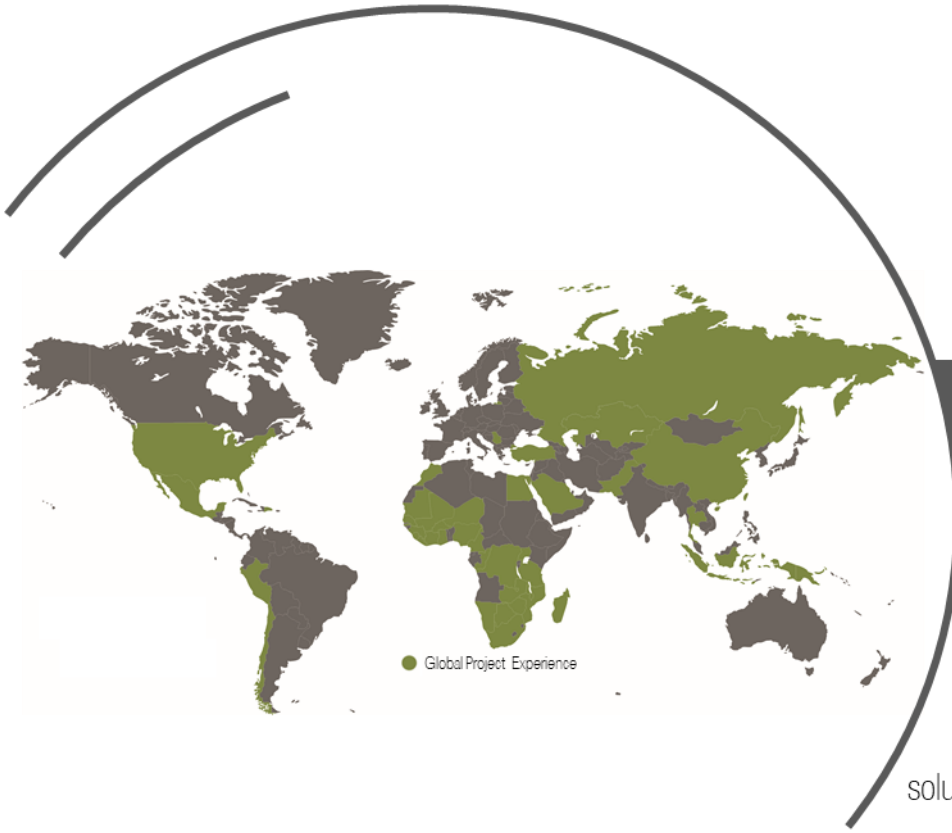

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Environmental Authorisation for Proposed Additional Infrastructure at the Universal Coal Development III (Pty) Ltd, Ubuntu Colliery, Nkangala, Mpumalanga Province

Hydrogeological Impact Assessment

Prepared for:

Universal Coal Development III (Proprietary) Limited

Project Number:

UCD6097

DMRE Reference Number:
MP30/5/1/1/2/10027 EM

January 2021

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This document has been prepared by Digby Wells Environmental.

Report Type:	Hydrogeological Impact Assessment
Project Name:	Environmental Authorisation for Proposed Additional Infrastructure at the Universal Coal Development III (Pty) Ltd, Ubuntu Colliery, Nkangala, Mpumalanga Province
Project Code:	UCD6097

Name	Responsibility	Signature	Date
Ayabonga Mpelwane	Report Writer		January 2021
Arjan van ‘t Zelfde	Reviewer		January 2021

DETAILS AND DECLARATION OF THE SPECIALIST

Digby Wells and Associates (South Africa) (Pty) Ltd

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Title/ Position:	Hydrogeologist
Qualification(s):	MSc Hydrogeologist
Experience (years):	6

I, Ayabonga Mpelwane, declare that: –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
    - I declare that there are no circumstances that may compromise my objectivity in performing such work;
    - I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and

- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist *Date: 21 January 2021*

Findings, recommendations and conclusions provided in this report are based on the best available scientific methods and the author's professional knowledge and information at the time of compilation. Digby Wells employees involved in the compilation of this report, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

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Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

EXECUTIVE SUMMARY

Universal Coal Development III (Pty) Ltd secured a mining right (MP 30/5/1/1/2/10027 MR) for the formerly known Brakfontein Colliery in 2017. The Environmental Management Plan (EMP) was also approved at the same time. Subsequently, the Colliery name was amended in January 2019 to reflect the name change of the mine to Ubuntu Colliery.

