage resources within a more local context.	
Intensity	7	Conservation of cultural heritage provide noticeable and far-reaching benefits.	
Probability	6	Applying mitigation measures almost certainly ensures the continued conservation of cultural heritage.	

Dimension	Rating	Motivation	Significance
Nature	Positive		

Table 17-42: Construction Phase Impacts on Cultural Heritage with Negligible Cultural Significance and a Grade IV C Field Rating

Dimension	Rating	Motivation	Significance
Cultural Heritage - Negligible Cultural Significance - Grade IV C (STE-001)			
Impact Description: Changes to cultural heritage whose cultural significance are designated as negligible are usually also negligible.			
Prior to Mitigation/Management			
Duration	7	Cultural heritage can or will be destroyed.	Negligible (negative) -15
Extent	1	Impacts are limited to very specific, generally poorly preserved, and very common cultural heritage.	
Intensity	1	Impacts on cultural heritage with a negligible value are considered negligible.	
Probability	7	Impacts will definitely occur.	
Nature	Negative		
Mitigation/Management Actions			
Cultural heritage with negligible cultural significance is generally sufficiently recording during baseline surveys.			
Permitted processes to destroy such cultural heritage may be required.			
Post-Mitigation			
Duration	7	Destruction is permanent.	Negligible (negative) -10
Extent	1	Impacts are limited to very specific, generally poorly preserved, and very common cultural heritage.	
Intensity	1	Impacts on cultural heritage with a negligible value are considered negligible.	
Probability	2	Impacts following destruction of negligible cultural heritage is conceivable, but rarely occurs.	
Nature	Negative		

Table 17-43: Impacts on Cultural Heritage with Very High Cultural Significance and a Grade III A Field Rating

Dimension	Rating	Motivation	Significance
Cultural Heritage - Very High Cultural Significance - Grade IIIA (BGG-001)			
Impact Description: Cultural heritage whose cultural significance is designated as very high are highly susceptible to changes that may result from any project-induces activities. This could range from loss of or restricted access, physical damage, or destruction, to the degradation of the cultural significance of the resource.			
Prior to Mitigation/Management			
Duration	7	Physical impacts on tangible cultural heritage resources are generally permanent as it affects the integrity of their fabric and cultural significance.	Major (negative) - 112
Extent	2	Physical impacts on tangible cultural heritage resources are generally limited to specific sites or aspects of cultural heritage. However, the rarity and cultural significance of every identified individual cultural heritage resource can extend the spatial impact up to international levels. Impacts on burial grounds pose specific risk for wider ranging social impacts.	
Intensity	7	Any impact on any cultural heritage with very high significance is irreparable.	
Probability	7	Without adequate mitigation impacts on cultural heritage are known to definitely occur.	
Nature	Negative		
Mitigation/Management Actions			
Project design must change to avoid all negative changes to identified tangible cultural heritage and ensure their continued in situ conservation.			
Where impacts cannot be avoided, mitigation *of* tangible cultural heritage will be required that may include relocation.			
Post-Mitigation			
Duration	7	Applying mitigation measures can generally maintain the cultural	

Dimension	Rating	Motivation	Significance
		significance and integrity of cultural heritage resources.	Major (positive) 112
Extent	3	Applying mitigation measures ensures the continued conservation of the cultural significance of other similar cultural heritage resources within a more local context.	
Intensity	7	Conservation of cultural heritage provide noticeable and far-reaching benefits.	
Probability	6	Applying mitigation measures almost certainly ensures the continued conservation of cultural heritage.	
Nature	Positive		

17.9.3. Unplanned and Low Risk Events

The Heritage Assessment identified unplanned events and their associated impacts (Table 17-44). These include the discovery of heritage resources unidentified during the assessment. The heritage resources of the project area have a high Cultural Significance, making them inherently vulnerable to any development, mitigation therefore needs to contemplate responses to chance findings etc. The unplanned events and associated impacts are presented in Table 17-45 below.

Table 17-44: Identified Unplanned Events and Associated Impacts

Description	Primary Risk
Heritage resources with a high Cultural Significance rating are inherently sensitive to any development in so far that the continued survival of the resource could be threatened. In addition to this, certain heritage resources are formally protected thereby restricting various development activities.	Negative Record of Decision (RoD) and/or development restrictions issued by MPHRA and/or SAHRA in terms of Section 38(8) of the NHRA.
Impacting on heritage resources formally and generally protected by the NHRA without following due process. Due process may include social consultations and/or permit application processes to SAHRA and/or MPHRA.	• Fines; • Penalties; • Seizure of Equipment; • Compulsory Repair / Cease Work Orders; and • Imprisonment.

Description	Primary Risk
Proximity of mining activities to burial grounds and graves specifically in terms of the Mine Health and Safety Act and the SAHRA BGG Policy. The former regards graves as structures and prohibits blasting activities from taking place within 500 m of structures unless the owner thereof provides consent. The latter requires that 100 m buffer zone be maintained between graves and mining activities.	• Cease Work Orders; and • Compulsory grave relocation.

Table 17-45: Identified Unplanned Events and Associated Impacts

<table>
<tr><th>Unplanned event</th><th>Potential impact</th><th>Mitigation / Management / Monitoring</th></tr>
<tr><td>Encountering unidentified in situ remnants of historical built environment resources during the implementation of the Project.</td><td>Damage or destruction of heritage resources generally protected under Section 34 of the NHRA.</td><td rowspan="5">Establish Project-specific CFPs as a condition of authorisation.</td></tr>
<tr><td>Accidental exposure of fossil bearing material implementation of the Project.</td><td rowspan="2">Damage or destruction of heritage resources generally protected under Section 35 of the NHRA.</td></tr>
<tr><td>Accidental exposure of in situ archaeological material during the implementation of the Project.</td></tr>
<tr><td>Accidental exposure of in situ burial grounds or graves during the implementation of the Project.</td><td rowspan="2">Damage or destruction of heritage resources generally protected under Section 36 of the NHRA.</td></tr>
<tr><td>Accidental exposure of human remains during the decommissioning and rehabilitation and closure phases of the Project.</td></tr>
</table>

17.10. Air Quality

The Air Quality impacts of the construction, operational and decommissioning phases are depicted in the tables below:

Table 17-46: Construction Phase Air Quality Impacts

Activity and Interaction: Site Clearing, Construction of Haul Roads and Topsoil Stockpiling			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Reduction in ambient air quality			
Prior to mitigation/ management			
Duration	Short term (1)	Dust will be generated for the duration of each activity in the construction phase	Negligible (negative) – 20
Extent	Limited (2)	Limited to the project area and immediate surroundings.	
Intensity	Minor (2)	Minor implications on the surrounding air quality.	
Probability	Probable (4)	Probable that generated dust may impact ambient air quality.	
Nature	Negative		
Mitigation/ Management actions			
• Limit activity to non-windy days (wind speed less than 5.4 m/s); • The area of disturbance must be kept to a minimum at all times and no unnecessary clearing, digging or scraping must occur, especially on windy days; • Application of dust suppressant on the haul roads and exposed areas; • Set maximum speed limits on haul roads and have these limits enforced; • The drop heights when loading onto trucks and at tipping points should be minimised; and • Rehabilitation of disturbed land to allow for vegetation growth.			
Post- mitigation			
Duration	Short term (1)	Dust will be generated for the duration of each activity in the construction phase .	Negligible (negative) – 12
Extent	Very Limited (1)	After mitigation measures are implemented, It is expected that the dust generated will be limited to isolated parts of the site.	
Intensity	Minimal (1)	Generated dust will have negligible impacts on the ambient air quality after mitigation.	

Probability	Probable (4)	Probable that the impact on ambient air quality will occur.	
Nature	Negative		

Table 17-47: Operational Phase Air Quality Impacts

Activity and Interaction: Establishment of Open Pit, Removal of Rock, Stockpiling of Topsoil, Use of Haul Road and Operation of the Plant			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Dust generation and reduction in ambient air quality			
Prior to mitigation/ management			
Duration	Project life (5)	Dust will be generated for the project life.	Minor (negative) – 60
Extent	Local (3)	Airborne dust will extend the development site.	
Intensity	Very Serious (3)	Serious impact on ambient air quality.	
Probability	Almost certain (6)	It is almost certain that the impact will occur.	
Nature	Negative		
Mitigation/ Management actions			
• Limit activity to non-windy days (wind speed less than 5.4 m/s); • The area of disturbance must be kept to a minimum at all times and no unnecessary clearing, digging or scraping must occur, especially on windy days; • Application of dust suppressant on the haul roads and exposed areas; • Set maximum speed limits on haul roads and have these limits enforced; • The drop heights when loading onto trucks and at tipping points should be minimised; and • The enclosure of the screening and crushing circuit			
Post- mitigation			
Duration	Project life (5)	Dust will be generated for the project life.	Minor (negative) – 36
Extent	Limited (2)	Airborne dust will be limited to the project area and its immediate surrounding after mitigation.	
Intensity	Minor (2)	Minor impacts anticipated after mitigation.	
Probability	Probable (4)	Probable that impact will occur after mitigation.	
Nature	Negative		

Table 17-48: Decommissioning Phase Air Quality Impacts

Activity and Interaction: Demolition and Removal of Infrastructure and Rehabilitation			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Dust generation and reduction in ambient air quality			
Prior to mitigation/ management			
Duration	Medium-term (3)	Dust will be generated in the medium term for the duration of each activity in the decommissioning phase.	Negligible (negative) – 28
Extent	Limited (2)	Limited to the project area and immediate surroundings.	
Intensity	Minor (2)	Minor effect on surrounding air quality.	
Probability	Probable (4)	Probable that generated dust may impact ambient air quality.	
Nature	Negative		
Mitigation/ Management actions			
• Limit activity to non-windy days (wind speed less than 5.4 m/s); • The area of disturbance must be kept to a minimum at all times and no unnecessary clearing, digging or scraping must occur, especially on windy days; • Application of dust suppressant on the haul roads and exposed areas; • Set maximum speed limits on haul roads and have these limits enforced; • The drop heights when loading onto trucks and at tipping points should be minimised; and • Rehabilitation of disturbed land to allow for vegetation growth.			
Post- mitigation			
Duration	Medium-term (3)	Dust will be generated in the medium term for the duration of each activity in the decommissioning phase.	Negligible (negative) – 20
Extent	Very Limited (1)	After mitigation measures are implemented, It is expected that the dust generated will be limited to isolated parts of the site.	
Intensity	Minimal (1)	Generated dust will have minimal impacts on the ambient air quality after mitigation.	
Probability	Probable (4)	Probable that an impact on ambient air quality will occur.	
Nature	Negative		

17.11. Closure and Rehabilitation Assessment

A closure and rehabilitation assessment was not part of this project scope. A comprehensive Closure and Rehabilitation Plan will be developed to feed the operational and closure phase of the project.

17.12. Traffic Assessment

The intersection of D1651 & R547 currently operates at a worst-case Level of Service (LOS) A with an average delay of 9.1 seconds. With the implementation of the proposed diversion and the additional estimated 5-year traffic growth, this intersection will have a worst-case Level of Service of (LOS) A, with a longer average delay of 9.4 seconds. The intersection will still operate at acceptable conditions (good Levels of Service and Avg. Delays) and it can be concluded that this intersection will operate acceptably with a geometric layout as set out within **Appendix O**.

18. Summary of specialist reports

The specialist studies conducted in support of the EIA process are tabulated below. The EIA process evaluated impacts on wetlands, aquatics, groundwater, surface water, soils, land use and land capability, hydropedology, fauna and flora, heritage, air quality, closure and traffic as indicated in Table 18-1 below.

