Anglo American Inyosi Coal (Pty) Limited

Integrated Water Use Licence Application

(Northern Underground Extension)

May 2020

Submitted as contemplated in Section 40 of the National Water Act, 1998 (Act No. 36 of 1998)

Integrated Water Use Licence Application: Brief Application Report

Anglo American Inyosi Coal (Pty) Limited's Zibulo Colliery:

Northern Underground Extension

Proponent: Anglo American Inyosi Coal (Pty) Ltd

BRIEF APPLICATION REPORT

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5	Zibulo Colliery – Groundwater and Geochemical Model for the Prediction of Water Inflows and Water Chemistry Evolution over Life of Mine and Post Closure.
6	Zibulo Colliery Water Balance – Draft.
7	Wetland Offset Strategy - Wetland Rehabilitation and Management Plan for the Anglo American Inyosi Coal – Zibulo Colliery, Mpumalanga Province.

EXECUTIVE SUMMARY

Zibulo Colliery, which is a Division of Anglo American Inyosi Coal (Pty) Ltd, is an operational opencast and underground coal mine located some 17 km southwest of Ogies in the Nkangala District Municipality within the Mpumalanga Province. Zibulo Colliery, formerly Zondagsfontein Project, is a member of the Anglo American group of companies, and is the first major project to be undertaken by the flagship empowerment company Anglo American Inyosi Coal (Pty) Ltd. Construction of the colliery started in 2008, and full production was reached in 2015. The mine is operated under water use licences 04/B11E/CGIJ/692 (Underground workings) and 04/B20G/AGJ/809 (Opencast), an approved EMPR (17/2/13 NK 31) and a mining right under DMR reference number: MP 30/5/1/2/2/338 MP.

Mining at Zibulo Colliery is undertaken by both opencast and underground mining methods. Run-of-mine (ROM) coal is brought to surface at the mine shafts and opencast workings and is deposited at the coal ROM stockpiling areas, which feeds the beneficiation plant at the Phola Washing Plant complex via an overland conveyor belt. Dirty water management structures are used for the collection, storage and re-use of dirty water generated at the operational underground and opencast mining operations. Recharge water to the underground workings is generally left underground and only water required for CM sections is pumped to surface. This project concerns the expansion of the underground operations into the northern areas of their mining right area, undermining various watercourses, containing water found underground in two, 40 000 m^3 underground pollution control dams, licensing already constructed infrastructure located within the 500m regulatory area of various wetlands and the pumping of groundwater from various parts of the underground working, via underground pipes to the two underground PCD's.

Various watercourses will be undermined by the Zibulo underground operations. Even though the Surface Water Bodies Analysis Report and Geotechnical studies indicate that, due to the depth of the underground mining (no shallower than 30m beneath the surface), the underground mining will not result in the formation of sinkholes or have any significant drawdown on surface watercourses it is still required to apply for authorisation in terms of Section 21(c) and (i) of the National Water Act (NWA), 1998 (Act 36 of 1998). All watercourses that will be/ have been undermined will thus be applied for in terms of this Section.

Water found underground (natural groundwater) will be pumped through pipes located within the underground area to two, 40 000m^3 underground PCD's. As the underground mining progresses these points will move to new locations as needed, and no point will be used on a permanent basis. Water pumped from the underground workings will firstly be pumped to the two underground PCD's. From there the water will be pumped to the surface pollution control dams (PCD's) and used for already licensed activities which include supplying water to the Phola coal washing plant and the eMalahleni Waste Water Treatment Works. For these activities authorisation in terms of Sections 21 (f) and (j) will be lodged with this application.

Surface infrastructure located at the underground mining area consist of access and ventilation shafts, workshops, offices, sewage treatment works, training facilities, roads, PCD's and storm water management infrastructure. These infrastructures are situated within the 500m regulatory area of two wetlands and were not licensed in terms of Sections 21 (c) and (i) in the original water use license

(WUL). As part Zibulo Colliery's ongoing compliance to both the NEMA and the NWA, they are applying for authorisation in terms of Sections 21 (c) and (i) for the above-mentioned infrastructure.

All of the above-mentioned activities will form part of the northern underground expansion WULA.

Environmental baseline data has been obtained through various agencies, pertaining to surface- and groundwater quantities and qualities, topographical analyses, soil surveys and wetland survey. The data accumulated and analysed is sufficient to gain a baseline indication of the present state of the environment. The use of this baseline data for impact assessments is thus justified, and reliable conclusions could be made. Based on the assessment it was determined that the proposed northern underground expansion and associated activities, the licensing of the infrastructure within 500m of various wetlands and ventilation shaft number 4 all indicate an acceptable impact on the watercourses and resources within their vicinities.

SECTION ONE

Introduction

1 INTRODUCTION

1.1 WHO IS DEVELOPING THE IWUL APPLICATION?

EIA / EMP Compilation :	Geovicon Environmental (Pty) Limited P.O. Box 4050 MIDDELBURG, 1050 Tel: (013) 243 5842 Fax: (013) 243 5843 Contact: Mr. O.T. Shakwane

Geovicon Environmental is a geological and environmental consulting company. The company was formed during 1996, and currently has twenty years' experience in the geological and environmental consulting field. Geovicon Environmental has successfully completed consulting projects in the Mining sector (coal, gold, base metal and diamond), Quarrying sector (sand, aggregate and dimension stone), Industrial sector and Housing sector. Geovicon Environmental has undertaken contracts within all the provinces of South Africa, Swaziland, Botswana and Zambia. During 2001 Geovicon Environmental entered the field of mine environmental management and water monitoring.

Geovicon Environmental is a Black Economically Empowered Company with the BEE component owning 60% of the company. Geovicon Environmental has three members i.e. O.T Shakwane, J.M Bate and T.G Tefu.

Mr. O.T Shakwane obtained his BSc (Microbiology and Biochemistry) from the University of Durban Westville in 1994, and completed his honours degree in Microbiology in 1995. Mr O.T Shakwane has also completed short courses on environmental law and environmental impact assessment with the University of North West's Centre for Environmental Management. He has worked with the three state departments tasked with mining and environmental management i.e. Department of Water and Sanitation (Gauteng and Mpumalanga Region), Department of Mineral Resources (Mpumalanga Region) and Department of Agriculture, Conservation and Environment (Gauteng Region). Mr. Shakwane has been in the consulting field since 2004 and has completed various projects similar to this project as an environmental assessment practitioner. Mr. O.T Shakwane is registered as a Professional Natural Scientist in terms of the section 20(3) of the Natural Scientific Professions Act, 2003 (Act 27 of 2003). He is also a member of the International Association for Impact Assessment, South Africa.

Mr. T.G. Tefu is a geologist. He obtained his BSc. in geology at the University of Witwatersrand. He worked with several mining companies and was also employed by the Department of Mineral Resources' Environmental Management directorate.

Mr. Bate, founder of Geovicon Environmental (Pty) Limited, is used by the company on an ad hoc (consultancy) basis. He is also a qualified geologist. He obtained his BSc (geology) from the

Potchefstroom University for CHE in 1993, and completed his honours degree (cum Laude) in geology in 1994. He obtained his MSC (cum Laude) in 1995.

Over the past years Geovicon Environmental has formalised working relationships with companies that offer expertise in the following fields i.e. Geohydrology, Hydrology, Civil and Geotechnical Engineering, Geotechnical Consultancy, Survey and Mine Planning, Wetland, Soil & Land Use Consultancy.

1.2 WHO WILL EVALUATE THE IWULA?

In an effort by Anglo American Inyosi Cola (Pty) Ltd to legally carry out the water use activities at the Zibulo Colliery Northern Underground Expansion, an integrated water use licence application is submitted to the Department of Water and Sanitation. After the submission of the water use licence application, the Department of Water and Sanitation will evaluate the submitted information and based on the outcome of the evaluation Department of Water and Sanitation will decide whether or not to authorise the water use activities applied for by Anglo American Inyosi Coal (Pty) Ltd.

1.3 LEGAL REQUIREMENTS

Pro-active management of environmental impacts is required from the outset of mining activities. Internationally, principles of sustainable environmental management have developed rapidly in the past few years. Locally the Department of Water and Sanitation (DWS) and the mining industry have made major strides together in developing principles and approaches for the effective management of water within the industry. This has largely been achieved through the establishment of joint structures where problems have been discussed and addressed through co-operation.

The Bill of Rights in the Constitution of the Republic of South Africa, 1996 (Act 108 of 1996) enshrines the concept of sustainability; specifying rights regarding the environment, water, access to information and just administrative action. These rights and other requirements are further legislated through the National Water Act (NWA), 1998 (Act 36 of 1998). The NWA provides the DWS with the mandate to protect, use, develop, conserve, manage and control the country's water resources in an integrated manner. The latter is the primary statute providing the legal basis the development of tools and means to ensure that the above-mentioned mandate is achieved, which will ultimately lead to water management in South Africa and ensuring ecological integrity, economic growth and social equity when managing and using water. One of these tools is the authorisation of water use as defined in Chapter 4 of the National Water Act, 1998 (Act 36 of 1998) (NWA). According to section 22 (1) of Chapter 4 of the National Water Act, 1998 (Act 36 of 1998), no person may use water without a proper authorisation from the responsible authority, which in this case is the DWS. Section 21 further describes activities that constitute water uses.

Further to the above, the NWA introduced the concept of Integrated Water Resource Management (IWRM), comprising all aspects of the water resource, including water quality, water quantity and the aquatic ecosystem quality (quality of the aquatic biota and in-stream and riparian habitat). The IWRM approach provides for both resource directed and source directed measures.

The integration of resource and source directed measures forms the basis of the hierarchy of decision-taking aimed at protecting the resource from waste impacts. Policies have been developed to assist mines in preparing reports that will ensure that their operations are compliant to the relevant requirements. Operational policies and guidelines, which describe the rules applicable to different categories and aspects relating to waste discharge and disposal activities, are one of the instruments used by the DWS to prevent and manage impacts by mining activities on water resources, which are integrated in the water use authorisation processes.

In addition to the NWA, the following key legislation is also relevant to the IWULA processing:

- The National Environmental Management Act (NEMA), No 107 of 1998 as amended
- Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002)
- Mine Health and Safety Act (MHSA), No 29 of 1996, as amended
- National Environmental Management Biodiversity Act (NEMBA), No 10 of 2004.
- National Environmental Management Waste Act (NEMWA), No 59 of 2008.
- National Environmental Management Air Quality Act (NEMAQA), No 39 of 2004.

1.4 PURPOSE OF THIS IWUL APPLICATION

This report addresses the requirements of the National Water Act, Act 36 of 1998. It is written to meet the technical requirements for the applied for water uses, in that it indicates in detail the intended water uses and the potential impacts the water uses applied for could have on the water resources. It outlines the measures that must be taken to avoid, minimise, rectify, reduce or offsets the effects of the negative impacts and to enhance effects of the positive impacts.

The aim of this Report is therefore to:

- Provide information on the intended water uses;
- Show how authorities and interested and affected parties have and will in future be afforded the opportunity to contribute to the project, and to indicate the issues raised and the responses to those issues;
- Describe the baseline water and associated environment;
- Describe water management measures that will be undertaken by the mine; and
- Give a motivation for the water uses applied for.

SECTION TWO

Project Background & Context

2 PROJECT BACKGROUND AND CONTEXT

2.1 THE APPLICANT (ANGLO AMERICAN INYOSI COAL (PTY) LIMITED, A DIVISION ANGLO OPERATIONS (PTY) LIMITED

Anglo American plc which Anglo American Inyosi Coal (Pty) Ltd forms part of with its subsidiaries, joint ventures and associates is a global leader in the mining and natural resources sectors. It has significant and focused interests in gold, platinum, diamonds, coal, base and ferrous metals, industrial minerals and forest products, as well as financial and technological strength. The Group has operations and developments in Africa, Europe, South and North America and Australia.

Anglo American is a coal producer with mining operations in South Africa, Colombia, Venezuela, China, Canada and Australia. It produces thermal, PCI (pulverised coal injection) and metallurgical and coking coals to customers in the inland domestic markets as well as the export markets of Europe; North, Central and South America; South East Asia and the Far East.

2.2 THE APPLICANT'S ENVIRONMENTAL CONSIDERATIONS

Anglo American Inyosi Coal (Pty) Ltd's environmental policy subscribes to international best practice in environmental management. As such, all its operations at the time of listing on the London Stock Exchange (LSE) have been ISO 14001 certified. ISO is the international certification system for environmental management, which has continuous improvement as its basic principle. This target was achieved and has been maintained for Anglo American Inyosi Coal (Pty) Limited's mines. All new mines have the target of being ISO 14001 certificated within two years from the commencement of operations. Zibulo Colliery received ISO 14001:2004 accreditation in 2011 and is in the process of recertification.

Environmental Management Programme Reports (EMPRs) for Anglo American Inyosi Coal (Pty) Ltd mines give effect to the environmental commitments in the Anglo Operations (Pty) Limited and Anglo Coal Policies on Safety and Sustainability Development. The following environmental considerations apply at Zibulo Colliery and are found within their policy statement:

- Conserve and protect environmental resources through, amongst others the efficient use of energy and water, minimising waste and reducing pollution.
- Prevent or minimise adverse impacts arising from our operations.
- Demonstrate active stewardship of land, fresh water systems and biodiversity with which we interact.
- Commit to open communication with our employees, local contractors, suppliers, investors, business partners and other interested parties to encourage an environmentally responsible culture that reflects the intent of this policy.

- Comply with environmental legislation and other requirements to which we subscribe and develop a culture of improvement.

2.3 Overview of the Project

2.3.1 Name of the Applicant

Anglo American Inyosi Coal (Pty) Limited

2.3.2 Name of Mine

Zibulo Colliery (Underground)

2.3.3 Name of the Project

Zibulo Colliery Northern Underground Expansion

2.3.4 Address of the Applicant

P.O. Box 399

Ogies, 2230

2.3.5 General Manager

Mr. Walter Douglas Tollemache

2.3.6 Contact Person

Mr. Melchior Joseph (Email: Melchior.joseph@angloamerican.com)

2.4 Description of the Property

2.4.1 Name of the properties

Zibulo Colliery Underground was granted the following portions as part of their mining right: Portion 5 of the farm Boschpoort 211 IR; portions 1 and 3 of the farm Cologne 34 IS; portions 2, 3, 4, 6 7, 8, 11, 12, 13, 14, 15, 18, 19, 20, 21, 23, 24, 25, 26, 28, 33 and 34 of the farm Leeuwfontein 219 IR; the remaining extent of the farm Olga 35 IS; portions 1 and 3 of the farm Onverwacht 66 IS; portions 1, 2, 4, 6, 7, 8, 9, 10, 11 and the remaining extent of the farm Rietvlei 64 IS; portions 2, 3 and 5 of the farm Smithfield 44 IS; portions 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 15, 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32 and 33 of the farm Straffontein 252 IR; portions 2, 4, 5, 7, 11 and 14 of the farm Strehla 261 IR; the remaining extent the farm Uitvlugt 255 IR; portions 7 and 8 of the Vlakvarkfontein 213 IR; portions 1, 4, 7, 9, 10, 11, 16, 17, 18, 20, 21, 22, 198 and the remaining extent of the farm Welgelegen 221 IR; and portions 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and the remaining extent of the farm Zondagsfontein 253 IR.

As part of this application, only the portions on/ underneath which the water uses will take place will be mentioned and required for the IWUL. The Zibulo Colliery Northern Underground Expansion water use activities fall on/ underneath the following properties: Portions 21 and 23 of the farm Leeuwfontein 219 IR, the remaining extent (portion 0) and portions 9 and 11 of the farm Zondagsfontein 253 IR and portion 1 of the farm Rietvlei 64 IS. Table 2-1 provides a summary of the portions on/ under which the activities will take place as well as the type of activity that will take place. Although all of the above-mentioned properties have been authorised within the mining right, Zibulo Colliery is not mining underneath all of them at the moment. As the underground mining progresses, Anglo American Inyosi Coal (Pty) Ltd will apply for water use licenses depending on the needs of the time.

Table 2-1: Portions on/ under which water use activities occur

Water use activity	Water use applied for	Portion and farm
Various wetlands that will be undermined. A centre coordinate is given. Table 4-1 will provide a list of wetlands that will be undermined as well as the central coordinate of each. For the purposes of efficiency only one water use will be applied for.	Section 21 (c) and (i).	Portion 9 of the farm Zondagsfontein 253 IR.
Various infrastructures have been constructed within wetlands and within the regulated areas of multiple wetlands. These infrastructures will be grouped into one water use.		Portion 1 of the farm Rietvlei 64 IS.
A 40 000 m^3 underground PCD (1).	Section 21 (g).	Portion 1 of the farm Rietvlei 64 IS.
A 40 000 m^3 underground PCD (2).		Portion 11 of the farm Zondagsfontein 253 IR.
Pumping of water found underground via an underground pipe to one of the PCD's (1).	Section 21 (f).	Portion 1 of the farm Rietvlei 64 IS.
Pumping of water found underground via an underground pipe to one of the PCD's (2).		Portion 11 of the farm Zondagsfontein 253 IR.
Pumping groundwater out of the underground working for the continuation of mining and the safety of people (1).	Section 21 (j).	Portion 21 of the farm Leeuwfontein 219 IR.

Water use activity	Water use applied for	Portion and farm
Pumping groundwater out of the underground working for the continuation of mining and the safety of people (2).		Portion 23 of the farm Leeuwfontein 219 IR.
Pumping groundwater out of the underground working for the continuation of mining and the safety of people (3).		Portion 21 of the farm Leeuwfontein 219 IR.
Pumping groundwater out of the underground working for the continuation of mining and the safety of people (4).		The remaining extent of the farm Zondagsfontein 253 IR.
Pumping groundwater out of the underground working for the continuation of mining and the safety of people (5).		Portion 9 of the farm Zondagsfontein 253 IR.
Pumping groundwater out of the underground working for the continuation of mining and the safety of people (6).		Portion 21 of the farm Leeuwfontein 219 IR.

2.4.2 Application Area

The majority of the water uses (Table 2-1) at the Zibulo Colliery Northern Underground Expansion will take place underground. The two underground PCD's can store a maximum of 40 000 m^3 each, PCD 1 has been constructed and is currently in use, PCD 2 is planned and has not yet been constructed. The infrastructures constructed on portion 1 of the farm Rietvlei 64 IS are situated within a wetland as well as within the regulated area of various other wetlands. The application area (northern underground expansion) forms part of the Zibulo Colliery mining right and is located on an unnamed road linking Ogies (to the north of the application area) and Leandra (to the south of the application area).

2.4.3 Magisterial District & Regional Services Council

Magisterial : eMalahleni and Victor Khanye Magisterial Districts, Mpumalanga

District Municipality : Nkangala District Municipality

Local Municipality : eMalahleni and Victor Khanye Local Municipalities

2.4.4 Direction and Distance to Nearest Towns

Table 2-2: Direction and distance to nearest towns.

Town	Direction	Distance (km)
Ogies	North East	16 km
Leandra	South West	21 km
Kriel	South East	25 km
Delmas	North West	33 km

2.4.5 Location

The Zibulo Colliery Northern Underground Expansion water use activities will be situated below portions 21 and 23 of the farm Leeuwfontein 219 IR, the remaining extent (portion 0) and portions 9 and 11 of the farm Zondagsfontein 253 IR and portion 1 of the farm Rietvlei 64 IS. The Zibulo Underground Colliery is located on an unnamed road between the town of Ogies (16 km) and Leandra (21 km) in the eMalahleni Local Municipality within the Mpumalanga Province (Table 2-2). The water found underground will be pumped to the two underground dams, one is situated beneath the Zibulo Colliery Underground infrastructure area, whereas the second underground dam will be located beneath portion 11 of the farm Zondagsfontein 253 IR. All of the activities will take place within the approved underground mining area as well as the mining right area. See Figure 2-1 for the regional setting and Figure 2-2 for the locality plan for the new water use activities.

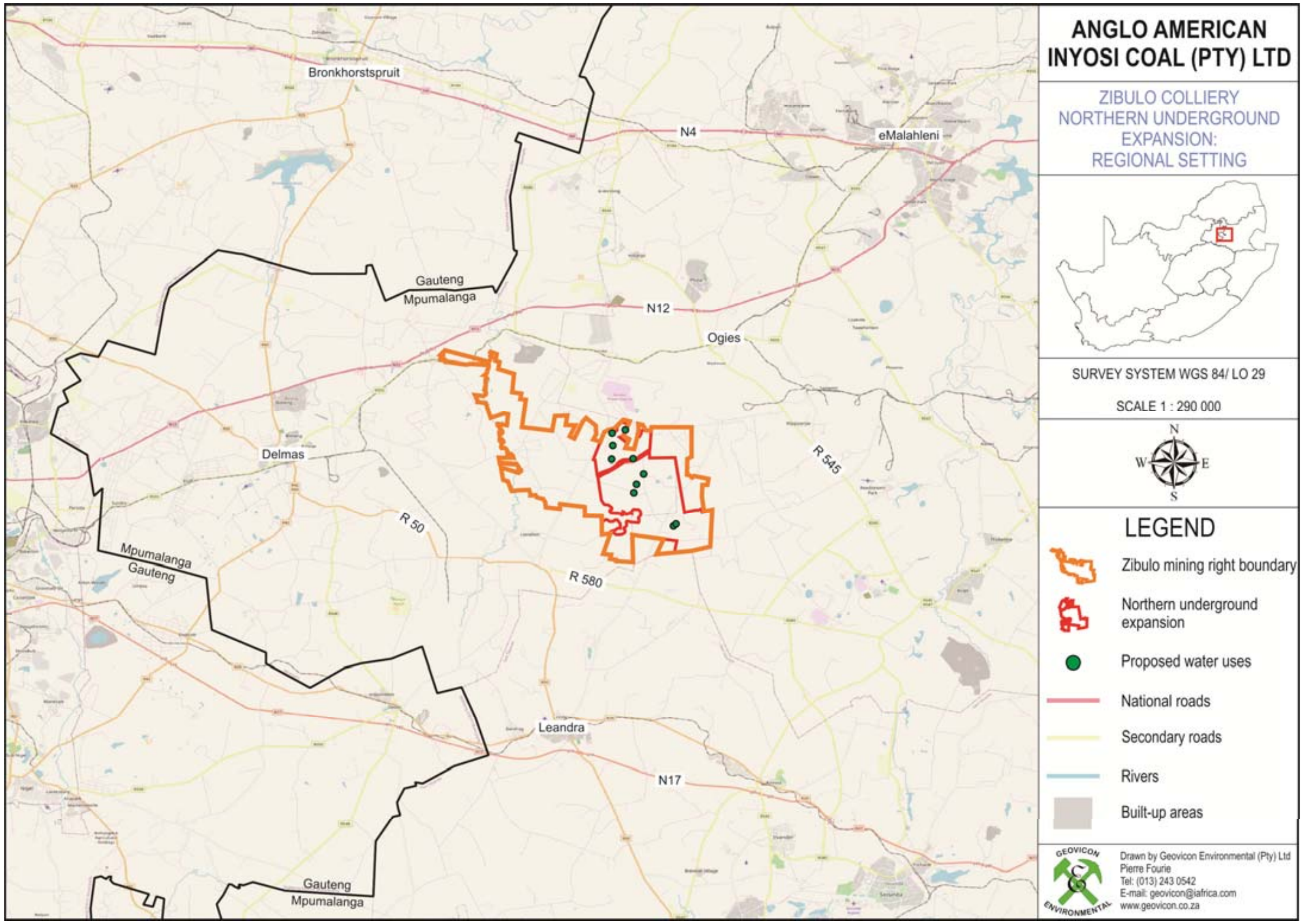

Figure 2-1: Zibulo Colliery Northern Underground Expansion regional setting

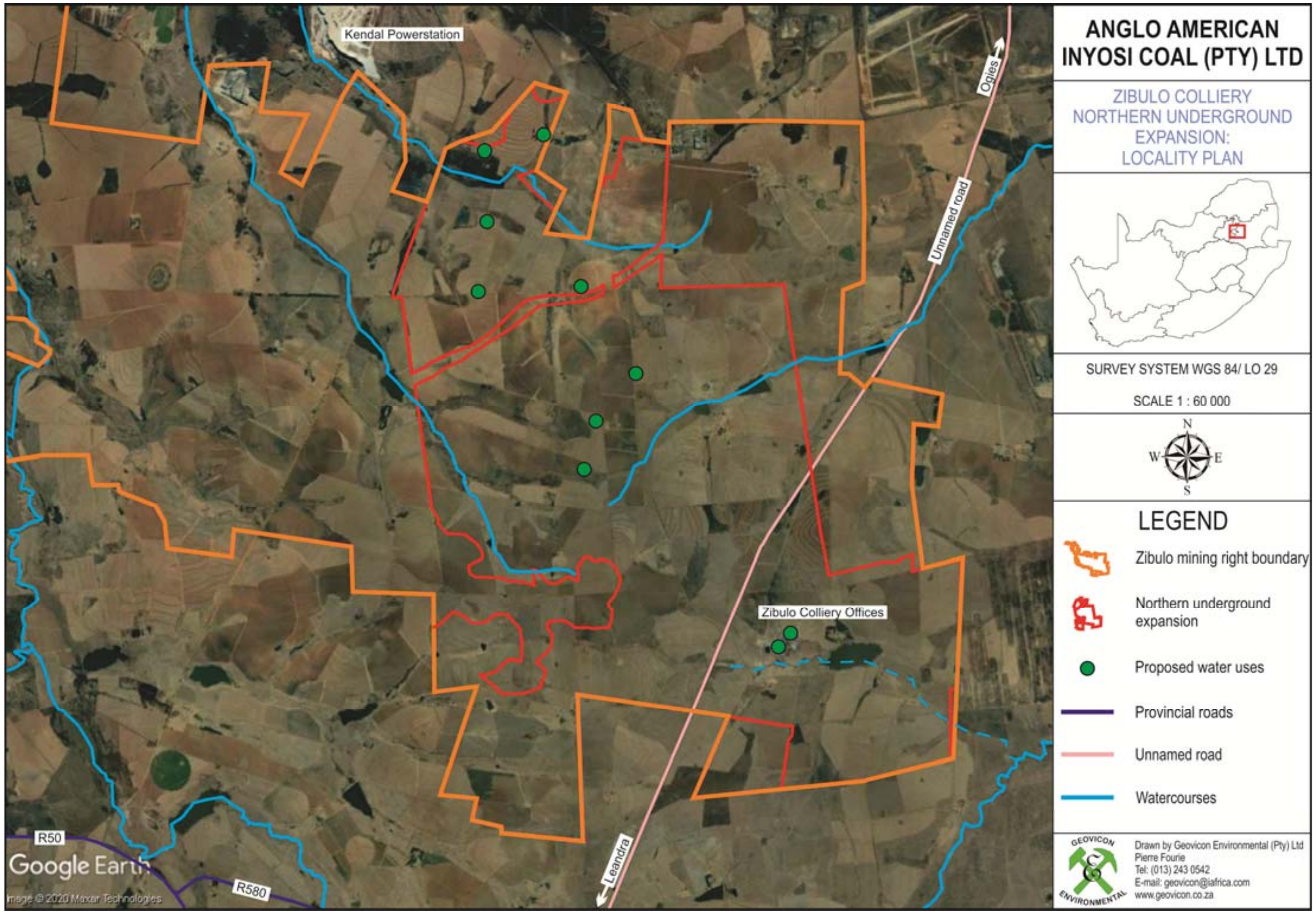

Figure 2-2: Zibulo Colliery Northern Underground Expansion locality plan

2.4.6 Name of River Catchments

The Zibulo Colliery Northern Underground Expansion water uses falls within the Upper Olifants River catchments. The Zibulo Colliery Underground Expansion water uses falls within the B11 tertiary drainage region of the Olifants River catchment. Within this tertiary region the water uses falls within the B11E, B11F and B20E quaternary drainage regions. The proposed water uses are separated within the three quaternary drainage regions as follows:

- B11E: Sections 21(g), (f), (c) and (i);
- B11F: Section 21(f);
- B20E: Section 21(j).

There are multiple perennial and non-perennial streams running across the area to be undermined. These streams drain primarily into the Rietspruit (B11E), Klippoortjiespruit (B11F) and the Wilge River (B20E), all of which flow into the Olifants River. The only surface impact, the infrastructure situated within the regulated areas of the wetlands, fall within the sub-catchments of the non-perennial tributaties of the Blesbokspruit. The Blesbokspruit is a tributary of the Rietspruit, which in turn is a tributary of the Steenkoolspruit. The Steenkoolspruit drains into the Olifants River upstream of the Witbank Dam.

2.4.7 Name of Direct Land Owners

Table 2-3 describes the properties on/ under which the proposed water uses for the Zibulo Colliery Northern Underground Expansion will take place.

Table 2-3: Description of direct landowners and their property

Farm	Portion	Surface Owner	Water Use
Rietvlei 64 IS	1	Anglo American Inyosi Coal (Pty) Ltd	Sections 21(c), (i), (g) & (f).
Leeuwfontein 219 IR	21	Cornelia Maria Bezuidenhout	Section 21(f).
	23	Truter Boerdery Trust	Section 21(f).
Zondagsfontein 253 IR	RE	Anglo American Inyosi Coal (Pty) Ltd	Section 21(f).
	9	Anglo American Inyosi Coal (Pty) Ltd	Sections 21(c), (i) & (f).
	11	Kallie Madel Trust	Sections 21(g) and (f).

2.5 DESCRIPTION OF THE SURFACE- AND UNDERGROUND INFRASTRUCTURE

2.5.1 Surface Infrastructure

Surface structure is located at the main area of the Zibulo Colliery Underground Operations. All of the surface infrastructure has been built and are licensed within the existing water use license. The surface infrastructure was not licensed in terms of Section 21(c) and (i) of the NWA (Act 36 of 1998) as they were constructed within wetlands as well as within the regulated areas of various wetlands. An updated wetland assessment has been conducted (Appendix 1) in which the new wetland boundaries have been delineated, the infrastructure located within and around these wetlands as well as the impact on the wetlands and mitigation measures. The following infrastructures are located within the wetlands as well as within the regulated areas of the various wetlands: vertical shafts for the transportation of people and materials, two PCD's, stone dust silo, roads, storm water management trenches, sewage treatment plant, storage areas, ventilation shaft and associated infrastructure, substations, multiple office blocks, training centres, security offices, parking areas, workshops and oil handling facilities, waste storage and handling areas, material shaft (R.O.M), coal silo, conveyor transfer area, three Erickson dams and the rock dump.

Up until 2017, there was limited excess mine water at the Zibulo underground section. The water pumped from underground was largely used for dust suppression on the mine. However, as the mine workings expanded, the groundwater ingress to the mine increased and the mine started to generate excess mine water. The excess water was sent via the opencast section to the EWRP for treatment. The water quality signature of the underground mine water is Sodium Chloride/ Sulphate and could not be treated at the EWRP. Blending with the Calcium Sulphate mine water from the opencast section was tried to reduce the sodium concentrations to acceptable levels for treatment but there was insufficient volume available to achieve the desired concentrations for treatment. AATC and South32 reached an agreement that the Zibulo underground mine water would replace the Klipspruit pit water used to beneficiate the coal at the Phola CHPP. The water quality of the Klipspruit mine water is similar to the Zibulo opencast water which can be treated in the EWRP. An equivalent volume of Klipspruit water would be sent to the EWRP. The water swop started in May 2017. The site consists of two major dams; 20ML Dam (PCD2) and 7.5 MLDam (PCD1). The 7.5ML Dam is used to collect the runoff from the Shaft and Workshop areas as well as the water pumped from underground. There are two pipelines that allow water to be pumped from the 7.5 ML to the 20 ML Dam. Water is abstracted from the 20ML Dam to supply the Phola CHPP or the same pipeline can be used to pump water to the 40ML Dam at the opencast section. Water is drawn off the pipeline to Phola CHPP to supply Ericson Dam 2 from where water is abstracted for the underground process water requirements as well as fire water. The Ericson Dam 1 receives potable water from the EWRP via the Phola CHPP. The potable water requirements at the underground offices and workshops are supplied from Ericson Dam 1 (Golder, 2019). See Figure 2-3 below for a graphical representation of the water reticulation system.