This application focuses on the inclusion of additional infrastructure not previously considered in the original applications (i.e. Current EMP). This infrastructure triggers Listed Activities contemplated under the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) and thus the need for prior Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

Note: *The Ubuntu Colliery holds a Mining Right and EMP approved for mining. The subject of this report and application is only for the additional infrastructure.*

This report is the groundwater impact assessment report and will serve as input into the EIA report.

The following conclusions can be drawn from the desktop assessment:

- The additional infrastructure is not anticipated to cause significant impacts. The additional proposed activities will only be a short-term, local impact during the construction and operational phase;
- Water quality in and around the Mining Right Boundary are found within the WUL standards at all groundwater monitoring locations, except for VABH01 which slightly exceeds the WUL standards for total alkalinity (260 mg/L), showing alkalinity of 269 mg/L. The slight exceedance is not an environmental concern. Additionally, the pH was neutral for all monitoring locations; and
- Groundwater levels indicate a good correlation with topography.

It is recommended that two new monitoring boreholes are drilled; the boreholes are located downgradient of the proposed infrastructure.

During the construction phase it is recommended that site clearance and topsoil removal activities may involve excavation which should take place above the water table, which is observed to be highly likely. No impacts on the groundwater environment are expected if the activities take place above the groundwater table.

During the operational phase the following recommendations are made:

- Lining the of diesel depot area, STP, product stockpile, WTP, crushing facilities and stockpile area;
- Hydrocarbons and hazardous materials must be stored in bunded areas; and

- If a considerable amount of fluid is accidentally spilled, the contaminated soil should be scraped off and disposed of at an acceptable dumping facility. The excavation should be backfilled with soil of good quality.

During the closure phase no mitigation measures are expected to be required. as the removal of potential sources and site rehabilitation will reduce the risk of impact to the groundwater environment.

An update to the currently monitoring network is recommended and geophysical surveys should be conducted to identify more suitable locations that take into consideration preferential groundwater flow paths in the area where boreholes are recommended.

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ACRONYMS, ABBREVIATIONS AND DEFINITION

EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
MAE	Mean Annual Evaporation
mamsl	Meters above mean sea level
mbgl	Meters below ground level
MR	Mining Right
STP	Sewage Treatment Plant STP
S.A.R.	Sodium adsorption ratio
WTP	Water Treatment Plant
WUL	Water Use License

CONTENT OF THIS REPORT IN ACCORDANCE WITH THE REGULATION GNR982 OF 2014, APPENDIX 6 (AS AMENDED)

Legal Requirement		**Section in Report**
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 2.3
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page (iii)
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 2.3
cA	And indication of the quality and age of the base data used for the specialist report;	Section 4.4.2
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7.4
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	Section 5

Legal Requirement		Section in Report
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	N/A
(g)	an identification of any areas to be avoided, including buffers;	N/A
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	N/A
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6
(k)	any mitigation measures for inclusion in the EMPr;	Section 6
(l)	any conditions/aspects for inclusion in the environmental authorisation;	Section 7.1.1.2 and 7.2.1.2
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 8
(n)	a reasoned opinion (Environmental Impact Statement) -	Section 10
	whether the proposed activity, activities or portions thereof should be authorised; and	
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 9
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(q)	any other information requested by the competent authority.	N/A

1. Introduction

Universal Coal Development III (Pty) Ltd (hereafter Universal Coal) secured a mining right (MP 30/5/1/1/2/10027 MR) for the formerly known Brakfontein Colliery in 2017. The Environmental Management Plan (EMP) was also approved at the same time. Subsequently, the Colliery name was amended in January 2019 to reflect the name change of the mine to Ubuntu Colliery. The following approvals exist for the Ubuntu Colliery:

- Mining Right (MR) and EMP issued by the Mpumalanga Department of Mineral Resources and Energy with reference number MP 30/5/1/1/2/10027 MR;
- The name change of the colliery from Brakfontein Colliery to Ubuntu Colliery on 29 January 2019; and
- Water Use License (WUL) issued by the Department of Water and Sanitation on 22 February 2019 with license number 03/B20E/ABCGIJ/4751.