Table 18-1 Summary of Specialist Reports

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included
Wetland Assessment	• Monitoring of decanting and dewatering to assess changes and impacts to the systems; • Improved vegetation cover through the establishment of hydrophytic plants and facultative hydrophytes that are native to the area. Reduced risk of erosion and sedimentation; • Reduce the risk of erosion, compaction, and the creation of preferential flow paths by re-vegetating exposed areas, maintaining linear infrastructure and culverts and installing sediment traps and erosion berms; • Encourage natural diffuse flow through the wetland and reduce the occurrence of channelisation; • Reduced risk of erosion and sedimentation of downstream wetland areas by re-vegetation and sediment traps; • Employment of a protective vegetated buffer zone strip around the adjacent and downstream wetland in proximity of the project area and implement an AIPs Control Programme; • Fence off adjacent wetlands within the project area (depending on Option 1 or 2) and MRA from livestock to prevent overgrazing, trampling and erosion. This will lead to improved wetland integrity and functionality; • 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 Water Treatment Plant to get purified water for discharge to the natural environment or other beneficial uses (refer to Groundwater Impact Assessment, 2021); and • Implement a Wetland Offset Strategy to compensate for wetlands lost (like-for-like).	Refer to the EMPr in Section B and **Appendix E**
Aquatics Assessment	• The depth of the Steenkoolspruit presents challenges in sampling the instream habitat, therefore, whole effluent toxicity assessments should be undertaken to provide a better indication of the PES and determine the potential drivers of change; • Sites NC1 and NC4 should be excluded from the monitoring programme due to the distance from the proposed project location and existing associated impacts. These sites were sampled due to their ease of accessibility. Additional sites, upstream and downstream of the proposed project location should be sampled along the Steenkoolspruit to provide better representation of the biophysical integrity of the River; and • The developed Aquatic Biomonitoring Programme must be adopted on an annual basis after commencement of the Establishment Phase of the Project. This programme should continue for the life of the Project and for at least three years post the Decommissioning Phase.	Refer to the EMPr in Section B and **Appendix F**
Groundwater Assessment	• Delineations of existing mining areas should be confirmed before mining commences to avoid the creation of direct flow paths and significant inter-mine flows between existing underground voids and the proposed Middeldrift open pit; • Mine plans and schedules for the adjacent underground mines should be obtained to understand when the end of LoM will be for each operation, and when flooding of the voids will take place; • A numerical flow and contaminant transport model should be developed for region, including historic, current, and planned mining activities. This consolidated model can then be used as a management tool to assess and quantify the regional impacts;	Refer to EMPr in Section B and **Appendix G**

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included
	• A feasibility study for a pit lake/final void or constructed decant point is recommended to assess the impact and costs of such mitigation measures. This study should be based on a post-closure landform design. This could reduce the post-closure impacts, as well as the required volume of water to be treated post-closure. • Kinetic leaching tests and geochemical modelling should be performed on coal and backfill material to obtain trends and variability in leachate and decant quality over time, as only static leach tests were used as input for post-closure seepage quality in this assessment; • The numerical groundwater model should be updated and re-calibrated every two years to reflect the operational and post-rehabilitation conditions and most recent groundwater levels; it should also be updated as new hydrogeological or geochemical information becomes available, or when there are significant changes made to the mine schedule; • Decant volumes should be re-calculated every two years using numerical models and spreadsheet calculations, and should be based on the rehabilitation design of the open pit; • Recharge estimates to the backfilled pit should be updated once when backfilling is complete, based on the actual characteristics of the backfill and capping to improve the accuracy of the decant volumes and time-to-decant; • A mine water decant action plan should be developed to address the impacts associated with decant, seepage and base flow salt loads for the operational and post-closure impacts; • A surface water blending model should be conducted to assess the risk associated with the salt load contribution to the base flow; • The groundwater monitoring network should be updated based on the existing and proposed monitoring positions as per this report; and • A monitoring database should be established that contains all historic and future groundwater monitoring data.	
Surface water Assessment	• Clearing of vegetation must be limited to the development footprint, and the use of any existing access roads must be prioritised so as to minimise creation of new ones; • 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; • 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 potential leakages or spills; • Vehicles should regularly be maintained as per the mine's maintenance program they must be inspected daily before use to ensure there are no leakages underneath; • Drip trays must be used to capture any oil leakages. Servicing of vehicles and machinery should be undertaken at designated hard park areas at the existing mining operations. Any used oil should be disposed of by accredited contractors; • Implementation of the proposed stormwater management plan is recommended to reduce siltation and sedimentation in watercourses; • All operational vehicles should be maintained and washed at designated wash bays of the existing NCC operations; • All mine waste should be handled and disposed of by an accredited vendor; • The proposed water quality monitoring program should be consistently implemented to ensure adherence to stipulated water quality standards. This will enable early detection and management of any water quality problems arising as a result of mining operations and associated activities; • The water requirements and demands should be clearly stated and regularly reviewed through water balance updates to ensure water uses and losses are accounted for; • Soil disturbances during decommissioning should be restricted to the relevant footprint area;	Refer to EMPr in Section B and **Appendix H**

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included
	• All decommissioning debris must be cleared as soon as practically possible, and it is recommended that demolition of infrastructure be conducted during the dry season to minimise chances of soil erosion to watercourses; • Movement of heavy vehicles and machinery must be restricted to existing roads to avoid further disturbance of landscapes thus minimising soil erosion; • In the event of decanting, passive treatment should be applied to neutralise and treat the AMD before being discharged back into freshwater resources. If passive treatment fails, active treatment by a conventional Water Treatment Plant should be considered; and • Backfilled, top-soiled areas should be re-profiled and revegetated to allow free drainage that supports desired post-mining land use.	
Soils, Land Use and Land Capability	• Improved vegetation cover native to the area; • Remove AIPs; • Reduced risk of erosion and sedimentation through vegetation and installation of silt traps; • Reduce the risk of erosion, compaction, and the creation of preferential flow paths by re-vegetating exposed areas, maintaining linear infrastructure and culverts and installing sediment traps and erosion berms; • Rehabilitated areas must be fenced, and animals should be kept off the area until the vegetation is self-sustaining; • Runoff must be controlled and managed using proper stormwater management measures. • Restriction of vehicle movement over sensitive areas to reduce compaction; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Deep rip compacted areas, cover with at least 1000 mm of topsoil and revegetate. • If soil is polluted, treat the soil using in-situ bioremediation; • If in-situ treatment is not possible then the polluted soil must be classified according to the minimum requirements for the handling, classification, and disposal of hazardous material, and disposed at an appropriate, permitted, or licensed disposal facility; • All vehicles and machines must be parked within hard park areas, and must be checked daily for fluid leaks; • Refueling must take place on a sealed surface area away from soils to prevent seepage of hydrocarbons into the soil; • Place drip trays where vehicles or machinery leaks are occurring; • Fuel, grease, and oil spills should be remediated using commercially available emergency clean up kits; • Any contractors on site must ensure that all employees are aware of the procedure for dealing with spills, and leaks, and undergo training on-site; • Soil pollution monitoring after spills should be conducted at selected locations on the project site to detect any extreme levels of pollutants. • Fence off rehabilitated areas from livestock until vegetation has been established. Follow a grazing plan to prevent overgrazing, trampling and erosion. This will lead to improved soil fertility land capability; and • Soil/Land Offset should form part of the biodiversity (wetland) Offset plan that will have to be developed and implemented after the residual impacts have been determined.	Refer to EMPr in Section B and **Appendix G**
Hydropedology Assessment	• DWS approval/exemption needs to be applied for to enable permissible mining and clearing of the pan in accordance with GN R704; • 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; • Minimise disturbance of river channel geometry during installation of the culvert/bridge. Re-profile and stabilise any disturbed soils when the culvert/bridge is constructed;	Refer to EMPr in Section B and **Appendix H**

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included
	• Installation of the proposed stormwater management plan is recommended to reduce sedimentation and siltation in nearby watercourses. The recommended perimeter berm around the Middeldrift Opencast Pit will also ensure that clean water is diverted from the dirty opencast pit; • Practice concurrent rehabilitation, as proposed, reduce the size of the opencast pit that intercepts rainfall and runoff at any time during the course of the mining process; • Re-profile the topography after backfilling to a slope gradient and angle that supports post-mining land use; • Soil disturbances during demolition should be restricted to the relevant footprint area; • All decommissioning activities should be undertaken in a way to minimise disturbance of soils which will lead to erosion, sedimentation and siltation of the Steenkoolspruit; • In the event of decanting, passive treatment (through application of calcium compounds) should be applied to neutralise and treat the AMD before being discharged back into freshwater resources; • Ongoing water quality monitoring of surface and groundwater monitoring is imperative during the life of mine to allow for early detection of potential contaminants that may cause unforeseen negative impacts on the receiving environment; • Use of constructed wetlands can also be considered as a mitigation measure against AMD; and • Alternatively, when passive treatment fails to correct the situation, active Water Treatment (e.g. Reverse Osmosis) should be considered.	
Fauna and Flora Assessment	• All identified faunal SCC must be located and relocated, if possible, before the construction phase; • All floral SCC must be identified and located. Protected Plant Permits from local governing authorities (Department of Environment Forestry and Fisheries) will be required for either the destruction or removal of protected flora (MNCA, 1998); • Regional relocation of protected species within development footprint must be instilled to offset the overall loss of floral SCC within the project area. As recommended in Section 10, replanting of indigenous flora during the rehabilitation phase as a means to re-vegetate the area after decommissioning the mining activities; • Restriction of vehicle movement over sensitive areas to reduce degradation of undisturbed areas; • Minimise unnecessary removal of the natural vegetation cover outside the development footprint; and • After rehabilitation, the area must be fenced, and animals (cattle) should be kept off the area until the vegetation is self-sustaining and established.	Refer to EMPr in Section B and **Appendix K**
Heritage Assessment	• A Chance Finds Protocol (CFP) be drafted and implemented as part of the EMPr; • The structure STE-001 may be subject to permitting to demolish the site if it near or older than 60 years at the time. This requirement must be verified prior to demolition; and • The burial ground BGG-001 must be monitored to determine if any proposed mining activities affect the site and whether the proximity of the site affects the operations of the NCC.	Refer to EMPr in Section B and **Appendix L**
Air Quality Assessment	• Revamp the dustfall monitoring network to include additional five dust monitoring locations for the LoM; • Designate a qualified person to act as the Environmental Officer to oversee implementation of mitigation measures and assess the efficiency of such measures regularly; • Ensure air quality information is incorporated into the environmental management information system and submit annual reports to the South African Atmospheric Emission Licensing & Inventory Portal (SAAELIP), as required by law;	Refer to EMPr in Section B of this report and **Appendix M**

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included
	• Establish codes of practice for good housekeeping concerning dust management and mitigation, including regular appropriate restrictions on vehicle movements and speeds; • Use of mitigation equipment at the coal handling and processing plant; and • Monitor the air quality management measures and information to ensure that adopted mitigation measures are sufficient to achieve current air quality standards at the project area and nearby receptors.	
Closure Assessment	• Consider the high-level conceptual model for the project and continually update the geohydrological and geochemical models based on monitoring results to confirm the expected water quantities and qualities post closure; • Develop a post mining landform design for the open pit to optimise the mass earthworks to ensure backfilling is done to design elevations; • Ensure the preferential materials handling is followed during backfilling operations, placing potentially reactive spoil material in the deepest portions of the pit prior to backfilling with inert overburden, where feasible; • Include clean-up of contaminated sediment such as coal veneers and hydrocarbons, as/if found to be required; • Confirm the post-mining land capability targets to be met over the rehabilitated open pit; and • The financial provision needs to be updated on an annual basis as a requirement of the Financial Provisioning Regulations, 2015 (as amended). This will ensure that all costs become more accurate over time and will reflect prevailing market conditions.	Refer to EMPr in Section B and **Appendix N**
Traffic Assessment	• The road is to be surfaced (dust free) and must have road signage complying with the most recent standards of the SARTSM (South African Road Traffic Signs Manual); and • Regarding non-motorised and public transport, no pedestrian walkways are proposed along the D1651. An internal public transport drop-off and pick-up zone is proposed for the expanded mining development.	Refer to **Appendix O**

19. Environmental Impact Statement

This section summarizes key findings of the EIA Process. A comprehensive assessment is found in Section 17 above.