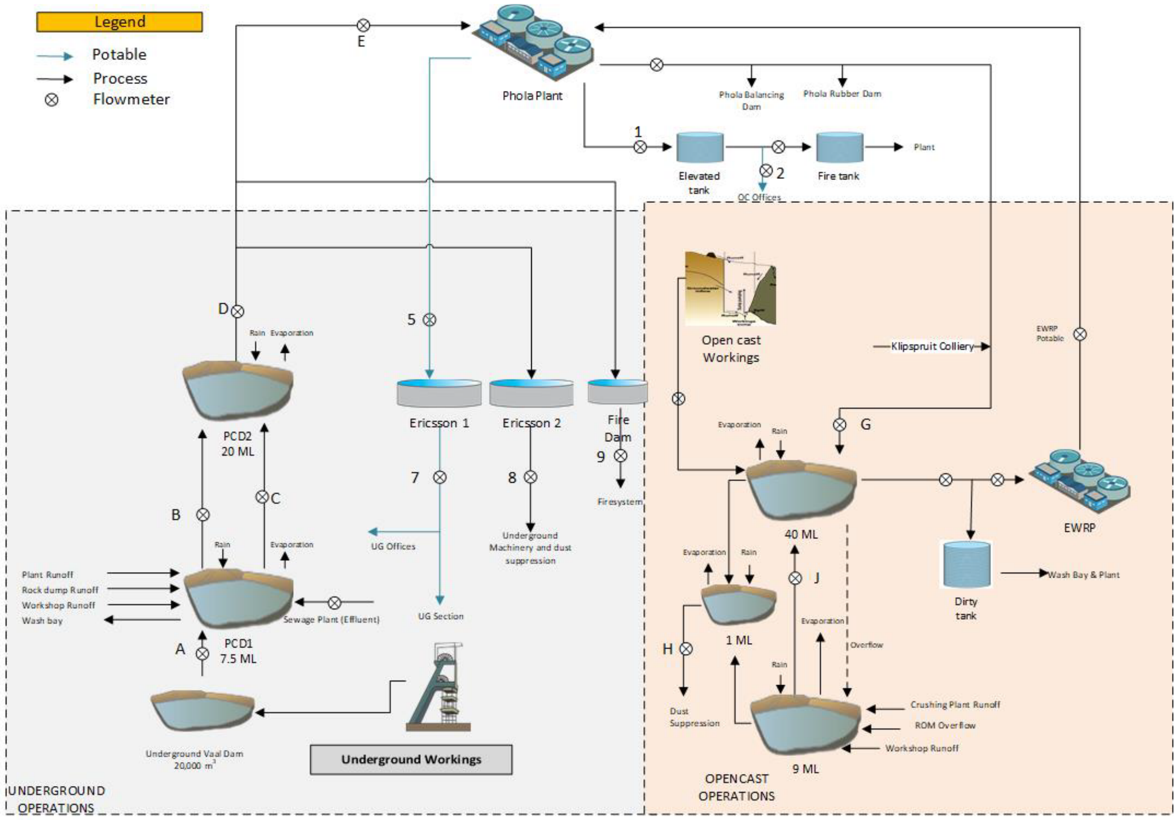

Figure 2-3: Zibulo Colliery Underground water reticulation system

2.5.2 Underground Infrastructure

The following underground infrastructure/ activities are to be licensed: Two 40 000 m^3 PCD's, one of which have been built and is currently in use and the second is to be constructed as the mining progresses. Both PCD's will be used to discharge water that is found underground during the mining activities. Water will be pumped from the underground PCD's to the surface PCD's and from there, via the 23km pipeline and a 26km pipeline to the eMalahleni Waste Water Treatment Works. Various pumps and plastic pipes will be used to pump water from the underground operations to the two underground PCD's. These pumps and pipes will be moved as the mining progresses and they are required. All other infrastructure found underground and used in the underground mining progress does not require licensing in terms of the NWA (Act 36 of 1998).

SECTION TWO

Water Uses Applied For

3 WATER USES APPLIED FOR

This section of the integrated water use licence application will describe the water uses that are applied for. Note that the mine i.e. Zibulo Colliery undertakes all its current water use activities under an integrated water use licence issued by the Department of Water and Sanitation. This is a new application for the water use undertaken during the operation of the northern underground expansion. See Figure 3-1 for the position of the water use activity applied for.

3.1 Impeding or Diverting the Flow of Water in a Watercourse (Section 21(c)) and Altering the Bed, Bank, Course or Characteristics of a Watercourse (Section 21(i))

According to the Department of Water and Sanitation's Water Use Authorisation Process (External Guideline), any activity that result in the change of physical characteristics of the water course, which include changes in the geohydrology and geology that affect groundwater fed system such as wetlands and any activity within the vicinity of the water course (not necessarily having a direct effect on the flow of water) that may affect the runoff and may lead to changes in the flow are defined as water use and hence requires a water use licence before commencement. In addition to the above, the Department of Water and Sanitation promulgated regulations for 21 (c) or (i) water uses general authorisations i.e. GNR 509 in terms of the National Water Act (Act 36 of 1998). According to this regulations, any activity that will occur within the regulated area defined as the outer edge of the 1 in 100 year flood line and/ or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or a 500 m radius from the delineated boundary (extent) of any wetland or pan must undergo a risk assessment to determine if it can be generally authorised. Should the risk be medium or high the activity cannot be generally authorised.

In view of the above, all activities that may result in the change of physical characteristics of the water course as determined by the DWS's Water Use Authorisation Process (External Guideline) will require a renewed water use licence before their commencement.

Evaluation of the wetland delineation report and the proposed activities to be conducted at the Zibulo Colliery Underground Area, has noted that a number of activities that may result in the change of physical characteristics of the water course will be undertaken within regulated area. These activities include the already constructed surface infrastructure (vertical shafts for the transportation of people and materials, two PCD's, stone dust silo, roads, storm water management trenches, sewage treatment plant, storage areas, ventilation shaft and associated infrastructure, substations, multiple office blocks, training centres, security offices, parking areas, workshops and oil handling facilities, waste storage and handling areas, material shaft (R.O.M), coal silo, conveyor transfer area, three

Erickson dams and the rock dump), and the undermining of various watercourses as part of the northern underground expansion.

3.2 Discharging Waste or Water Containing Waste into a Water Resource through a Pipe, Canal, Sewer or Other Conduit (Section 21(f))

According to Section 21 (f) of the National Water Act, 1998 (Act 36 of 1998) read together with the Department of Water Affairs and Forestry (2007) External Guideline: Generic Water Use Authorisation Application Process, water use defined in terms of the above section entails the discharge of waste or wastewater directly into a water resources. According to the external guideline, discharge of waste water via a pipeline into a water resource requires a water use licence.

It is proposed that excess groundwater emanating from the underground mining workings at Zibulo Colliery Underground be pumped into one of two underground pollution control dams. Each underground PCD has a capacity of 40 000 m^3. Note that the water pumped is considered waste water since it would have come in contact with coal and the underground workings are considered as water resources since they are accumulating seepage water from the surrounding groundwater regime. The waste water is then pumped to the licensed surface PCD's and pumped from there to various other licensed activities. These activities include the Phola Washing Plant and the eMalahleni Waste Water Treatment Works.

Based on the above, a 21 (f) water use licence application will be required and is hence applied for.

3.3 Disposing of Waste which may Detrimentally Impact on a Water Resource (Section 21(g))

Section 21 (g) states that any activity that disposes of waste in such a way that it has a detrimental impact on a water resource must be licensed. Zibulo Colliery proposes to license the two, underground 40 000 m^3 PCD's in accordance with this Section that water found underground will be discharged into and stored on a temporary basis. Note that the water pumped is considered waste water since it would have come in contact with coal and the underground workings are considered as water resources since they are accumulating seepage water from the surrounding groundwater regime. The waste water is then pumped to the licensed surface PCD's and pumped from there to various other licensed activities. These activities include the Phola Washing Plant and the eMalahleni Waste Water Treatment Works.

3.4 Removing, Discharging or Disposing of Water Found Underground if it is Necessary for the Effective Continuation of an Activity or for the Safety of People (Section 21(j))

Groundwater that flows into the underground mine workings will be pumped, via pipes, to the underground PCDs' so that the underground mining can continue and to ensure the safety of all of the employees.

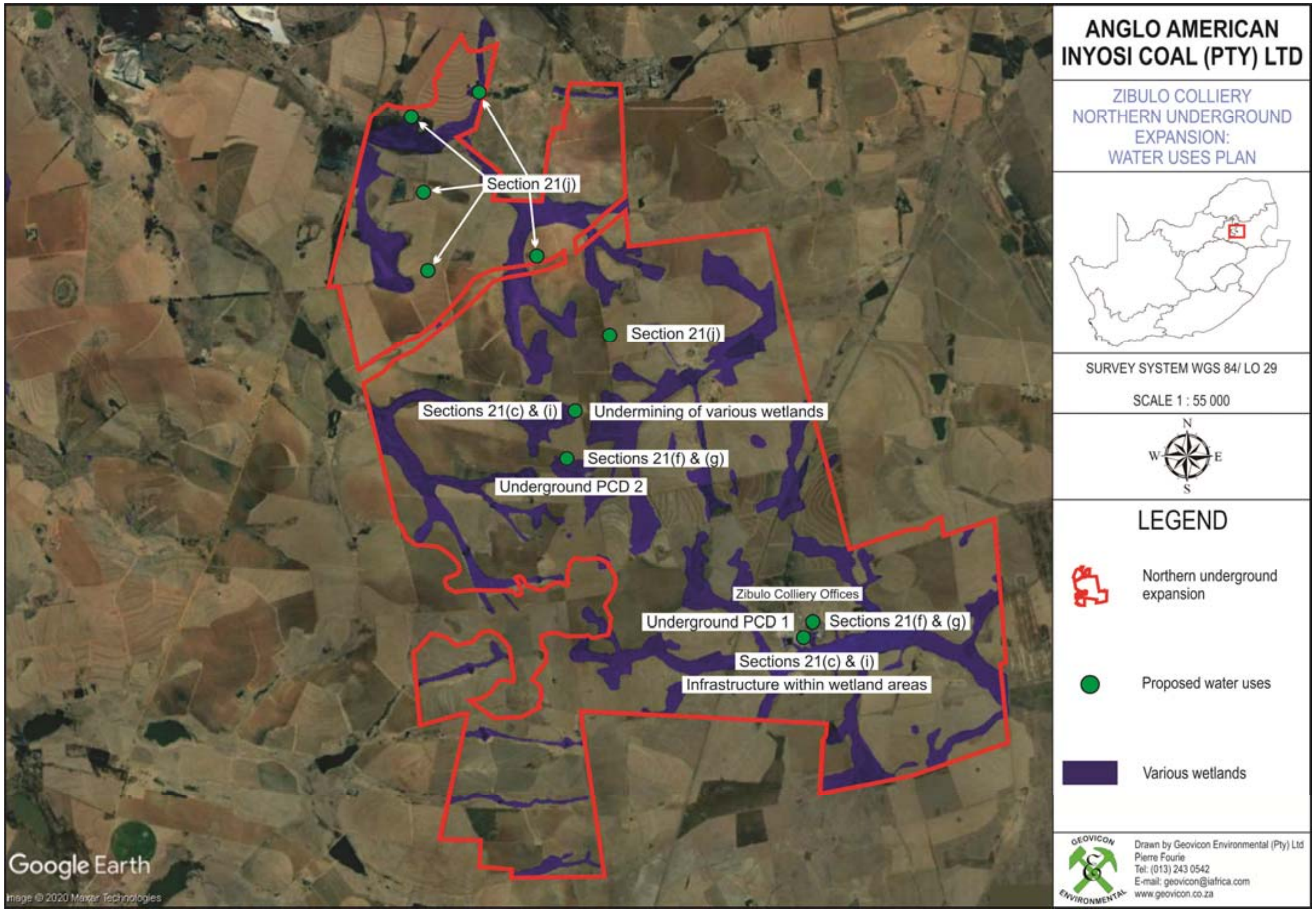

Figure 3-1: Zibulo Colliery Northern Underground Expansion water use locations

SECTION THREE

Legal Assessment

4 LEGAL ASSESEMENT

4.1 NATIONAL WATER ACT

According to the National Water Act, 1998 (Act No. 36 of 1998), the National Department of Water and Sanitation has an overall responsibility for and authority over water resource management, which includes the allocation and use of water in the interest of the public. In view of the above, a person is only entitled to use water if the water use is permissible under the National Water Act, 1998 (Act No. 36 of 1998).

4.1.1 Applicable sections

Section 21: Water Use

Section 21 of the National Water Act (Act 36 of 1998) defines water use into eleven different uses which include - taking water from a water resource; storing water; impeding or diverting the flow of water; engaging in a stream flow reduction activity; engaging in a controlled activity; discharging of waste or water containing waste into a water resource; disposing of waste in a manner which may detrimentally impact on a water resource; disposing of water containing waste or which has been heated; altering the bed, banks, course or characteristics of a watercourse; removing of water found underground if it is necessary for efficient continuation of an activity and using water for recreational purposes.

Section 22: Permissible Water Uses

Section 22 of the National Water Act (Act 36 of 1998) gives conditions, limitations, restrictions, prohibitions, standards and practises that must be adhered to by any person who use water without a licence.

4.1.2 Summary of Water Uses Applied For

Table 4-1 below gives a summary of the water uses that are being applied for. The project area, which includes the undermining of various watercourse/ wetlands, the two, 40 000 m^3 underground PCD's, pumping water from the underground working for the continuation, pumping water from the underground workings through pipes to the PCD's and licensing the infrastructure that has been constructed within the wetlands and the 500m regulatory area of the wetlands.

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Table 4-1: Summary of the Zibulo Colliery Northern Underground Expansion water use applied for

Type of Water Use	Quantities/ Area	Property	Coordinates	
			Latitude	Longitude
Section 21 (c): Impeding or diverting the flow of water in a watercourse and Section 21 (i): Altering the bed, bank, course or characteristics of a watercourse.				
Infrastructure (vertical shafts for the transportation of people and materials, two PCD's, stone dust silo, roads, storm water management trenches, sewage treatment plant, storage areas, ventilation shaft and associated infrastructure, substations, multiple office blocks, training centres, security offices, parking areas, workshops and oil handling facilities, waste storage and handling areas, material shaft (R.O.M), coal silo, conveyor transfer area, three Erickson dams and the rock dump.) situated within the 500m regulatory area of multiple wetlands.	11 ha	Portion 1 of the farm Rietvlei 64 IS.	-26.204507	29.018074
Undermining of various watercourses. The following wetlands (a centre point for each is provided) will be undermined or undermining will be conducted within the regulated area:	-	Portions 11, 12, 13, 18, 21, 23, 24, 25 and 26 of the farm Leeuwfontein 219 IR. The remaining extent, portions 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11 of the farm Zondagsfontein 253 IR. The remaining extent of the farm Olga 35 IS. Portions 2, 4, 5, 7, 11 and 14 of the farm Strehla 261 IR. Portions 2, 3 and 5 of the farm Smithfield 44 IS. The remaining extent of the farm Uitvlugt 255 IR. Portion 1 of the farm Onverwacht 66 IR.	-26.168905	28.986782

Type of Water Use	Quantities/ Area	Property	Coordinates	
			Latitude	Longitude
		The remaining extent, portions 1, 2, 4, 6, 7, 8, 9, 10, 11 and 12 of the farm Rietvlei 64 IS.		
Wetland Type		**Area (ha)**		
Channelled valley bottom.		10.01	-26.233507	28.975753
Hillslope seepage.		6.79	-26.232604	28.975075
Channelled valley bottom.		14.84	-26.224100	28.970721
Channelled valley bottom.		9.74	-26.215230	28.973311
Hillslope seepage.		17.32	-26.225592	29.022767
Unchannelled valley bottom.		3.64	-26.224560	29.031751
Channelled valley bottom.		42.05	-26.216389	29.025096
Hillslope seepage.		9.1	-26.219017	29.022660
Pan.		1.41	-26.219389	29.034612
Hillslope seepage.		15.64	-26.223103	29.038476
Unchannelled valley bottom.		12.52	-26.220106	29.045817
Channelled valley bottom.		57.42	-26.209382	29.043009
Hillslope seepage.		13.23	-26.207318	29.037985

Type of Water Use	Quantities/ Area	Property	Coordinates	
			Latitude	Longitude
Channelled valley bottom.		10.01	-26.204426	29.047238
Hillslope seepage.		4.51	-26.192688	29.045899
Hillslope seepage.		4.57	-26.208850	29.033680
Channelled valley bottom.		102.39	-26.206946	29.009446
Hillslope seepage.		1.82	-26.208783	29.021069
Hillslope seepage.		10.03	-26.196658	29.030089
Channelled valley bottom.		18.36	-26.198509	29.027754
Hillslope seepage.		24.82	-26.202285	29.015243
Hillslope seepage.		1.26	-26.204734	29.024041
Hillslope seepage.		1.95	-26.205437	29.020240
Hillslope seepage.		7.15	-26.206235	28.983981
Hillslope seepage.		30.62	-26.205479	28.988427
Hillslope seepage.		25.75	-26.203844	28.989844
Channelled valley bottom.		7.22	-26.203406	28.970309
Unchannelled valley bottom.		7.94	-26.202361	28.974452
Channelled valley bottom.		22.86	-26.200366	29.009406

Type of Water Use	Quantities/ Area	Property	Coordinates	
			Latitude	Longitude
Hillslope seepage.		16.86	-26.193914	29.007366
Hillslope seepage.		34.02	-26.193914	29.007366
Pan.		3.17	-26.180585	29.025647
Hillslope seepage.		47.44	-26.183385	29.019277
Channelled valley bottom.		6.99	-26.181275	29.019228
Pan.		1.12	-26.172687	29.017712
Hillslope seepage.		0.8	-26.179092	29.017219
Pan.		3.88	-26.176570	29.014791
Hillslope seepage.		3.23	-26.179092	29.017219
Channelled valley bottom.		29.42	-26.192674	28.969858
Channelled valley bottom.		128.16	-26.170196	28.956895
Hillslope seepage.		3.9	-26.183893	28.990280
Pan.		0.53	-26.187102	28.983672
Hillslope seepage.		33.81	-26.184108	28.995212
Unchannelled valley bottom.		9.63	-26.182745	28.974175
Hillslope seepage.		7.89	-26.183543	29.006312

Type of Water Use	Quantities/ Area	Property	Coordinates	
			Latitude	Longitude
Hillslope seepage.		7.65	-26.183564	28.979485
Pan.		0.64	-26.184819	28.983005
Unchannelled valley bottom.		13.7	-26.180809	29.005933
Unchannelled valley bottom.		22.18	-26.176945	28.992600
Channelled valley bottom.		32.53	-26.172041	28.996414
Hillslope seepage.		77.21	-26.175295	28.992844
Hillslope seepage.		3.55	-26.176124	29.001289
Channelled valley bottom.		8.34	-26.171496	29.005703
Hillslope seepage.		44.25	-26.170323	28.981302
Hillslope seepage.		13.81	-26.166680	29.011110
Hillslope seepage.		1.98	-26.167217	28.973103
Unchannelled valley bottom.		2.92	-26.167302	28.999805
Hillslope seepage.		4.24	-26.166150	29.001653
Channelled valley bottom.		4.93	-26.165364	29.008661
Hillslope seepage.		6.84	-26.164984	28.994749
Channelled valley bottom.		1.42	-26.163065	29.002685

Type of Water Use	Quantities/ Area	Property	Coordinates	
			Latitude	Longitude
Hillslope seepage.		22.73	-26.162292	28.981944
Hillslope seepage.		56.66	-26.157972	29.017871
Hillslope seepage.		4.06	-26.155253	29.019028
Channelled valley bottom.		9.35	-26.158581	29.019790
Unchannelled valley bottom.		70.49	-26.148437	28.979667
Hillslope seepage.		8.2	-26.159592	29.000606
Hillslope seepage.		15.74	-26.158149	28.987544
Pan.		1.38	-26.155806	28.966779
Unchannelled valley bottom.		67.52	-26.142524	28.990553
Hillslope seepage.		3.78	-26.152388	28.993696
Unchannelled valley bottom.		7.47	-26.151055	29.00917
Hillslope seepage.		4.38	-26.149801	28.990778
Hillslope seepage.		77.87	-26.138209	28.956472
Hillslope seepage.		5.58	-26.147427	28.997703
Channelled valley bottom.		11.95	-26.140158	28.981834
Channelled valley bottom.		42.63	-26.128975	28.973520

Type of Water Use	Quantities/ Area	Property	Coordinates	
			Latitude	Longitude
Hillslope seepage.		6.93	-26.131023	28.958688
Hillslope seepage.		46.67	-26.127707	28.972836
Hillslope seepage.		2.34	-26.125503	28.997989
Channelled valley bottom.		4.36	-26.124933	28.992657
Pan.		0.1	-26.122011	28.965104
Section 21 (f): Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit.				
Groundwater will be discharged through a pipe into one of the underground PCD's.	42 573 m^3/a	Portion 1 of the farm Rietvlei 64 IS.	-26.20269	29.02019
Groundwater will be discharged through a pipe into one of the underground PCD's.	42 573 m^3/a	Portion 11 of the farm Zondagsfontein 253 IR.	-26.17618	28.98449
Section 21 (g): Disposing of waste in a manner which may detrimentally impact on a water resource.				
Underground PCD 1 into which groundwater is pumped from the underground workings.	40 000 m^3/a	Portion 1 of the farm Rietvlei 64 IS.	-26.20269	29.02019

Type of Water Use	Quantities/ Area	Property	Coordinates	
			Latitude	Longitude
Underground PCD 2 into which groundwater is pumped from the underground workings.	40 000 m^3/a	Portion 11 of the farm Zondagsfontein 253 IR.	-26.17618	28.98449
Section 21 (j): Removing, discharging or disposing of water found underground if it is necessary for the effective continuation of an activity or for the safety of people.				
Water (natural groundwater) pumped from the underground workings for the continuation of mining.	5 256 m^3/a	Portion 21 of the farm Leeuwfontein 219 IR.	-26.13656	28.96667
Water (natural groundwater) pumped from the underground workings for the continuation of mining.	10 512 m^3/a	Portion 23 of the farm Leeuwfontein 219 IR.	-26.12314	28.97736
Water (natural groundwater) pumped from the underground workings for the continuation of mining.	52 560 m^3/a	Portion 21 of the farm Leeuwfontein 219 IR.	-26.12610	28.96612
Water (natural groundwater) pumped from the underground workings for the continuation of mining.	1 051 m^3/a	The remaining extent of the farm Zondagsfontein 253 IR.	-26.16021	28.99276
Water (natural groundwater) pumped from the underground workings for the continuation of mining.	5 256 m^3/a	Portion 9 of the farm Zondagsfontein 253 IR.	-26.14771	28.98397

Type of Water Use	Quantities/ Area	Property	Coordinates	
			Latitude	Longitude
Water (natural groundwater) pumped from the underground workings for the continuation of mining.	10 512 m^3/a	Portion 21 of the farm Leeuwfontein 219 IR.	-26.14804	28.96576

4.1.3 Summary of Relevant Exemptions

Existing Lawful Water Uses

In terms of Section 32 of the NWA, an Existing Lawful Water Use (ELWU) is defined as follows:

"*Water use which has taken place at any time during a period of two years immediately before the date of commencement of the Act (1 October 1996 to 30 September 1998) and which was authorised by or under any law which was in force immediately before the date of commencement of this Act, or which has been declared an existing lawful water use in terms of Section 33 of the Act*".

Summary of GN 704 Exemptions Required

The Department of Water and Sanitation is responsible for the protection, use, development, conservation, management and control of the water resources of South Africa on a sustainable basis. The GN 704 Regulations were promulgated as minimum requirements to fulfil the above-mentioned goal.

In view of the above, Anglo American Inyosi Coal (Pty) Limited does not require any exemptions for the Northern Underground Expansion and associated water uses.

4.1.4 Summary of General Authorisations

In terms of Section 22(1) of the NWA a person may use water without a licence if that water use is permissible in terms of a General Authorisation (GA) issued under Section 39 of the Act.

An assessment was done of the General Authorisations under the NWA, namely:

- General Authorisation No. 399, dated 26 March 2004 in terms of Sections 21 (e), (f) (g) and (h) water uses;
- General Authorisation No. 398, dated 26 March 2004 in terms of Section 21 (j) water use;
- General Authorisation No. 538 of September 2016 in terms of Section 21 (a) and (b) water uses;
- General Authorisation No. 509, dated 26 August 2016 in terms of Sections 21 (c) and (i) water uses.

No general authorisation is applied for, for the Zibulo Colliery Northern Underground Expansion.

4.1.5 Compliance with Section 27 of the National Water Act

Section 27 of the National Water Act, Act 36 of 1998 sets out factors that should be considered by the Department of Water and Sanitation before issuing water use licenses. This section of the report will describe in detail the relevancy of the above-mentioned factors in relation to the water uses that are applied for and how the mine will comply with the requirements of section 27 of the National Water Act, Act 36 of 1998.

Section 27(1)(a): Existing Lawful Use

Section 32(1)(2) of the National Water Act, 1998 (Act 36 of 1998) gives a definition of an existing lawful water use. Based on the above section, any water uses which has taken place at any time during the period of two years immediately before the date of commencement of the National Water Act, 1998 and which was authorised under any law which was in force immediately before the date of commencement of the National Water Act, 1998 (Act 36 of 1998) is an existing lawful water use.

Section 27(1)(b): Redressing Results of Past Discrimination

A stable workforce, representing every aspect of South Africa's demographics are currently under employment at the Zibulo Colliery mining operations. The operation of the Zibulo Colliery underground area allows for continued and efficient coal supply to Anglo American Inyosi (Pty) Limited's clients and will ensure both temporary and permanent jobs at Zibulo Colliery.

Benefits from the above-mentioned continuation of the mining operation include amongst others the profits from the sales of the mined minerals, contracts from the mining of the minerals, other contracts associated with the mining operations, remunerations resulting from occupation of senior or managerial positions and community development initiatives. The implementation of the Social and Labour Plan for Zibulo Colliery also goes a long way in redressing the results if past discrimination.

Section 27(1)(c): Efficient and Beneficial use of Water in the Public Interest

Anglo American Inyosi Coal (Pty) Ltd commits to undertake its water uses in such a manner that the water resources in the vicinity of the mine are efficient and beneficial to the public. The public in this case will be the organisations that have been identified through the public consultation process, the immediately adjacent land owners, the relevant state organs and the applicant. This section of the report will therefore illustrate how Anglo American Inyosi Coal (Pty) Ltd intends on using the water within its sub catchment to be of beneficial use for the interest of the public.

Through the Integrated Water Use License, the water uses will be undertaken, managed and controlled in such a way to ensure that pollution and degradation of the water resources are minimised, hence protection of the water resource. This will further ensure that all water users within the sub catchment are not negatively impacted by the water uses applied for.

Anglo American Inyosi Coal (Pty) Ltd has designed its Zibulo Colliery Northern Underground Expansion and associated water uses in such a way that as much as possible of the impacts are situated within the underground areas and to make use of existing infrastructure. The already constructed infrastructure within the 500 m regulatory area of various wetlands have been designed in such a way as to have a limited impact on the wetlands. These infrastructure areas have been provided with stormwater management infrastructure to contain any surface water contamination by diverting any contaminated surface water runoff to the two surface PCDs'. All other activities take place underground, deep enough below the surface to have limited impact on watercourses and surface water users.

Section 27(1)(d): Socio-economic Impact

If water use is authorised:

Anglo American Inyosi Coal (Pty) Ltd believes in investing in communities beyond the workforce due to the following reasons i.e. it increases opportunities for outsourcing various activities, through increasing capacity of local business, it decreases the dependence of neighbouring communities on the mine; it increases the labour pool from which to secure local employees and it contributes towards a more stable community, particularly where development of human capital contributes to the increased quality of life and decreases poverty and associated ills. The results of this philosophy can be seen by the outcome of the implementation of the Social and Labour Plan for the mine.

The continued success of Zibulo Colliery not only to the shareholders but also to the local communities heavily depends on the authorization of the water uses applied for. The successful implementation of the Zibulo Colliery Northern Underground Expansion project will result in the mine having the ability to continue with the mining and processing of the mined coal reserves. The continuation of the operation of Zibulo Colliery will enhance the results noted from the implementation of the community and workforce development programmes.

The continuation of the undertaken water uses applied for will be an integral part of the entire Zibulo Colliery, which will have positive impacts in terms of the economic growth of the eMalahleni local economy. The continuation of the operations at Zibulo Colliery will ensure that the economy of eMalahleni Local Municipality continue to grow. The mine will continue with the implementation of a local economic development programme that will see a number of projects being initiated. These projects are intended to uplift the local communities. These projects will be targeting the growth of the local economy especially for the small and medium entrepreneurs within the immediate local authority jurisdiction. This will benefit the local communities in that a number of business opportunities will be created.

The continuation of the Zibulo Colliery Northern Underground Expansion project will hence result in sustaining of old job opportunities.

If water use is not authorised:

The continuation of the Zibulo Colliery Northern Underground Expansion project will results in sustaining employment directly and indirectly via contractors used at the site and the ability of the mine continue with their mining and processing operation and if the water uses are not authorised the mine will not be able to continue mining when a breakdown or maintenance of the conveyor occurs. Hence resulting in possible premature closure of the mining operation, resulting in the loss of the opportunity to create or sustaining job opportunities. This will not only affect the mine but the larger public.

As mentioned before, Anglo American Inyosi Coal (Pty) Ltd has already formed contracts with their suppliers to supply coal. If the water uses are not authorised, Anglo American Inyosi Coal (Pty) Ltd will not be able to honour their supply contracts. This will not only affect Anglo American Inyosi Coal (Pty) Ltd financially but will affect their clients.

Thus, the consequences of not proceeding with this project will have a detrimental impact on the labour force, the surrounding previously disadvantaged community, the owners of the mine, and the coal export and inland market. This may ultimately have an impact on the region as a whole, due to a loss of revenue and taxes.

Section 27 (1)(e): Applicable Catchment Management Strategy

The Department of Water and Sanitation is responsible for the National Water Resource Strategy for South Africa. According to the National Water Act, 1998 (Act 36 of 1998), a Catchment Management Agency should be established for each water management area. The Catchment Management Agency will then be responsible for the Catchment Management Strategy for each water management area. The aim of the Catchment Management Strategy is to set principles for allocating water to existing and prospective water users, considering the protection, use, development, conservation, management and control of water resources.

Section 27(1)(f): Impact of Mining Activities on Water Resources and Water Users

Anglo American Inyosi Coal (Pty) Ltd is committed to managing impacts from their mining activities, which include the impacts from the water transfer pipeline water uses being applied for, to be within acceptable limits. Specialist studies were conducted to qualify and quantify these impacts. The impacts that may arise during, and after the water transfer pipeline project were determined and ranked according to their significance. Management measures for all the negative environmental impacts were determined and are measurable, and the effectiveness of the measures can be audited.

An extensive monitoring programme including surface- and groundwater monitoring has been specifically devised for the Zibulo Colliery Underground which will include the emergency stockpile. The monitoring data from this monitoring programme enables Zibulo Colliery to critically evaluate their water uses and make timely adjustments if and where necessary.

Section 27(1)(g): Class and Resource Quality Objectives

The South African Water Quality Guidelines are used for the Water Quality Objectives. The Minister of Department of Water and Sanitation is required to establish a classification system, and to determine the class and resource quality objectives for all or part of the resources considered to be significant. A determination of the preliminary class or resource quality objectives will be requested, which will include the water quality and quantity objectives for the reserve.

Section 27(1)(h): Investments already made and to be made

The emergency stockpile constitutes an investment on behalf of Anglo American Inyosi Coal (Pty) Ltd (Zibulo Colliery) and is carried out in the interest of protecting the environment and to continue exploiting their coal reserve in a sustainable way.

Section 27(1)(i): Strategic Importance of the Water use to be Authorised

The commencement and continuation of the Zibulo Colliery's Northern Underground Expansion is of strategic importance to the community of the eMalahleni Local Municipality. The continuation of underground mining will ensure that Zibulo Colliery can reach their targets and supply all of their clients with the required coal.

Further to the above, the authorisation of the water use applied for in this application will ensure that the current employment levels at the mine are sustained. The above with the effect of the multiplier effect will ensure that many families are catered for during the operation of the mine.

Section 27(1)(j): Water Resource Quality Requirements for the Reserve

Section 16 of the National Water Act, 1998 (Act 36 of 1998), requires that the Minister of the Department of Water and Sanitation determine the Reserve for the river system before any license can be issued.

The Reserve consists of two parts: namely, the basic human need and the ecological reserve, which must be determined for all or part of any significant water resource. The Reserve is basically a specification of the amount of water that must be present in water resources as well as the quality of the water for the water resource to remain ecologically healthy and to be able to provide water for basic human needs.

If a resource has not yet been classified, a preliminary determination of the Reserve may be made and later superseded by a new one. Once the Reserve is determined for a water resource, it is binding in the same way as the class and the resource quality objectives.

The determination of the reserve is the competency of the Department of Water and Sanitation, hence Anglo American Inyosi Coal (Pty) Ltd will via the submission of this licence rely on DWS to determine the reserve for the mining area.