This application focuses on the inclusion of additional infrastructure not previously considered in the original applications (i.e. Current EMP). This infrastructure triggers Listed Activities contemplated under the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) and thus the need for prior Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

Note: *The Ubuntu Colliery holds a Mining Right and EMP approved for mining. The subject of this report and application is only for the additional infrastructure.*

2. Project Description

Details of the project are summarized below.

2.1. Alternatives Considered

No adverse impacts are expected from the location of the proposed infrastructure detailed in Section 2.2 (on condition that the management actions in Section 7 are implemented). Therefore alternatives were not considered during the groundwater impact assessment.

2.2. Additional Infrastructure and Activities

Further to on-site crushing and screening, the following additional infrastructure is required to be included in the EMP. Based on Digby Wells knowledge, all the below listed infrastructure has been established on site, except for the road diversion:

- Guard house and access control gate
- Control room
- Toilet facilities
- Haulage truck queueing area
- LDV and main access road
- Heavy duty truck access road
- Storm water diversion berm/trench
- Access control and boom gate

- Hard park area
- Brake test ramp area
- Diesel depot area
- Product stockpile
- Perimeter fencing
- Crushing facilities and stockpile area
- Diversion of D2546 District road
- Topsoil safety berm
- Lab office
- Sewage Treatment Plant (STP)
- Contractors camp site
- Water Treatment Plant (WTP)
- 45 000 litre silo tank

The following should be further noted pertaining to the above infrastructure:

- The additional infrastructure, except for the road diversion, has been established and does not trigger NEMA Listed Activities;
- The WTP will treat borehole water sourced from areas in the project footprint. The treated water will be for domestic use. The daily throughput of the WTP will be 12m^3 p/day;
- The additional infrastructure, including the road, will be relocated in 2023; and
- The specific designs for the diversion of district road D2546 will be confirmed. It is proposed to have a reserve of 30 m and length of 2,5 km.

Table 2-1: Project Phases and Associated Activities

Phase	Activity
Construction	Surface preparation for infrastructure
	Construction of surface infrastructure
Operational	Operation and maintenance of infrastructure
	Use and maintenance of haul roads (incl. transportation of coal to washing plant)
Decommissioning	Demolition and removal of all infrastructure (incl. transportation off site)
	Rehabilitation (spreading of soil, re-vegetation and profiling/contouring)

Phase	Activity
	Installation of post-closure water management infrastructure

2.3. Scope of Work

The objectives of this groundwater study are to:

- Review the current groundwater conditions (water levels and quality). This represents the baseline groundwater conditions for the site considered to be used as a reference point to identify impacts (if any) from the proposed infrastructure;
- Assess the proposed activities and the resultant impacts to the groundwater environment; and
- Recommend groundwater monitoring and management methods to minimise any potential impacts associated with the proposed activities.