19.1. Summary of the key findings of the environmental impact assessment

The environmental impact assessment indicates that the proposed project site is highly sensitive, with significant impacts on the wetland, groundwater and surface water environments. The findings of the impact assessment are summarised as follows:

- **Wetlands:** High biodiversity sensitivity, major impacts are expected on the wetland environment.
- **Aquatics:** The road construction will have minor impacts while major impacts are anticipated for the bridge construction, this is prior and post mitigation.
- **Groundwater:** Impacts on groundwater resources during the construction and operational phases are minor before and after mitigation. Major impacts associated with Acid Mine Drainage (AMD) are anticipated during closure.
- **Surface water:** Impacts on the surface water environment are major throughout all phases of the project**.** These impacts are however acceptable with mitigation.
- **Soils, Land Use and Land Capability:** The project site has high soil sensitivity, major impacts are therefore identified prior and post mitigation. These are associated with the clearance of vegetation, the road construction and open pit mining.
- **Hydropedology:** Major impacts anticipated throughout all stages of the project. The impacts are assessed as minor with mitigation.
- **Fauna and Flora:** Impacts are largely major prior to mitigation and are anticipated to be minor or negligible with mitigation.
- **Heritage:** Heritage environment is highly sensitive, but some positive impacts are anticipated with mitigation.
- **Air Quality**: The impacts are minor and can be mitigated to acceptable levels.

Most of the above impacts are major prior to mitigation but are anticipated to be minor or negligent with the application of mitigation measures. All recommendations from the specialists need to be contemplated and requirements of the EMPr must be strictly adhered to.

19.2. Final Site Map

The final site is indicated in Figure 3-1 and Figure 4-1 above.

19.3. Summary of the positive and negative implications and risks of the proposed activity and identified alternatives

The positive and negative impacts associated with the proposed project are indicated in Section 19.3 and Table 12-1 above.

20. Impact management objectives and outcomes

The impact management objectives and outcomes for the project include:

- Understanding the baseline conditions of the proposed site environment;
- Identification of potential environmental impacts;
- Identification of the project's cumulative impacts and influence on surrounding mining areas;
- The avoidance of these impact. When it is not possible to avoid an impact, the next step is to minimise the impact and thereafter rectify or reduce the impact. When it is not possible to rectify or reduce the impact, offsets need to be implemented;
- The development of appropriate mitigation measures in response to impact reduction, minimisation or avoidance;
- Inclusion of affected and interested communities in decision-making;
- Consideration of socio-economic benefits of the project;

21. Final proposed alternatives

At this phase of the assessment process, only operational alternatives are known. These are mentioned in Section 7.1.5 above. The alternatives are guided by the approval of the road diversion, which may either elongate or shorten the planned LoM (See Figure 7-1 and Figure 7-2).

22. Aspects for inclusion as conditions of authorisation

The conditions of authorisation should include:

- Adherence to the EMPr in Part B of this report;
- The development and implementation of a wetland offset strategy;
- The relocation of significant fauna and flora for conservation;
- Rehabilitation and stringent decant monitoring to protect groundwater during closure;
- Internal auditing of environmental performance; and
- External auditing of environmental performance.

23. Description of any assumptions, uncertainties and gaps in knowledge

The following assumptions and uncertainties were made:

- No final alternatives were contemplated, the impact assessment is therefore limited to the scope defined at the time of assessment;
- No alternatives were established for the road diversion, the most feasible route alternative could therefore not be determined;
- It was assumed that no infrastructure will be constructed on the Middeldrift site except the proposed opencast pit and that the infrastructure at the existing NCC mine will be utilised for all other mining processes;
- The cultural heritage assessment considered accurate, but may not include new data or information which may not have been made available to the public;
- The CCA has been undertaken for the LoM situation only (i.e. for scheduled closure in 2038, as per Option 2) since the immediate closure costs are currently not applicable due to the greenfields nature of the project;
- With regard to wetlands, some discrepancies within the buffer zone may occur such as the confidence level of delineations and wetland health assessments. These systems were scrutinised at a desktop level using aerial imagery; and
- Some discrepancies with the soil delineations may occur due to changing impacts on the land; for example, intensive vegetation clearing, sedimentation, water extraction, damming, excavations, stockpiling and cultivation.

24. Reasoned opinion as to whether the proposed activity should or should not be authorised

The proposed project should be authorised since the environmental impacts associated with the project can be mitigated to reduce adverse impacts on the environment. The project also has socio-economic benefits, including:

- The extension of the life of the existing operation which has created long-term employment opportunities and generates revenue for local and national economies.

Should the project not be authorised:

- The socio-economic potential of NCC will be limited;
- The potential to improve on environmental performance will be limited;
- NCC will not be able to influence the national economy; and
- NCC's contractual obligations to Eskom may be affected.

25. Reasons why the activity should be authorised or not

25.1. General Conditions

- All EMPr requirements must be implemented;
- All legislative requirements must be adhered to; and
- The NCC's environmental performance must be audited.

25.2. Specific conditions to be included into the compilation and approval of EMPr

The following conditions need to be included in the EMPr:

- Noise levels should be reduced at all times;
- The cultural heritage of the project area should be conserved and protected;
- Ground and surface water monitoring should be continuously conducted;
- Re-vegetation must be implemented as much as possible were required;
- Delineations of existing mining areas should be confirmed before mining commences to avoid the creation of direct flow paths and significant inter-mine flows between existing underground voids and the proposed Middeldrift open pit;
- Mine plans and schedules for the adjacent underground mines should be obtained to understand when the end of LoM will be for each operation, and when flooding of the voids will take place; and
- Decant volumes should be re-calculated every two years using numerical models and spreadsheet calculations, and should be based on the rehabilitation design of the open pit.

25.3. Rehabilitation requirements

The affected environment must be rehabilitated to a state that is conducive for plant growth, grazing and resumption of ecological function.

26. Period for which the environmental authorisation is required

The planned operational life of the mine is estimated to be at least 17 years depending on the outcome of the road diversion application.

27. Undertaking

It is confirmed that the undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the EIA Report and the EMPr.

28. Financial provision

The closure cost estimation for Middeldrift at LoM (i.e. for scheduled closure) amounts to **R 120,902,160.00** (excl. VAT and including P&Gs and Contingencies at 12% and 10%, respectively). A summary is provided in Table 28-1 below. A full closure cost is attached in **Appendix K.**

Table 28-1: Closure Cost Summary

DIGBY WELLS ENVIRONMENTAL	Digby Wells Environmental Universal Coal Development IV (Pty) Ltd, Middeldrift Project, UCD6587 Revision: 0	
Area and Description **Infrastructure demolition**	**Current disturbance 2021**	**Life of Mine 2038**
Area 1: Middeldrift	R0	R0
Sub-total	**R0**	**R0**
Rehabilitation		
Area 1: Middeldrift	R0	R97,846,410
Sub-total	**R0**	**R97,846,410**
Monitoring and Maintenance		
Groundwater and Surface water	R0	R1,086,011
Vegetation Monitoring	R0	R20,697
Vegetation Maintenance	R0	R422,833
Sub-total	**R0**	**R1,529,541**
Preliminary and General (12%)	R0	R11,741,569
Contingency (10%)	R0	R9,784,641
GRAND TOTAL	**R0**	**R120,902,160**

28.1. Explain how the aforesaid amount was derived

A complete costing sheet is attached in **Appendix N**.

28.2. Confirm that this amount can be provided for from operating expenditure

The costing review and update was conducted as follows:

- Conduct a GIS based analysis to assess the volume of backfill material required for the final void at closure, assuming Option 2 as the go-ahead option (source file: DEM_Bottom_Seam_clip_cape27.prj);
- Input the outputs from the above work into the closure cost model;
- Develop closure measures for backfill and rehabilitation of the open pit (for Option 2);
- Assign third-party contractor rates (sourced from the Digby Wells unit rates data base) to the allocated closure measures applied; and
- Compile a succinct closure costing report (this report) describing the project outcomes.

29. Deviations from the approved scoping report and plan of study

There were no deviations from the approved scoping report and plan of study.

30. Specific Information required by the competent Authority

30.1. Impacts on the socio-economic conditions of any directly affected person

The socio-economic impacts of the proposed project include long-term to short job creation, skills development and training.

30.2. Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act.

The heritage environment is described in Section 9.12. The HIA is presented in Section 17.9 (See **Appendix K** for full report).

31. Other matters required in terms of sections 24(4)(a) and (b) of the Act

This section requires proof of compliance with section 24(4)(b)(i) of the NEMA, which section reads as follows:

"24. Environmental authorisations

(4) Procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment -

(b) must include, with respect to every application for an environmental authorisation and where applicable-

(i) investigation of the potential consequences or impacts of the alternatives to the activity on the environment and assessment of the significance of those potential consequences or impacts, including the option of not implementing the activity;"

Part B: Environmental Management Programme Report

32. Details of the EAP

Refer to Section 1.2 above. Please find attached EAP CV in **Appendix A**

33. Description of the aspects of the activity

The project scope is defined in Section 4, Section 6 and Section 7.

34. Composite Map

Please refer to Figure 3-1.

35. Description of Impact management objectives including management statements

35.1. Determination of closure objectives

The baseline conditions of the project area were considered in the formulation of the closure objectives (Refer to **Appendix K**).

35.2. Process for managing any environmental damage, pollution, pumping and treatment of extraneous or ecological degradation as a result of a listed activity

NCC will implement the mitigation measures prescribed in this section and consider all recommendations from the EAP and the specialist studies. NCC will also adhere to the conditions of the environmental authorisation. Other management processes will include:

- Monitoring and reporting;
- Implementing dust suppression measures;
- Recycling, reducing and re-using waste;
- Limiting impact to the development footprint;
- Ensuring that rehabilitated areas are free draining; and
- Adhering to management plans developed for specific environmental features, .i.e., plant management plan.

35.3. Potential risk of Acid Mine Drainage

The geochemistry results presented in Section 9.6 above indicate that the minerology of the project site is non-acid forming.

Surrounding river systems can however act as potential pathways for contamination, especially when decant or contaminated seepage occur. The closest river system is the Steenkoolspruit system. When decanting occurs from the proposed operations, the contaminated water may enter the streams, where the contaminants are transported to downstream receptors.

Seepage emanating from the open pit and decant areas, may impact on the perched aquifer and migrate towards surface drainage features. Surface water groundwater water interaction is likely to occur, with the streams and river generally acting as gaining streams.

The Steenkoolspruit could potentially be affected by seepage and decant from the proposed Middeldrift open pit.

Mitigation measures are documented in 35.8.1 below.