Section 27(1)(k): Duration of the Water Uses in Relation to the Northern Underground Expansion Project

The duration of the water uses applied for will be entirely dependent on the duration of the Zibulo Colliery Northern Underground Expansion project. In view of the above and the fact that the Northern Underground Expansion and associated infrastructure will be used for the entire operational phase of the mine, Anglo American Inyosi (Pty) Limited (Zibulo Colliery) requests that the maximum duration for a water use licence be issued to this application.

4.2 OTHER STATUTORY REQUIREMENTS

The following environmental legislation must be complied with for the Zibulo Colliery Northern Underground Expansion:

National Environmental Management Act, 1998 (Act 107 of 1998):

Anglo Coal a division of Anglo Operations (Pty) Limited has been issued an environmental authorisation for the Zibulo Colliery Underground in terms of section 22 of the largely repealed Environmental Conservation Act, 1989 (Act 73 of 1989). This legislation has been replaced by the National Environmental Management Act, 1998 (Act 107 of 1998). Zibulo Colliery Underground has applied for an amendment of their EIA/ EMPr to address all of the impacts that were not part of the original EIA/ EMPr.

4.3 Water Use Licence Application Forms

For the purpose of the integrated water use licence application the following application forms are submitted to the DWS in electronic form (eWULAAS) i.e. DW 758, DW 763, DW 766, DW 767, DW 768, DW 805, DW 901, DW 902 and DW 905. Figure 3-1 illustrate the position of the water use applied for to be undertaken at the Zibulo Colliery Northern Underground Expansion.

4.4 Public Participation Process

Public participation is the cornerstone of the EIA process. The principles of the NEMA govern many aspects of EIA's, including public participation. The general objectives of integrated environmental management laid down in the NEMA include to "*ensure adequate and appropriate opportunity for public participation in decisions that may affect the environment*". The National Environmental Management Principles include the principle that "*The participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary to achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured*", which basically means that the person responsible for the application (EAP) must ensure that provision of sufficient and transparent information on an ongoing basis to stakeholders are made to allow them to comment, and to ensure that the participation of previously disadvantaged people like women and the youth are undertaken.

4.4.1 Details of the Public Participation Process followed and Results Thereof

In terms of Regulations 17, 18 and 19 of the regulations regarding the procedural requirements for the water use license applications and appeals (No. R. 267) of the NWA, 1998 (Act no. 36 of 1998) under sections 21(6)(*k*) and 41(6), when applying for a new IWUL, the Environmental Assessment Practitioner managing the application must conduct a public participation process where all potential or registered interested and affected parties, including the competent authority, are given a period of at least 30 days to submit comments on the new IWUL and Brief Application Report (BAR) (NWA Regulations, 2017).

This section of the BAR will give an explanation of the public participation process taken so far in order to comply with the above-mentioned requirements. A number of public participation guidelines were published in a bid to assist persons responsible for the IWUL. As much of the available guidelines were used in determining the public participation process, in guiding the public participation process of the proposed project.

Anglo American Inyosi Coal (Pty) Ltd is applying for a new WUL with regards to the previously mentioned water uses for the Zibulo Colliery – Underground Operations.

In view of the above, a public participation process will be initiated for the new water uses that will form part of a new IWUL. The public participation process for the proposed project is designed to provide sufficient and accessible information to interested and affected parties (I&APs) in an objective manner to assist them to:

- raise issues of concern and make suggestions for enhanced benefits;
- contribute local knowledge and experience;
- verify that their issues have been captured;
- verify that their issues have been considered in the technical investigations; and
- comment on the findings of the EIA and the BAR.

The following were conducted in undertaking of the public participation process for the proposed project.

4.4.2 Notification of Potential Interested and Affected Parties

Due to the current Covid-19 Emergency Regulations proper Public Participation cannot be currently conducted. Once the Emergency Regulations have been lifted, proper Public Participation will be conducted.

4.4.3 Registered Interested and Affected Parties

The following will be registered as interested and affected parties for Zibulo Colliery:

- Department of Mineral Resources, Mpumalanga Regional Office (Competent Authority);
- Department of Water and Sanitation, Mpumalanga Regional Office (Commenting Authority);
- Department of Agriculture, Rural Development, Land and Environmental Affairs, Mpumalanga Provincial Office (Commenting Authority);
- SANRAL;
- Mpumalanga Tourism and Parks Agency (Commenting Authority);
- South African Heritage Resources Agency (Commenting Authority);
- National Department of Agriculture, Forestry and Fisheries, Mpumalanga Regional Office (Commenting Authority);
- Mpumalanga Tourism and Parks Agency (Commenting Authority);
- Victor Khanye Local Municipality;
- Ward Councillor (Victor Khanye Local Municipality);
- Zibulo Colliery, immediately surrounding land owners and lawful occupiers.

4.4.4 Proof of Consultation

Proof of the above-mentioned consultation and results thereof will be submitted to the DWS as a separate report.

4.4.5 Comments, Issues and Responses on the BAR and New Water Uses

All comments and issues received will be recorded and responses to the comments made. The comments and issues raised by the interested and affected parties, their responses and reaction to the response will be presented in a stand-alone document to the DWS.

SECTION THREE

Baseline Environmental Assessment

5 BASELINE ENVIRONMENTAL ASSESSMENT

This section of the report will give a description of the environment likely to be affected by the water use activities.

5.1 GEOLOGY

The project area is underlain by a number of lithostratigraphical units, ranging from the Transvaal to the Karoo Supergroups (Delta H, 2017). The following sections describe the different lithostratigraphical units.

5.1.1 Transvaal Supergroup

The Transvaal Supergroup is represented by the Pretoria Group within the study area. The Pretoria Group comprises of mudrocks, quarztitic sandstone, lavas, diamicties, conglomerates and carbonate rock types, all which have been subjected to low grade metamorphism. The four main formations located within the study area are the Daspoort, Silverton, Magaliesberg and Timeball Hill Formations. The Daspoort formation is characterised by mature quartz arenites and subordinate mudrocks and ironstones as well as sandstones, pebbly arenite and conglomerates. The Daspoort Formation is overlain by the Silverton Formation which comprises massive mudstones, laminated claystones and siltstones as well as graded siltstone/ mudstone. The Silverton Formation is overlain by the Magaliesberg formation. The Magaliesberg Formation represents a shallow marine sandstone with alternating quartzitic sandstone and shales. The Magaliesberg formation gradually overlies the Silverton formations.

5.1.2 Bushveld Igneous Complex

The granites of the Bushveld Igneous Complex occupy the large semi-circular lobes within the western and eastern limbs. The complex is generally subdivided into the mafic rocks of Rustenburg suite, Lebowa Granite and the Rashoop Granophyte Suite. The Lebowa Granite is associated with the study area and comprises fine to coarse grained granites. The volcanic Rooiberg Group, although not included as part of the BIC, forms part of the Bushveld Magmatic Province (BMP). The Group comprises volcanic units that are up to 400 m thick, together with interbedded, thin extensive sedimentary strata.

5.1.3 Waterberg Group

The Middelburg basin extends from east Pretoria further eastwards for about 130 km to the town of Middelburg. The Wilgeriver Formation is the only stratigraphic unit in the basin. It represents an erosional remnant of a much larger basin, possibly linked with the basin of the Waterberg Group. The Wilgeriver formation overlies the Loskop formation unconformably and is overlain by the Karoo Supergroup. The Wilgeriver formation comprise of medium-coarse grained sandstone, subordinate conglomerates and some shales.

5.1.4 Loskop Formation (Proto-Waterberg Unit)

The Loskop formation occurs below the Waterberg group in the Middleburg basin and is up to 1000m thick north of Middelburg. A basal conglomerate largely reflects reworking of volcanic parent material; however, the formation is predominantly made up of argillaceous clastic sedimentary rocks. Interbedded lavas are mafic to intermediate. The Loskop formation overlies the Rooiberg Group lavas.

5.1.5 Karoo Supergroup

The study area is dominated by rocks from the Vryheid Formation of the Ecca Group, Karoo Supergroup. The Vryheid Formation consists of mudrock, rhythmite, silstone and fine to coarse grained sandstone and includes five mineable coal seams. The generally horizontal disposed sediments of the Karoo Supergroup are typically undulating with a gentle regional dip to the south. The coal seams tend to be discontinuous due to the presence of palaeo highs and the effect of present day erosion. In particular, the no. 5 Seam is not present in the Zibulo opencast section due to erosion. The coal seams are separated by various lithologies of (interbedded) shale, sandstone and cabonaneous mudstone/ siltstone of varied thickness. The lowermost seam overlies the coarse grained diamicite or pre-Karoo rocks.

The pre-Karoo rocks are unconformably overlain by the Dwyka Group tillite in palaeo-valleys. The Dwyka Group comprise of different diamictive facies of poorly to well stratified, highly compacted diamictite, carbonate rock diamictite, conglomerate, sandstone and mudrocks (Delta H, 2018).

5.1.6 Structures

Dolerite intrusions and also large sills intruded the entire Karoo sequence and form the most significant geological disturbance. The sills and inclined sheets range from a few meters to hundreds of meters in thickness and typically form the resistant caps of hills. The dykes are generally 2 to 10 m wide and 5 to 30 km long. The presence of the dykes and sills may also influence the groundwater yield capacity in some areas. Virtually impermeable dolerite dykes may act as no-flow boundaries, leading to localised compartmentalisation. The most significant fault zone is related to the east-west striking graben structure due to reverse faulting, which stretches throughout the northern part of the study area. Boreholes targeting this fault zone (drilled in 2004) had variable water makes from low to substantial. The results indicated that the presence of the graben structure could enhance water flow due to the discrete faults associated with the structure. The pre-Karoo rocks gave rise to an undulating palaeo-topography and the glacio-fluvial rocks of the Dwyka accumulated in palaeo-lows. Locally elevated basement occurs in the southern to central parts of the study area, which influenced the thickness of the overlying coal seams. The no. 2 seam is only partly developed above this palaeo-topographical high and the no. 1 and no. 3 seams are absent.

5.2 CLIMATE

5.2.1 Regional Climate

The Zibulo Colliery Northern Underground Expansion is located in the Mpumalanga Province of South Africa and the Eastern Plateau Highveld climate zone. The province is characterised by a mild to warm summer rainfall climate and cool to cold winters. Sharp frost is a common occurrence during winter. The hottest months in the region have been measured in December and January, whilst the coldest months are June and July. The days during summer are generally warm, but a substantial drop in temperature occurs the winter nights.

5.2.2 Mean Monthly Rainfall and Evaporation

The mean annual precipitation of the site is 687 mm. The mean annual evaporation of the site is 1522 mm (S-Pan). The monthly average rainfall, rainfall days, and evaporation rates are presented in Table 5-1. The Mpumalanga Highveld has distinct wet and dry seasons. 91% of the Colliery's mean annual rainfall falls between October and April inclusively. 68% of the area's mean annual evaporation occurs in this period.

Table 5-1: Mean monthly rainfall, rain days and evaporation data for the site.

Month	Ave Rainfall (mm)	Ave rain days	Ave Evaporation (mm S-Pan)
October	67.8	7.0	164.1
November	112.6	10.4	154.8
December	110.6	10.3	170.5
January	116.5	10.4	167.4
February	96.3	7.8	139.6
March	74.8	7.1	137.7
April	42.8	4.5	105.9
May	16.3	2.1	89.2
June	7.6	1.2	72.4
July	6.6	0.9	79.3
August	6.9	1.0	105.0
September	24.2	2.8	136.1
Mean Annual	**687**		**1522**

5.2.3 Mean Monthly Temperature

The mean maximum and minimum temperatures, extrapolated from the Pretoria, Middelburg, Belfast and Carolina weather stations are presented in Table 5-2.

Table 5-2: Mean monthly temperature data for eMalahleni

Month	Daily max. (°C)	Daily min. (°C)	Daily mean. (°C)
January	27.2	13.7	20.5
February	26.8	13.4	20.1
March	26.0	11.4	18.7
April	23.9	7.4	15.7
May	21.3	2.2	11.7
June	18.5	-1.8	8.3
July	18.4	-1.7	8.3
August	21.4	0.8	11.1
September	24.0	5.3	14.7
October	26.0	10.1	18.0
November	26.2	11.8	19.0
December	27.1	13.2	20.1

5.2.4 Wind Direction and Speed at the Mine

During the summer months the wind direction is generally northerly and easterly, at speeds ranging from 5 km/h to 25 km/h. During July (winter conditions), the winds are somewhat more southerly and westerly at speeds ranging from 5 km/h to 48 km/h. The period August to November is the period when wind speeds are at their greatest (aside from the periods associated with local thunderstorms), with wind speeds in excess of 40 km/h having been recorded (Table 5-3).

Table 5-3: Average wind speed and direction

Month	N		NE		E		SE		S		SW		W		NW	
	n	v	n	v	n	v	n	V	n	v	n	v	n	v	n	v
Jan	67	4.3	124	4.0	119	4.5	92	5.1	40	4.6	47	4.3	45	3.8	149	3.8
Feb	48	4.1	108	3.8	139	4.1	135	4.9	61	4.5	48	3.9	41	3.5	91	3.7
Mar	53	3.9	99	3.7	16	3.7	99	4.5	50	4.1	56	4.1	43	3.5	111	3.9
Apr	50	4.0	88	3.5	94	4.0	55	4.2	45	4.3	71	4.4	71	4.5	129	4.0
May	54	4.4	66	3.7	61	3.9	62	4.5	47	4.2	79	4.5	67	4.7	116	4.1
Jun	48	4.1	47	3.7	59	4.1	42	4.8	46	4.7	99	4.5	76	4.3	115	4.3
Jul	43	4.1	66	3.7	64	4.1	62	4.9	54	4.6	84	4.5	57	4.2	121	4.1
Aug	80	4.9	96	4.4	97	4.3	33	5.6	35	4.9	75	4.9	65	4.9	192	4.7
Sept	115	4.8	134	4.8	101	5.0	48	5.7	32	4.1	53	5.1	59	5.0	203	4.8
Oct	115	4.5	139	4.7	116	5.4	58	5.6	41	4.9	54	4.7	47	4.8	223	4.8
Nov	105	4.4	135	4.4	110	5.0	56	5.3	37	4.9	45	4.6	55	4.3	229	4.7
Dec	91	4.2	138	4.1	102	4.8	55	4.9	35	4.5	47	4.9	55	4.2	194	4.2
Avg	**72**	**4.4**	**103**	**4.1**	**98**	**4.4**	**66**	**4.9**	**44**	**4.5**	**64**	**4.5**	**57**	**4.4**	**156**	**4.4**

5.2.5 Mean Monthly Evaporation

The mean monthly evaporation for the region obtained from Bethal is presented in Table 5-4. The gross average "A" pan evaporation recorded amounts to 1774 mm, with the maximum evaporation occurring during the summer months, from October to January, due to high summer temperatures. If the mean annual rainfall is compared to the mean annual evaporation there is a net monthly deficit throughout the year. This results in an annual water deficit of approximately 1102 mm.

Table 5-4: Mean monthly evaporation for the region

Month	Evaporation (mm)
January	192
February	64
March	164
April	122
May	113
June	94
July	107
August	149
September	190
October	202
November	181
December	196
TOTAL	**1774**

5.2.6 Extreme Weather Conditions

Hail: Occurs 4 to 7 times per year

Drought: ± every 6 years

Frost: Can occur from end of April to September

5.3 SURFACE WATER

Zibulo Colliery conducts monthly surface water monitoring upstream and downstream of the underground colliery (Appendix 2) as well as the surrounding area. This surface water monitoring will include the existing mining infrastructure as well as the future expansion of the underground mining activities. The following section describes the surface water around the predominantly around the surface infrastructure area, as those will be mainly impacted upon. Section 5.3.7, taken from a Rock Engineering Report, will describe the insignificant impact the undermining will have on surface water bodies (Mahne, 2018).

5.3.1 Regional and Local Setting

The Zibulo Colliery Northern Underground Expansion proposed water uses fall within the B11E (Rietspruit), B11F (Klippoortjiespruit) and B20E (Wilge River) quaternary catchments. All of these drains into the Olifants River with Rietspruit and Klippoortjiespruit entering the Olifants River upstream of Witbank Dam and the Wilge River entering the Olifants River downstream of Witbank Dam. The Zibulo Colliery infrastructure area falls locally within a catchment of a tributary of the Rietspruit

(B11E), and regionally into the Olifants River catchment. The Zibulo Colliery infrastructure area falls in the B11 tertiary drainage region of the Olifants River catchment. Within this tertiary region the infrastructure area falls predominantly within the B11E quaternary drainage region with some of the infrastructure within the B11F quaternary drainage region. Figure 5-1 depicts the location of the Zibulo Colliery Northern Underground Expansion water uses in relation to the tertiary and quaternary drainage region within the Olifants River. The mean annual precipitation of the B11E quaternary drainage region is 682mm, the B11F quaternary drainage region is 691mm and the B20E quaternary drainage region is 657.5mm. Whereas the mean annual simulated runoff of the B11E quaternary drainage region is 51.4mm, the B11F quaternary drainage region is 45.8mm and the B20E quaternary drainage region is 38.9mm.

No streams are directly affected by the Zibulo Colliery infrastructure area. The adjacent streams (spruits) can be divided into two groups, either perennial or non-perennial. Both of these streams are tributaries of the Rietspruit. The Rietspruit flows into the Steenkoolspruit which the flows into the Olifants River upstream of the Witbank Dam. These streams are shown in Figure 5-2 (Golder, 2015).

The Zibulo Colliery emergency stockpile will be situated outside of the 1:50 year and 1:100 year floodlines (Golder, 2015) (Figure 5-3).

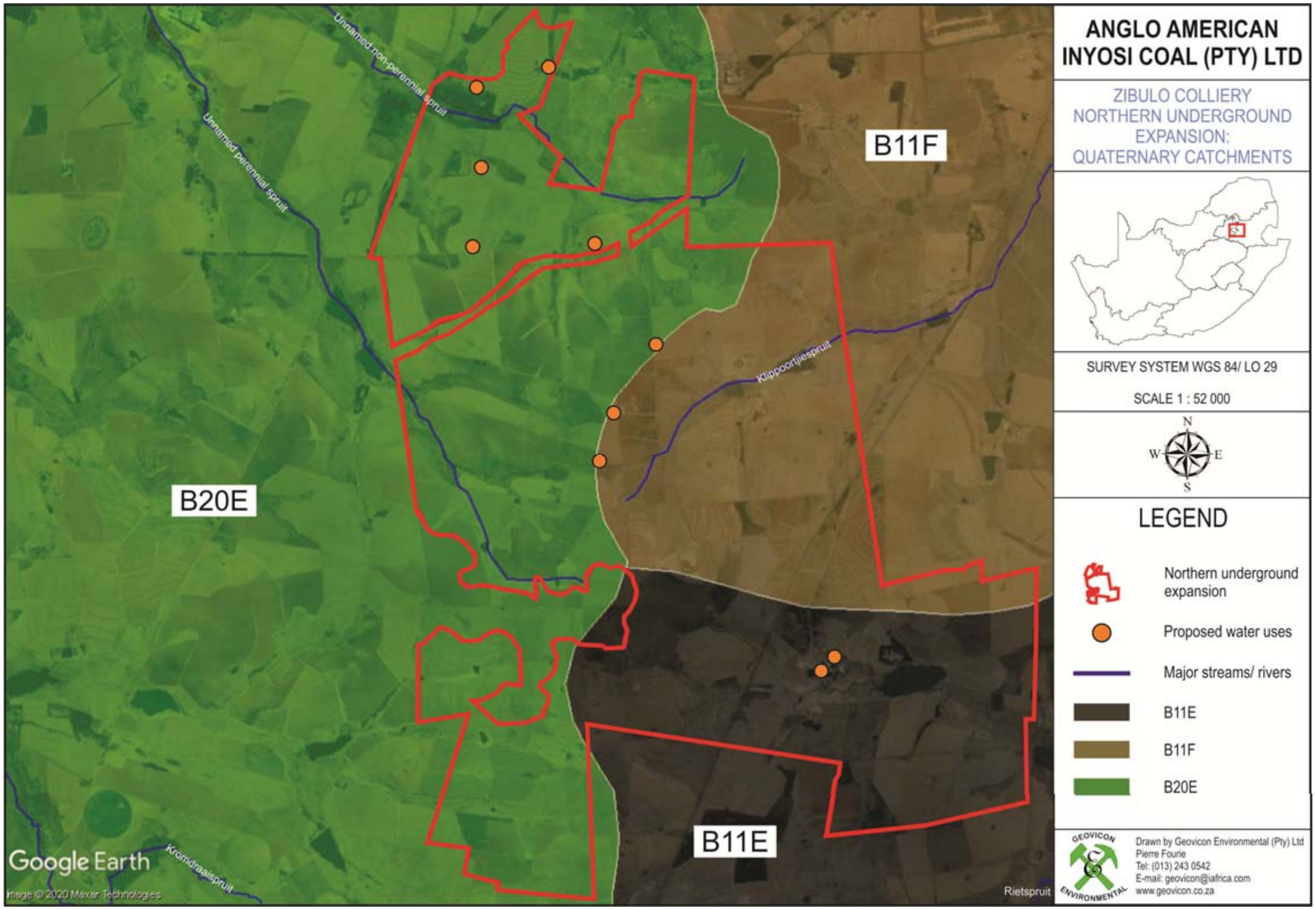

Figure 5-1: Position of the Zibulo Colliery Northern Underground Expansion water uses in relation to the DWS quaternary drainage regions

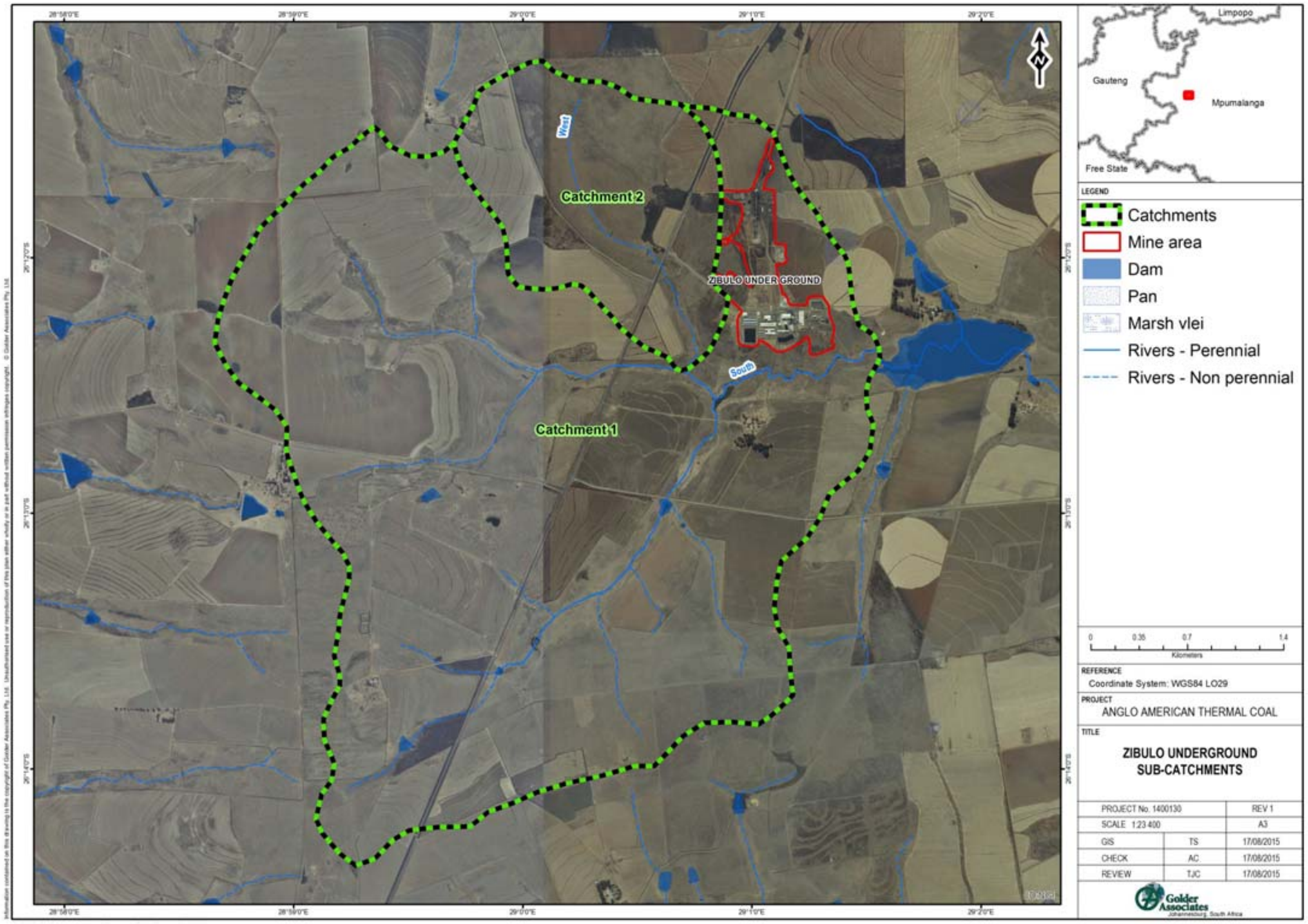

Figure 5-2: Local steams in relation with the Zibulo Colliery infrastructure area (Golder, 2015)

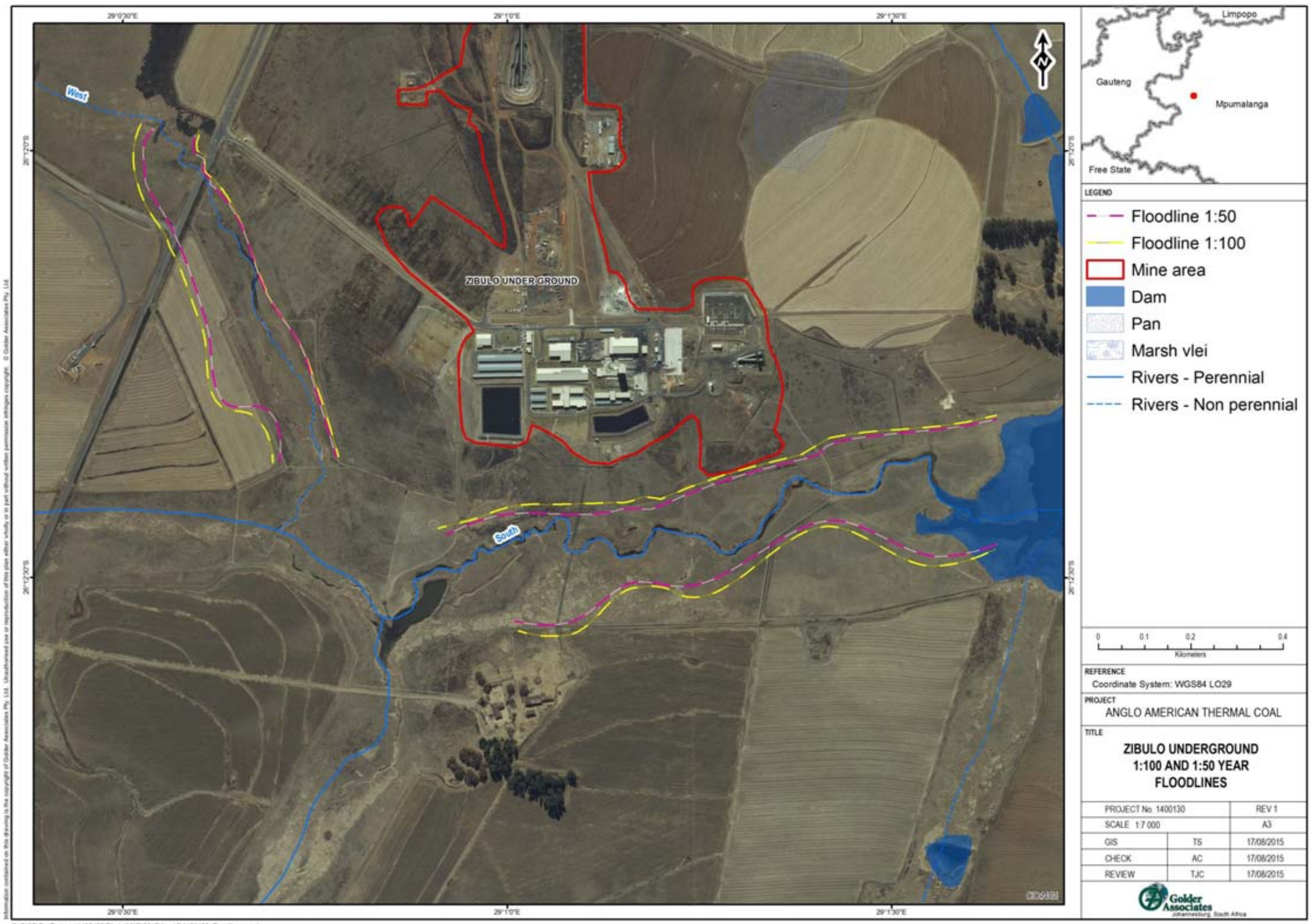

Figure 5-3: Floodlines at the Zibulo Colliery infrastructure area (Golder, 2015)

5.3.2 Baseline Hydrology

Catchment Characterisation

The Zibulo Colliery infrastructure area is located in quaternary drainage regions B11E and B11F, in the Olifants Water Management Area.

The catchment is a typical Mpumalanga Highveld catchment. Vegetation is predominantly Highveld grasslands (Eastern Highveld Grassland) and dry land maize lands. Limited lands appear to be under irrigation. There are numerous small dams located on the spruits within the B11E and B11F quaternary drainage regions. There are multiple developments in the Klippoortjiespruit and Rietspruit tributary catchments, including farmsteads, mining activities, roads, housing and agricultural land.

5.3.3 Mean Annual Runoff Analysis

The mean annual runoff of the B11E and B11F quaternary drainage regions are described in Table 5-5 below. Due to the relatively small area of the infrastructure and the fact that it has already been constructed, there will be a low impact on the adjacent streams as well as on the mean annual surface runoff of the B11E and B11F quaternary drainage regions.

Table 5-5: Mean annual runoff for the catchment of affected streams

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (mm)	Mean Annual Run-off (mm)	Evaporation Potential (mm)
B11E	46 670 ha	682.42	32.2	1600 – 1800
B11F	43 100 ha	691.00	45.8	1600 – 1800

5.3.4 Normal Dry Weather Flows

In the absence of any stream flow monitoring, the conventional approach to compute the dry weather flow (also often termed “normal flow”) is to analyse the long term synthetic monthly stream flow time series in order to develop a flow-duration relationship. An accepted definition of the dry weather flow in a stream is that flow in the stream that is equalled or exceeded for 70% of the time, a value which can readily be ascertained from an analysis of the flow-duration relationship.

The dry weather flows (DWF) for the Zibulo Colliery infrastructure area were determined using the WRSM90 synthetic stream flow generation model. For some of the areas, the DWF from WRSM90 was correlated to the mean annual run-off (MAR) and the values extrapolated for these catchments. The computed dry weather flows (DWF) for the sub-catchment is shown in Table 5-6.

Table 5-6: Normal dry weather flows for the sub-catchment

Sub-catchment	Contributing area (km^2)	Computed DWF (x 10^6 m^3 per month average)	Computed DWF (m^3/s average over month)
D01	31.51	0.02	0.01

5.3.5 Peak Rainfall Data

Maximum Monthly Rainfall Data

The maximum monthly rainfall data was distilled from the daily rainfall record and is presented in Table 5-7.

Table 5-7: Maximum monthly rainfall data (mm)

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
202.7	250.7	308	360.5	345.9	184	144.5	143.8	104.1	75.7	37.8	135.5

5.3.6 Flood Flow Analysis

The floodlines (see Appendix 3) for the tributaries of the Rietspruit were determined using the following method (Golder, 2015):

- The catchment area of the tributaries was delineated based on the 1:50 000 topographical maps;
- A flood peak analysis was undertaken to determine the flood peaks for the different recurrence interval storms for the water courses within the area using various flood estimation methods;
- The flood peaks and 5 m survey data of the study area were used as inputs to the HEC-RAS backwater programme to determine the surface water elevations for the 1:50 and 1:100 year flood peaks;
- The floodlines were plotted against the available mapping; and
- Manning's *n* coefficients were estimated by comparing the vegetation and nature of the channel surfaces to published data.

Four flood estimation methods namely, the Rational Method using Point Precipitation (RM-PP), the Rational Method using TR102 (RM-TR_102), the Standard Design Flood method (SDF) and the Empirical Flood Estimation method or the Regional Maximum Flood method (RMF) were applied to the two sub-catchments (see Table 5-8). The sub-catchment characteristics used in applying these methods for each area are shown in Table 5-9 and the flood peaks for the 1 in 50 and 1 in 100 year flood are shown in Table 5-10. Figure 5-2 above indicates the position of the Zibulo Colliery infrastructure area within catchment 1.