35.4. Steps taken to investigate, assess and evaluate the impact of acid mine drainage

Please refer to the Geochemistry Assessment in Section 9.6 above.

35.5. Engineering or mine design solutions to be implemented to avoid or remedy acid mine drainage

No specific engineering or mine design solutions have been contemplated. All reasonable measures to avoid seepage and drainage have been contemplated in this EMPr.

35.6. Measures that will be put in place to remedy any residual or cumulative impact that may result from acid mine drainage

See Table 35-1 below.

35.7. Volumes and rate of water use required for the operation

A water balance has been developed for the proposed project (See Section 9.7.6 and **Appendix F**). The annual average water balance indicates a total inflow volume into the Middeldrift Opencast pit of 910 267 m^3/annum emanating from rainfall, runoff and groundwater ingress. A dewatering volume of 58 560 m^3/annum is pumped to Pollution Control Dam 2 (PCD2) situated at the existing NCC operations, while 88 000 m^3/annum is used for dust suppression. There are no water storages that happen at the Middeldrift Resources opencast pit site.

35.8. Has a water use licence has been applied for

An IWULA has been lodged with the DWS.

35.8.1. Impacts to be mitigated in their respective phases

The impacts to be mitigated are presented in Table 35-1 below. These impacts are to be mitigated according to national and international best practice principles, guidelines and standards.

Table 35-1: Impacts to be mitigated in their respective phases

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
Wetlands					
• Site/vegetation clearance • Contractor laydown yard • Access and haul road construction • Topsoil stockpiling	• Direct loss of 224.35 ha wetlands; • Loss of habitat and biodiversity; • Erosions and sedimentation of adjacent wetlands and water courses; • Water quality contamination and deterioration; • Increased runoff from hardened surfaces; • Increased or decreased water supply to the wetlands systems; and • Change in habitat and potential change in species composition.	• Construction	• Control. if the destruction of wetlands is unavoidable disturbance must be minimised and suitably rehabilitated; • Control. 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; • Control. Environmental Practitioner and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; • Control and Remedy. Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction. • Control and Remedy. Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • Control and Remedy. If spills have occurred, it should be cleaned up immediately; • Control and Remedy. RoM must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; and • Control and Remedy. RoM stockpiles must be located outside wetlands and at least a 100 m Zone of Regulation.	• Concurrent rehabilitation through the LoM.	• Life of Construction Phase.
• Open pit establishment • Removal of rock (blasting) • Stockpiling (i.e., soils) establishment and operation • Operation of the open pit workings	• Impacts to downstream and adjacent wetlands and watercourses; • Loss of habitat and biodiversity; • Erosions and sedimentation; • Water and soil quality contamination and deterioration;	• Operational	• Freshwater resource adjacent and downstream of the project area monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact (e.g., dewatering, contamination and erosion) to the freshwater resources present, and if so that a remedy is put in place as soon as possible; • Remedy. If it is unavoidable that any of the wetlands adjacent and downstream will be affected, the disturbance must be minimised and suitably rehabilitated;	• Concurrent rehabilitation through the LoM.	• Life of Operational Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
	• Increased runoff and flow from hardened surfaces; • Increased or decreased water supply; • Dewatering of wetland adjacent and downstream to the project area; and • Change in habitat and potential change in species composition.		• Control. All vehicle maintenance must occur within designated areas; • Control. All vehicles must be regularly inspected for leaks; • Control and Remedy. All spills must be cleaned up immediately to prevent contaminants to enter the wetlands; • Control. Refueling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil; • Control and Stop. All areas of increased ecological sensitivity adjacent of the Project Area should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel; • Control and Stop. No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines; • Control and Remedy. Culverts, roads and river crossings must be maintained, cleared and monitored; • Control and Stop. No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their Zone of Regulation areas. All vehicles must remain on demarcated roads and within the operational footprint; • Control and Remedy. Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • Control and Remedy. Stockpiles must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; • Control and Stop. Stockpiles must be located outside wetlands and at least a 100 m Zone of Regulation; • Control and Remedy. A SWMP should already be implemented. This should consider all wetlands and other watercourses adjacent and downstream of 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		

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
			traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Control and Remedy. 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; • Control and Remedy. 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 • Control and Stop. 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.		
• Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation • Post-closure monitoring and rehabilitation	• Impacts to downstream and adjacent wetlands and watercourses: • Erosions and sedimentation; • Increased AIPs; and • Change in habitat and potential change in species composition	• Rehabilitation Phase	• Control and Stop. Rehabilitation should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands; • Control and Remedy. Stormwater must be diverted from or equally spread over newly rehabilitated areas; • Control and Stop. No stored mine-affected water should be reintroduced into the environment without cleaning and an IWUL; • Modify, Control and Remedy. Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material, and sedimentation into wetland areas; • Modify, Control and Remedy. Implement and maintain a Wetland and AIPs Management Plan for the duration of the rehabilitation phase and into closure; • Control and Stop. No material should be dumped/stockpiled within any wetlands or watercourses; • Control and Stop. No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their Zone of Regulation areas. All vehicles must remain on demarcated roads; • Control and Remedy. Wetland monitoring must be carried out during the Rehabilitation phase into mine closure to ensure no unnecessary impact to wetlands takes place;	• Concurrent rehabilitation through the LoM and after mine.	• Life of Rehabilitation Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
			• Modify, Control and Remedy. Rehabilitation must be done as soon as any impacts are observed; • Modify. 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, 2021); • Modify, Control and Remedy. Newly shaped and topsoiled areas must be revegetated as soon as possible to prevent sedimentation and erosion; and • Modify, Control and Remedy. Implement a Wetland Offset Strategy to compensate for the wetlands lost.		
Aquatics					
• Site clearing; • Access and haul road construction; • Construction of a bridge; • Topsoil stockpiling; and • Loading, transport, tipping and spreading of materials.	• Siltation of water resources due to increased turbidity from dust and soil erosion; and • Water contamination due to leaks or spills of hazardous and hydrocarbon containing material.	• Construction	• 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; • 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; • 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 potential 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; • 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; and • Implementation of the proposed stormwater management plan including installation of drains, berms and storage structures.	• Modify through construction site planning; and • Control through stormwater management and sediment containment infrastructure.	• Life of Construction Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
• Stockpiling; • Movement of vehicles and mine machinery; and • Storage, handling and treatment of hazardous products (including fuel and oil) and waste	• Siltation of water resources due to increased turbidity from dust and soil erosion; and • Water contamination due to leaks or spills of hazardous and hydrocarbon containing material.	• Operational	• The aquatic biomonitoring programme 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 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 management system (including the maintenance of berms 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). 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.	• *Control* through Implementation of the proposed stormwater management plan.	• Life of Operational Phase.
• Backfilling of the pit; • Rehabilitation and closure.	• Siltation of water resources due to increased turbidity from soil erosion; and • Restoration of the pre-mining streamflow regime .	• Decommissioning	• 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; • Clearing of vegetation should be limited to the decommissioning footprint area and immediate revegetation of cleared areas; • Decommissioning 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 machinery and vehicles should be restricted to designated access roads to minimise the extent of soil disturbance; • Use of accredited contractors for removal of infrastructure during decommissioning is recommended; this will reduce the risk of waste generation and accidental spillages; and	• Storm water management: prevent contamination of receiving waterbodies by controlling storm water/surface runoff and strategic decommissioning to minimise on potential environmental impacts.	• Life of Decommissioning Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
			• The groundwater levels should be considered during excavations to minimise potential impact of groundwater quality.		
Groundwater					
• Fuel storage, construction vehicles causing potential groundwater contamination	• site contamination of groundwater due to hydrocarbon spillages and leaks from construction vehicles. Small scale dewatering during stripping of topsoil and softs.	• Construction	• Separate clean and dirty runoff and divert dirty water to adequately sized PCDs; • Prevent dirty water runoff from leaving the general mining area (stormwater management); • Minimise dirty footprints; • A sufficient supply of absorbent fibre should be kept at the site to contain accidental spills; • Monitoring boreholes should be monitored based on the IWUL conditions; and • Contain dirty water in lined dams and re-use dirty water for dust suppression.	• Concurrent rehabilitation through the LoM.	• Life of Construction Phase.
• Mine dewatering causing groundwater level drawdown • AMD formation in the open pit causing groundwater contamination • Mine decant causing contamination of groundwater	• AMD formation in the open pit causing groundwater contamination; • Active mine dewatering will be required to ensure dry working conditions in the open pit. The dewatering will cause ground levels to be drawn down in the vicinity of the mining area; • Due to active mine dewatering required to ensure dry working conditions in the open pit, certain groundwater volumes will be extracted from the open pit, limiting the groundwater resource; • Due to AMD taking place within the open pit, potential groundwater contamination with	• Operational	• Restrict the impact of contaminated groundwater to the mining area and mitigate the impact on groundwater levels and stream flow reduction in the catchment; • Minimise the extent of groundwater contaminant plume migration and decant volumes, all mining areas should be free draining to reduce the pit recharge rate post closure; • A site assessment re-calculating the decant volumes using numerical model results and spreadsheet calculations should be carried out every two years based on the rehabilitation design of open pit; • Re-estimations of the recharge based on the used capping and determination of the backfill porosity into each pit should be assessed when backfilling is complete. This will improve the accuracy of the decant volumes and time-to-decant to be expected; • Delineations of mining areas, contribution of each of those mining areas to the constructed decant points and anticipated decant volumes (average and seasonal variations) should be assessed and/or confirmed and these volumes should correspond to values in the site water balance; • All boreholes to be mined out should be grouted and sealed to prevent cross contamination of aquifers; • Mine water must be used or pumped to dirty water dams or pollution control facilities in order to avoid	• Concurrent rehabilitation through the LoM.	• Life of Operational Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
	sulphate and a lower pH could occur, which would have an impact on the groundwater quality; and • If groundwater levels within the pit recover to elevations higher than surface elevations, this water may then flow from the backfilled open pit areas and cause groundwater contamination down gradient of the mine.		deterioration of the mine water. The longer the mine water resides in the pit the higher the TDS will be; • As much as possible coal must be removed from the open pit mine during the operational phase; • Carbonaceous rocks (especially shale) and discard should be placed in the deepest part of the pit (as far as practical possible) and below the long-term pit water level in order to ensure that it is flooded, and that pyrite oxidation is minimised; • Soft overburden and weathered rock should be placed at the top of the backfill in order to minimise oxygen diffusion into the pit; • The mined-out sections of the pit should be backfilled, compacted and rehabilitated where practically possible. Concurrent rehabilitation is practiced at the mine. Rehabilitation can include covering the backfill with a topsoil layer as well as vegetation thereof. Installation of a soil cover could significantly decrease water infiltration and contamination. If less water is infiltrating it will likely not have a negative effect on mine water quality (increasing TDS) as the salt content is controlled by mineral saturation rather than straightforward dilution; • Static groundwater levels should be monitored as mentioned in Section 14 to ensure that any deviation of the groundwater flow from the idealised predictions is detected in time; • The numerical model should be updated every two years by using the measured water ingress and water levels to re-calibrate and refine the impact predictive scenario; • If it can be proven that the mining operation is indeed affecting the quantity of groundwater available to certain users, the affected parties may need to be compensated. This may be done through installation of additional boreholes for water supply purposes, or an alternative water supply; however, this should be assessed on an individual basis to determine the most appropriate solution for all affected; • The monitoring results must be interpreted annually by a qualified hydrogeologist and the adequacy of the network should be assessed annually ensure compliance;		

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
			• The rehabilitated open pit should be free draining to reduce drainage into the pit; • Boreholes should be drilled into the open pit so that the rate of flooding and water level recovery and quality can be established. Stage curves should be made which would aid in the management prior to the closure phase. The location of these boreholes can be established based on the coal floor elevations and should generally be placed in the deeper sections of the rehabilitated open pit; • A detailed mine closure plan should be prepared during the operational phase, including a risk assessment, water resource impact prediction, etc.; • An investigation on inter-mine flow should be commissioned to assess the likely changes to the various impacts; • A numerical model should be developed for NCC area including and the historic and current mining activities. This consolidated model can then be used a management tool to assess and quantity impacts across the NCC area; and • It is recommended that a comprehensive geochemical assessment be conducted. Geochemical samples should be collected and analysed annually. A geochemical model should be performed to assess the effectiveness of potential mitigation measures. The model can then be updated every two years with the new data.		
• Mine dewatering causing a decrease in groundwater reserves • AMD in open pit causing groundwater contamination • Mine Dewatering and residual effect on rebounding groundwater levels	• Due to AMD taking place within the backfilled open pit, potential groundwater contamination with sulphate and a lower pH could occur, which would have an impact on the groundwater quality; and • Due to the dewatering activities during the operational phase, groundwater levels surrounding Middeldrift pit will be subdued at	• Post-closure.	• Properly engineered decant containment or treatment solutions should be designed; • Negotiate and obtain groundwater closure objectives approved by relevant stakeholders during the decommissioning phase of the project, based on the results of the monitoring information obtained during the construction and operational phases of the project, and through verification of the numerical model constructed for the project; • Continue with the groundwater quality and groundwater level monitoring for a period of two to four years after mining ceases in order to establish post-closure groundwater level and quality trends. The monitoring information must be used to update, verify and recalibrate the predictive tools used during the	• Concurrent rehabilitation through the LoM.	• Life of Rehabilitation Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
	the start of the post-closure phase, after it will gradually recover towards pre-mining levels.		study to increase the confidence in the closure objectives and management plans; • Present the results of the monitoring programme to relevant authorities on an annual basis. The post-closure monitoring programme will be re-evaluated on an annual basis in consultation with relevant authorities; • Negotiate mine closure with relevant authorities based on the results of the groundwater monitoring undertaken, after the two- to four-year post-closure monitoring periods. • Multiple-level monitoring boreholes must be constructed to monitor groundwater level behaviour in the backfilled pit. The results of the monitoring programme could be used to confirm/validate the predicted impacts on groundwater availability and quality after closure; • Update existing predictive tools to verify long-term impacts on groundwater; • Present the results to the authorities on an annual basis to determine compliance with the closure objectives; • Implement as many closure measures, such as concurrent rehabilitation, during the operational phase, while conducting appropriate monitoring programmes to demonstrate actual performance of the various management actions during the LoM; • All mined areas should be flooded as soon as possible to bar oxygen from reacting with remaining pyrite; • The final backfilled open pit topography should be engineered such that runoff is directed away from the open pit areas; • A soil cover design study should be conducted to assess the likely closure cover for the open pits; and • Audit the monitoring network annually.		
Surface water					
• Vegetation clearing; • Construction of infrastructure including the culvert, haul road and	• Sedimentation and siltation of water sources due to increased soil erosion.	• Construction	• Strategically clear all vegetation within the development site and limit disturbing the soil; • Encourage the use of existing access roads and minimise creating new ones as to limit soil disturbances;	• Control by implementing proposed stormwater management plan to	• Life of Construction Phase

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
diversion of the provincial road; and • Loading and transportation of materials including topsoil and discard to designated dumps and stockpile areas,			• Avoid stockpiling close to the drainage lines and construction must be done mostly during drier periods to minimise erosion; and • Maintain vehicles and machinery regularly to avoid leakages.	minimise impacts on the environment.	
• Flow of dirty water from workshops, stockpiles, operational plants, haul roads and blasting sites; and • Hydrocarbon spillages and leakages from equipment, moving heavy vehicles and machinery.	• Siltation of water resources due to increased dust and soil erosion; and • Hydrocarbon contamination of water resources.	• Operational	• Installation of effective drainage systems with sediments filtration material is recommended to reduce siltation and sedimentation in watercourses; • Ensure that water quality complies with DWS guidelines before discharging it to watercourses; • Storage facilities for hydrocarbon fuels, oils and grease must be equipped to contain leakages and spills and must be on impermeable surface (concrete or paved) and should be an enclosed area built in accordance with the SANS1200; • All mining personnel must be trained and educated on proper handling and disposal of hazardous material; • All operational vehicles should be maintained and washed in a single designated area and all the runoff water should be diverted to the PCD and all mine waste should be handled by a trained contractor; • Water quality monitoring should be effectively implemented to ensure adherence to the stipulated water quality standards, and through this, any water quality problems arising because of the mine can be detected and dealt with early; • The water requirements should be clearly stated and frequently reviewed as to not compromise the Reserve; and • Recycling and reusing of mine water are highly recommended to reduce the abstraction of freshwater resources.	• Control by implementation of proposed SWMP and regular monitoring of water quality and quantity to minimise the negative impacts of mining and related activities; and • Regular maintenance of SWMP to ensure effective functioning of storm water structures.	• Life of Operational Phase.
• Decommissioning and removal of mine infrastructure will result in the disturbance of soils thereby accelerating soil erosion	• Sedimentation and siltation of watercourses subsequently affecting water quality and flow of streams;	• Decommissioning	• Soil disturbances during decommissioning should be restricted to the relevant footprint area; • All decommissioning debris must be cleared as soon as practically possible, and it is recommended that demolition of infrastructure be conducted during the	• Monitoring of water quality and quantity post-closure; and • Rehabilitation of disturbed landscapes monitoring and	• Life of Decommissioning Phase