Table 5-8: Sub-catchment characteristics used in the flood estimation methods

Catchment	Quaternary Catchment	Area (km²)	River Length (m)	10 – 85 Slope (m/m)	Time of Concentration (h)
Catchment 1	B11E	18.61	5 686	0.006113	1.8

Table 5-9: Flood peak calculations from various flood estimation methods

Flood Estimation Methods	Catchment 1	
	1:50	1:100
Rational Method – Point Precipitation	141.952	192.116
Rational Method – TR 102 – Adamson	111.379	136.201
Standard Design Flood – Alexander	116.240	148.183
Regional Maximum Flood	121.043	154.194
Average	**116.220**	**146.193**

Table 5-10: Computed 50 year and 100 year flood peaks

River	Peak Flow (m³/s)	
	1 in 50 year	1 in 100 year
West	116.22	146.19
South	32.76	42.84

5.3.7 Limited Impact on Surface Water Bodies due to Undermining

Throughout the life of the underground workings at Zibulo Colliery, there will be surface features that will be undermined. Protection of the infrastructure is brought into the design and planning of each underground working. These surface infrastructures include the water bodies that are currently on surface, whether they are natural or man-made. Dams were created, in the past, within the flow of the natural streams. There is currently no secondary mining planned at Zibulo Colliery that would influence the stability of the surface negatively, i.e. causes subsidence or sinkholes. Therefore the stability of the water bodies should not be influenced by the mining of the 2 seam workings (Mahne, 2018).

This is also the case with the planned mining. With the planning of the future panels, the aim will be to protect the surface infrastructure in accordance with the following criteria:

- Probability of pillar stability to be 100%;
- Life of pillars will be in excess of 500 years (minimum);
- Shallow mining guidelines will apply where the depth of mining is less than 40m from surface 1;
- Pillar width to mining height ratio may not be less than 2.2;
- Areal percentage extraction should not be greater than 75%;
- The minimum pillar width should not be less than 6.5m;
- A minimum safety factor may not be less than 2.1; and
- The prevailing conditions will determine the maximum bord width for an area.

Current mining does not pose a risk to any of the water bodies already undermined mainly due to the depth of the workings. An assessment was done on the undermining of the river and dam in the vicinity of the main offices. The depth of cover above the 2 seam ranges between 16m to 122m, the thickness of the hard overburden material ranges between 7.9m and 115m. Current Anglo American Coal SA (AACSA) standard (AATC023136) would not allow underground mining where the thickness of the overburden is less than 25m without a detailed analysis to ensure there is no probability of sinkhole formation.

In conclusion if was noted that mining must comply with the parameters indicated in this analysis (Appendix 4) to ensure the stability of the water bodies on surface. Due to the thickness of the overburden material there should not be a risk of sinkhole formation and the required shallow mining analysis must be done on each panel where the thickness of the overburden is less than 30m.

5.3.8 Water Quality

Surface water quality monitoring is being conducted at Zibulo Underground Colliery. Nine (9) surface water quality points are taken at the locations shown in Figure 5-4. Two points (ZU PCD 01 and ZU PCD 02) are PCD's which monitor contaminated surface runoff as well as groundwater from the underground mining. Monitoring points ZU 04, ZU 05, ZU 06, ZU 08, ZU 09, ZU 10 and ZU 11 monitor surface water downstream of the underground mining and infrastructure area. These points will be sufficient for the emergency stockpile as it will fall within the dirty water area. The water quality sampling and monitoring is done by Aquatico Scientific (Pty) Ltd on a monthly basis and the results reported on a quarterly basis (Appendix 2). The water quality results are compared the South African Water Quality Guidelines for domestic, recreation, irrigation and livestock water use. These are considered the most likely downstream users. The results of the water quality analysis of points ZU 05, ZU 09, ZU 10 and ZU PCD 02 are summarised in Table 5-11.

Sample Locations

All nine (9) of the surface water quality points that are monitored are indicated in Figure 5-4. Monitoring points ZU 05, ZU 09, ZU 10 and ZU PCD 02 will indicate any increase in variable concentrations from the emergency stockpile (if any). A short description of the above-mentioned monitoring points as well as the values that exceed the water quality targets as prescribed in the South African Water Quality Guidelines (DWS) are discussed below.

ZU 05:

- Spruit upstream from Zibulo Underground.
- Electrical conductivity (EC), total dissolved solids (TDS), calcium (Ca), magnesium (Mg) and manganese (Mn).

ZU 09:

- Farm dam south-west from conveyer terminal flowing towards locality ZU10.
- Electrical conductivity (EC), total dissolved solids (TDS), sodium (Na), sulphates (SO_4) fluoride (F) and iron (Fe).

ZU 10:

- Farm dam downstream of Zibulo Underground.
- Electrical conductivity (EC), total dissolved solids (TDS), sodium (Na), sulphates (SO_4) fluoride (F), aluminium (Al) and iron (Fe).

ZU PCD 02:

- Eastern pollution control dam.
- Electrical conductivity (EC), total dissolved solids (TDS), calcium (Ca), sodium (Na), sulphates (SO_4) and fluoride (F).

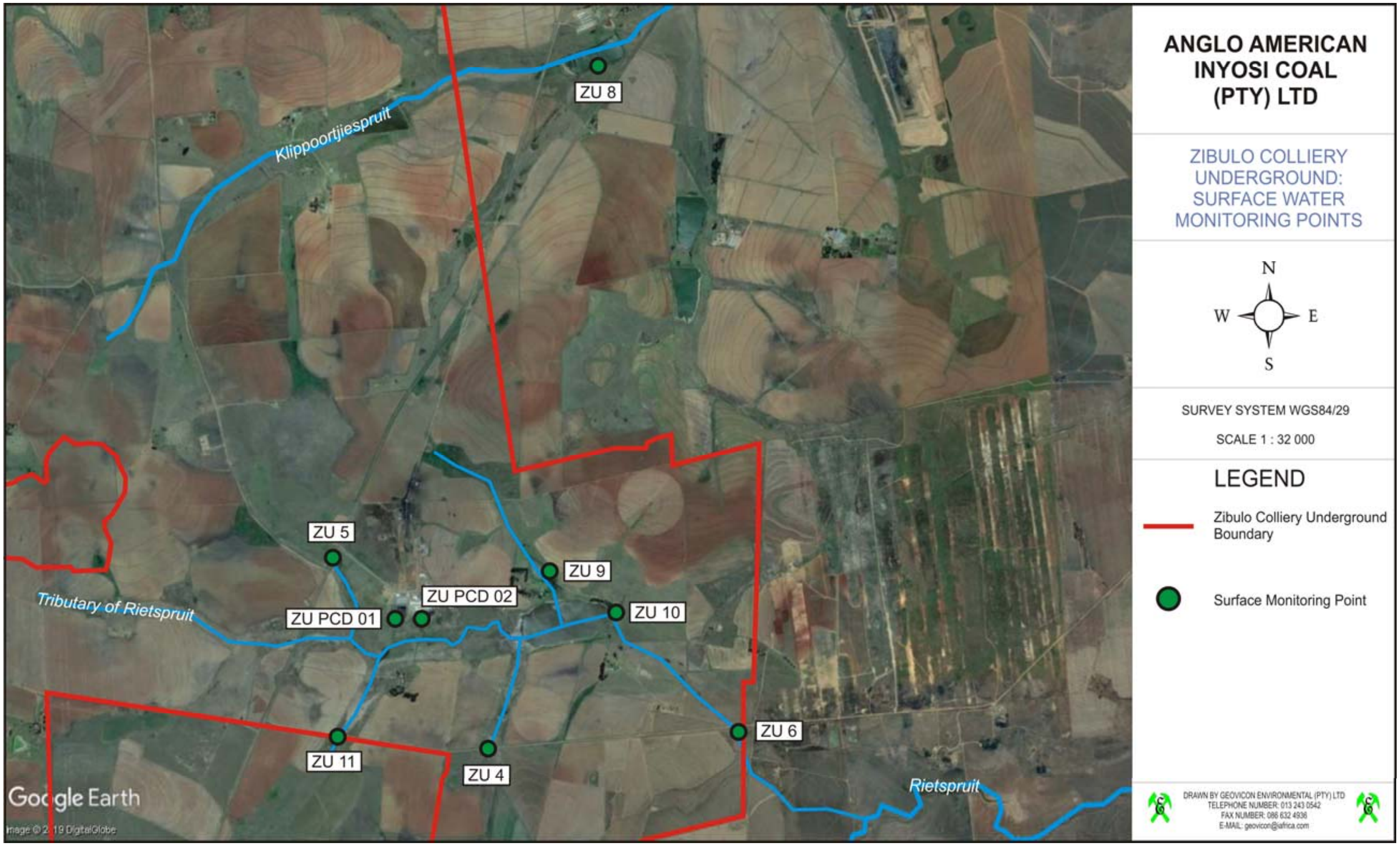

Figure 5-4: Positions of surface water monitoring sampling points

Table 5-11: Surface water qualities compared to water quality targets (DWS)

	Zibulo Surface Water Monitoring Points				Water Quality Targets			
Parameter	**ZU 05**	**ZU 09**	**ZU 10**	**ZU PCD 02**	**Domestic**	**Aquatic Systems**	**Agriculture**	**Livestock**
Total Dissolved Solids (TDS) (mg/ℓ)	516	728.3	817	1819.3	450	78.2	260	1000
Nitrate (NO_3) (mg/ℓ)	0.04	0.11	0.112	0.899	6	<0.1	0.5	100
Nitrite (NO_2) (mg/ℓ)	0.03	0.159	0.157	0.324	6	<0.1	0.5	100
Chloride (Cl) (mg/ℓ)	34.38	35.10	36.11	48.2	100	10.3	100	1500
Alkalinity ($CaCO_3$) (mg/ℓ)	434.25	291.67	303.81	445.7	-	-	-	-
Fluoride (F) (mg/ℓ)	0.46	2.573	2.79	9.613	1	0.75	2	2
Sulphate (mg/ℓ)	67.3	235.33	283.33	836.1	200	12.4	N/A	1000
Total Hardness as $CaCO_3$	424	219	250	286	200	N/A	N/A	N/A
Ammonia (NH_4) (mg/ℓ)	1.783	0.329	0.291	0.41	1.0	7	N/A	N/A
Phosphate (PO_4) (mg/ℓ)	0.439	0.164	0.19	0.225	N/A	0.005	N/A	N/A
Calcium (Ca) (mg/ℓ)	71.57	32.09	35.37	44.7	32	9.78	N/A	1000
Magnesium (Mg) (mg/ℓ)	51.61	26.26	30.52	24.2	30	5.1	N/A	500
Sodium (Na) (mg/ℓ)	27.66	152.73	173.89	508.1	100	5.9	70	2000
Potassium (K) (mg/ℓ)	5.52	16.77	12.52	7.9	50	1.3	N/A	N/A
Iron (Fe) (mg/ℓ)	0.061	0.132	0.154	0.007	0.1	1.13	5	10
Manganese (Mn) (mg/ℓ)	0.877	0.03	0.027	0.001	0.05	0.01	0.02	10
Electrical Conductivity (EC) (mS/m)	83.36	108.26	121.69	263	70	12.89	40	150
pH-Value at 25^0C	7.73	8.22	8.3	8.42	6 – 9	6 – 8	6.5 – 8.4	N/A
Zinc (Zn) (mg/ℓ)	0.001	0.001	0.001	0.017	3	0.002	1	20
Aluminium (Al) (mg/ℓ)	0.019	0.15	0.252	0.07	0.15	<0.01	5	5

5.4 GROUNDWATER

Based on the 1:250 000 geological map sheet (2628) and 1:500 000 hydrogeological map sheet (2526 Johannesburg), the Vanggatfontein Mine Project area is underlain by shallow weathered, sub-horizontal Karoo sediments with interbedded Karoo dolerite intrusions. The sediments are classified as an 'intergranular fractured aquifer' with low expected borehole yields ranging between 0.1 – 0.5 l/s. The sedimentary rocks provide primary porosity and storage capacity with limited groundwater flow, while secondary features enhance the potential for groundwater flow. Other interbedded features such as interconnected dolerite sills and dykes as well as clay lenses limit groundwater flow further. Karoo Supergroup rocks occurring in the area have very low primary porosity, permeability and storage capacities. The possible occurrence of groundwater is thus related to secondary hydrogeological properties developed from the process of weathering, faulting, fracturing and the influence of intrusives (e.g. dykes). As a result, two main aquifer types exist in the area: an upper, weathered/ fractured rock aquifer and a deeper bedrock fractured aquifer. The weathered and deeper fractured Karoo sediments are referred to as the Karoo Aquifer (Delta H, 2017).

The regional Karoo aquifer is overlain by an unconfined alluvial (primary) sand aquifer along river and drainage courses which typically exhibit higher hydraulic conductivity and storativity. Furthermore, the shallow weathered Karoo sediments and fractured deeper Karoo aquifer overlay the Dwyka Group, which acts as an impermeable layer due to its low hydraulic conductivity.

5.4.1 Hydrostratigraphic Zones

Based on the detailed hydrogeological study undertaken in the area by JMA (2004) and knowledge obtained by the project team working within similar settings, the following hydrostratigraphic zones (Figure 5-5) can be differentiated:

- Shallow alluvial and weathered Karoo Aquifer;
- Fractured Karoo aquifer & coal seams;
- Transvaal Supergroup and BIC;
- Dolerite intrusions and faults.

<u>Weathered Karoo Aquifer</u>

The weathered zone of the Karoo sediments hosts the unconfined or semi-confined shallow weathered Karoo aquifer or hydrostratigraphic zone. Water levels are often shallow (few meters below ground level) and the water quality good due to direct rainfall recharge and dynamic groundwater flow through the unconfined aquifer in weathered sediments, which makes it also vulnerable to pollution. Localised perched aquifers may occur on clay layers or lenses, but are due to their localised nature of no further interest in the context of the current study. Water intersections in the weathered aquifer are mostly encountered above or at the interface to fresh bedrock, where the vertical infiltration of water is typically limited by impermeable layers of weathering products and capillary forces, with subsequent lateral movement following topographical gradients. Groundwater daylights as springs (contact springs) where the flow path is obstructed by paleotopographic highs of the basement rocks or, to a minor extent for the area of interest, where the surface topography cuts into the groundwater level at e.g. drainage lines (free draining springs). Based on the geological information obtained from the client, the thickness of the weathered zone (this includes both highly and slightly weathered material) varies between 2 and 30 m (with an arithmetic average thickness of 13 m). JMA (2004) reported an average hydraulic conductivity of 0.079 m/d or 1.1^{E-06} m/s for the weathered zone of the Karoo and Pre-Karoo rocks.

It is expected that the weathered aquifer is overlain or replaced by an alluvial aquifer along major river courses. In the absence of any monitoring borehole characterizing the alluvial aquifers in the area, the two shallow primary aquifers are treated as a single unit for the purpose of the current study.

Fractured Karoo Aquifer

The fractured Karoo aquifer consists of the various lithologies of siltstone, shale, sandstone and the coal seams. Groundwater flow is governed by secondary porosities like faults, fractures, joints, bedding planes or other geological contacts (including coal seams), while the rock matrix itself is considered impermeable. Geological structures are generally better developed in competent rocks like sandstone, which subsequently show better water yields than the less competent silt- or mudstones and shales. Not all secondary structures are water bearing due to e.g. compressional forces by the neo-tectonic stress field overburden closing the apertures. The fractured Karoo aquifer is considered a semiconfined aquifer, depending on the prevailing sedimentary succession. Fractured Karoo aquifers have typically a low hydraulic conductivity (<0.001 m/d). Based on drilling results into the deeper Karoo Aquifer by JMA (2004), an average hydraulic conductivity of 0.003 m/d or 3.5^{E-08} m/s was reported. Higher yields are typically associated with higher hydraulic conductivities along shallow coal seams and at contact zones with intrusive rocks. The contact zones of dolerite dykes and sills with the host rock provide preferential flow paths, while the dolerite itself is rather impermeable or semi-permeable. This setting promotes groundwater flow along, but not across the dykes or sills. Depending on the residence time of the water in the aquifer, groundwater quality can be poor. On top of the basement, the sequential geological units are Dwyka Group tillite. If present, the irregularly developed tillite horizon is generally thought to form an important vertical flow barrier at the base of the Karoo rocks, forming the bottom of the Karoo flow system.

Pre-Karoo Aquifer (Basement)

Pre-Karoo rocks of the Lebowa Granite Suite of the Bushveld Complex and the Rooiberg Group underlie the Karoo rocks and outcrop in the northern parts of the area of interest. They host a secondary fractured aquifer with limited conductivity and storativity.

Dykes and Faults

While dolerite dykes may act as localized preferential pathways depending on the degree of weathering of the dyke and fracturing associated with the intrusion, its hydraulic properties obtained from the 2004 drilling and testing revealed similar yields to the regional shallow aquifer. However, borheoles targeting the graben fault zone revealed several water strikes and a generally higher hydraulic conductivity of around 0.1 m/d or 1.2^{E-06} m/s in the shallow aquifer and around 0.01 m/d or 1.2^{E-07} m/s in the fractured aquifer.

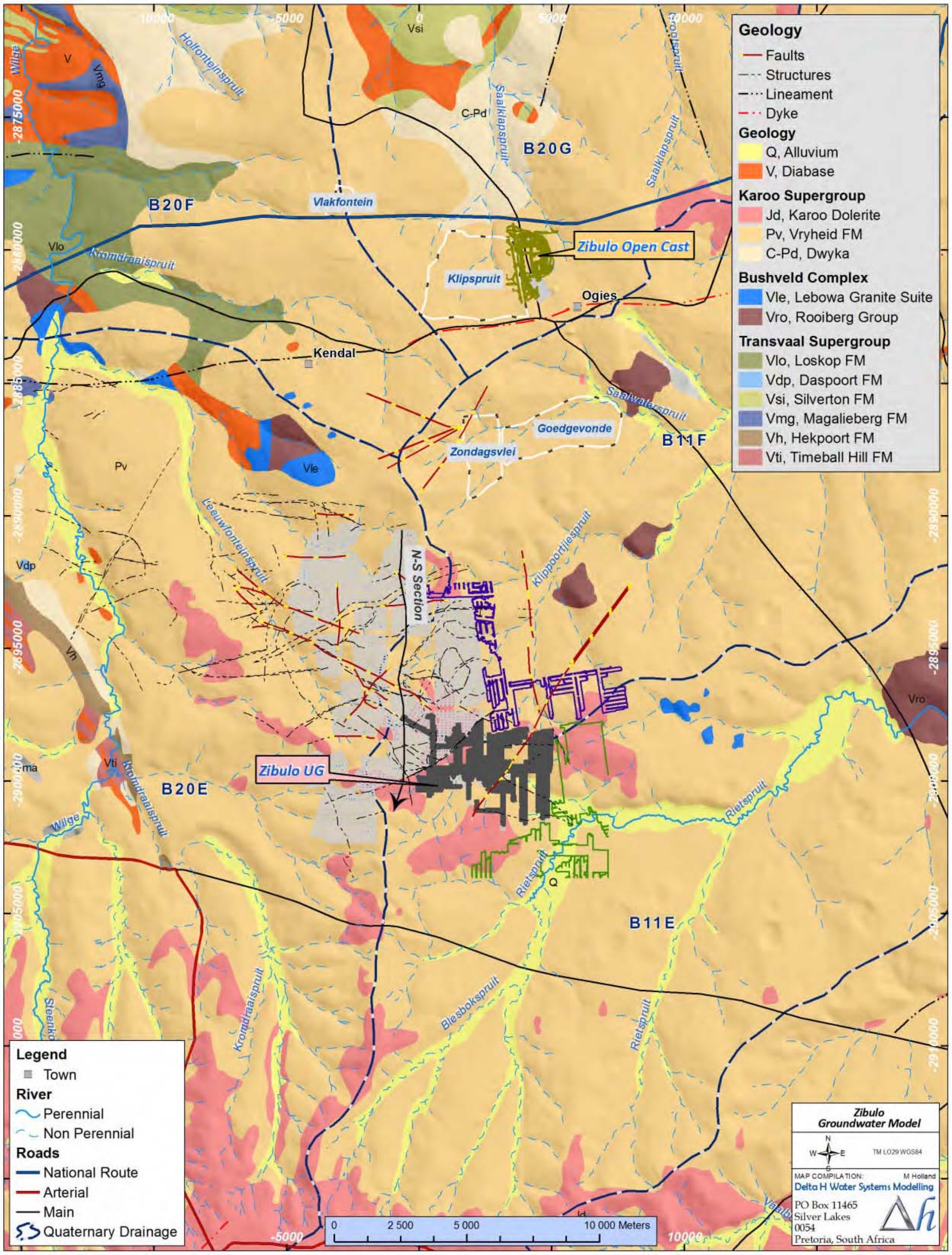

Figure 5-5: Regional geology of the study area

5.4.2 Groundwater Elevation and Flow Directions

Seventy-four (74) water levels were collated from boreholes over the wider study area, which includes JMA's (2004) baseline assessment and monitoring data. Water levels in the shallow aquifer average around 7.5 mbgl. Only twelve (12) of water levels were obtained from boreholes specifically drilled to target the deeper fracture aquifer, with an average groundwater level of 32 mbgl. A plot of the (shallow) groundwater table against surface elevation data for all boreholes (Figure 5-6) shows a correlation of 97%, indicating that regional water levels mimic surface topography within the study area and groundwater flows from higher lying ground towards lower lying ground and drainage systems (natural streams). The clearly poor correlation between water levels and topography, which plot below the linear regression line is related to the occurrence of the deeper fractured aquifer (Delta H, 2017). From Figure 5-6 it's also obvious that some "deep boreholes" measure in fact water levels expected for the shallow weathered aquifer (which subsequently plot on or near the regression line). This might be due to borehole construction with an incomplete zonal isolation of the weathered aquifer by sold casing only (additional bentonite plugs are commonly installed in the annulus to better seal off aquifer horizons) or a hydraulic interconnection between the two aquifer systems in the specific area.

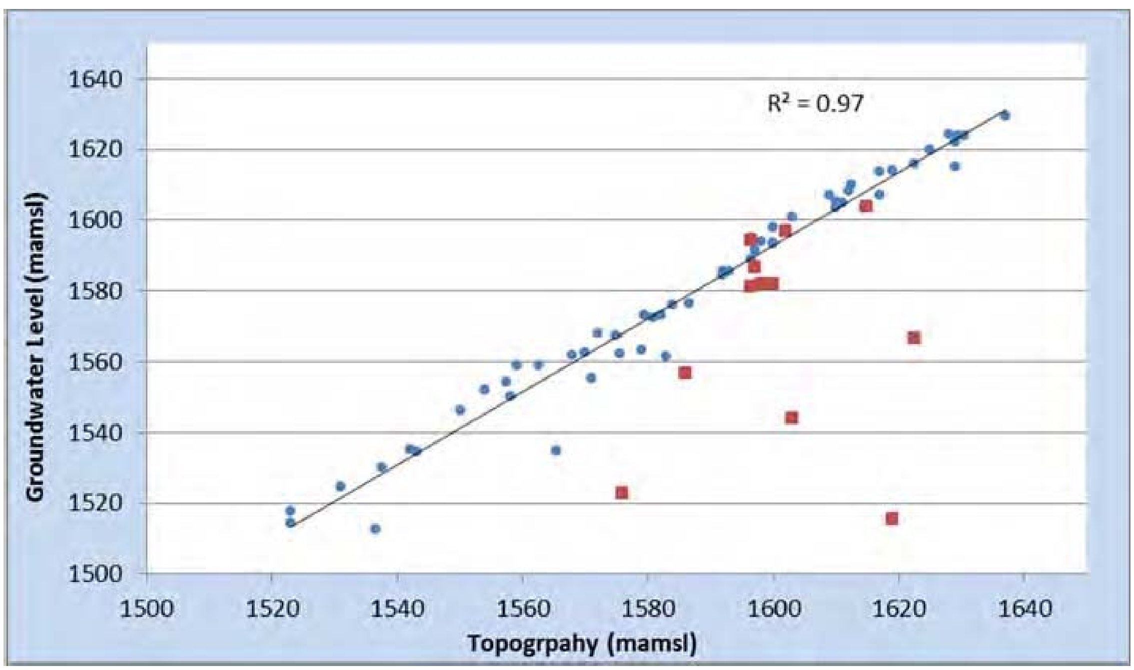

Figure 5-6: Correlation between surface topography and groundwater elevation

The observed correlation within the shallow aquifer is used to improve the interpolation of initial water levels for the numerical model in data scarce environments by applying co-kriging based on known topography (Bayesian interpolation). A groundwater piezometric map was interpolated from the collated measured shallow water levels using Bayesian interpolation, based on the established correlation between surface topography and groundwater levels. The Bayesian interpolation method uses correlated data to improve the spatial interpolation of the unknown variable, in this case the groundwater level. As a Universal Kriging algorithm, it relies on a mathematical description of the change (or variance) of a variable with distance, i.e. to what extent neighbouring observations are spatially correlated. Such correlation is expressed in a semi-variogram, as depicted in the empirical semi-variogram for the wider study area below (Figure 5-7) with the fitted Bayesian model used for the interpolation.

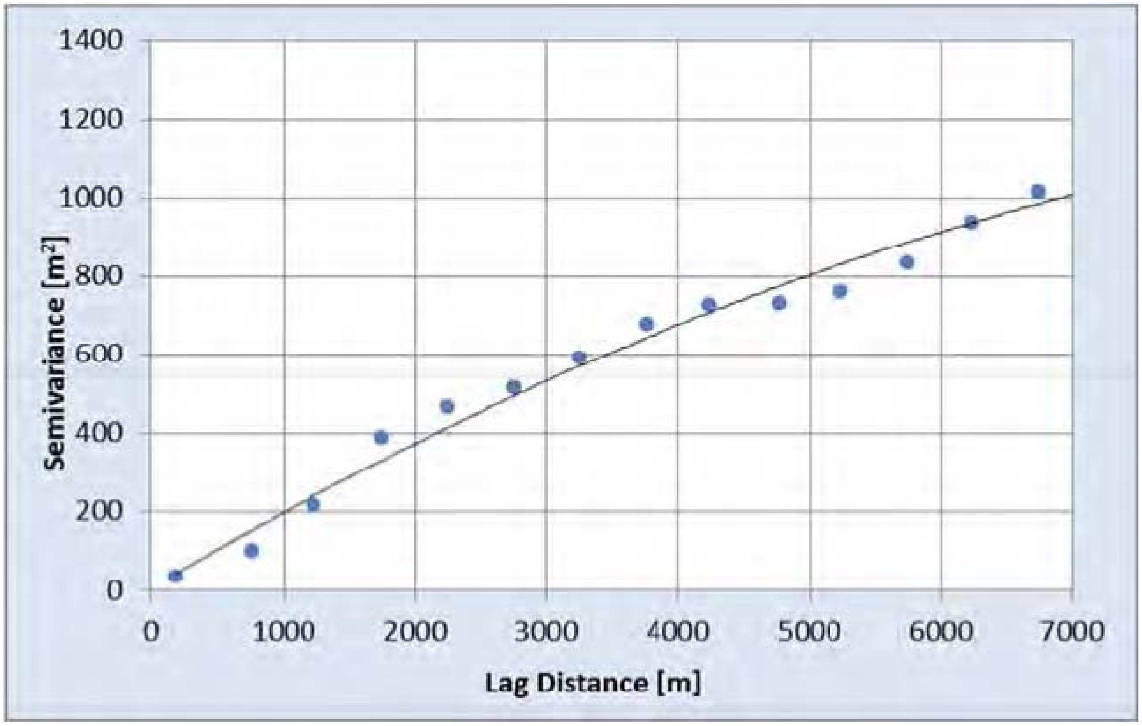

Figure 5-7: Empirical semi-variogram and fitted Bayesian model for the study area

The semi-variogram model is then used in combination with the knowledge of the surface elevation and its correlation to the groundwater elevation as a qualified guess to improve the spatial interpolation of water levels. The interpolated (unconfined) groundwater piezometric map for the shallow weathered aquifer using Bayesian interpolation is shown in Figure 5-8 and was subsequently used as initial heads for the model calibration. It must be noted that initial heads only facilitate the mathematical convergence of a steady-state model, but do not change the outcome of the model i.e. the calculated steady-state heads.

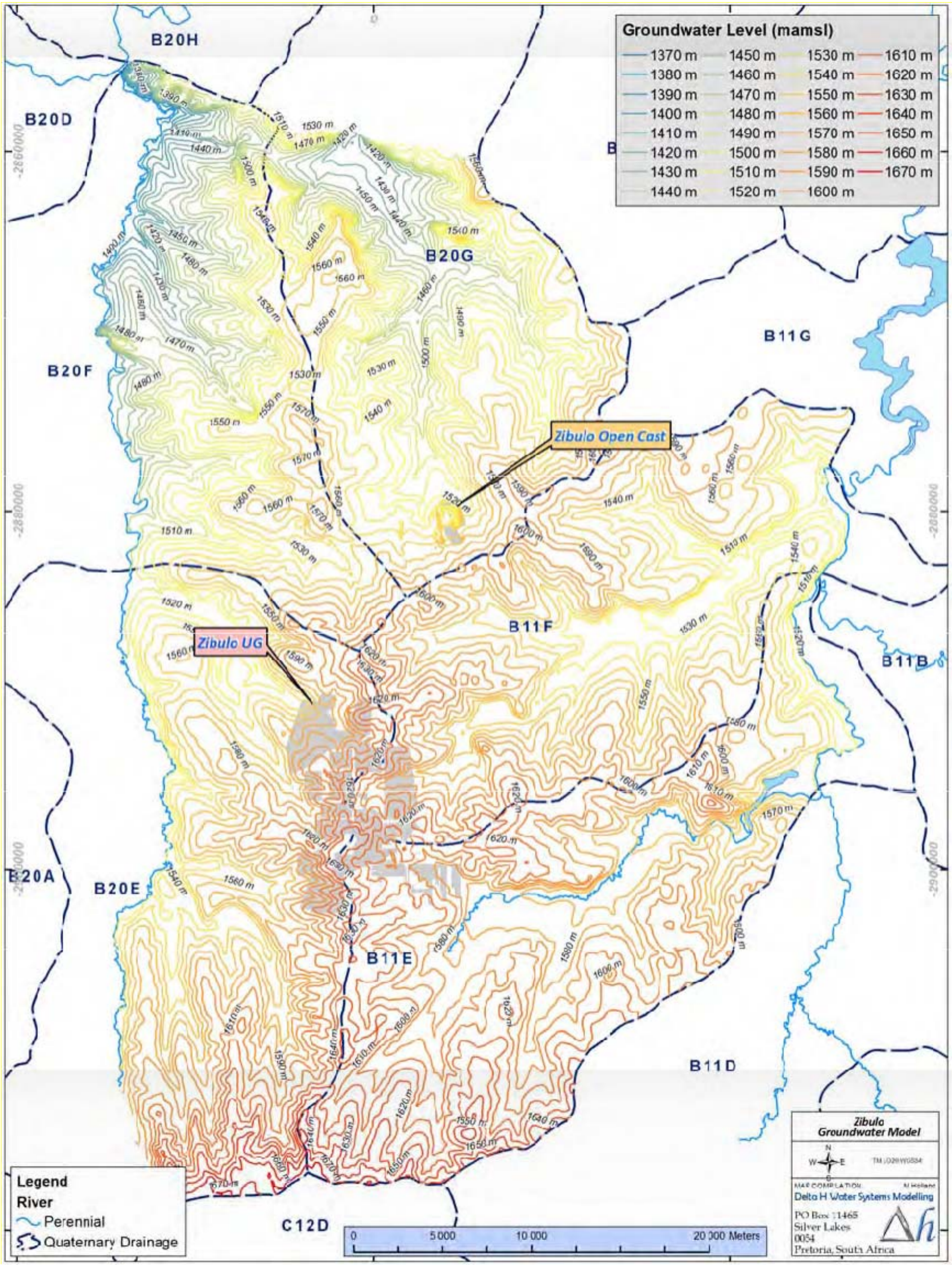

Figure 5-8: Interpolated shallow water table elevations for the wider study area

5.4.3 Groundwater Level Monitoring

The combined groundwater level trends of the quarterly measurement results for the underground workings are shown in Figure 5-9. Groundwater elevation for these boreholes between 1600 and 160 mamsl, except for the private borehole (ZDF1) monitored up to 2014 which sits ate around 1578 mamsl. While some seasonal fluctuation can be inferred no significant decline in water levels are observed suggesting the limited connection of the shallow aquifer from the deeper fractured aquifer being dewatered for underground mining purposes (Deltha H, 2017).