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
• Handling hydrocarbon material and potential leakage and spillage from moving vehicles and machinery • Backfilling, re-profiling and revegetation of disturbed landscapes	• Contamination of water resources due to chemical contamination such as hydrocarbons as result of mishandling; • Contamination of water resources from decant of AMD at low-lying riverine areas; and • Allowing free drainage and possible increase of streamflow regimes.		dry season to minimise chances of soil erosion to watercourses; • Movement of heavy vehicles and machinery must be restricted to existing roads to avoid further disturbance of landscapes thus minimising soil erosion; • In the event of decanting, passive treatment should be applied to neutralise and treat the AMD before being discharged back into freshwater resources. If passive treatment fails, active treatment by a conventional Water Treatment Plant should be considered; and • Backfilled, top-soiled areas should be re-profiled and revegetated to allow free drainage that is close to pre-mining conditions.	maintenance of rehabilitated areas until vegetation has fully been established.	
Soils, Land Use and Land Capability					
• Site/vegetation clearance • Contractor laydown yard • Access and haul road construction • Topsoil stockpiling	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	• Construction	• Control and Remedy. If any erosion occurs on site and adjacent to the Project Area, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; • Control and Remedy. If erosion has occurred on site and adjacent to the project area, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Control. The topsoil should be stripped with vegetation by means of an excavator bucket and loaded onto dump trucks; • Control. Plan site clearance and alteration activities for the dry season (May to October); • Control. Restrict the extent of disturbance within the project area and minimise activity within designated areas of disturbance; • Control. Minimise the period of exposure of soil surfaces through dedicated planning; • Control. Ensure proper stormwater management designs are in place; • Control and Remedy. If any spillage occurs, clean up and remediate immediately; • Control and Remedy. Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of spillage with appropriate disposal as necessary; and	• Concurrent rehabilitation through the LoM.	• Life of Construction Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
			• Control and Remedy. Implement post-mitigation monitoring to ensure the well-functioning of the road diversion and bridge. This should include an AIPs plan.		
• Open pit establishment • Removal of rock (blasting) • Stockpiling (i.e., soils) establishment and operation • Operation of the open pit workings	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	• Operational	• Remedy. Re-vegetate cleared areas and stockpiles to avoid wind and water erosion; • Control and Remedy. Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand; • Control. Soil stockpiles should be monitored for fertility via sampling and testing; • Control and Remedy. Monitoring of the condition of all unpaved roads is necessary due to the high rainfall and potential water runoff and erosion of the soils present in the Project Area. Water runoff from compacted road surfaces may cause erosion of road shoulders degrading the road surface; • Control. Monitoring needs to be carried out of all unpaved roads especially during the rainy season; • Control and Remedy. If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; • Control and Stop. A Topsoil Management Plan must be prepared to demonstrate how topsoil will be preserved in a condition as near as possible to its pre-mining condition to allow successful mine rehabilitation (Statham, 2014); • Control, Remedy and Stop. Long-term stockpiles should be revegetated to minimise loss of soil quality. This will minimise AIPs, maintain soil organic matter levels, maintain soil structure, and microbial activity; • Control, Remedy and Stop. Soil pollution monitoring should be conducted at selected locations on the project site to detect any high levels of pollutants; • Control. Only the designated access routes are to be used to reduce any unnecessary compaction; • Control and Remedy. Compacted areas are to be ripped to loosen the soil structure; • Control and Stop. Operations vehicles and equipment should be serviced regularly; • Control and Stop. Service and parking areas must be paved; and	• Concurrent rehabilitation through the LoM.	• Life of Operational Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
			• Control and Stop. Fuel and heavy hydrocarbon product storage on site should be secured by bunded facilities.		
• Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation • Post-closure monitoring and rehabilitation	• Soil compaction; • Soil erosion; • Sedimentation; and • Topsoil degradation.	• Rehabilitation	• Modify, Control and Remedy. Demolition and removal of infrastructure should be restricted to the dry season (May to October); • Modify, Control and Remedy. Minimise the period of exposure of soil surfaces through dedicated planning; • Control and Stop. Ensure proper stormwater management designs are in place and should be kept in place until all infrastructure is removed. Where infrastructure will remain, stormwater and culverts should be maintained and monitored for erosion and AIPs; • Modify, Control and Remedy. Continue with Concurrent Rehabilitation, and implement land rehabilitation measures; • Modify, Control and Remedy. Address compacted areas by deep ripping to loosen the soil, and revegetate the area; • Control and Stop. Only designated access routes are to be used to reduce any unnecessary compaction; • Modify, Control and Remedy. The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions; • Modify, Control and Remedy. Monitoring of the condition of all unpaved roads and rehabilitated areas; and • Modify, Control and Remedy. If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place.	• Concurrent rehabilitation through the LoM and after mine.	• Life of Rehabilitation Phase.
Hydropedology					
• Clearing and mining through a pan • Removal of vegetation / topsoil for establishment of opencast mining and construction of linear infrastructure such as the access or haul road including diversion of the	• The mining of a pan will lead to loss of a water resource through disruption of flow paths ; • Sedimentation and siltation of watercourses due to increased soil erosion leading to reduced water quality; and	• Construction	• DWS approval/exemption needs to be applied for to enable permissible mining and clearing of the pan in accordance with GN R704; • 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; and • Minimise disturbance of river channel geometry during installation of the culvert/bridge. Re-profile and stabilise any disturbed soils when the culvert/bridge is constructed.	• Control through restricting clearance or disturbance to the project footprint.	• Life of Construction Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
existing provincial road. • Construction of a culvert/bridge over the Steenkoolspruit)	• Alteration of channel geometry at crossings resulting in fluvial erosion and reduced flow regime.				
• Opencast Pit Excavation during mining will intercept rainfall and runoff which would have otherwise reported to the Steenkoolspruit had the pit not been there. • Opencast Pit Excavation during mining and removal of rock through blasting will disrupt hydrological flow paths within affected hillslopes, thereby reducing the amount of water that reports to the Steenkoolspruit. • Concurrent rehabilitation involving backfilling, re-profiling and revegetation of previously disturbed landscapes as mining progresses.	• Runoff and rainfall interception by the opencast pit will affect the availability of water resources for downstream water users; • Disruption of water flow paths will likely reduce the quantity of water reporting to the Steenkoolspruit thereby affecting the availability of water for downstream water users; and • Allowance for free drainage and increase in runoff yield supporting desired post-mining land use.	• Operational	• Installation of the proposed stormwater management plan is recommended to reduce sedimentation and siltation in nearby watercourses. The recommended perimeter berm around the Middeldrift Opencast Pit will also ensure that clean water is diverted from the dirty opencast pit; and • Practice concurrent rehabilitation, as proposed, reduce the size of the opencast pit that intercepts rainfall and runoff at any time during the course of the mining process.	• Control through implementation of the stormwater management plan; and • Rehabilitation through backfilling, re-profiling and revegetation of disturbed landscapes as mining progresses.	• Life of Operational Phase.
• Demolition and removal of infrastructure • Backfilling, reprofiling and revegetation of the final void • After rehabilitation, dewatering ceases	• Sedimentation and siltation of nearby watercourses leading to reduced water quality; • Allowance for free drainage and increase in runoff yield supporting desired	• Decommissioning and closure	• Re-profile the topography after backfilling to a slope gradient and angle that supports post-mining land use; • Soil disturbances during demolition should be restricted to the relevant footprint area; • All decommissioning activities should be undertaken in a way to minimise disturbance of soils which will lead to erosion, sedimentation and siltation of the Steenkoolspruit;	• Control through water quality monitoring; • Remedy through passive treatment of AMD; and • Rehabilitation through backfilling, re-profiling and	• Life of Decommissioning and Closure.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
and water accumulates within the backfilled pit and the water reacts with the pyrite in the backfilled material, thereby becoming acidified and starts decanting at low lying positions, including the adjacent Steenkoolspruit.	post-mining land use; and • Contamination of soil and water resources from potential decant of AMD and movement of contamination plume due to the re-watering of the backfilled pit.		• In the event of decanting, passive treatment (through application of calcium compounds) should be applied to neutralise and treat the AMD before being discharged back into freshwater resources; • Use of constructed wetlands can also be considered as a mitigation measure against AMD; • Alternatively, when passive treatment fails to correct the situation, active Water Treatment (e.g., Reverse Osmosis) should be considered; and • Post closure monitoring will allow for monitoring the effectiveness of rehabilitation and will serve as an early detection tool for contamination on water resources.	revegetation of previously disturbed landscape.	
Fauna and Flora					
• Site clearing, and preparation by the removal of vegetation and associated habitats and removal of soils; • Movement of vehicles, and heavy machinery; • Construction of infrastructure, including access and haul roads, merging bridge and opencast pit; and • Waste management activities, including handling of hydrocarbon chemicals, transportation of waste material, transportation of product coal, and disposal of waste material.	• Removal of vegetation, basal cover, and thus increasing the potential of loss of topsoil, organic material, and increased erosion potential; • Loss of sensitive habitat; • Removal of flora and fauna SCC and faunal habitat; • Removal of vegetation communities such as woodlands and pans (wetlands); • AIP proliferation; • Increased runoff potential and consequently sedimentation and compaction of the soil; • Potential spillage of hydrocarbons such as oils, fuels (diesel), and grease, thus contamination of the	• Construction Phase	• Keep site clearing to an absolute minimum by adhering to the Project layout only, and restrict vehicle movement to dedicated areas, specifically outside of wetlands (pans) and rocky outcrops; • Floral SCC located in areas of development should be marked prior to commencement of construction. Necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe and ideal location. Sourcing representative and indigenous flora to rehabilitate the area, local nurseries and contractors should be contracted to supply the saplings and seed mixes; • Make use of and upgrade existing roads to encourage minimal impacts/footprint to the Project Area, this would limit the impacts proposed from the construction of the road diversion; • Whilst the removal of vegetation is underway, key monitoring methods should be focussed on the prevention of AIP proliferation during the construction and operational phase. Measures must be in place to prevent the spread of AIPs; • Erosion prevention is key thus runoff must be controlled, and managed by use of proper stormwater management measures; • Management of dust may involve the spraying of water and / or covering exposed pits with mulch. Mulch can be sourced from the removed vegetation from the site;	• Concurrent rehabilitation through the LoM.	• Life of Construction Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
	soils and surrounding grounds; • Risk of fire during the dry season; and • Increased dust pollution.		• Vehicles should regularly be surveyed and checked that oils spill and other contaminants are not exposed to the soils; • Storage and refueling of vehicles must take place on bunded impervious surfaces to prevent seepage of hydrocarbons into the soil; • 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; and • Fire management plan is recommended in case of uncontrolled fires during the dry season.		
• Vehicle, and heavy machinery movement • Open-pit establishment • Removal of rock (blasting) • Stockpiling (rock dumps, soils, ROM, discard dump) establishment, and operation • Waste management activities • Diesel storage, explosives magazine, and handling, and treatment of hazardous products (including fuel, explosives, and oil).	• Increased vehicle movement in the area, Increasing the risk of faunal casualties due to roadkill; • Increased risk of AIP proliferation without adequate control measures; • Increased dust pollution; • Increase risk of fire during dry season; • Increased erosion, runoff and compaction of soil and consequently sedimentation potential; • Changes to the landscape with subsequent removal of faunal habitats and a decrease in biodiversity and loss of SCC (faunal and floral); and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of	• Operational Phase	• Make use of existing roads to ensure minimal impacts and footprint to the project area; • Monitor AIPs and ensure measures are in place to prevent spread and proliferation; • All bare patches of soil should be vegetated, preferably with pioneer species (such as *Cynodon dactylon*, *Chloris gayana and Digitaria eriantha*) which will colonise open and disturbed patches quickly; • Avoid disturbing extensive footprint of sensitive areas as much as possible – i.e., ridges and wetlands (see Sensitivity Map); • Adhere to the recommended mitigation measures around the sensitive wetland pans (refer to the Digby Wells Wetland Report, 2021); • Management of dust may involve the use of dust suppressants, spraying of water and / or covering exposed pits with mulch; • Monitoring must be carried out during the operational phase to ensure no unnecessary impact to the remaining vegetation and associated habitats, and if so that a remediation plan is put in place as soon as possible; • In support of the Digby Wells Wetland Report 2021, a SWMP should already be implemented. This should consider all high land capability areas, high potential erosion areas, 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	• Concurrent rehabilitation through the LoM.	• Life of Operational Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
	the soils and surrounding grounds.		SWMP should also convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Fire management plan is recommended in case of uncontrolled fires during the dry season; • Hydrocarbons should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; and • Refueling of vehicles and machinery must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons in the surrounding area.		
• Movement of vehicles, and heavy machinery removing infrastructure; • Rehabilitation – rehabilitation mainly consists of reprofiling the landscape via re-vegetation. • Post-closure monitoring, and rehabilitation	• Increased vehicle movement in the area, Increasing the risk of faunal casualties due to roadkill; • Increased risk of AIP proliferation without adequate control measures; • Increased erosion, runoff and compaction of soil and consequently sedimentation potential; • Changes to the landscape with subsequent removal of faunal habitats and a decrease in biodiversity and loss of SCC (faunal and floral); and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils and surrounding grounds.	• Decommissioning Phase	• Address areas that have been impacted by erosion, compaction, sedimentation by loosening the soil, and revegetate the area as soon as possible; • Begin with the rehabilitation of the vegetation and replant with indigenous flora identified in vegetation communities, particularly pioneer species. • Ensure removal of all AIPs. This can be done manually and if necessary, with a systemic solution such as Round-Up; • Ensure designated access routes and roads are used to reduce any unnecessary compaction and degradation; • Inventory of hazardous waste materials stored on-site should be compiled, and complete removal must be arranged; • Rehabilitation and a Monitoring Plan should be implemented. In terms of biodiversity, a key component of the rehabilitation is the re-establishment of natural vegetation. The overall objectives for the establishment of natural vegetation are to: ○ Create a sustainable cover that prevents erosion and promotes ecological succession; ○ Avoid soil loss and reduce sedimentation into freshwater and aquatic ecosystems; ○ Re-establish ecosystem processes to ensure sustainable land use; and ○ Restore the biodiversity of the area as far as possible. • Rehabilitation of the vegetation cover will require varying species that complement the soil moisture content of the landscape. Rehabilitation of the dryland	• Concurrent rehabilitation through the LoM.	• Life of Decommissioning Phase.

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
			areas and rocky slopes will require good soil stabilising, easily establishing and nurse cropping grass species such as *Chloris gayana*, *Cynodon dactylon*, *Eragrostis curvula* and E. tef. Drainage areas, seepage zones and permanent wet areas will require species that stabilise the soils and are able to grow in permanent wet areas such as *C. gayana* and T*ypha capensis.*		
Heritage					
• Site/vegetation clearance • Contractors laydown yard • Access and haul road construction • Topsoil stockpiling • Open pit establishment • Removal of rock (blasting) • Stockpiling (i.e., soils) establishment and operation • Operation of the open pit workings • Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation • Post-closure monitoring and rehabilitation	• Damage to or destruction of previously unidentified heritage resources; • Damage to or destruction of STE-001; and • Loss of or restricted access to BGG-001	• Construction and Operation	• Develop and implement CFP; • Determine if a NHRA Section 34 permit will be required prior to demolition of historical built environment / structures older than 60 years; and • Develop a Conservation Management Plan (CMP) including identification of any living relatives or persons who may have *bona fide* interests in the site.	• Control.	• Life of Construction and Operational Phase.
Air Quality Assessment					
• Site clearing; • Access and haul road construction; and	• Poor air quality due to the generation of dust	• Construction	• As far as possible, limit activity to non-windy days (wind speed less than 5.4 m/s);	• Control	• On commencement of the construction phase and for the duration of the phase

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
• Topsoil stockpiling.			• The area of disturbance must be kept to a minimum at all times and no unnecessary clearing, digging or scraping must occur, especially on windy days; • Application of dust suppressant on the haul roads and exposed areas; • Set maximum speed limits on haul roads and have these limits enforced; • The drop heights when loading onto trucks and at tipping points should be minimised; and • Rehabilitation of disturbed land to allow for vegetation growth.		
• Open-pit development; • • Removal of rocks; • Stockpiling of topsoil; • Use of haul road; and • Operation of the plant	• Poor air quality due to the generation of dust	• Poor air quality due to the generation of dust	• As far as possible, limit activity to non-windy days (wind speed less than 5.4 m/s); • The area of disturbance must be kept to a minimum at all times and no unnecessary clearing, digging or scraping must occur, especially on windy days; • Application of dust suppressant on the haul roads and exposed areas; • Set maximum speed limits on haul roads and have these limits enforced; • The drop heights when loading onto trucks and at tipping points should be minimised; and • The enclosure of the screening and crushing circuit	• Control	• Measurements must commence before the start of the operation phase and for the LOM.
• Dismantling and removal of infrastructure • Rehabilitation of the project area • Post-closure monitoring and rehabilitation	• Poor air quality due to the generation of dust	• Decommissioning	• Limit activity to non-windy days (wind speed less than 5.4 m/s); • The area of disturbance must be kept to a minimum at all times and no unnecessary clearing, digging or scraping must occur, especially on windy days; • Application of dust suppressant on the haul roads and exposed areas; • Set maximum speed limits on haul roads and have these limits enforced; • The drop heights when loading onto trucks and at tipping points should be minimised; and • Rehabilitation of disturbed land to allow for vegetation growth	• Control	• On commencement of the decommissioning phase and for the duration of the phase
Closure					
• Open pit area • Infrastructure demolition	• Soil compaction; • Soil contamination;	• Closure Phase	Infrastructure demolitions and clean-up: Not applicable since there is no infrastructure to be constructed as part of the proposed Middeldrift Project. The	• Remediation, remedy.	• Closure Phase

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
• Monitoring and maintenance	• Ground and surface water contamination; and • Ecosystem disturbance .		new road and bridge over the Steenkoolspruit will be retained for beneficial reuse post-closure, this should be considered in future updates of the CCA, should the project go ahead. Final void backfill and rehabilitation: The final void will be backfilled to pre-determined design elevations, topsoil replaced, ripped and revegetated, as follows: • Doze backfill material (20% of total backfill material to be moved by dozer); • Load and haul backfill material (80% of backfill material to be moved by truck and shovel, with a 2 km load and haul distance applied). *The unit rate applied for load and haul was aligned with the site specific unit rate for load and haul supplied by NCC for the annual update of the NCC CCA, compiled by Digby Wells in March 2021)*; • Place topsoil to 1 000 mm (load and haul topsoil from stockpile, assume 2 km load and haul). *It is assumed the soils will be appropriately pre-stripped to the required depth, based on the pre-mining land capability assessment;* • Rip to alleviate compaction; and • Establish vegetation including soil amelioration based on dedicated sampling and analysis, seed bed preparation and the application of an appropriate seed mix. **Note:** the final void area was assumed to be 10 ha, with a volume of 2 715 567.9 m^3 (as per the *DEM*_Bottom_Seam_clip_cape27.prj file supplied by Universal Coal). Overburden dump • Rip footprint area to alleviate compaction; and • Establish vegetation. Haul road: (from crusher to final coal cut at the open pit) • Rip footprint area to alleviate compaction; • Establish vegetation including soil amelioration based on dedicated sampling and analysis, seed bed preparation and the application of an appropriate seed mix; and		

Activities	Potential Impact	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
			• Allowance for any carboniferous veneers requiring clean-up (over haul roads) at closure has not been included and should be considered in future updates of the CCA. Water monitoring costs are included and will take place for five years post-closure, assuming the following: • Three groundwater points; • Five surface water monitoring points; and • Vegetation monitoring and care and maintenance over the rehabilitated areas has been included for a period of five years post-closure.		

36. Financial provision

36.1.1. Environmental objectives in relation to closure

36.1.1.1. Physical Stability

To facilitate the implementation of the planned land use, by:

- Closing, dismantling, removing and disposing of all surface infrastructure that has no beneficial post-closure use;
- Ripping, shaping, and vegetating of reclaimed footprint areas as well as access roads with no beneficial post-closure use and integrating these into the surrounding areas; and
- Sealing all project boreholes except those drilled for monitoring purposes.

36.1.1.2. Environmental Quality

To ensure that local environmental quality is not adversely affected by possible physical effects and chemical contamination arising from the project area by:

- Limiting dust generation on the rehabilitated infrastructural areas that could cause nuisance and/or health effects to surrounding landowners/communities;
- Conducting dedicated soil surveys over the footprint of the infrastructure site and removing any identified pockets of contaminated soil;
- Cleaning up of any sources of potential soil contamination present on the site to protect the downstream receiving environment; and
- Ensuring that the rehabilitated site is free-draining and runoff is routed to local/natural drainage lines as far as possible.

36.1.1.3. Health and Safety

To limit the possible health and safety threats to humans and animals using the rehabilitated site by:

- Removing, for safe disposal, all potential process-related contaminants to ensure that no hazardous waste is present on the mine site once it has been rehabilitated;
- Demonstrating by means of suitable sampling and analysis that the threshold levels of salts, metals and other potential contaminants over the rehabilitated site in terms of the long-term land use planning for human and animal habitation are acceptable; and
- Demonstrating through a review of monitoring data that no possible surface and/or groundwater contaminant sources remain on the rehabilitated site that could compromise the planned land use and/or pose health and safety threats;

36.1.1.4. Land Capability/Land-use

To re-instate suitable land capabilities over the affected site to facilitate the progressive implementation of the planned land use, by:

- Zoning of the project area and obtaining agreement with stakeholders on this;
- Upfront materials balancing and handling to ensure that the soil types are stockpiled separately and subsequently placed, during site rehabilitation, to allow the desired land capability and end land use to be achieved; and
- Re-vegetating the project-affected area with a mix of locally indigenous grass and forb species with the objective of rendering it fit for grazing.

36.1.1.5. Aesthetic Quality

To leave behind a rehabilitated infrastructure site that, in general, is not only neat and tidy, giving an acceptable overall aesthetic appearance, but which in terms of this attribute is also aligned to the respective land use, by:

- Tidying-up the site by removing demolition waste, rubble, etc.;
- Shaping and levelling disturbed areas to create landforms that emulate the surrounding surface topography and would facilitate drainage; and
- Re-establishing vegetation on the above areas to be self-sustaining, ecologically functional and aesthetically pleasing.

36.1.1.6. Biodiversity

To encourage the re-establishment of locally indigenous vegetation on the rehabilitated areas such that the terrestrial biodiversity is largely re-instated over time, by:

- Stabilising disturbed areas to prevent erosion in the short to medium term until a suitable vegetation cover has established;
- Establishing viable self-sustaining vegetation communities that will encourage the re-introduction of local fauna as far as possible;
- Identifying those aspects/obstacles once site rehabilitation has been completed which could inhibit and/or deter animal life from returning to the rehabilitated site; and
- Removing the identified obstacles without compromising the adopted final land use.

36.1.1.7. Socio-economic Aspects

To ensure that any infrastructure transfers, measures and/or contributions made by the project towards the long-term socio-economic benefit of the local communities are sustainable, by:

- Identifying buildings and other infrastructure that could be of commercial and/or other value/benefit to the local community and transferring these to third parties as agreed between NCC and these parties and/or the stakeholders;

- Communicating and negotiating with local communities and related civil structures on the closure of the project and the possible transfer of surface infrastructure to them;
- Ensuring effective hand-over of pre-determined project-related surface infrastructure for future use by other parties;
- Providing, until hand-over of the project-related surface infrastructure, training and awareness creation to empower the communities to effectively manage the financial and/or commercial resources transferred from the mine; and
- Clearly defining the roles of the parties responsible for future management of transferred facilities.

36.1.2. Quantum of financial provision

Main aspects and assumptions in relation to closure are mentioned in Section 9.15 above. A detailed closure costing sheet is attached in **Appendix K** .

36.1.3. Guarantee that financial provision will be provided as determined

NCC has required financial guarantees (**Appendix N**).

36.1.4. Recommendations

The following is recommended to improve the resolution of the closure cost estimate and to advance the rehabilitation and closure planning and implementation accuracy:

- Consider the high-level conceptual model for the project and continually update the geohydrological and geochemical models based on monitoring results to confirm the expected water quantities and qualities post closure;
- Develop a post mining landform design for the open pit to optimise the mass earthworks to ensure backfilling is done to design elevations;
- Ensure the preferential materials handling is followed during backfilling operations, placing potentially reactive spoil material in the deepest portions of the pit prior to backfilling with inert overburden, where feasible;
- Include clean-up of contaminated sediment such as coal veneers and hydrocarbons, as/if found to be required;
- Confirm the post-mining land capability targets to be met over the rehabilitated open pit; and
- The financial provision needs to be updated on an annual basis as a requirement of the Financial Provisioning Regulations, 2015 (as amended). This will ensure that all costs become more accurate over time and will reflect prevailing market conditions.

37. Mechanisms for Monitoring Compliance

The mechanisms for monitoring are displayed in Table 37-1 below. It should be noted that NCC must ensure that the appointed persons to conduct the monitoring must stick to the monitoring programme.

Table 37-1: Mechanisms for compliance monitoring

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
Wetlands				
Wetland extent (size)	• Direct loss of 224.35 ha wetlands.	Wetland update report and recommendations for impact mitigation, if any.	Environmental Officer	Up to Rehabilitation
Wetland health (PES, ES, EIS)	• Loss of habitat and biodiversity.	Wetland update report and recommendations for impact mitigation, if any.	Environmental Officer	3 years after Rehabilitation
Wetland physical attributes (Vegetation, erosion, habitat, open water extent)	• Erosions and sedimentation of adjacent wetlands and water courses.	Take photos of adjacent and downstream wetland areas and record any impacts seen.	Environmental Officer	Up to Rehabilitation
Surface water and soil contamination assessment (incl. decant points)	• Water quality contamination and deterioration; • Increased runoff from hardened surfaces; • Increased or decreased water supply to the wetlands systems; and • Change in habitat and potential change in species composition.	Take water and soil samples for laboratory analysis, measuring heavy metals and potential harmful elements	Mine Environmental Manager.	3 months thereafter (monthly) the spill has occurred
Aquatics				
Water Quality: *In situ* water testing focusing on temperature, pH, conductivity and oxygen content.	• Siltation of water resources due to increased turbidity from dust and soil erosion; • Water contamination due to leaks or spills of hazardous and hydrocarbon containing material; • Siltation of water resources due to increased turbidity from dust and soil erosion; • Water contamination due to leaks or spills of hazardous and hydrocarbon containing material; • Siltation of water resources due to increased turbidity from soil erosion;	• No noticeable change from determined baseline water quality for each respective season; • Nutrient concentrations must be improved to prevent deterioration of the ecological conditions; and • Salt Concentrations must be maintained at levels where they do not render the ecosystem unsustainable.	Aquatic Ecologist (SASS-accredited)	Water quality should be tested on a biannual basis at each monitoring site to determine the extent of change from baseline results.
Habitat Quality: Instream and riparian habitat integrity; and Availability/suitability of macroinvertebrate habitat at each monitoring site.		• The application of the IHI should be done for the Steenkoolspruit system;		Habitat quality should be assessed on a biannual basis

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
	• Restoration of the pre-mining streamflow regime; • Siltation of water resources due to increased turbidity from dust and soil erosion; and • Water contamination due to leaks or spills of hazardous and hydrocarbon containing material.	• The IHAS must be applied at each monitoring site prior to sampling; and • The Ecological Category determined for each assessed site must be in a largely modified or better conditions to support the ecosystem.		
Aquatic Macroinvertebrates: Aquatic Macroinvertebrate assemblages must be assessed biannually.		• This must be done through the application of the latest SASS, incorporated with the application of the MIRAI as outlined in this Aquatic Study; • The baseline SASS5 scores should not noticeably deteriorate; and • Baseline Ecological Categories should not be allowed to drop in category for each assessed site.		The latest version of the SASS should be conducted on a biannual basis.
Fish: Fish assemblages must be assessed biannually		• Sampling of fish must be undertaken by utilising various methods such as cast nets or by means of a boat in addition to the standard electro-narcosis techniques for the inaccessible deeper sites; and • Baseline Ecological Categories should not be allowed to drop in category for each assessed site.		Sampling of fish communities should be undertaken on a biannual basis Macroinvertebrate assemblages must be assessed biannually.
Integrated EcoStatus Determination		• The EcoStatus is defined as: "The totality of the features and characteristics of the river and its riparian areas that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services" (Iversen et al., 2000); and • The Ecological Category for each assessed river reach should not deteriorate from the Resource Quality Objectives of the Olifants Catchment		The Integrated EcoStatus should be determined upon completion of the biannual aquatic surveys.