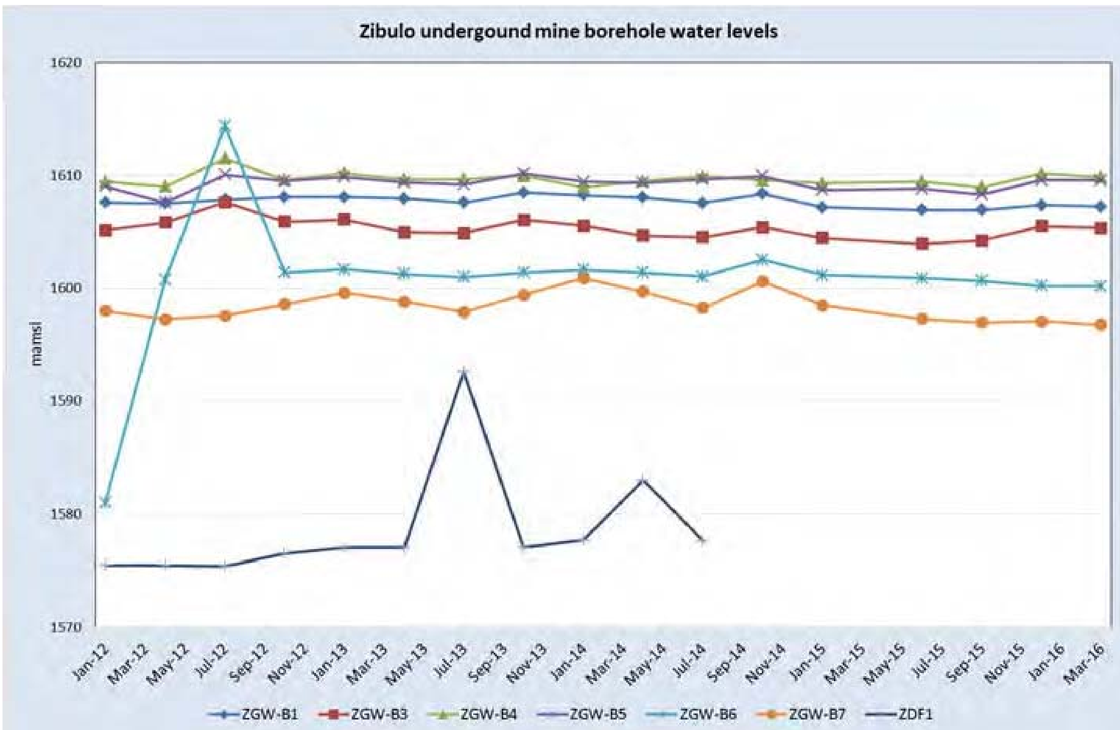

Figure 5-9: Groundwater levels monitored at the Zibulo underground workings

5.4.4 Groundwater Quality

The baseline description of the groundwater quality in the Zibulo study area was done by JMA (2004) based on analysis retrieved from a hydrocensus survey, including the drilling of shallow and deep monitoring boreholes. Based on the regional quality assessment by JMA (2004), the background groundwater quality for the Karoo aquifer summarised in Table 5-12 can be classified as Calcium-bicarbonate dominated water type of good quality.

The description of the site-specific groundwater quality is based on the continuous groundwater monitoring program for the Zibulo open cast and underground sections. The results collated from the Zibulo groundwater monitoring programme are compared against the following standards.

- South African National Standards (SANS) (2015). Drinking Water Quality Standard. Part 1: Microbiological, physical, aesthetic and chemical determinants, SANS241-1: 2011.
- South African Water Quality Guidelines by the Department of Water Affairs and Forestry (1996) for domestic use (DWAF, 1996).
- Integrated Water Use Licence (IWUL) for the Zibulo Underground Mine (Licence no. 04/B11E/CGIJ/692) and Open Cast Mine (Licence no. 04/B20G/AGJ/809).

Six (6) monitoring boreholes are currently used for groundwater quality at the Zibulo Underground. These locations are indicated in Figure 5-10 below. Table 5-13 below indicates the latest water quality variables for monitoring point ZGW B6 and ZGW B7. An additional borehole (ZGW B8) was drilled (by Delta H) adjacent to the area where the proposed emergency stockpile is to be constructed and operated. The results of the groundwater quality are also indicated in Table 5-13.

Table 5-12: Background groundwater quality (2004) for the study area (Karoo aquifer)

Variable	Minimum	Maximum	Average
pH	6	8.2	-
EC (mS/m)	7	56	29
TDS (mg/l)	80	364	197
Ca (mg/l)	4	54	24
Mg (mg/l)	2	25	11
Na (mg/l)*	5	44	21
K (mg/l)	2	22	4
Si (mg/l)	3	24	14
T-Alk (mg/l)	26	240	125
Cl (mg/l)	5	42	12
SO_4 (mg/l)	5	20	8
NO_3 (mg/l)	0	5	1
F (mg/l)*	0	1	0
Al (mg/l)**	<0.1	3.4	0.5
Fe (mg/l)**	<0.1	164	14.3
Mn (mg/l)**	<0.1	0.9	0.1

* F and Na may be naturally elevated at respectively >1 mg/l and >50 mg/l, if water quality is influenced by basement granites.

** Acidified before filtration.

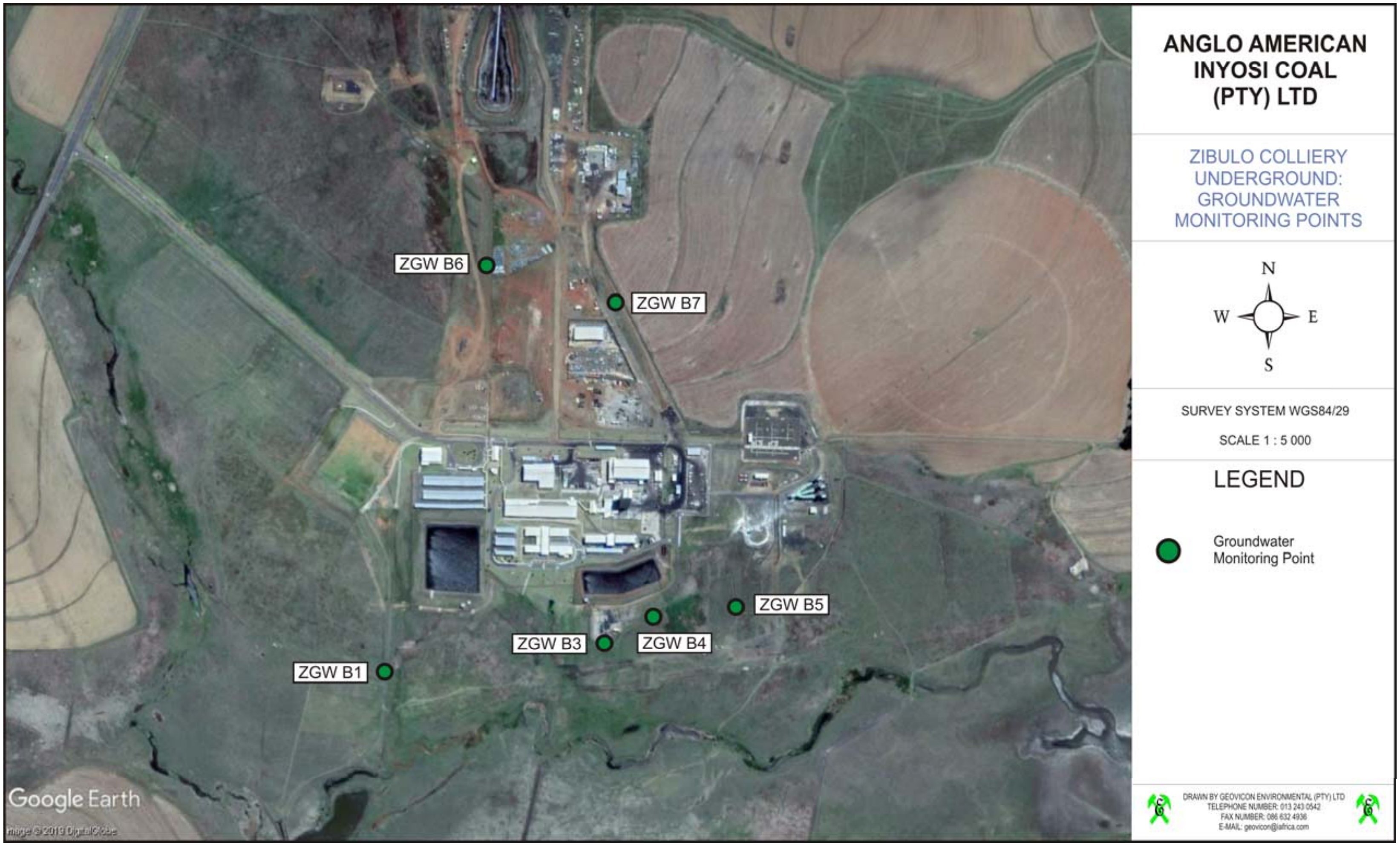

Figure 5-10: Zibulo Colliery Underground groundwater monitoring points

Table 5-13: Groundwater qualities compared to water quality targets (DWS)

	Zibulo Surface Water Monitoring			Water Quality Targets			
Parameter	**ZGW B6**	**ZGW B7**	**ZGW B8**	**Domestic**	**Aquatic Systems**	**Agriculture**	**Livestock**
Total Dissolved Solids (TDS) (mg/ℓ)	310	173	524	450	78.2	260	1000
Nitrate (NO_3) (mg/ℓ)	0.17	0.159	17	6	<0.1	0.5	100
Nitrite (NO_2) (mg/ℓ)	0.098	0.159	-	6	<0.1	0.5	100
Chloride (Cl) (mg/ℓ)	10.4	18.4	29	100	10.3	100	1500
Alkalinity as $CaCO_3$ (mg/ℓ)	91.9	90.7	216	-	-	-	-
Fluoride (F) (mg/ℓ)	0.133	0.123	0.2	1	0.75	2	2
Sulphate (SO_4) (mg/ℓ)	112	38.2	91	200	12.4	N/A	1000
Total Hardness as $CaCO_3$	210	122		200	N/A	N/A	N/A
Ammonia (NH_4) (mg/ℓ)	0.024	0.024	-	1.0	7	N/A	N/A
Phosphate (PO_4) (mg/ℓ)	0.001	0.001	0.1	N/A	0.005	N/A	N/A
Calcium (Ca) (mg/ℓ)	37.8	19.3	76	32	9.78	N/A	1000
Magnesium (Mg) (mg/ℓ)	28.1	17.9	34	30	5.1	N/A	500
Sodium (Na) (mg/ℓ)	12.3	10.5	21	100	5.9	70	2000
Potassium (K) (mg/ℓ)	6.72	6.21	9.6	50	1.3	N/A	N/A
Iron (Fe) (mg/ℓ)	0.001	0.001	0.025	0.1	1.13	5	10
Manganese (Mn) (mg/ℓ)	0.001	0.001	0.025	0.05	0.01	0.02	10
Electrical Conductivity (EC) (mS/m)	45.8	28.1	70.8	70	12.89	40	150
pH-Value at 25^0C	8.45	8.37	7.4	6 – 9	6 – 8	6.5 – 8.4	N/A
Zinc (Zn) (mg/ℓ)	0.001	0.001	0.068	3	0.002	1	20
Aluminium (Al) (mg/ℓ)	0.001	0.001	0.1	0.15	<0.01	5	5

5.4.5 Predictive Simulations

The solution of the calibrated steady-state groundwater model was subsequently used for the predictive model simulations. Based on the scope of work, the following scenarios were assessed:

- Predicted mine inflow rates for the remaining life of mine for the Zibulo open cast and underground operations;
- Predicted mine inundation rates and decant volumes based on current closure plan;
- Predicted post closure water quality separated into mine inundation and long term decant quality.

For a full description of the model please see the groundwater report (Delta H, 2017) attached as Appendix 5.

In order to reflect the annual planned underground mining blocks, the following changes to the boundary conditions were performed:

- For the next year's mining block, a leakage boundary (with no losses or flow of water) was assigned to the floor elevation of the targeted 2 Seam (Figure 5-11);

- The assigned extraction factors respectively porosity values (0.6) consider remaining pillars as well as coal remaining in the roof and floor of the respective workings (not entire seam thickness mined out).

- The future mining blocks was also simulated as a zone with elevated hydraulic conductivity (1^{E-03} m/s) and a slight increase from natural recharge of 2.5% to 3.5%. The chosen approach assumes that any groundwater entering any of the underground workings is removed immediately and no groundwater storage or flow within the mine workings or return flows into the aquifer is considered. In other words, it is assumed that the entire mine workings are dry due to continuous dewatering of any water ingress. The estimated dewatering rates do not account for any water storage in mining compartments, sealing of mining areas or grouting of mine inflows and are therefore considered an upper estimate.

The simulated mine inflows for the Zibulo underground workings are shown in Figure 5-12 and reflect the planned mine development. Based on the current mine plan and within the model assumptions, the average inflow over the remaining LoM of the Zibulo underground workings is around 3.7 Ml/d. However, the east-west striking graben structure could enhance water flow due to the discrete faults associated with the structure. Similar smaller features such as dykes and faults could also lead to higher than anticipated inflows, if intersected (and water bearing). From Figure 5-11 it is observed that the lowest part in the coal mine floor is in the south-eastern part of the mine between 1490 mamsl and 1495 mamsl, resulting in significant water accumulation in these 'lower' lying sections. Inter-mine flow between Khutala and the Matla underground sections could occur, however, the status of flooding of these sections is not known.

Figure 5-13 shows a cross-section of the predicted potential heads at the end of life of mine (simulation month 12 of 2024) as shown in were subsequently used as starting heads for the post-closure simulations.

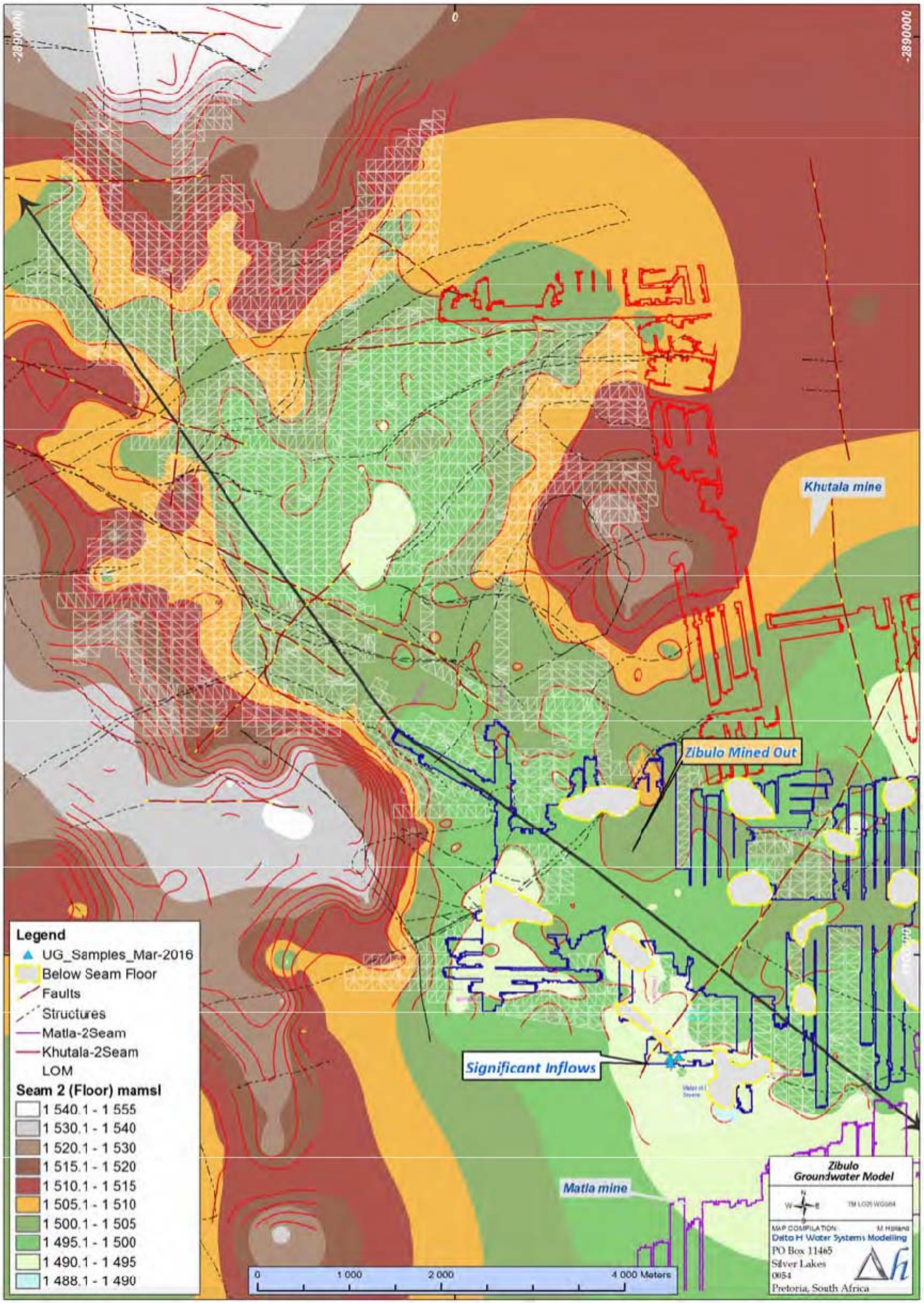

Figure 5-11: Seam 2 elevation and floor contours

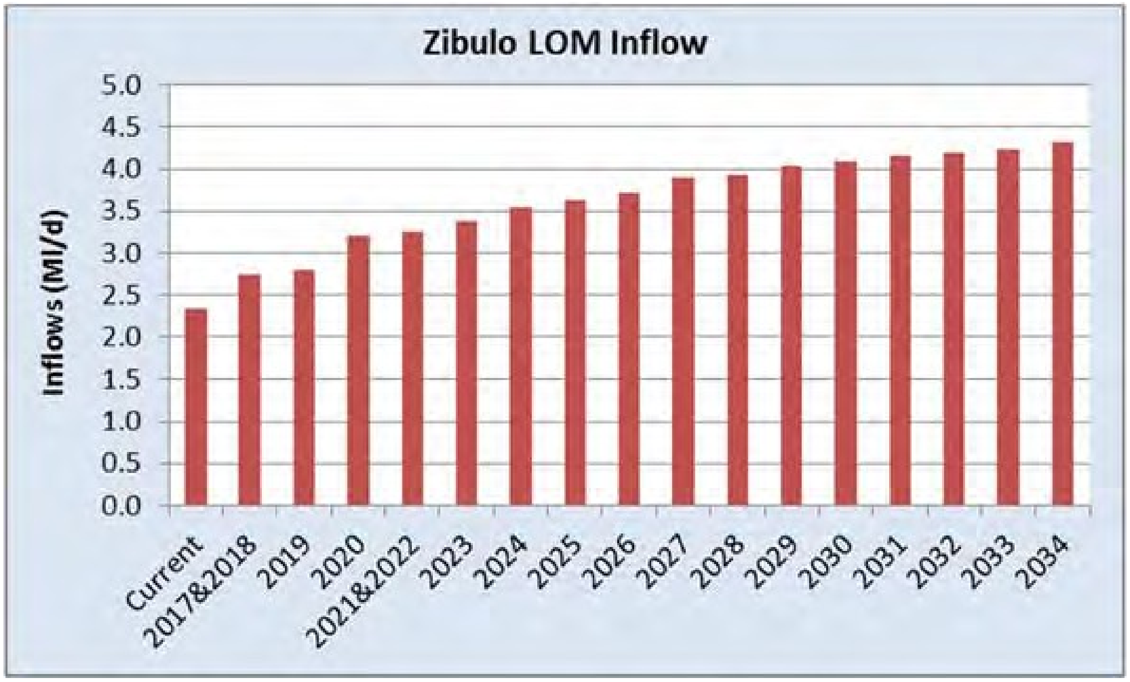

Figure 5-12: Simulated average inflows LOM inflows for the Zibulo underground workings

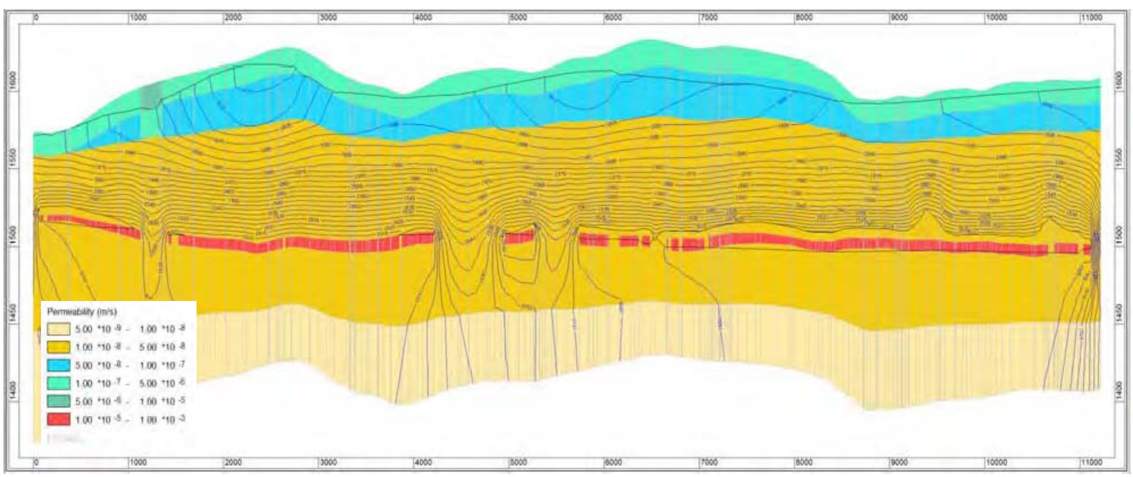

Figure 5-13: Potential head contours at the end of life of mine (2034) for Zibulo underground

<u>Predicted Groundwater Flow Based on the Current Closure Plan</u>

The current and LOM water storage (voids) relative to the elevation of the coal seam (floor and roof) is calculated and presented in the form of stage curves in Figure 5-14. Based on the current and LOM mining layout, mining height distribution (±3.8 m), the total water storage capacity of the underground mine is 92 Mm^3.

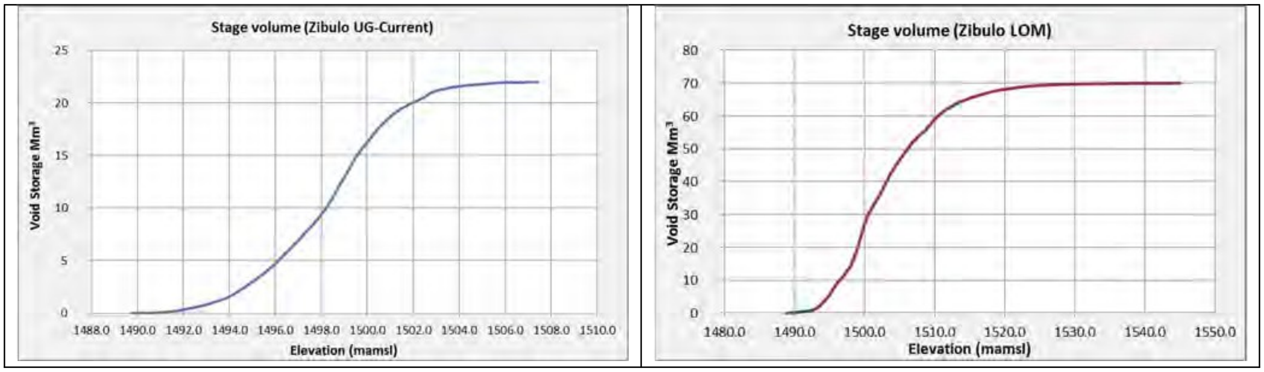

Figure 5-14: Stage-volume relationship for the Zibulo underground workings

For the post-closure model scenario, groundwater seepage into the underground mine voids was no longer removed from the model domain (water balance), but allowed to fill up the mine voids over time. In other words, pumping ceases immediately at the end of the 'life of mine' and the ground-water levels in the deeper fractured Karoo aquifer are allowed to rebound freely and flood the mine. During the flooding process, the mine voids (or parts thereof) change from seepage to recharge faces depending on the potential head gradient between the voids and the aquifer, resulting in simultaneous groundwater inflows and outflows. The computation of the rebounding water table in the aquifer takes therefore cognizance of interactions with the mine voids as well as unsaturated and saturated flow conditions in the (initially dewatered) aquifer surrounding the mine voids. The post-closure modelling results indicate that it will take around 70 years for the mine voids itself to be completely flooded (Figure 5-15) once active dewatering is stopped.

It must be noted that the simulated timeframe of mine flooding is highly sensitive to assigned aquifer permeability and, porosities. The predicted rate of mine flooding should therefore be re-evaluated during LOM and at closure when groundwater abstractions from the mine voids cease and groundwater monitoring data of the water table rebound become available. Inflows to the mine workings will continue and water levels will rise until all mine voids are filled. Eventually a dynamic equilibrium is achieved between inflow and outflow. The shape of the mine flooding curve (Figure 5-15) mirrors the stage-volume curve of the mine voids, though changes due to declining groundwater gradients towards the mine with increasing water levels within the mine are evident.

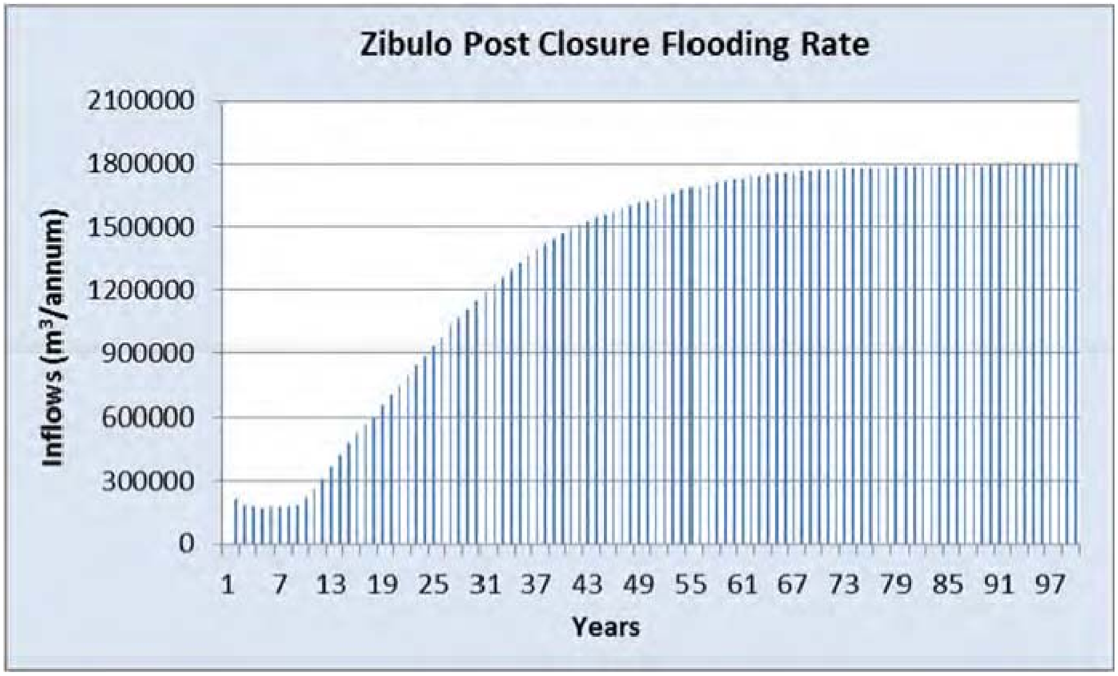

Figure 5-15: Simulated flooded mine volume over time

The "decant elevation" of the underground mine (void) is well below surface towards the south-east of the mining area. However, the term 'decant' is used in its wider context as potential groundwater movement from the flooded mine workings into the shallow aquifer (which is in hydraulic connection with surface drainages), the decant locations are not only dependent on the hydraulic pressure exerted, but also on the proximity and connectivity of the mine workings to the shallow aquifer. The potential positions (i.e. lowest surface elevation) at which such vertical exchange is likely to occur (driven by upwards directed head gradients) are therefore shown in Figure 5-16.

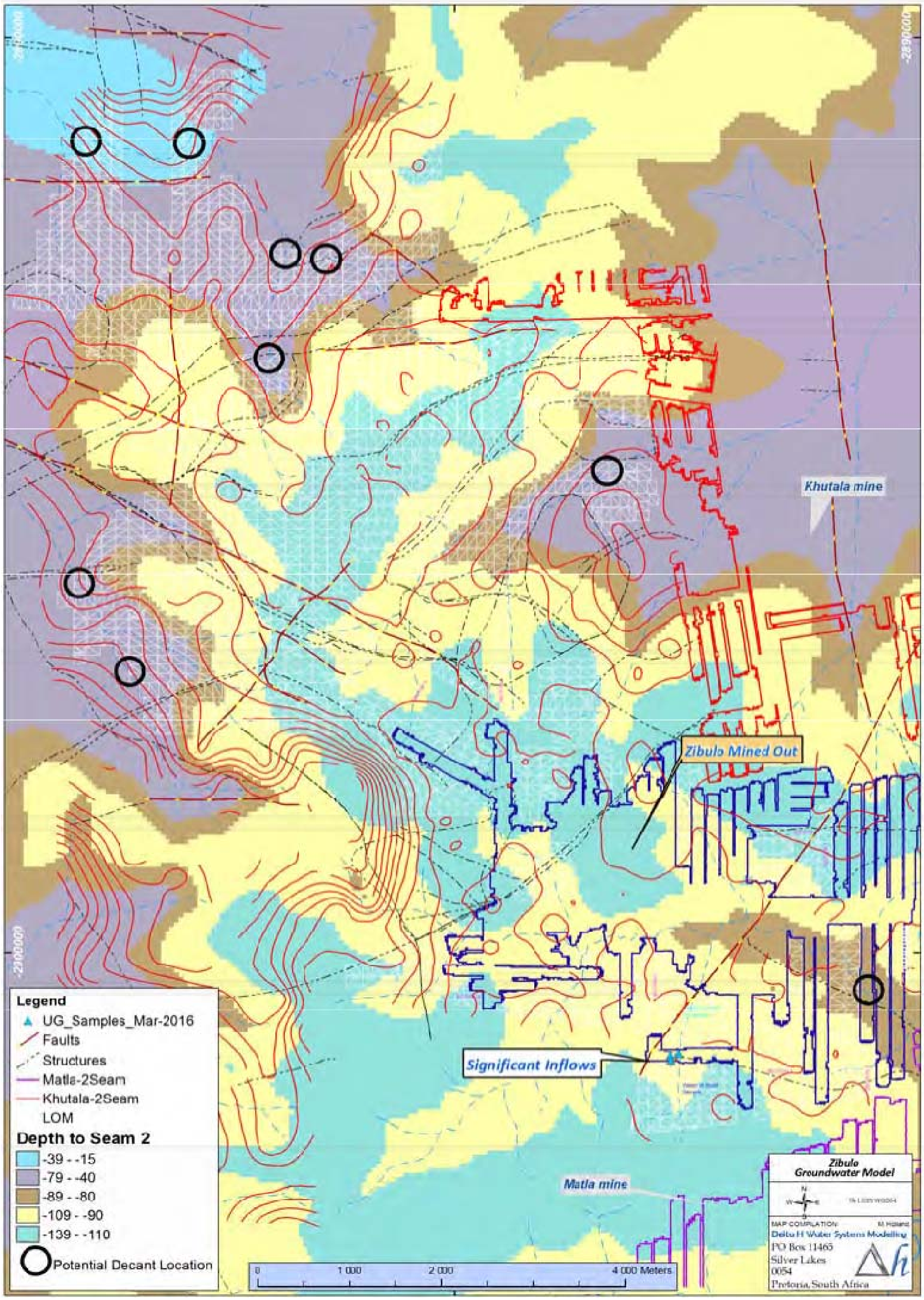

Figure 5-16: Depth to Seam 2 (roof) from surface

5.5 SENSITIVE LANDSCAPES

The first part of this section will describe the wetland baseline for parts of the underground mining right area as well as the northern underground expansion area conducted by Wetland Consulting Services (Pty) Ltd in 2005. The second part will describe the updated wetland conditions around the infrastructure area and the impact that it has on the surrounding wetlands (as it was not done as part of the original WUL application), this study was conducted by GreenGab (Pty) Limited in 2020. The final part will discuss the offset strategy that was developed by Wetland Consulting Services for Zibulo Colliery with regards to two wetlands situated to the east and west of the infrastructure area.

These specialist studies consist of the identification and delineation of wetland areas above the underground mining area and within the vicinity of the infrastructure area. The ecological functioning and integrity (health) of the delineated wetland areas were also described during this study. Findings from this specialist study are attached as Appendices xx, xx and xx.

PART 1: BASELINE WETLAND ASSESSMENT

5.5.1 Study Area

This study area is located to the west of the town of Ogies between 28° 55.5' E and 29° 03.5' E and 26° 06.8' S and 26° 14.1' S [See the third edition 1996 Kendal(2628 BB) and Ogies (2629 AA) 1:50 000 topographic map published by the Chief Directorate: Surveys and Land Information, Mowbray]. It includes sections of the farms: Leeuwfontein 219 IR, Straffontein 252 IR, Zondagsfontein 253 IR, Strehla 261 IR, Uitvlugt 255 IR, Onverwacht 66 IS, Rietvlei 64 IS and Olga 35 IS. The majority of the area is currently used for agriculture including cultivated fields, planted pastures and livestock farming.

5.5.2 Methods used for Mapping the Wetlands

Black and white aerial photographic contact prints at a scale of 1:50 000 were purchased from the Chief Directorate: Surveys and Mapping for the purpose of desktop delineation of the wetlands in the study area. Orthophotographs (at a standard scale of 1:10 000) of the study area were purchased from the Chief Directorate: Surveys and Land Information to provide the base map for the delineation. These included:

- 2628 BB 14, 15, 19, 20 and 25;
- 2629 AA 16, 21.

These were scanned and used to provide the ortho-rectified digital base map onto which the wetland boundaries were delineated using ArcView 3.2. Hard copy black and white photographs of the area were used in combination with the 5m contour map to assist with the remote mapping of the wetlands. The black and white air photography offered slightly better clarity in terms of signature identification. This combined method is similar to that recommended by Thompson, Marneweck, Bell, Kotze, Muller, Cox and Clark (2002) for wetland inventory mapping purposes. The baseline digital map from the Upper Olifants River Catchment study (Marneweck and Batchelor, 2001) was used as a first level indication of the broader boundaries of the wetlands in the study area. These were refined using the black and white air photo imagery and the hard copy 1:10 000 orthophotos. Site visits were undertaken in July 2002 for orientation and field verification purposes. Soil augering was used to look for indicators of hydric conditions (see Kotze and Marneweck, 1999) in order to verify whether or not the areas delineated as wetlands met the criteria for classification as wetlands. Experience form having undertaken other projects in the area were used to support the write-up on the key determinants of the wetlands identified (WCS, 2005). The wetlands in the study area were delineated onto 1:10 000 orthophotographs and transferred to digital format using heads-up digitizing. This gets around the problems associated with manual transfer and hard copy line thickness errors in relation to on-ground distance (Thompson *et al*., 2002). The wetlands were classified according to their hydro-geomorphic determinants based on a modification of the system first described by Brinson (1993), further developed for the upper Olifants River catchment by Marneweck and Batchelor (2002), and then refined for national application by Kotze, Marneweck, Batchelor, Lindley and Collins (2004). Wherever possible, the dominant plant species were also recorded in the wetlands. The plant list in the vegetation report by EkoInfo (2004) was used to supplement the wetland plant species field data list. Notes were made on the levels of degradation in the wetlands based on field experience and a general understanding of the types of systems present. The status of the wetlands was assessed based on the information collected. The likely impacts of the underground mining operations on the wetlands in the study area were evaluated based on a significance rating scale embracing the notions of extent, magnitude, duration and significance of impacts.

5.5.3 General Wetland Description

The presence of the wetlands in the study area is linked to both perched groundwater and surface water. A schematic diagram of how these systems are positioned in the landscape and the general topography of the study area is given in Figure 5-17. Four Hydro-geomorphic (HGM) types of natural wetland systems totalling 668.5 ha occur within the study area. These are:

- Valley bottom wetlands with channels;
- Valley bottom wetlands without channels;
- Hillslope seepage wetlands connected to watercourses; and
- Pans.

The area of the different wetland types within the study area and a description based on their setting in the landscape and hydrologic components are given in Table 5-14 and Table 5-15 respectively. Dams occupy 116 ha of the area and these form the main artificial wetland type within the study area.

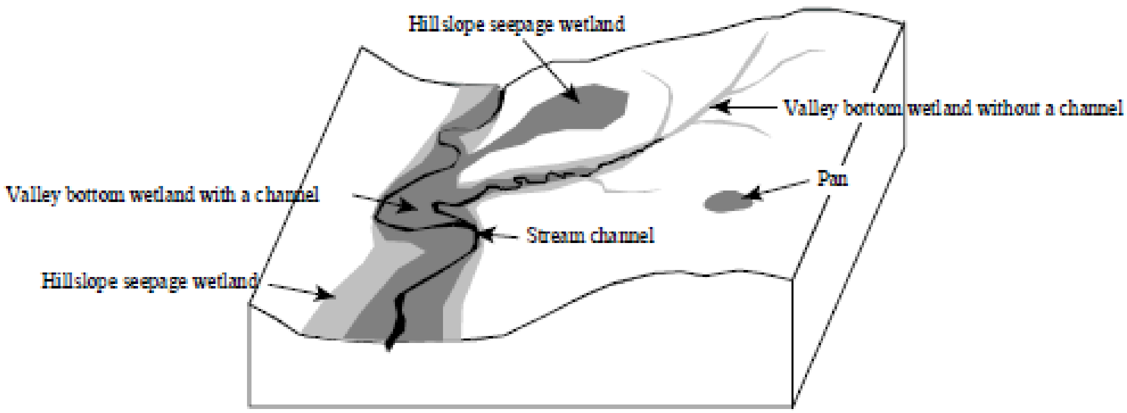

Figure 5-17: Schematic of the HGM wetland types found in the study area

Table 5-14: Area of the different HGM wetland types within the study area

Wetland Type	Area of Wetland within the Study Area (ha)
Valley bottom wetlands with channels	453.3
Valley bottom wetlands without channels	109
Hillslope seepage wetlands connected to watercourses	100.6
Pans	5.6
Total	**668.5**

Table 5-15: The definition of the different HGM wetland types occurring in the study area

Wetland Type	Topographic Setting	Description	Hydrologic Components		
			Inputs	Throughputs	Outputs
Valley bottom wetlands with channels.	Occur in the steeper headward parts of the streams and in the shallow valleys that drain the slopes.	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. Are gently or steep sloped and characterized by eroding as opposed to depositional processes.	Receive water inputs from the main channel (when channel banks overspill) and from adjacent slopes, as well as from adjacent hillslope seepage wetlands if these are present.	Surface flow and interflow.	Variable but predominantly stream flow.
Valley bottom wetlands without channels.	Occur in the shallow valleys that drain the slopes.	Valley bottom areas without a stream channel. Are gently or steep sloped and characterized by the	Receive water inputs from adjacent slopes via runoff and interflow. May also receive	Surface flow and interflow.	Variable but predominantly stream flow.

Wetland Type	Topographic Setting	Description	Hydrologic Components		
			Inputs	Throughputs	Outputs
		alluvial transport and deposition of material by water.	inputs from a channelled system. Interflow may be from adjacent slopes, adjacent hillslope seepage wetlands if these are present, or may occur longitudinally along the valley bottom.		
Hillslope seepage wetlands connected to watercourses	Hillslopes.	Occur on concave or convex slopes immediately adjacent to, or at the head of watercourses including other wetlands. Characterized by the colluvial (transported by gravity) movement of materials. Generally, always associated with sandy soil forms.	Predominantly groundwater from perched aquifers and interflow.	Interflow and diffuse surface flow.	Variable including interflow, diffuse surface flow and stream flow.
Pans.	In depressions and basins, often at drainage divides on top of the hills	A basin shaped area with a closed elevation contour that allows for the non-permanent (seasonal or temporary) accumulation of surface water. An outlet is usually absent.	Runoff from the surrounding catchment area and lateral seepage from adjacent hillslope seepage wetlands.	None.	Evapo-transpiration and groundwater discharge from leakage.

5.5.4 Specific Description of the Wetland Types

Valley Bottom Wetlands

These wetland systems are evident as longitudinal bands of facultative wetland indicator plants comprising a mixture of grasses and sedges contained within a relatively narrow zone along the valley bottoms. Most of the valley bottom wetlands are associated with lateral seep zones which from part of adjacent hillslope seepage wetlands. Two types of these systems occur, namely:

- Valley bottom wetlands with channels; and
- Valley bottom wetlands without channels.

Due to the shallow gradients along the valley bottoms, diffuse horizontal surface flow and interflow also characterise these systems with rapid flow being restricted to the channels in the channelled type. There is generally a clearly visible transition in the vegetation between the mixed grass-sedge meadow zones that characterise these wetlands to the more intermittently wet grassland habitats associated with the adjacent hillslope seepage wetlands.

Temporarily wet grasslands define most of the valley bottom wetlands in the Zondagsfontein area with the dominant plant species here including the grasses *Themeda tiandra* on the edges *and Eragrostis plana* and the sedge *Fimbristylis complanata* throughout. There is also generally a rapid transition from the mixed grass-sedge meadow zone of these more temporarily wet habitats to the more seasonally wet habitat closer to the centre of the drainage lines and/ or the channels (where these occur). These areas comprise a mixture of grasses and sedges, with the dominant plant species being true wetland indicator species such as the sedges *Cyperus fastigiatus* and *Eleocharis dregeana* and the grasses *Seteria sphacelata* and *Paspalum* species.

Hillslope Seepage Wetlands

The hillslope seepage wetlands that occur in the study area are associated with sandy soil forms and maintained predominantly by perched sub-surface flow. The A horizon in these soils commonly remains saturated for periods during the summer months, and in some areas these systems are only saturated for short periods during the summer rainfall months. The resulting vegetation in these areas comprises a mixture of wetland and upland species. The boundaries of these systems often extend well away from the easily recognizable saturated zones thus forming a gradual ecotone that can extend tens of metres as the depth to the perched water table increases with distance away from the unconfined seep front. Only one HGM type of hillslope seepage wetland, namely hillslope seepage wetlands connected to watercourses, occurred in the study area. No isolated hillslope seepage wetlands or hillslope seepage wetlands connected to pans were found. Hillslope seepage wetlands connected to watercourses are seepage systems directly linked on the surface to watercourses. They typically contribute to flow in the watercourses, even if this contribution is only on a seasonal basis. Typical hillslope seepage wetland species in the study area include the grasses *Eragrostic plana*, *Helictotrichon turgidulum*, *Imperata cylindrica*, *Setaria sphacelata* and the forbs *Haplocarpha scaposa*, *Commelina african* and *Pelargonium luridum* to mention but a few.

Pans

Four pans occur within the study area and all are non-perennial. These have a total area of 5.6 ha which represents approximately 0.8% of the total wetland area. Typically, the pans are relatively floristically poor given the types of systems and the area in which they occur. The pans are typically dominated by mixed grass/ sedge meadows of *Setaria sphacelata* and *Eleochris dregeana/ Fimbristylis complanata* with some *Leersia hexandra* in places. Indications are that the pans are probably only inundated for short periods during the summer rainfall season following local rainfall events and then fairly rapidly draw down to empty. In the lowest lying areas, shallow water may stand for longer but for most of the year the pans do not contain surface water. Unlike is the case with most pans in the region, none of the pans have hillslope seepage wetlands on the slopes of the pan basins. This probably accounts for their relatively dry nature.

Despite not having notable hillslope seepage wetlands directly associated with them, the pans are nevertheless likely to be influenced by an interflow component. Direct runoff from the pan basins probably accounts for the majority of water input into the pans. The pan floor of all the pans is characteristically dominated by clay. No water or sediment quality data are available for the pans and no water quality data was collected during field sampling. Despite the lack of data on water quality, indications based on vegetation composition suggest that the water in the pans is not likely to be saline. All the pans are therefore expected to be fresh and likely to "leak". In other words, water that collects in the pans is likely to move into the subsoil layers. Given the relatively small size of the pans, they are unlikely to contribute significantly to local shallow or deeper groundwater dynamics.

5.5.5 Present State of the Wetlands

The present state of the wetlands in the study area cannot be regarded as pristine when compared with what would be expected for reference conditions without disturbance or modification. Sections of most of the valley bottom systems showed signs of the effects of overgrazing and mining or prospecting. Although cultivation has taken place throughout the study area, this has been restricted to outside the boundaries of the valley bottom systems and pans. As such, there has been little direct effect of cultivation on these wetland systems. Farm dams are common in the valley bottom systems and some marginal wetland area has been lost due to these. The dams now provide open water habitats that remain wet during the summer season. In contrast to the valley bottom systems and pans, the hillslope seepage wetlands have been extensively impacted by agricultural practices.

5.5.6 Functional Values

Indirect use Values

Despite the widely held notions about wetland functionality, extensive literature searches have revealed that very few practitioners have actually quantified these benefits (Batchelor, PC). Moreover, it appears that these functions are highly variable depending on the characteristics of the wetlands and the landscape. In the present study, it was not possible to perform the types of investigations necessary for determining functionality such as nutrient balance studies or flood attenuation quantifications. This was due both to the complexity of the task and the costs and time that would have been involved. It is therefore difficult to speculate on the functional values of the wetlands on site. Nevertheless, some general discussion is possible based on anecdotal evidence on site and experience from projects undertaken in the region. These are discussed for each of the main wetland types found within the study area.

Hillslope seepage wetlands are commonly considered to be valuable in that they perform a number of beneficial functions such as removing excess nutrients and inorganic pollutants produced by agriculture, industry and domestic waste (Rogers, Rogers and Buzer, 1985; Gren 1995; Ewel, 1997; Postel and Carpenter, 1997). In so doing they perform a purification service that saves on purification costs of downstream water supplies, and prevent damage caused by polluted water. Besides their contribution to biodiversity, this is likely to be their main function in the landscape. They may also play a role in replenishing or recharging groundwater supplies (Thompson and Goes, 1997). This would occur when water percolates through the topsoil to the underlying aquifer. The significance of this contribution in the study area is however not known. Since the hillslope seepage wetlands really represent the expression of groundwater at or near the soil surface, it is more likely that the sandy soil landscape around the wetlands is more important (in terms of extent and depth of the soil profile) in terms of ground water recharge than the wetlands themselves.

With respect to the pans, the role they play in the physico-chemical landscape is even less clear. In systems like those in the study area that dry out completely at some stage, for example, some of the accumulated salts and nutrients such as organic nitrogen, various phosphate and sulphate salts might be transported out of system by wind and be deposited on the surrounding slopes. Where such deposited materials are not transported out of the system completely, they may redissolve when water enters the system again after rainfall events. The valley bottom wetlands are likely to contribute towards flood attenuation, as a result of both their topographic form and general resistance to flow. Their function in relation to enhancing water quality however is less clear. This will largely depend on the volume of water flowing over the surface compared to that moving in the soil. Retention time which influences the length of time that there is contact between the bulk of the water and the sediments is the main determinant that affects the opportunity for the removal of certain nutrients. One exception to this is suspended solids, the concentration of which will vary depending on the gradient (slope) of the valley bottom wetlands and the sources of sediment (eg. adjacent agricultural lands). Where flows permit, there may be selective deposition of particles that are deposited along the valley bottom systems. Due to the nature of the systems in the study area, this is predominantly confined to finer particles due to the slower flows. Some nutrient removal, for example of phosphates and ammonia bound to clay minerals and soil particles, is likely to occur coincidentally with the deposition of these sediments. Sedimentation will thus tend to reduce phosphate loads in the short term. This is however likely to be recycled through plant and animal uptake and possibly rereleased into the system at some later stage. Re-release may also occur if the sediments are submerged for periods long enough to result in the formation of anaerobic conditions, such as would occur in depressions and pools.

During the drying out phase, similar processes to those documented in pans can be expected, with progressive concentrating of solutes until their solubility products are exceeded. The actual mass of these precipitates is however unlikely to represent a significant proportion of the mass of elements transported during high flow events. In addition to removal, inundation can also result in the release of salts and nutrients into the water column through mineral exchange. During the initial wetting phase for example, previously deposited salts and nutrients may be dissolved and leached from the sediments into the water column. Another effect that inundation in these systems may have on sediments is a change in the redox potential. Typically, the redox potential would decrease as a function of time after inundation. The change in redox increases the solubility of a number of metals such as manganese and iron and can result in the release of these and previously bound phosphates. The converse also holds when the system dries out and the sediments are re-aerated.

Direct use Values

The wetlands in the area are not only used to provide water, fodder and grazing for livestock, but are also used as sites for dams. Rough estimates of direct use values from the wetlands in the upper Olifants River catchment indicate values of R100 – R750/ha for drainage line type systems and floodplains up to R3250/ha for pans (Palmer, Turpie, Marneweck and Batchelor (Eds) 2002). Based on present value terms (calculated at an 8% discount rate), the land value of wetlands (using upper bound estimates) is this region was then estimated at approximately R1 000 – R7500/ha for drainage lines and floodplains, R18 000/ha for dams and R32 000/ha for pans (Turpie and van Zyl, 2002).

5.5.7 Ecological Importance of the Wetlands

In a local comparison with three adjacent areas, the species richness per ha for the Zondagsfontein systems is lowest relative to the adjacent wetland areas at Khutala, Smithfield and Goedgevonden. The relatively small difference in the ratio of species richness per hectare between the Zondagsfontein wetlands and those of the other areas suggests that this is unlikely to be significant from an ecological importance perspective.

In a regional comparison of the wetlands in terms of plant species richness, the Zondagssfontein systems sit on the line of the regional species area curve (Figure 5-18). This indicates that despite the relatively low plant species richness recorded in the wetlands, it is comparable with what would be expected for this size wetland area in the region. The Viskuile wetland complex which is regarded as a regional benchmark (reference site) is shown for reference. In conclusion, in terms of wetland types, the systems are common in the region, in terms of present state, the systems are mostly degraded, and in terms of ecological importance, the systems are average for the region. None of the wetlands in the study area have any formal conservation status. Fig xx indicates the wetlands that were identified during this study.

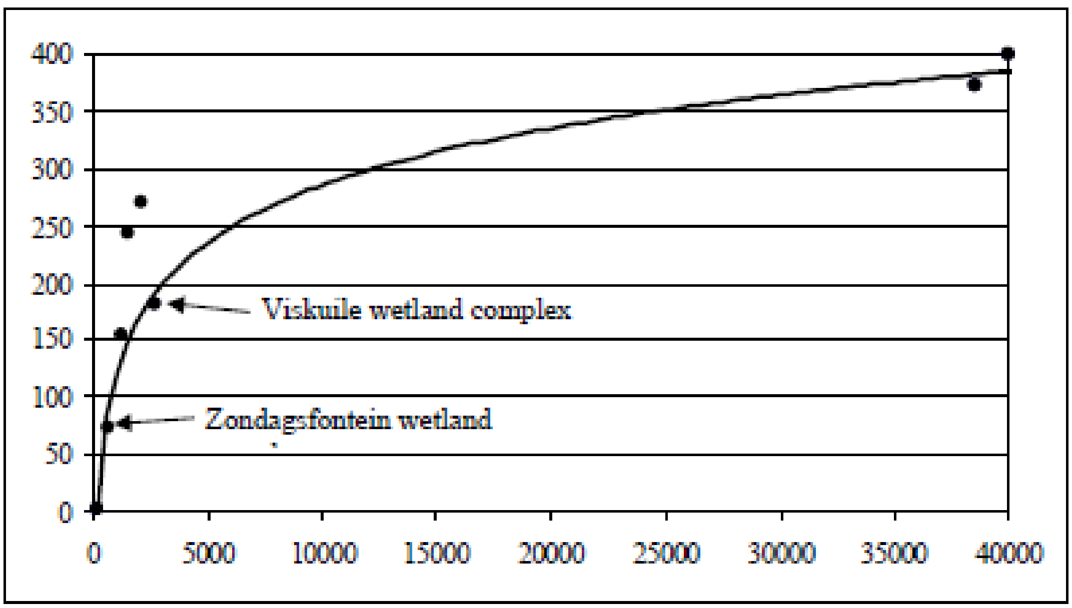

Figure 5-18: Species area curve showing the species richness per unit area of wetland in the upper Olifants River catchment

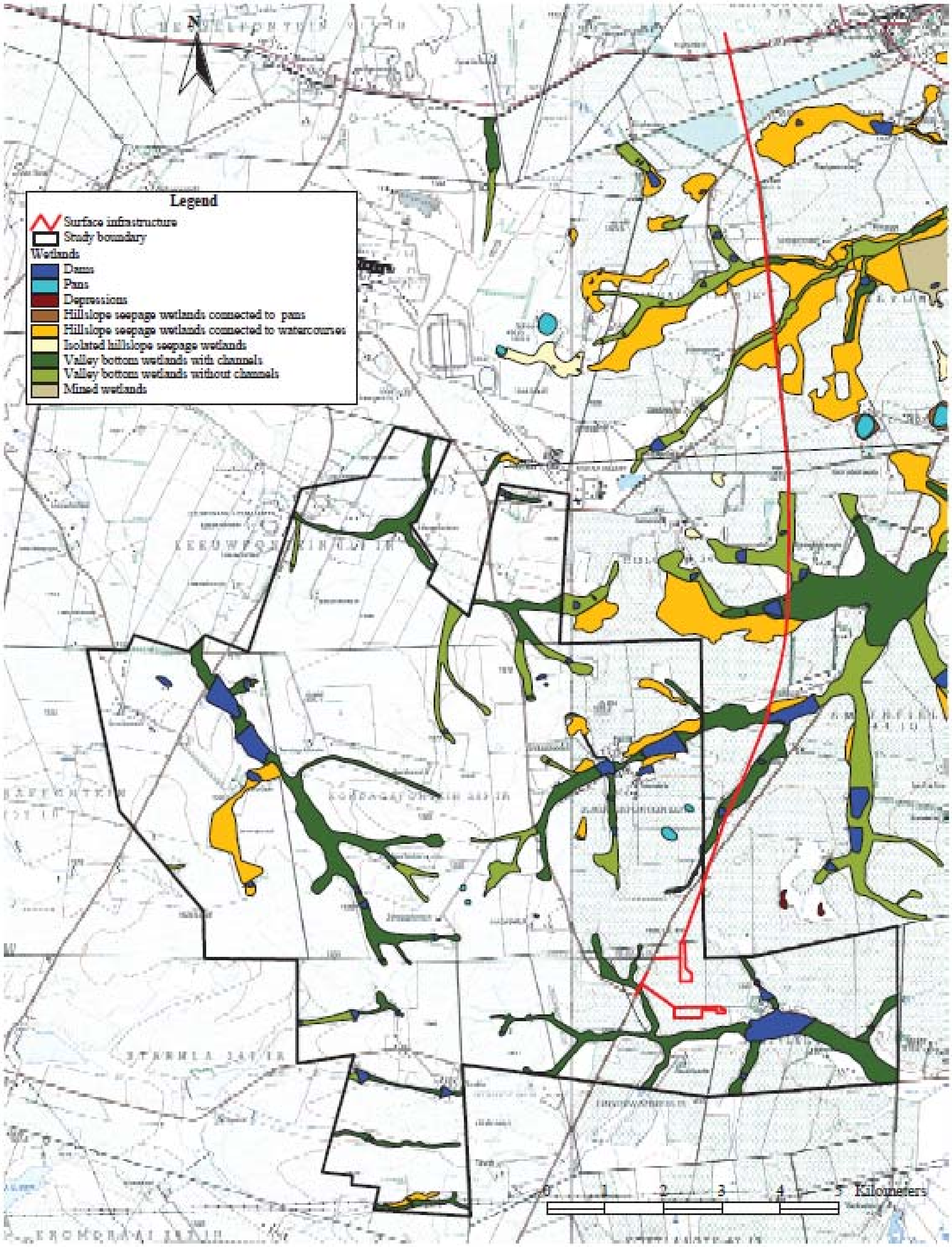

Figure 5-19: Wetlands of the study area

PART 2: INFRASTRUCTURE AREA WETLAND ASSESSMENT

5.5.8 Approach

A site visit was undertaken to assess the current ecological conditions of the wetlands on site. This included collecting ecological data and recording impacts on the wetlands. The information collected was used to establish a baseline ecological condition (the current state) of the wetlands with particular emphasis on wetland directly impacted by mining activities, and to provide an indication of the conservation value and sensitivity of the wetlands. The methods described by Macfarlane *et al.*, (2008) and Rountree *et al*., (2013) were utilised to determine the Present Ecological State (PES) and Importance and Sensitivity (IS) of the wetland directly impacted by the mine surface infrastructure on site. The ecological integrity (PES and IS) of the wetland system directly impacted by the mine infrastructure was compared to its ecological integrity before mining took place. The comparison is to provide information on the changes within the wetland as a result of the development on site, and to assist in the identification of impacts and required mitigation measures to achieve no net loss of wetlands due to the current development on site. The drivers and importance of the artificial wetlands on site were evaluated by:

- Identification of visible water inputs to the wetlands;
- Review of stormwater management plans associated with existing infrastructure, and identification of various discharge points;
- Determination of the importance of artificial wetlands. The importance will be derived from the perceived value of wetlands in regulating flows and improving water quality. Assessment will include analysis of water qualities at different strategic points and inferences made based on the general landform setting of the wetlands, and their position in relation to on site water management systems. and
- The functional gains associated with artificial wetlands will be evaluated using offset evaluation methods/ calculators (SANBI and DWS, 2015). The functional benefits of the created wetland systems will be evaluated by looking at the wetland vegetation composition, flow regulation and water quality improvement capacities.

5.5.9 Findings

Wetland habitat was identified within the study area and classified as channelled valley bottom wetland and hillslope seepage wetlands (GreenGab, 2020) based on the wetlands locations within the landscape, drainage patterns and soils (Table 5-16). Figure 5-20 indicates the wetlands that are currently on-site and directly affected by the surface infrastructure.

Table 5-16: Hydro-geomorphic classification system

Hydro-geomorphic Type	Description
Channelled valley bottom.	Valley bottom areas with a well-defined stream channel. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.
Hillslope seepage.	Slopes on hillsides which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from the subsurface flow, and outflow can be via a well-defined stream channel connecting the area directly to a stream channel or outflow can be through diffuse subsurface and/ or surface flow but with no direct surface water connection to a stream channel.

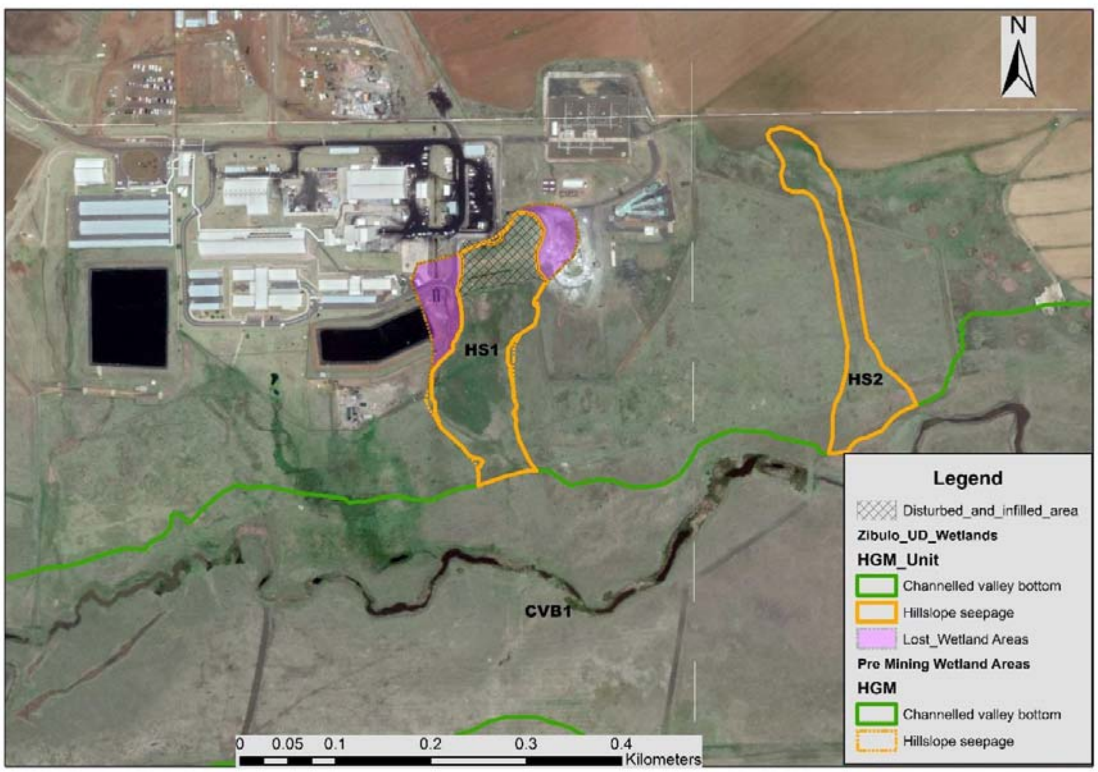

Figure 5-20: Natural wetland areas currently present on site

The hillslope seepage wetland (HS1) is directly impacted by the mine infrastructure. This poses new challenges in terms of mitigating and/ or offsetting the impacts to the wetlands on site. Approximately 16% of the wetland area has been lost as a result of the mine infrastructure footprint extending into the wetland (see Figure 5-20 above). The following activities were identified as impacting on the wetland on site:

- Several stormwater canals and trenches are discharging into the hillslope seepage wetland HS1, and this includes effluent from the surface stormwater management system, greywater from showers in the change houses and overflow from the Pollution Control Dam (PCD);

- Sections of the wetland area have been infilled, presumably with excavated materials;

- The infilled areas are dominated by weeds and alien species such as *Conyza sp*., *Cynodon dactylon, Cyperus esculentus, Digitaria eriantha, Paspalum dilatatum, Plantago sp., Pennisetum clandestinum*, and *Verbena sp*.; and

- Areas below the infilled area are vegetated with tall, robust vegetation (e.g. *Phragmites australis* and *Typha capensis*) suggesting a permanent presence of water, which is likely a result of stormwater discharge.

5.5.10 Present Ecological State of HS 1

The Present Ecological State (PES) of the impacted wetland on site HS1 was undertaken using a Level 1 assessment tool as described by the WET-Health manual (Macfarlane *et al*., 2008). A description of the PES is provided in Table 5-17 below.

Table 5-17: Scoring system used for the WET-Health PES Assessment

Description	Combined Impact Score	PES Category
Unmodified: Natural.	0 – 0.9	A
Largely natural with few modifications: A slight change in ecosystem processes is discernible, and a small loss of natural habitats and biota may have taken place.	1 – 1.9	B
Moderately modified: A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2 – 3.9	C
Largely modified: A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9	D
Seriously modified: The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognisable.	6 – 7.9	E
Critically modified: Modifications have reached a critical level, and the ecosystem processes have been entirely modified with an almost complete loss of natural habitat and biota.	8 – 10	F

The hillslope seepage wetland HS1 is considered to be Seriously Modified (PES category E). Several impacts and disturbances have contributed to the present ecological state of the hillslope seepage wetland departing significantly from the reference condition or un-impacted state. Disturbances include approximately 16% of the wetland and associated functionality being lost within the footprint of the mine surface infrastructure and other impacts associated with the mine infrastructure, such as stormwater canals and trenches feeding into the seep wetland. Observations made during the site visit suggest that these disturbances have negatively impacted all three aspects of wetland integrity, and are discussed below.

Hydrology

This has been modified in terms of water inputs to and retention within the wetland. Flow inputs have been altered due to increased flows into the wetlands from stormwater canals and trenchs discharging into the wetland. The natural pattern of flows delivered to the wetland has been altered by the presence of hardened surfaces within the infrastructure footprint resulting in increased flood peaks and reduced sub-surface water inputs into the wetland. The infill and reduced surface roughness from the lack of vegetation cover within the mine infrastructure footprint also increase flow velocity through the wetland, affecting water retention and distribution within the wetland. The presence of impeding features, such as the fence and road crossing through the wetland have upstream (i.e. impoundment) and downstream (i.e. reduced flow) effects on the affected areas of the wetland.

Geomorphology

The increases in flood peaks reaching the wetland due to hardened surfaces from the mine infrastructure upstream and within the wetland have modified the morphological characteristics of the wetland. Increased flood peak flowing into the wetland lead to increased capacity to transport sediment. The morphology of the hillslope seepage wetland has been altered by the presence of the deposition/ infilling area within the upper section of the wetland which has resulted in burial of the wetland soils and reduced expression of wetland characteristics at the soil surface.