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
Groundwater				
Groundwater	• The impact of mine dewatering on the surrounding aquifers; • Groundwater inflow into the mine workings; • Groundwater quality trends; and • The rate of groundwater recovery and the potential for decant after mining ceases.	• Monitoring of groundwater levels in the monitoring boreholes. If private boreholes are identified within the zone of impact on groundwater levels, these will be included in the monitoring programme; • Monitoring of groundwater levels in the monitoring boreholes as well as measuring water volumes pumped from mining areas; • This will be achieved through sampling of the groundwater in the boreholes at the prescribed frequency; and • Measuring groundwater levels in the open pit workings. Stage curves will be drawn to assess the inflow into defunct workings.	NCC, Monitoring contractors	• Quarterly: measuring the depth of groundwater levels; • Quarterly: sampling for water quality analysis; and • Daily at the mine.
Surface water				
Water quality	• Siltation of water resources due to increased dust and soil erosion; • Hydrocarbon contamination of water resources; • Sedimentation and siltation of watercourses subsequently affecting water quality and flow of streams; • Contamination of water resources due to chemical contamination such as hydrocarbons as result of mishandling; • Contamination of water resources from decant of AM) at low-lying riverine areas; and • Allowing free drainage and possible increase of streamflow regimes.	• Ensure water quality monitoring as per sampled and proposed monitoring locations. Parameters should include but not limited to pH; Electrical Conductivity; major cations (K, Ca, Mg & Na); trace metals (Al, Fe, Zn, Cu, Mn, Co, Se, Mo, Cd, Ni, Cr (VI), Pb, Hg & As); Anions (NO_3, NO_2, NH4, Cl, F, SO_4, PO_4); TDS; Total Suspended solids; and • It is also recommended to monitor water quality within the mine water dams or water containment facilities at the existing NCC operations to determine the concentration levels in case of an overflow or need for discharge.	Environmental Officer	Monthly monitoring during construction, operation, decommissioning and for at least five years after closure, or until rehabilitation has reached a sustainable state with no further changes.
Sedimentation		• Inspect construction sites, sites where infrastructure is demolished and rehabilitated sites for traces of		After rainfall event, until the establishment of vegetation on all rehabilitated sites

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
		erosion to ensure no entrance of sediment occurs into nearby watercourses, especially after rainfall events. Temporary silt fences, soil stabilisation blankets should be installed and maintained until vegetation is established.		
Water quantity and water balance		• Monitoring or measuring of all the water inflows into the mine, reticulation within the mine and the outflows from the mine. This can be achieved by installing automatic flow meters to ensure real time measurements of water.		In operational areas where automatic flow meters are in place, daily records need to be kept
Physical structures and Storm Water Management Plan (SWMP) performance		• 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; and • Storm water channels, and existing mine dams are inspected for silting and blockages of inflows, pipelines for hydraulic integrity; monitor the overall SWMP performance.		Continuous process and yearly formal report
Soils, Land Use and Land Capability				
Stockpiles (i.e., height, erosion, compaction, low vegetation cover)	•	• Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Environmental Officer	Twice every year and after storm events
Soil health and fertility		• Implementation of intervention/mitigation measures.	Environmental Officer	Twice every year during rehabilitation Once every year
Soil physical attributes (vegetation, erosion, sedimentation)		• Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Mine Environmental Manager	Once every year Once every year during rehabilitation
Soil contamination assessment (incl. decant points)		• Report any irregularities to the Environmental Officer for	Environmental Officer	Only after a spill has occurred

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
		assessment and mitigation/remediation measures.		
Hydropedology				
Water quality	• The mining of a pan will lead to loss of a water resource through disruption of flow paths; • Sedimentation and siltation of watercourses due to increased soil erosion leading to reduced water quality; • Alteration of channel geometry at crossings resulting in fluvial erosion and reduced flow regime; • Runoff and rainfall interception by the opencast pit will affect the availability of water resources for downstream water users; • Disruption of water flow paths will likely reduce the quantity of water reporting to the Steenkoolspruit thereby affecting the availability of water for downstream water users; • Allowance for free drainage and increase in runoff yield supporting desired post-mining land use; • Sedimentation and siltation of nearby watercourses leading to reduced water quality; • Allowance for free drainage and increase in runoff yield supporting desired post-mining land use; and • Contamination of soil and water resources from potential decant of AMD and movement of contamination plume due to the re-watering of the backfilled pit.	• Ensure regular water quality monitoring in the proposed monitoring sites/locations. This includes water within the mining sites in cases of potential overflow and water discharges into the surface water. Examples of parameters to be monitored include Total Dissolved Solids, Total Suspended solids, pH, Electrical Conductivity; Sulphate; major cations (K, Ca, Mg & Na).	Environmental Officer	Monitoring should be done on weekly-monthly bases during construction, operation, and decommissioning. After that monitoring should be done at least five years after closure or until rehabilitation becomes sustainable.
Sedimentation and Siltation		• Investigate the site after a rainfall event, during construction and demolishing to ensure that there is no erosion of soil which may lead to siltation and sedimentation of surface water resources. Rehabilitated sites should be inspected for any signs of erosion. Install filtration material or temporary silt fences and soil stabilising blankets until vegetation has been established.	Environmental Officer	After rainfall events or after overland flow
Physical structures and SWMP performance		• Facilities around the mine should be physically inspected and checked regularly for any anomalies/malfunctions and leakages; and • Ensure that there is no blockage of inflows in stormwater channels, dams and pipelines in order to maintain good hydraulic conditions. The overall SWMP performance should be monitored to ensure its' effectiveness.	Environmental Officer	Frequently and continuously
Surface inspection during rehabilitation		• Surface inspection should be done during concurrent rehabilitation until	Environmental Officer	Frequently and continuously

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
		the vegetation cover is established to prevent erosion and sedimentation which will subsequently lead to topsoil loss, sedimentation and siltation of nearby watercourse		
Fauna and Flora				
Alien Invasive Management	• Removal of vegetation, basal cover, and thus increasing the potential of loss of topsoil, organic material, and increased erosion potential; • Loss of sensitive habitat; • Removal of flora and fauna SCC and faunal habitat; • Removal of vegetation communities such as woodlands and pans (wetlands); • AIP proliferation; • Increased runoff potential and consequently sedimentation and compaction of the soil; • Potential spillage of hydrocarbons such as oils, fuels (diesel), and grease, thus contamination of the soils and surrounding grounds; • Risk of fire during the dry season; and • Increased dust pollution.	• During the operational phase, the presence if AIPs should be detected and monitored every six months. An active programme of weed management, to control the presence and spread of invasive weeds, will need to be instituted so that encroaching weeds (from edge effects and fragmentation) are controlled by means appropriate to the species. This should run for the life of the mine and five years after rehabilitation.	Environmental Officer	Annually during the wet season (December to February) for the first five years after rehabilitation.
Vegetation Cover Monitoring	• Removal of vegetation, basal cover, and thus increasing the potential of loss of topsoil, organic material and increased erosion potential; • Loss of sensitive habitat; • Removal of flora and fauna SCC and faunal habitat; • Removal of vegetation communities such as woodlands and pans (wetlands); • AIP proliferation;	• The natural vegetation cover established on the disturbed areas needs to be monitored annually for the first five years after rehabilitation has been carried out, to ensure that the rehabilitation work has been successful in terms of stabilising the newly formed surfaces (preventing air and water erosion from affecting those surfaces), and that the newly established vegetation cover is trending towards convergence with the original vegetation cover found	Botanist / Flora Specialist	Annually during the wet season for the first five years after rehabilitation.

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions

	• Increased runoff potential and consequently sedimentation and compaction of the soil;
	• Potential spillage of hydrocarbons such as oils, fuels (diesel), and grease, thus contamination of the soils and surrounding grounds;
	• Risk of fire during the dry season; and
	• Increased dust pollution.
		on the areas prior to disturbance (and on adjacent undisturbed areas).
		• Parameters to be followed during monitoring:
		  • Plant species present/absent;
		  • Weed species composition;
		  • Species density (number of individuals);
		  • Species frequency (number of times species is recorded);
		  • Basal cover; and
		  • Biomass for ground cover.		

Red Data listed fauna and flora		• All protected and Red Data plant and animal species must be marked prior to any construction taking place;	Field Specialist	Monitored every 6 months from rehabilitation
Fauna monitoring		• This will be closely linked to the flora monitoring to enable scientific conclusions and comparisons. To successfully monitor faunal and floral biodiversity with a Savannah biome, a solid baseline (pre-construction) will be established through the first round of monitoring; • This needs to be supplemented with regular repeats to compile a reasonable comparison between the pre-construction faunal communities present and faunal communities found in the same areas during various stages of construction and operation of the proposed project; and • It is recommended that this monitoring be carried out through the life of the mine and concurrently during rehabilitation.	Field Specialist	Monitored every six months from rehabilitation
Air Quality				

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
Fine particulate matter monitoring (i.e., PM_{10} and $PM_{2.5}$); Dustfall monitoring	• Generation of dust • Increased particulate matter load in the atmosphere leading to poor air quality • Soiling of surfaces due to dustfall	• The reference method for the determination of PM2.5 fraction (EN 14907); • The reference method for the determination of PM10 fraction (EN 12341); and • Dustfall monitoring in accordance with the American Standard Test Method ASTM 173998 in SANS1137:2019.	A designated Environmental Officer onsite to collect ambient air quality data and submit it to an independent consultant for interpretation and reporting. The reports are submitted to the South African Atmospheric Emission Licensing and Inventory Portal (SAAELIP) in accordance with the National Atmospheric Emission Reporting Regulations (GN R 283 of 2 April 2015)	Monthly for dustfall.

38. Environmental Awareness Plan

38.1. Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work

NCC will establish a procedure for Environmental Awareness Training. This procedure will include:

- Induction and awareness training for contractors and employees;
- Basic environmental management training;
- Job specific training – training for personnel performing tasks which could cause potentially significant environmental impacts;
- Assessment of extent to which personnel are equipped to manage environmental impacts;
- Comprehensive training – on emergency response, spill management, etc;
- Specialised skills;
- Training verification and record keeping; and
- Periodic re-assessment of training needs, with specific reference to new developments, newly identified issues and impacts and associated mitigation measures.

38.2. Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment

NCC will develop an emergency response team to handle potential incidents such as accidents, fires and environmental impacts.

39. Specific information required by the Competent Authority

It is confirmed that the financial provision will be reviewed annually.

40. Undertaking

The EAP herewith confirms:-

- the correctness of the information provided in the reports
- the inclusion of comments and inputs from stakeholders and I&APs ;
- the inclusion of inputs and recommendations from the specialist reports where relevant; and
- the acceptability of the project in relation to the finding of the assessment and level of mitigation proposed.

Signature of the Environmental Assessment Practitioner:	
Name of Company:	
Date:	

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Appendix A: NCC Mining Right

Appendix B: EAP CV and Qualifications

Appendix C: Infrastructure Layout Plans

Appendix D: Public Participation Report

Appendix E: Wetland Assessment Report

Appendix F: Aquatic Assessment Report

Appendix G: Groundwater Assessment

Appendix H: Surface Water Assessment

Appendix I: Soils, Land Use and Land Capability Assessment

Appendix J: Hydropedology Assessment

Appendix K: Fauna and Flora Assessment

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Appendix L: Heritage Assessment

Appendix M: Air Quality Assessment

Appendix N: Closure Costing Assessment

Appendix O: Traffic Assessment

Appendix P: Mining Work Programme