Vegetation

Impacts to wetland vegetation are a result of the mine infrastructure totally replacing wetland vegetation within the infrastructure footprint in the wetland and modifications to hydrology from the mine infrastructure. The mine infrastructure takes up 16% of the wetland area and has replaced wetland vegetation within this area. Increased water inputs into the wetland from stormwater canals and trenches associated with the mine infrastructure combined with impeding features such as the road crossing through the wetland have resulted in a marked increase in water retention within the wetland. This is particularly evident in the wetland's ability to support taller, robust vegetation typically associated with permanent saturation (e.g. reeds such as *Phragmites australis*, *Typha capensis* found growing on the western side of the wetland where stormwater discharges). In contrast, the Hillslope seepage wetland would have naturally supported a shorter grass-sedge community adapted to temporary to seasaonal saturation. Weeds of disturbed places and alien species such as *Conyza sp., Cynodon dactylon, Cyperus esculentus, Digitaria eriantha, Paspalum dilatatum, Plantago sp*. and *Pennisetum clandestinum* were found to be growing more markedly in the areas of sediment deposition and infilling in the upper section of the Hillslope seepage wetland and more sparcely within the rest of the wetland.

In addition to these impacts, the quality of water entering the hillslope seepage wetland HS1 is a concern considering the stormwater discharge and dirty water from the PCD dam discharging into the wetland.

The results of the PES assessment and rankings based on our current understanding of the wetland are summarised in Table 5-18: Results of the WET-Health Level 1 assessment.

Table 5-18: Results of the WET-Health Level 1 assessment

Wetland ID	Wetland HGM	Wetland Area (ha)	Impact Scores			Combined PES Score	PES Category	Ha-Eq
			Hydrology	Geo-morphology	Vegetation			
HS 1	Hillslope seepage	2.69	6	5.50	6.70	6.06	E	0.11

The wetland functional loss, in this case, can be achieved through the existing Zibulo offset strategy (GreenGab, 2020).

5.5.11 Artificial Wetlands

Phase 1 indicated two artificial wetlands that have formed as a result of the erected mine infrastructure on site. A site visit was conducted to assess the visible water inputs or drivers of these wetland systems. The artificial wetland systems are shown and described below.

During site investigations it was apparent that stormwater, return flows in the form of greywater from the change houses, discharges from the sewerage treatment plant and possible PCD discharges were the main drivers of the artificial wetland systems. These drivers/ inputs exclude input from rainfall. The two artificial wetland systems AW1 and AW2 can be considered hillslope seepage wetlands based on the wetlands locations within the landscape and drainage patterns (refer to Table 5-16). Both these systems are connected to a channelled valley bottom system downstream.

The artificial Hillslope seepage wetland AW1 (Figure 5-21) is mostly vegetated with a mix of short sedge and grass species including alien weeds such as *Verbena sp*. and *Tagetes minuta*. The artificial hillslope seepage wetland AW2 is a narrower system consisting of two arms in the upper section joining into a drainage line downslope before decanting into the valley bottom wetland. The arm to the western side and adjacent to the PCD is dominated by the alien weed *Bidens formosa*, while the arm on the eastern side directly below the PCD is dominated by *Typha capensis* and *Agrostis lachnantha*). Weed species such as *Bidens formosa, Cirsium vulgare, Paspalum dilatatum* and *Schkuhria pinnata* are also present within the wetland.

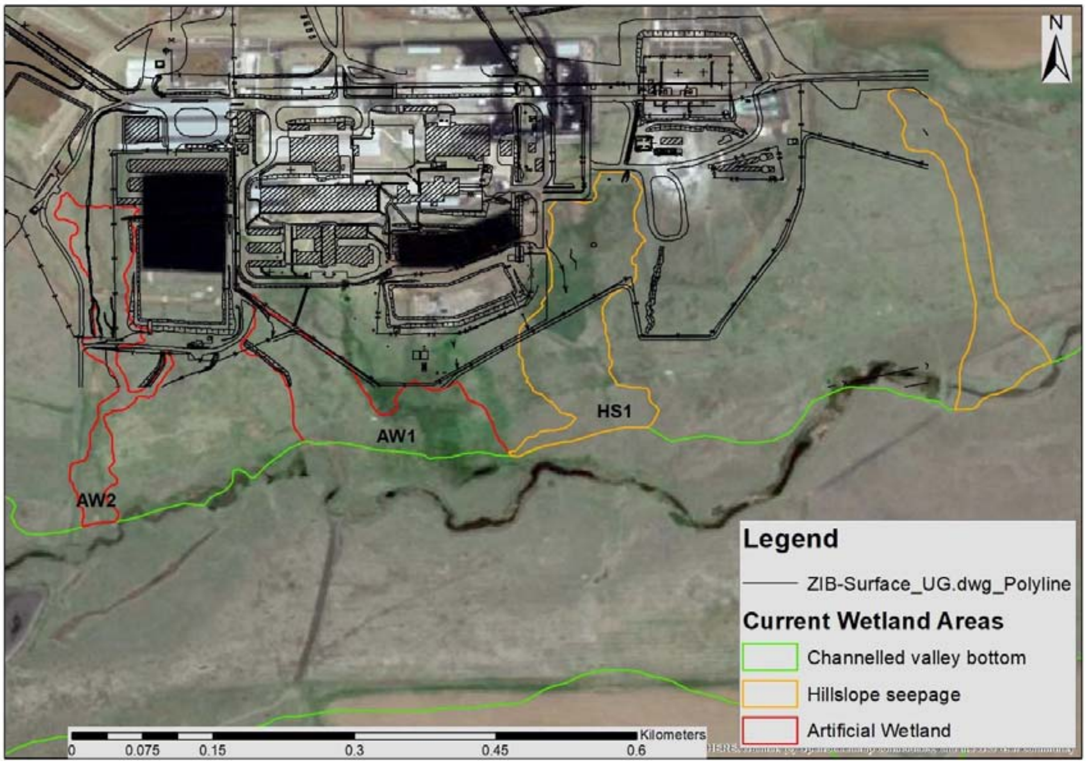

Figure 5-21: Natural wetlands and newly developed artificial wetland areas

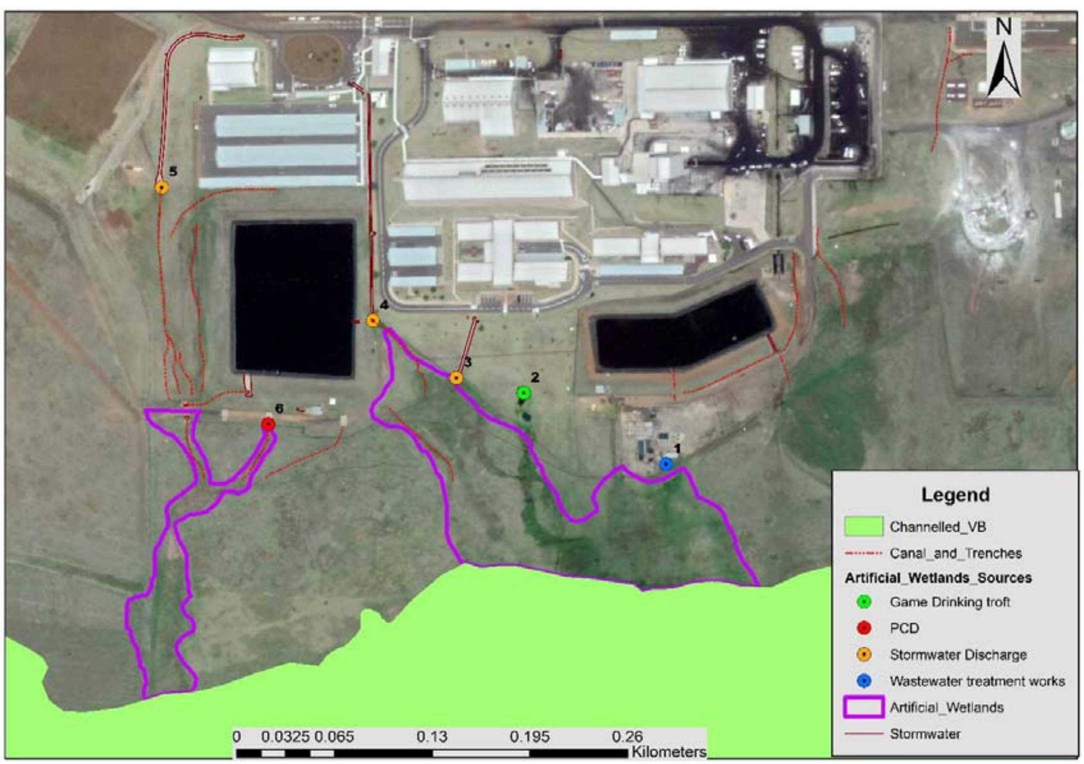

Figure 5-22: Discharge sources of various water inputs/ drivers of the wetlands

There are two main functions that the artificial wetlands are thought to be performing on site. The functions include flow regulation, particularly attenuation of stormwater flows as a result of dense vegetation and the nature of soils within the wetlands and water quality improvement by increased retention time and contact time of pollutants with sediments and increased absorption time of pollutants by the vegetation of wetlands which facilitate a certain anaerobic process to precipitate some of the pollutants. The position of the wetlands at discharge points of stormwater canals and trenches provides an opportunity for the wetlands to dissipate and diffuse flow, enhancing the water quality of the discharged stormwater before entering the main valley bottom draining downstream. AW1, in particular, provides attenuation of flows from stormwater discharges and overflow from a game drinking trough. AW1 is also linked to the sewerage discharge point at Point 1. The wetland area below this point provides a polishing system for effluent from the sewerage plant.

5.5.12 Significance of Findings

The assessment of wetlands on site indicated that infrastructure is built within the regulated area (500m) of the watercourses (wetlands). An assessment of the extent of wetland habitat before the erection of surface infrastructure was collated from the wetland assessment studies that were undertaken onsite between 2005 and 2007 (WCS, 2008). The erected infrastructure directly impacts on one natural hillslope seepage wetland (HS1) delineated onsite before underground mining took place. The PES of the impacted hillslope seepage wetland is rated as seriously modified (PES category E) and as being of moderate importance and sensitive. The drivers of change in the wetland are related to the loss of 16% aerial extent of wetland area and associated functions as a result of the surface infrastructure. There are also residual impacts on the remaining HS1 wetland on site. These impacts include:

- Changes in hydrology in terms of flow patterns, seasonality and wetness regime as a result of excess water discharged into the wetland and increased hardened surfaces associated with infrastructure;

- Water quality deterioration as a result of stormwater canals and trenches discharging greywater and return flows from operations within the erected infrastructure. PCD1 and the wastewater treatment plant continuously discharging water below standard water quality requirements into the wetland; and

- Morphological and vegetation composition changes of the upper reaches of the wetland area as a result of infilling and encroachment of alien vegetation and weeds.

In addition to the natural wetlands onsite, two artificial wetland systems were identified and are thought to be present as a result of the mine infrastructure onsite. The drivers of these systems are stormwater, grey water, overflowing of a game drinking trough, and discharge from the PCD and wastewater from the treatment plant. The functions associated with the artificial wetlands include flow regulation, particularly attenuation of stormwater flows, and water quality improvement by increased retention time and contact time of pollutants with sediments and increased absorption time of pollutants by the vegetation of wetlands. The position of the wetlands below discharge points provides an opportunity for the wetlands to dissipate and diffuse flow, enhancing the water quality before entering the main valley bottom draining downstream and leaving Zibulo Colliery surface right area.

The assessment of water quality at various monitoring points within the Zibulo Colliery indicates that the artificial wetlands AW1 and AW2 are not doing a significant job in water quality improvement under current conditions. The improvement observed at point ZU10 could be linked to massive dilution provided by the dam on site. It is recommended that to isolate this effect an additional point be considered below point Z003 and/ or upstream of the dam as the result to that point could be linked directly to the contribution of the artificial wetlands. Zibulo colliery will be undertaking further sampling for both surface and groundwater adjacent to the PCD1 for the next three months to improve confidence in the results and to determine trends that may assist in defining linkages and sources of water for the artificial wetland. It is also recommended that, as part of proposed on-going sampling and analysis of water quality, faecal coliform should be included in the two monitoring points, particular points Z002 and ZU10. It is also recommended that additional sampling should be added point south-east of Z002 downstream of the Z001 (at these coordinates -26.207397, 29.019398) before the confluence with the valley bottom wetland system to assist in determining or confirming of any sewerage treatment capacity of the artificial wetland. The accumulative effect of potential treatment and dilution is also contributing toward Zibulo meeting the RWQO for catchment B11E as well as the Ecological Water Requirements monitoring site (Olifants EWR1) at the Olifants catchment at point ZU10.

In recognising the residual impacts on the remaining natural hillslope seepage wetland as discussed above, the following mitigation measures are recommended to improve the state of the wetland onsite. The already lost 16% aerial extent of wetland will now have to be compensated for either onsite or offsite. The assessment of the wetland before and after the erection of the surface infrastructure indicated a loss of 1.33 ha-eq. The surplus hectare equivalents associated with the existing Zibulo wetland mitigation strategy can be assigned to offset the functional losses associated with the Zibulo UG surface infrastructure and to ensure there is no net loss of wetland functionality, which is advocated by the DWS.

The residual impacts on natural wetlands can be mitigated or addressed by:

- Updating the current mine water balance with clear separation of clean and dirty water systems;
- Continuation of the water sampling and possible sediment sampling where surface water not present to gain a series of water qualities at the highlighted points and to include additional sampling point immediately downstream of main valley bottom upstream of the dam;
- Upgrade the sewage treatment plant so that it meets discharge water quality requirements and/ or acceptable levels as stated in the Water Use Licence (WUL);
- Ensure the PCDs are not spilling more than the licenced frequency;
- Ensure the change houses grey water is diverted to the sewage plant water system; and
- Post closure, profile and shape the current infrastructure footprint area to continue to feed clean surface water runoff to the two artificial wetland AW1 and AW2.

In conclusion, the loss of functions within the natural wetland as a result of the erected infrastructure can be successfully compensated with the implementation of the existing Zibulo Colliery wetland mitigation strategy. The artificial wetlands onsite may provide a limited degree of ecosystem services, such as water quality improvement. As they are a result of the discharge, they should remain present as long as the discharges persist. Suggesting that it is essential that these artificial wetlands be kept in place, may hamper efforts to implement the mitigation measures mentioned above, if the measures have the potential to reduce discharge volumes, and thereby threaten the persistence of the artificial seeps.

PART 3: WETLAND OFFSET STRATEGY

5.5.13 Wetland Delineation and Classification

The National Water Act, Act 36 of 1998, defines wetlands as follows:

"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

The presence of wetlands in the landscape can be linked to the presence of both surface water and perched groundwater. Wetland types are differentiated based on their hydro-geomorphic (HGM) characteristics; i.e. on the position of the wetland in the landscape, as well as the way in which water moves into, through and out of the wetland systems (WCS, 2017).

Use was made of 1:50 000 topographical maps, 1:10 000 orthophotos and Google Earth Imagery to create digital base maps of the study area onto which the wetland boundaries could be delineated using ArcMap 10.2. A desktop delineation of suspected wetland areas was undertaken by identifying rivers and wetness signatures on the digital base maps. All identified areas suspected to be wetlands were then further investigated in the field (Figure 5-23).

Wetlands were identified and delineated according to the delineation procedure as set out by the *"A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas"* document, as described by DWAF (2005) and Kotze and Marneweck (1999). Using this procedure, wetlands were identified and delineated using the terrain unit indicator, the soil form indicator, the soil wetness indicator and the vegetation indicator.

For the purposes of delineating the actual wetland boundaries use is made of indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils), with particular emphasis on hydromorphic soils. It is important to note that under normal conditions hydromorphic soils must display signs of wetness (mottling and gleying) within 50 cm of the soil surface for an area to be classified as a wetland (*A practical field procedure for identification and delineation of wetlands and riparian areas, DWAF*).

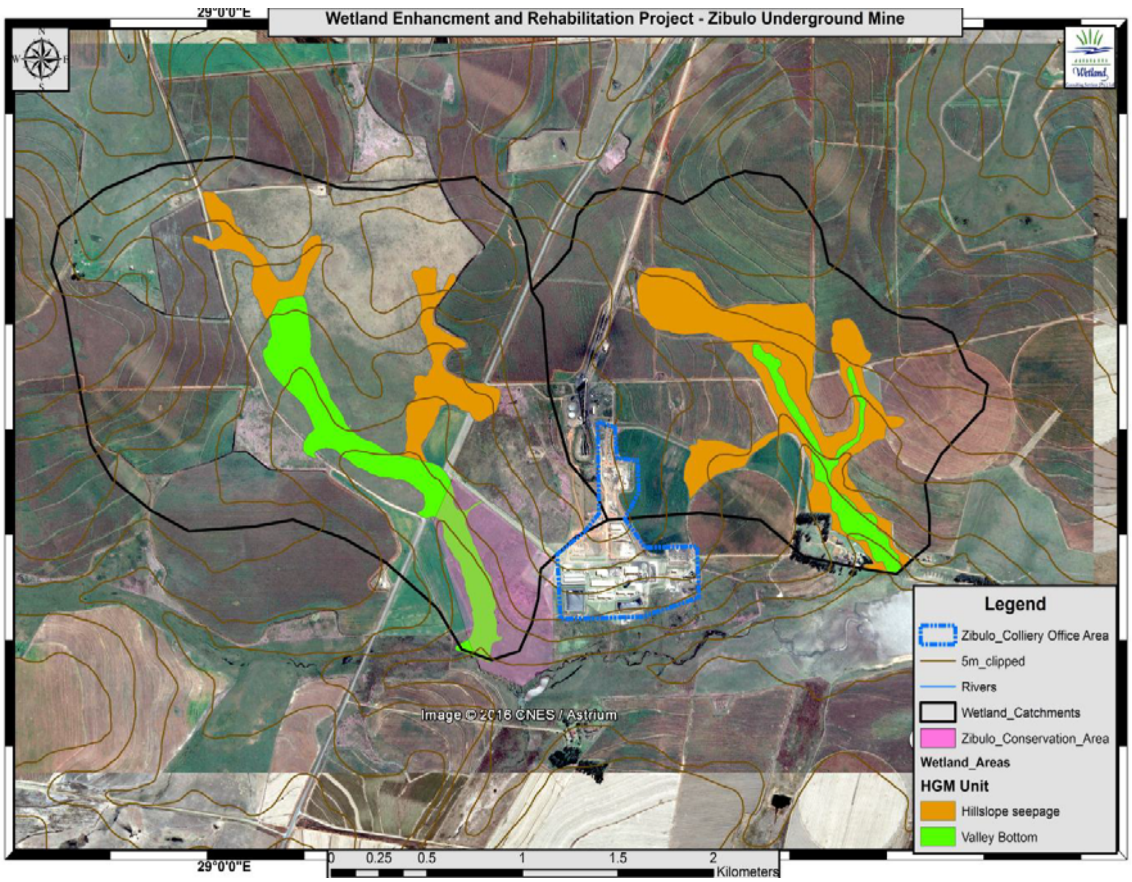

Figure 5-23: Delineated wetlands used for the offset

The wetland systems targeted for rehabilitation as part of this project cover approximately 112 hectares. It is important to note that the southern portion of the wetland within the western wetland catchment falls within the conservation areas designated by Zibulo Colliery next to their office area. The delineated and classified wetlands within the study area and surrounds are illustrated in Figure 5-23 above, with more detail regarding the different wetland types identified also provided in Table 5-19 and Table 5-20.

Table 5-19: Areas covered by the different wetland types recorded on site

Wetland Type	Area (ha)	% wetland area
Hillslope Seepage	70.84	63.17
Unchannelled valley bottom	41.3	36.83
Total	112.14	100.00

Table 5-20: Hydro-geomorphic classification system

Hydro-geomorphic Type	Description
Hillslope seepage	Slopes on hillsides which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from subsurface flow, and outflow can be via a well-defined stream channel connecting the area directly to a stream channel or outflow can be through diffuse subsurface and/or surface flow but with no direct surface water connection to a stream channel.
Unchannelled valley bottom	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channelized or diffuse longitudinal flow entering the wetland and also from adjacent slopes.

It is clear in Table 5-20 above that the wetland areas on site are dominated by hillslope seepage wetlands, which make up approximately 63 % of the wetland area on site. This is no surprise given the location of the study area at the head of a small watercourse. Hillslope seepage wetlands occur on hillslopes where a shallow aquitard prevents deeper infiltration of water and maintains a fluctuating water table at or near the soil surface allowing the establishment of hydrophilic vegetation. The fluctuation of the water table causes accumulation and localisation of iron and manganese oxides in the soil which appear as mottles and/ or concretions.

The northern and eastern portions of the hillslope seepage wetlands within the study area are typically temporarily to seasonally saturated habitats and seldom have areas of surface water, with flows remaining within the soil profile as interflow or as diffuse sheet flow following large storm events.

As such, these wetlands are often classed as moist grasslands. Within the study area these wetlands are characterised by a typical highveld assemblage of grass species, with occasional sedges. Key wetland indicator species observed included *Imperata cylindrica, Eragrostis gummiflua, Cynodon dactylon, Agrostis lachnantha*, and *Kyllinga erecta*. Lower reaches of the wetland catchments consist of unchannelled valley bottom wetlands that drained the entire catchments. These systems are impacted in places by impoundments and/ or dams and a number of informal agricultural road crossings. The soils typically dominating these systems are clays which display signs of crusting and cracking. The valley bottom systems are seasonally to permanently saturated. Zibulo Colliery currently utilises the sections of these wetlands lying adjacent to the office complex for bird watching with several bird hides established in certain sections. One section of wetland in particular already falls within a well-defined conservation area managed by the mine.

5.5.14 Wetland Unit Identification

Wetlands are described in terms of their position in the landscape, and the classification was thus done according to the hydrogeomorphic setting. Different groups of wetlands are determined according hydrological characteristics (by the way water flows into, through and out of the wetland system), and their position in the landscape (whether the wetland is located on the slope, crest or in the valley bottom – the geomorphological landscape position of the wetland). The type of soil form (i.e. the type of soil according to a standard soil classification system), since wetlands are associated with certain soil types; the presence of wetland vegetation species, and the presence of redoxymorphic soil features, which are morphological signatures that appear in soils with prolonged periods of saturation (due to the anaerobic conditions which result) also play a role in the identification of wetland areas.

The delineated wetlands were then classified using a hydro-geomorphic classification system based on the system proposed by Brinson (1993), and most recently modified for use in South African conditions by Ollis *et al*. (2013).

A functional assessment of the wetlands on site was undertaken using the level 2 assessment as described in "Wet-EcoServices" (Kotze *et al*., 2007). This method provides a scoring system for establishing wetland ecosystem services. It enables one to make relative comparisons of systems based on a logical framework that measures the likelihood that a wetland is able to perform certain functions.

5.5.15 Wetland Integrity (PES)

Present ecological state (PES) and ecological importance and sensitivity (EIS) assessments were undertaken for every HGM unit identified and delineated within the study area. This was done in order to establish a baseline of the current state of the wetlands and to provide an indication of the conservation value and sensitivity of the wetlands in the study area.

For the purpose of this study the Level 1 assessment as described by the WET-Health manual (Macfarlane *et al*., 2007), was applied for the determination of the PES. The EIS was determined using the methodology detailed by Rountree *et al*. (2013).

The targeted wetlands and associated catchment areas are located within agricultural lands underlain by Zibulo Colliery's underground mining footprint. There are a number of impacts which were recorded as affecting the wetlands onsite, including the following:

- Numerous trenches cross the hillslope seepage wetlands, diverting and intercepting flows;
- A number of old excavations occur within the valley bottom and hillslope seepage wetlands;
- Stands of alien vegetation, including stands of *Populus* x *canescens* and Eucalyptus trees within the catchments of the targeted wetland areas;
- Livestock trampling and grazing throughout the wetland areas;
- Numerous roads and tracks cross the wetland areas; and
- Impoundment of flow in dams and upstream of road crossings.

The above impacts have resulted in the present ecological state of the wetlands on site departing significantly from the assumed reference condition or un-impacted state of the wetlands. This is reflected in the results of the PES assessment which classes the hillslope seepage wetlands on site as being moderately modified (PES C), and the unchannelled valley bottoms as seriously modified (PES D). The results of the assessment are provided in Table 5-21 and Figure 5-24 below.

Table 5-21: PES scores for the affected wetlands

HGM unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation		Combined Impact Score	Individual PES Category
			Impact score	Change score	Impact score	Change score	Impact score	Change score		
1	10	9	6.5	-1.0	1.8	-1.0	2.8	-1.0	4.09	D
2	48	42	4.0	-1.0	1.8	-1.0	5.6	-1.0	3.81	C
3	9	8	3.5	-1.0	1.1	-1.0	2.1	-1.0	2.40	C
4	31	28	6.5	-1.0	2.1	-1.0	3.1	-1.0	4.27	D
5	14	13	3.5	-1.0	1.5	-1.0	4.0	-1.0	3.05	C

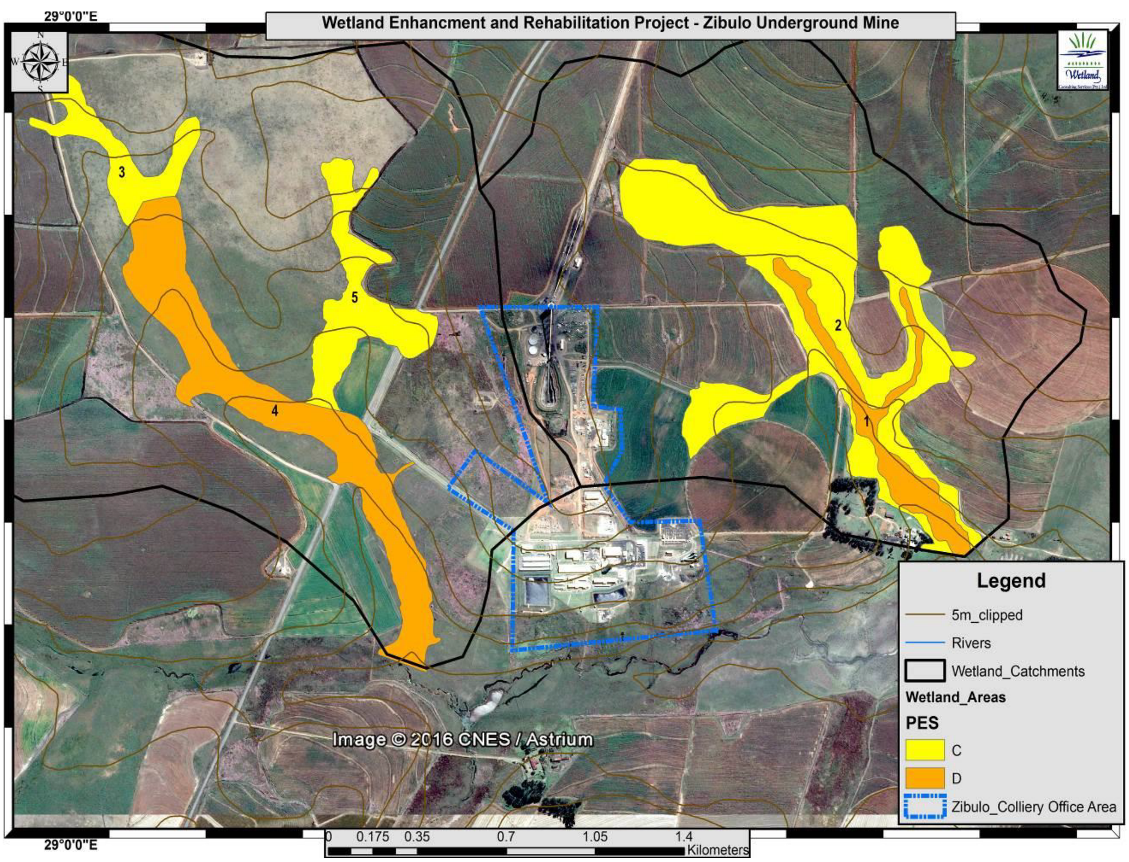

Figure 5-24: PES scores for wetlands used for the offset

5.5.16 Ecological Integrity Sensitivity (EIS) assessment

Present ecological state (PES) and ecological importance and sensitivity (EIS) assessments were undertaken for every HGM unit identified and delineated within the study area. This was done in order to establish a baseline of the current state of the wetlands and to provide an indication of the conservation value and sensitivity of the wetlands in the study area.

For the purpose of this study the Level 1 assessment as described by the WET-Health manual (Macfarlane *et al*., 2007), was applied for the determination of the PES. The EIS was determined using the methodology detailed by Rountree *et al*. (2013).

"Ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system's ability to resist disturbances and its capability to recover from disturbance once it has occurred. In determining the EIS of a wetland, the following factors are considered:

- Biodiversity – i.e. the presence of rare and endangered species, populations of unique species, species richness, diversity of habitat types, and migration/breeding and feeding sites for wetland species
- Hydrological functionality – i.e. sensitivity to changes in the supporting hydrological regime and/or changes in water quality, Toxins and nitrate assimilation and sediment trapping
- Functionality – i.e. flood storage, energy dissipation and particulate/element removal
- Direct human benefit – i.e. human water use as a harvestable resource, cultivation and cultural heritage

The wetlands within the study area form part of the Olifants River Primary catchment, which is a heavily utilised and economically important catchment. Wetlands and rivers within the Olifants River Catchment upstream of Loskop Dam have been greatly impacted upon by various activities, which include mining, power stations, water abstraction, urbanization, agriculture, etc. As a result of these impacts, serious water quality and quantity concerns have been raised within the sub-catchment. Given this situation, and the fact that wetlands can support functions such as water purification and stream flow regulation, a high importance and conservation value is placed on all wetlands and rivers within the catchment that have as yet not been seriously modified. Within this context, an EIS assessment was conducted for every hydro-geomorphic wetland unit identified within the study area. Further considerations that informed the EIS assessment include:

- The location of the study area within a vegetation type (Eastern Highveld Grassland) considered extensively transformed and threatened, having been classed as Vulnerable.
- The wetland vegetation type of the area, Mesic Highveld Grassland Group 4 wetlands, is considered to be endangered.
- The specific wetland ecosystem type of the hillslope seepage wetland and unchannelled valley bottom system, Mesic Highveld Grassland Group 4, is considered least threatened.

- The level of degradation observed within the wetland systems on site, including the fact that the wetlands forms part of the mines self-proclaimed and managed conservation area.
- The wetlands connect to the larger system/water resource that drains the entire area.

It is these considerations that have informed the scoring of the systems in terms of their ecological importance and sensitivity. The results of the assessment and rankings based on our current understanding of the wetlands is summarised in Table 5-22 and Figure 5-25.

Table 5-22: EIS Scores for the affected wetlands

Summary	Wetland ID 1 UNCHVB	Wetland ID 2 HS	Wetland ID 3 HS	Wetland ID 4 UNCHVB	Wetland ID 5 HS
Ecological importance and sensitivity	2.7	2.7	3.0	2.0	3.0
Hydro-functional importance	2.0	1.9	1.9	2.1	1.9
Direct human benefits	0.9	1.1	1.1	1.4	1.1
Overall EIS score	**1.9**	**1.9**	**2.0**	**1.8**	**2.0**
Overall EIS category	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**

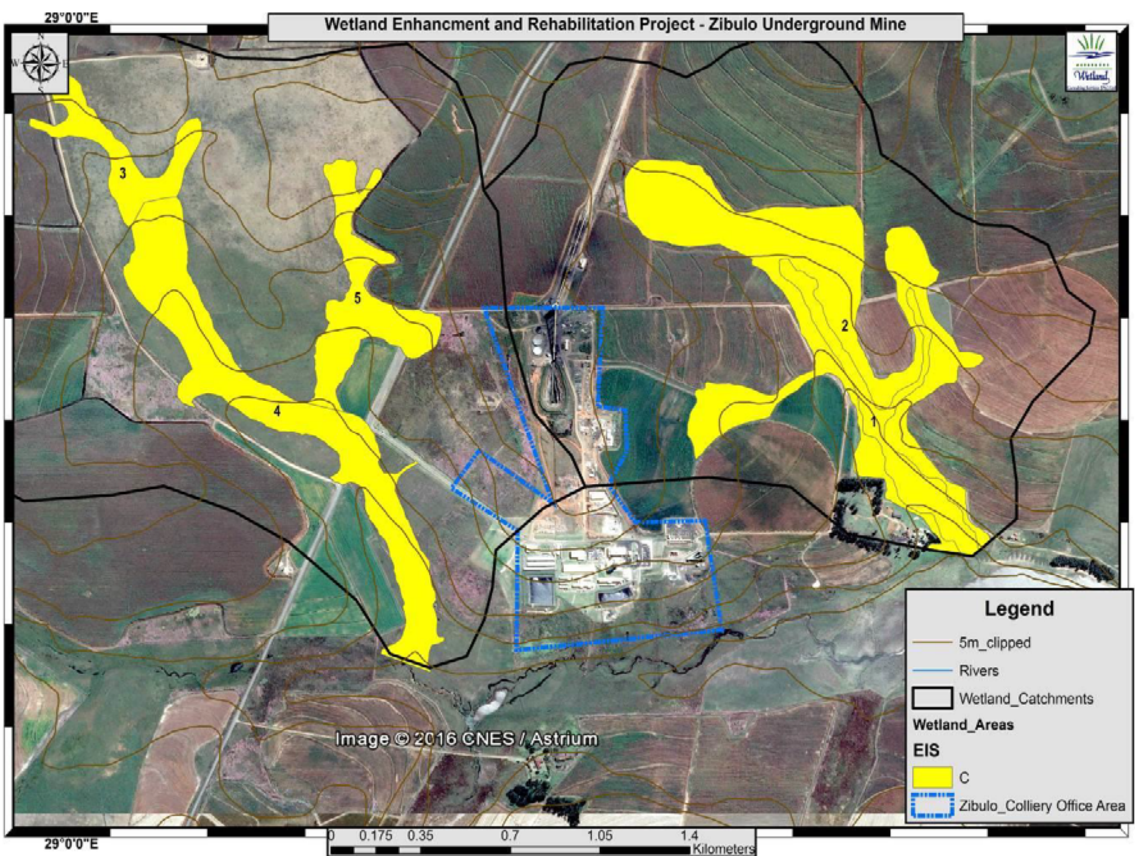

Figure 5-25: EIS scores for wetlands used for the offset

5.6 Regional Socio-Economic Structure

In the mid-1990s Mpumalanga Province had one of the fastest growing economies in South Africa. Although it is one of the less populated provinces, Mpumalanga has the fourth largest economy, based largely on the rich natural resources of the area. However, as with the rest of the SA economy, this growth rate has slowed down considerably in the late 1990s. In the 4 years to 2005 the province showed economic growth of 3.2% per annum well below their target of 6%. The population of 2.6 million in 1996 has grown to just over 3 million in 2001, this figure being around 7% of the South African population. Severe levels of poverty are evident, a result of the geographic characteristics and racial inequalities of the province. The main industrial and manufacturing activities in Mpumalanga include, iron, steel, stainless steel, petrochemicals and chemical products, agricultural products, mining, power generation, timber and wood products and food processing. The potential for further development in these sectors, as well as tourism is considerable. The favourable location of the province enhances its development potential. The Maputo harbour is less than 100km from the Mozambique border, and there is close proximity to the substantial Gauteng market and the good rail and road infrastructure allowing access to ports at Durban and Richards Bay.

The coal deposit for the Zibulo Colliery Underground is located in the Nkangala District Municipality (although it is very close to the border with the Gert Sibande Magesterial District and as such both areas will be covered by this report). The route of the conveyor runs through this District and the towns of Ogies and Phola are located within this district. These areas likely to be of interest in terms of the recruitment for the mine, as well as because they are the areas closest to where the coal is likely to be washed and transported.

The Gert Sibande Magesterial District is very close to the Zibulo Colliery study area. The towns of Lebohang and Leandra are also situated within the Gert Sibande Magisterial District and these are the areas of economic interest to the project. It should be noted that both the name of this Magisterial District and some of the Municipalities within it have changed in recent years.

The towns of Ogies and Leandra are the closest towns to the proposed development and are likely to be impacted both positively and negatively by the mine development. Phola, a large squatter settlement close to Ogies in the 1996 census Ogies and Phola were combined into one area with Kendal, in the 2001 census they were all counted individually. For this reason no comparative statistics will be shown because the geographically the areas are not comparable without a high level of manipulation. Other than its geographical closeness to the mine what makes the Ogies/ Phola area of particular relevance is that it is the area closest to the end point of the conveyor route and the washing plant.

Leandra is the second of the towns that will be most affected by the proposed development. It is situated 21km south of the proposed site in the Gert Sibande District Municipality. Traditionally a small farming services town en-route from Sasol-Secunda to Johannesburg. In the early 1990s informal settlement establishment began on land to the South of the town and has grown at a steady rate ever since. In the latter part of the 1990 a programme of basic service provision to the informal settlement was initiated. In 1996 this town was counted as part of Leandra however in 2001 it was counted on its own and called Lebohang. Statistics for Lebohang are counted with those of Eendrag which is considered an extension of it. The actual town of Leandra is in fact very small with a total population of less than 100; it is a service centre, as it is so small one set of stats will be considered named Lebohang/ Leandra which covers all the areas mentioned above

5.6.1 Population Density, Growth and Location

The Zibulo Colliery Underground Expansion is situated in the Witbank (eMalahleni) Magisterial District. Witbank, which is a city situated 41 km north-west of the Colliery, acts as the service centre for the region. eMalahleni has had a steadily increasing population since the 1920's. In 1994, the rate of population growth for eMalahleni was steady at 1 – 2 % per annum. The population for eMalahleni was estimated to be 90 000 in 1994.

The population density in the local area where Zibulo Colliery is located is limited to residents of the mine situated in the Phola informal settlement, the town of Ogies and Leandra (to the south), farmers and their workers and the owners of the trading store complexes and mine related industries. It is therefore expected that population changes will occur as a result of births and deaths in the area, and due to the fact that more people may move to the area in search of work.

5.6.2 Major Economic Activities and Sources of Employment

The major economic activities in the eMalahleni/ Ogies area are those associated with coal mining, metallurgical industries, commerce and light engineering, power generation, agriculture and administration.

5.6.3 Housing

The majority of employees of Zibulo Colliery are housed in informal and formal accommodation. This consists of accommodation close to the mine (Phola, Ogies and Leandra), various hostels and married quarters, and houses owned or rented by the mine in eMalahleni, Middelburg and Ogies.

5.6.4 Water Supply

Raw water for domestic use is obtained from the eMalahleni Water Reclamation Plan.

5.6.5 Power Supply

The area is adequately supplied by the Eskom power grid.

SECTION FIVE

Environmental Impact/ Risk Assessment Process

SECTION SIX

Impact/ Risk Assessment

6 ENVIRONMENTAL IMPACT/ RISK ASSESSMENT

The methodology applied in the Zibulo Colliery's proposed northern underground expansion water uses environmental risk assessment was undertaken in compliance with the SANS 3100:2009 standards manual. The environmental risk assessment was informed by an environmental risk assessment matrix. See Table 6-2 for the above-mentioned risk matrix used to assess the environmental risk at Zibulo Colliery. The risk assessment was also undertaken to comply with the requirements of the G5 DWS Best Practice Guidelines and the DMR MPRDA Regulations (GN R 527).

The environment risk assessment addresses the actions of the activities at the proposed project and assesses the significance of their risk on the environment. The risk on the environment was determined based on the rated level of significance of the risk i.e. maintain, ALARP, moderately intolerable and extremely intolerable. Based A risk register was created in Microsoft Excel.

The assessment was used to identify all possible environmental risks (significant and insignificant ones). The process was based on the input from existing data, credible and recognised specialists and persons with a detailed long-standing knowledge of the mine's operations and history and where actual data was not available, consciously conservative assumptions are made. The environmental risk assessment involved subjecting identified potentially significant residual risks to a detailed, quantitative risk assessment that have a high degree of certainty and are typically supported by extensive site-specific data. The process has resulted in the compilation of a risk register i.e. environmental risk assessment register. The risk register comprised a number of fields, grouped as risk identification, risk analysis and risk mitigation.

See Table 6-1 for the above-mentioned environmental risk assessment register.

6.1 ENVIRONMENTAL RISK ASSESSMENT PROCESS FOLLOWED

Risk assessment is the overall process of risk identification, risk analysis and risk evaluation. In view of the above, the process followed include the above-mentioned three components i.e. identification, analysis and evaluation. Risk monitoring and review was looked at during the risk management process.

6.1.1 Risk Identification

During the identification process sources of risk, areas of impacts, events (including changes in circumstances) and their causes and their potential consequences were identified. The aim of this step is to generate a comprehensive list of risks based on those events that might create, enhance, prevent, degrade, accelerate or delay the achievement of mine closure objectives.

The identification step has ensured that it include as much risks as possible whether or not their source is under the control of the mine, even though the risk source or cause may not be evident. The assessment considered as much of the significant causes and consequences as possible.

6.1.2 Risk Analysis

Risk analysis involved developing an understanding of the risk. The risk analysis has provided inputs to the next assessment step i.e. risk evaluation. It was also used to decide on whether risks need to be treated, and if so what risk treatment strategies and methods would be used. Risk analysis involved consideration of the causes and sources of risk, their positive and negative consequences, and the likelihood that those consequences can occur. Existing controls and their effectiveness and efficiency were also be considered during risk analysis.

6.1.3 Risk Evaluation

The purpose of risk evaluation is to assist in making decisions, based on the outcomes of risk analysis, about which risks need treatment and the priority for treatment implementation. Risk evaluation involves comparing the level of risk found during the analysis process. Based on this comparison, the need for treatment was considered.

Decisions taken during the evaluation took account of the wider context of the risk and included consideration of the tolerance of the risks borne by parties other than the mine owner. Legal, regulatory and other requirements were also considered.

6.1.4 Risk Treatment

Risk treatment involves selecting one or more options for modifying risks, and implementing those options.

Risk treatment is undertaken in a cyclical process where a risk treatment is assessed, deciding whether residual risk (after treatment) levels are tolerable and if not tolerable, generating a new risk treatment and assessing the effectiveness of that treatment.

The risk treatment options can include the following i.e. avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk, taking or increasing the risk in order to pursue an opportunity or removing the risk source, changing the likelihood, changing the consequences, sharing the risk with another party or parties (including contracts and risk financing) and retaining the risk by informed decision. A number of treatment options can be considered and applied either individually or in combination.

Based on the above, a most suitable treatment programme was selected for each risk identified. Note: selecting the most appropriate risk treatment option involves balancing the costs and efforts of implementation against the benefits derived, with regard to legal, regulatory, and other requirements such as social responsibility and the protection of the natural environment.

6.1.5 Risk Monitoring and Review

Monitoring and review forms part of the mine's risk management process and involve regular checking or surveillance. It is either periodic or ad hoc and the responsibilities for monitoring and review are clearly defined. The monitoring and review processes should encompass all aspects of the risk management process.

Risk management monitoring and review aims to achieve the following:

- ensuring that controls are effective and efficient in both design and operation;
- obtaining further information to improve risk assessment;
- analysing and learning lessons from events (including near-misses), changes, trends, successes and failures;
- detecting changes in the external and internal context, including changes to risk criteria and the risk itself which can require revision of risk treatments and priorities; and
- identifying emerging risks.

The results of monitoring and review will be recorded and externally and internally reported as appropriate.

6.2 Identified Environmental Risk Sources, Areas of Impacts and Events

The sources, events and areas of impact for Zibulo Colliery were determined in consultation with Anglo American Inyosi Coal (Pty) Limited prior to the risk assessment, and were presented to the workshop team at the commencement of the risk assessment for review. See Table 6-1.

Table 6-1: Risk sources, areas of impacts and events

Risk sources, Areas of Impacts and Events	
Land Management	Land management
Water Management	Groundwater management Surface water management
Sensitive landscapes	Wetland management
Biodiversity	Fauna Flora
Air Quality	Dust
Waste	Waste management
Social impacts	Social impacts
Rehabilitation	Rehabilitation

6.3 ENVIRONMENTAL RISK ASSESSMENT MATRIX AND ASSESSMENT

See below Table 6-2 for the Environmental Risks Assessment and Table 6-3 for the Environmental Risk Assessment.

Table 6-2: Environmental risk matrix

		ALARP	High Risk (Intolerable)					Norms and standards (N)	Effect on work image (WI)	Effect on environment (E1)	Effect on social and ecosystem processes (E2)	Public reaction (P)	Legal implication (L)
Severity	A	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable	Consistently outside of the norm or standard.	Reputation impacted with majority of key stakeholders.	Irreversible changes to abundance/ biomass in affected area. Loss of ecological functioning with little prospect of recovery.	**Major:** potential for irreversible change to valued flora and fauna, ecosystem processes and structure, including ecosystem services.	Severe national pressure to cease business. Serious public or media outcry (international coverage).	Referral to the National Prosecuting Authority. Potential investigation by authority with prosecution and fines.
	B	ALARP	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable	Largely deviating from the norm or standard.	Reputation impacted with significant number of key stakeholders.	Substantial reduction of abundance/ biomass in affected area. Eventual recovery of ecological systems possible, but not necessarily to same pre-impact conditions.	**Major:** potential for unacceptable, longer-term change to valued flora and fauna, ecosystem processes and structure, including ecosystem services.	Severe local and national public or press reaction.	Withdrawal of permit.
	C	ALARP	ALARP	Intolerable	Intolerable	Intolerable	Intolerable	Frequent and significant deviations from the norm or standard.	Reputation impacted with some stakeholders.	Reduction of abundance/ biomass in affected area. Limited impact to local biodiversity without significant loss of pre-impact functioning.	**Moderate:** potential for unacceptable, short term change to valued flora and fauna, ecosystem processes and structure, including ecosystem services	Local public or press reaction.	Notification of intent to issue a directive.
	D	Maintain	Maintain	ALARP	ALARP	Intolerable	Intolerable	Occasional and minor deviation from the norm or standard.	Reputation impacted with small number of people.	Minimal reduction of abundance/ biomass in affected area. Limited impact to local biodiversity without significant loss of pre-impact functioning.	**Moderate**: potential for acceptable, longer term change to valued flora and fauna, ecosystem processes and structure, including ecosystem services	Minor local public or media reaction.	Departmental enquiry and correspondence.
	E	Maintain	Maintain	Maintain	ALARP	ALARP	ALARP	Rare and minimal deviation from the norm or standard.	No discernible impact on reputation.	Reduction of the abundance/ biomass of flora and fauna in affected area. No permanent changes to biodiversity or exposed ecological system.	**Minor**: potential for acceptable, short term change to valued flora and fauna, ecosystem processes and structure, including ecosystem services.	Little or no reaction Public concern restricted to local complaints.	Complaints from the public and/ or regulator.
	F	Maintain	Maintain	Maintain	Maintain	Maintain	Maintain	Consistently within the norm or standard.	No discernible impact on reputation.	Possible incidental impacts to flora and fauna in locally affected area. No ecological consequences.	**Minor**: potential for incidental and/ or transient changes to valued flora and fauna, ecosystem processes and structure, including ecosystem services	None.	No legal implications.

	Probability/ Likelihood					
	G	H	I	J	K	L
	Highly unlikely	Rare	Low likelihood, unlikely	Probable, Possible	Can happen, likely	Regular, almost certain
Percentage	< 0.1 %	0.1 – 4 %	5 – 14 %	15 – 49 %	50 – 74 %	75 – 100 %
Description	Practically impossible, not foreseen to occur, once in more than 10 000 years.	Conceivable under exceptional circumstances, once in 1 000 years.	Only remotely possible (has happened somewhere), once in 100 years.	Unusual but possible (can happen), once every 10 years	Quite possible, once every year	Is the most likely and expected to happen (has and foresee it to happen again), more than once a year

Colour	Descriptor	Action	Sign-off
EI	Extremely intolerable (EI)	Immediate action	CEO
I	Highly intolerable (I)	Short term action required	BU Manager
A	ALARP (A)	Heightened action	Section Manager
M	Maintain (M)	Ensure levels of control	Supervisor

ALARP: As Low as Reasonably Possible

Table 6-3: Risk Assessment Table for Zibulo Colliery Northern Underground water uses

Description of the Activity (risk event)	Nature of the risk of Environment and Human Health (Risk impact)	Existing Management Measures	Severity	Probability	Risk Rating	Further actions to be taken to mitigate or to control the risk issue
Operational Phase						
Infrastructure within wetlands and within the regulated areas of various wetlands						
Already constructed infrastructure, and their use, situated within the wetlands and regulated areas of various wetlands. These infrastructures are vertical shafts for the transportation of people and materials, two PCD's, stone dust silo, roads, storm water management trenches, sewage treatment plant, storage areas, ventilation shaft and associated infrastructure, substations, multiple office blocks, training centres, security offices, parking areas, workshops and oil handling facilities, waste storage and handling areas, material shaft (R.O.M), coal silo, conveyor transfer area, three Erickson dams and the rock dump.	Loss of wetland habitat: There has been a 16% loss of wetland habitat as a result of infrastructure erected in areas that were previously marked as wetland habitat. Associated with this loss, is the loss of wetland vegetation, associated biodiversity, and wetland functionality (GreenGab, 2020).	An offset strategy has been developed to repair multiple wetlands in accordance with the wetlands that have been destroyed or impacted upon. See Appendix 7 for the Zibulo Colliery Wetland Offset Strategy.	D	K	I	Mitigation of the already lost wetland extent (16%) is not possible, as the infrastructure is already present within the wetland. The loss of the wetland will now have to be compensated for either through onsite or offsite wetland offsetting. Thus, the development of the Wetland Offset Strategy.
	Hydrology changes: Increased flows result from several stormwater canals and diversion trenches discharging water into HS1, and continuous overflow and discharge of PCD 1 into HS1. The replacement of catchment and wetlands soils with hardened surfaces within the footprint of infrastructure has resulted in increased surface runoff. As a result of the additional flows and changes in flow patterns, the seasonality of the wetland has changed, and the degree of saturation has increased, creating permanently saturated conditions within the wetland.	Trenches and canals are in place to divert any dirty surface runoff to the existing PCD's. These trenches and canals also divert clean water to the wetlands which is the cause of this problem.	D	K	I	Update of the current mine water balance. Ensure the sewage treatment plant is working correctly. Ensure the PCDs are not spilling more than the licenced frequency. Ensure the change houses greywater is diverted to the sewage plant water system.
	Water quality deterioration: It was evident on site that overflow of the PCD 1 into HS1 wetland has caused harm to the water make (water quality constituents) within the wetland. Although wetlands are generally considered to aid in water quality improvement, continuous discharge of unknown loads of pollutants into a wetland system with unknown purification capacity may have a significant impact of the overall health of the wetland and the quality of water discharged from the wetland to downstream watercourses if the load exceeds the wetland's capacity.	Monthly water monitoring is conducted to determine the water quality of the water courses downstream of the mining activities. Trenches and canals are in place to divert any dirty surface runoff to the existing PCD's.	D	K	I	Update of the current mine water balance. Continue with water sampling to gain a series of water qualities at the highlighted points. Ensure that the sewage treatment plant is working correctly, and if capacity is currently being exceeded, upgrade the facilities accordingly. Ensure the PCDs are not spilling more than the licenced frequency. Ensure the change houses grey water is diverted to the sewage plant water system. Ensure dirty water areas do not discharge to the wetland.
Undermining of various watercourses and wetlands						
Undermining of various watercourses and wetlands.	Water quantity loss in watercourses and wetland: Drawdown of surface- and subsurface water may lead to a loss of water in the streams, dams,	Anglo American Inyosi Coal (Pty) Ltd conduct underground mining according to strict rules and regulations. For example, the Anglo American Coal SA (AACSA) standard	E	I	M	Mining must comply with the parameters indicated in this analysis to ensure the stability of the water bodies on surface (Mahne, 2018) – See Appendix 4.

Description of the Activity (risk event)	Nature of the risk of Environment and Human Health (Risk impact)	Existing Management Measures	Severity	Probability	Risk Rating	Further actions to be taken to mitigate or to control the risk issue
	spruite and wetlands located above the mining activities.	(AATC023136) would not allow underground mining where the thickness of the overburden is less than 25 m without a detailed analysis to ensure there is no probability of sinkhole formation. These standards ensure that no sinkholes are formed and that no surface or subsurface drawdown occurs into the underground mining that will result on any negative impacts on the surface water resources. Both Mahne (2018) and JMA (2005) concluded that due to the depth of the underground mining, the thickness of the overburden and bord and pillar technique used, there will be no impact of watercourses and wetlands.				The required shallow mining analysis must be done on each panel where the thickness of the overburden is less than 30 m. Should this panel analysis indicate a risk to surface instability, the mining parameters of such a panel must be re-evaluated and suitable parameters must be issued. A risk assessment will be required if these parameters cannot be met and a decision on the mining of the panel must be taken. Continued compliance with standard (AATC023136).
	Loss of wetlands and the subsequent loss of biodiversity: A loss of surface- and subsurface water through drawdown into the underground mine working will result in a complete loss of the hydrological function of the watercourses and wetlands. This will result in the destruction of the wetland and the complete loss of fauna and flora species.		E	I	M	
	Sinkhole formation: Poor underground mining techniques may result in the formation of sinkholes which not only has a physical impact on the surface area of the watercourses and wetlands but will also cause drawdown of the surface- and subsurface water sources.		E	I	M	
Disposing of groundwater into the underground PCD's						
Pumping groundwater into the underground PCD's for short term storage before sending it to the surface PCD's.	Groundwater quality: Contaminated groundwater (which includes the creation of acid mine drainage) that is disposed into the PCD's may seep into clean groundwater regimes. It must be noted that high sodium levels occur naturally in the groundwater within this area.	Water that is currently found underground and pumped to the existing underground PCD is pumped to the surface PCD's and from there to the eMalahleni Water Treatment Plant. Contaminated groundwater (with a higher sodium and sulphate content) is currently pumped to the Klipspruit mine where it is mixed with there PCD water and sent to the eMalahleni Water Treatment Plant (Golder, 2019) (Appendix 6). Continuous water quality- and groundwater level monitoring is conducted. New boreholes are drilled as the underground mining progresses to effectively continue with monitoring. Zibulo Colliery communicates with groundwater users as to the levels of their boreholes and the quality of the water. Barrier pillars of 32m are left between the Zibulo Colliery and the edge of their mining right area. This includes any adjacent underground mines.	E	J	A	Continuation with regards to the pumping of contaminated- and normal groundwater found within the underground workings to Klipspruit and the eMalahleni Water Treatment Plant. Surface- and groundwater monitoring and the monitoring of groundwater levels to be continued and updated as the underground mining progresses. New boreholes must target the deeper fractures aquifer (Delta H, 2017). Continuous communication with the surrounding water users to determine the quantity and quality of there groundwater. Protocols can be developed whereby affected water users can be provided with water. Continuous monitoring of mine inflows/ seepages. This can be done in conjunction with surrounding underground mines to determine the amount of groundwater flowing from other operations. Build up database of significant water intersections and sample these inflows for water quality analysis. On-site rainfall measurements.
	Groundwater quantity: A decrease in the groundwater volume will occur when water found underground is pumped to the PCD's.		E	J	A	
	Geology: Contaminated groundwater (such as the onset of acid mine drainage) may seep into the rock and damage the surrounding geology.		E	J	A	
Pumping groundwater through plastic pipes to the underground dams.	Groundwater quality: Contaminated groundwater that is pumped through the pipes into the PCD's may leak from the pipes into clean groundwater regimes.		E	J	A	
	Groundwater quantity: A decrease in the groundwater volume will occur when water found underground is pumped to the PCD's.		E	J	A	

Description of the Activity (risk event)	Nature of the risk of Environment and Human Health (Risk impact)	Existing Management Measures	Severity	Probability	Risk Rating	Further actions to be taken to mitigate or to control the risk issue
Pumping groundwater from the underground workings to allow the continuation of mining and ensure the safety of employees.	Groundwater quantity: A decrease in the groundwater volume will occur when water found underground is pumped to the PCD's.		E	J	A	Update of groundwater- and geochemical model on a regular basis to ensure relevant information with regards to groundwater flow.
Closure/ Decommissioning Phase						
Removal of infrastructure from the wetlands						
Infrastructure will be removed once underground mining has been completed. Only the impacts on the wetlands will be considered as all other impacts have been competed as part of the original IWUL.	Change in water flow and hydrology: The surface infrastructure increased the flow of surface water to the various wetlands. The removal of the infrastructure will decrease the flow of water and return the wetland to a more natural system.	Zibulo Colliery has developed a Wetland Offset Strategy (Appendix 7) which will be used for the closure and decommissioning phase. An updated wetland study has been conducted for the infrastructure area, and relevant mitigation measures have been developed based on this study (Appendix 1). A closure plan has been developed and is updated regularly as to maintain the best possible procedures for the closure and decommissioning phase.	E	I	M	Profile and shape the current infrastructure footprint area to continue to feed clean surface water runoff to the two artificial wetland AW1 and AW2 (GreenGab, 2020). Develop a wetland maintenance and rehabilitation plan using a wetland specialist, prior to the start of closure and decommissioning. Adhere to the mitigation measures that can currently be applied with regards to the Wetland Offset Strategy (Appendix 7) and the update Wetland Assessment (Appendix 1). Various conditions have also been provided within the IWUL that must be adhered to during operational phase which will have an impact on the closure and decommissioning phase. Surface- and groundwater monitoring to continue until a closure certificate has been issued to Anglo American Inyosi Coal (Pty) Ltd.
	Loss of artificial wetlands: Surface runoff, discharge from the PCD and sewage plant resulted in the formation of two artificial wetlands. These wetlands will be lost once the infrastructure are removed.		E	J	A	
	Damage to existing wetlands: The removal of infrastructure by mobile machinery and people may lead to damage of the existing wetlands.		E	J	A	
	Surface water quality: During the removal stage contaminated runoff (silt or hydrocarbon spills) may enter into the existing wetlands and affect the water quality.		E	J	A	
Underground PCD's						
Once underground mining has been completed, the underground working will be left to fill with the natural groundwater. The PCD's will also remain underground. All other pipes and pumps related to pumping water from the underground workings will be removed.	Groundwater quality: With the removal of carbonaceous material, the water quality deterioration will decrease over time and a lack of oxygen will prevent the formation of acid mine drainage.	A closure plan has been developed and is updated regularly as to maintain the best possible procedures for the closure and decommissioning phase. Continuous water quality- and groundwater level monitoring is conducted. New boreholes are drilled as the underground mining progresses to effectively continue with monitoring. Barrier pillars of 32m are left between the Zibulo Colliery and the edge of their mining right area. This includes any	E	I	M	Surface- and groundwater monitoring to continue until a closure certificate has been issued to Anglo American Inyosi Coal (Pty) Ltd. Various conditions have also been provided within the IWUL that must be adhered to during operational phase which will have an impact on the closure and decommissioning phase.
	Groundwater quantity: There will be an increase in groundwater quantity as the underground workings fill with groundwater.		E	I	M	
	Surface water quality: Possible decant point have been identified in the Groundwater Study (Appendix 5). These decant		E	I	M	

Description of the Activity (risk event)	Nature of the risk of Environment and Human Health (Risk impact)	Existing Management Measures	Severity	Probability	Risk Rating	Further actions to be taken to mitigate or to control the risk issue
	points may allow contaminated groundwater to enter into the clean environments and affect the quality of the surface water resources.	adjacent underground mines.				
	Surface water quantity: Decant water from the underground workings will increase the surface water quantity, hydrology and flow. Depending on the area it may lead to erosion.		E	I	M	

7 MONITORING SYSTEMS

7.1 MONITORING

7.1.1 Surface Water Monitoring

Zibulo Colliery has initiated and implemented a surface-water monitoring programme consisting of strategically placed surface water monitoring points to monitor water quality within the affected catchment. Water monitoring samples takes place on a monthly basis. See Figure 5-4 for the position of the surface water monitoring points. The emergency stockpile will be incorporated into this monitoring programme.

The following constituents i.e. pH, total dissolved solids (TDS), electrical conductivity (EC), alkalinity, suspended solids (SS), calcium (Ca), sodium (Na), magnesium (Mg), potassium (K), chloride (Cl), sulphate (SO_4), iron (Fe), manganese (Mn), and aluminium (Al) are monitored at the different points.

A water quality report (for both groundwater and surface water) is compiled, which show all risk areas and areas showing diversion to the current background water quality. Recommendations are included in this water quality report (See latest water quality report attached as Appendix 2).

7.1.2 Bio-Monitoring

Zibulo Colliery will continue with its existing bio-monitoring programme. The stream health-monitoring programme consists of three components i.e. chemical monitoring, macro-invertebrate monitoring and toxicological monitoring. This monitoring programme will be a useful tool for the determination of the health of the streams, and in the long term will provide predictive analyses of the streams.

The stream health-monitoring programme has bio-monitoring sampling points on the streams that are crossed by the pipeline. Results of the monitoring will be used for compilation of monitoring reports, which will be submitted to the Department of Water and Sanitation.

7.1.3 Groundwater Monitoring

Zibulo Colliery has initiated and implemented a groundwater monitoring programme consisting of strategically placed groundwater monitoring points to monitor groundwater quality within the affected catchment. Water monitoring samples takes place on a quarterly basis. See Figure 5-10 for the position of the groundwater monitoring points. The groundwater monitoring programme will be updated as the underground mining progresses and as requested by the DWS and a groundwater specialist. A new monitoring borehole, ZGW-B8, has been drilled and will be added to the quarterly groundwater monitoring reports.

The following constituents i.e. pH, total dissolved solids (TDS), electrical conductivity (EC), alkalinity, suspended solids (SS), calcium (Ca), sodium (Na), magnesium (Mg), potassium (K), chloride (Cl), sulphate (SO_4), iron (Fe), manganese (Mn), and aluminium (Al) are monitored at the different points.

A water quality report (for both groundwater and surface water) is compiled, which show all risk areas and areas showing diversion to the current background water quality. Recommendations are included in this water quality report (See latest water quality report attached as Appendix 2).

7.2 Environmental Management Performance Assessment and Reporting

This section will describe how the mine intends to ensure that the Mitigation Measures for the reduced impacts are undertaken and that their effectiveness is proven.

As part of the general terms and conditions for a mining right, and in order to ensure compliance with the approved environmental management programme, issued water use licences and environmental authorisations and to comply with the NEMA EIA Regulations, 2014, Anglo American Inyosi Coal (Pty) Limited will undertake the following:

- Conduct monitoring on a continuous basis;
- Conduct the following audits i.e. performance assessments of the approved environmental management programme once in two years, internal and external audits of the water use licences once every year and auditing of the environmental authorisation and environmental management programme once every year;
- Compile and submit a performance assessment report and relevant audit reports to the minister in which compliance or non-compliance with the approved Environmental Management Programme and authorisations is demonstrated.
- The performance assessment report and audit reports will as a minimum contain the following:
- Information regarding the period applicable to the performance assessment/audit
- The scope of the assessment/ audit
- The procedure used for the assessment/ auditing
- The interpreted information gained from environmental monitoring
- The evaluation criteria used during the assessment/ auditing
- The results of the assessment/ auditing; and
- Recommendations on how and when non-compliance and deficiencies will be rectified.

8 REFERENCES

Delta H, (2017). Zibulo Colliery – Groundwater and Geochemical Model for the Prediction of Water Inflows and Water Chemistry Evolution over Life of Mine and Post Closure. Report number: Delh.2015.011-9. Delta H, Pretoria.

Delta H, (2018). Zibulo Colliery – 38 000 ton Run-of-Mine Coal Stockpile – Groundwater and Geochemical Investigation. Report number: Delh.2018.011-9_C1. Delta H, Pretoria.

Golder, (2015). Surface Water Flood Risk Management Plan for Zibulo Open Cast Plan and Underground Collieries. Report number: 1400130-13561-1. Golder Associates, Johannesburg.

Golder, (2019). Zibulo Colliery Water Balance – Draft. Report number: 1788279-326326-23_Draft. Golder Associates Africa, Johannesburg.

GreenGab, (2020). Wetland Delineation, Ecological Impact Assessment and Impact/ Risk Assessment Associated with the Erected Infrastructure as Part of the Zibulo Colliery Underground Mine Surface Infrastructures. Report number: P1025. GreenGab, Pretoria.

JMA, (2005). Compilation of Geology and Groundwater Inputs for the Zondagsfontein Project EMPr – Anglo Western Reserve. Report number: 10281. Jasper Müller Associates, Braamfontein.

Mahne, W. (2018). Zibulo Colliery – Assessment on the Stability of Surface Water Bodies at Zibulo Colliery. Report number: ZBC-WM-067-Surface Water Body-Analysis Report-2018-06-06. Anglo-American, Johannesburg.

South Africa, (2017). National Water Act, 1998 (Act No. 36 of 1998), Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals (Proclamation No. R. 267). *Government Gazette 40713:141*, March 2017.

Wetland Consulting Services, (2005). Wetland Baseline and Impact Assessment: Zondagsfontein. Report number: 81/2002, Updated 2005. Wetland Consulting Services, Pretoria.

Wetland Consulting Services, (2017). Wetland Offset Strategy – Wetland Rehabilitation and Management Plan for Anglo American Inyosi Coal – Zibulo Colliery, Mpumalanga Province. Report number: 1233B-2017. Wetland Consulting Services, Pretoria.

9 APPENDICES