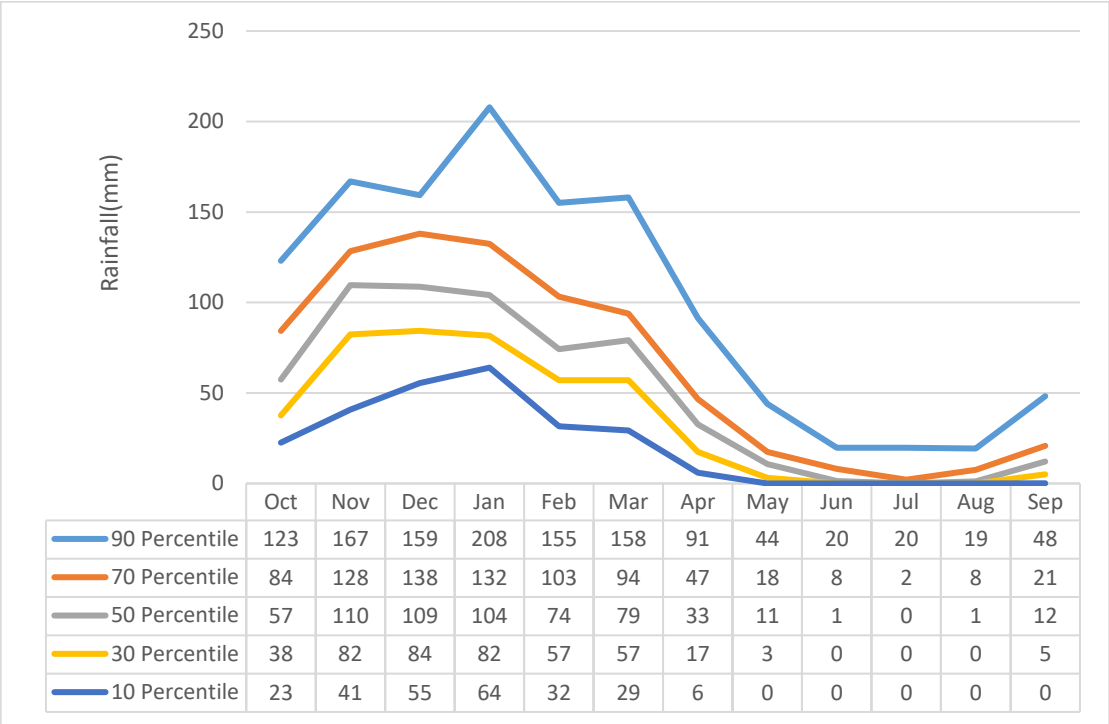
3. Specialist Details

Ayabonga Mpelwane is a Hydrogeologist with 6 years' experience. She holds a MSc degree in Hydrogeology; attained from the Institute of Groundwater Studies (University of the Free State). Her technical expertise includes project management, conducting and managing hydrogeological field investigations, water quality assessments, aquifer characterization, geochemical assessments, numerical modelling and analytical modelling, groundwater impact assessments and groundwater management plans.

4. Baseline Description

4.1. Climate

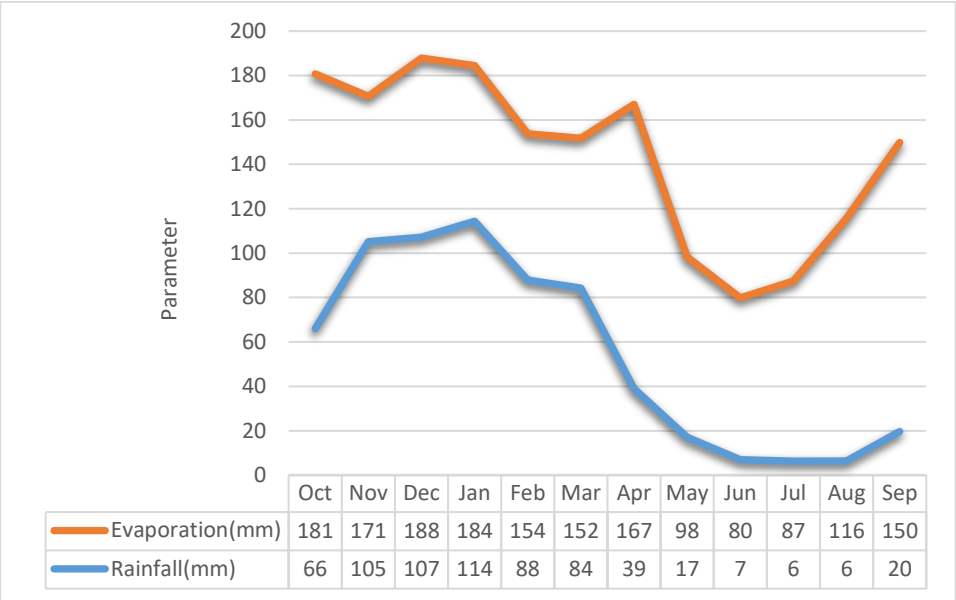
The Mean Annual Precipitation (MAP) for quaternary catchment B20E is 659.7 mm (WRC, 2015) and is likely to be distributed as shown in Figure 4-1. The normal rainfall (70% of events) for the wettest month (January) will likely not exceed 132 mm, while extreme rainfall (10% of the events) will likely not exceed 208 mm. This implies that the region experiences moderate to high rainfall.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
90 Percentile	123	167	159	208	155	158	91	44	20	20	19	48
70 Percentile	84	128	138	132	103	94	47	18	8	2	8	21
50 Percentile	57	110	109	104	74	79	33	11	1	0	1	12
30 Percentile	38	82	84	82	57	57	17	3	0	0	0	5
10 Percentile	23	41	55	64	32	29	6	0	0	0	0	0

Figure 4-1: Monthly Rainfall Distribution within Quaternary Catchment B20E

The Mean Annual Evaporation (MAE) for quaternary catchment B20E is 1 727 mm (WRC, 2015). The region experiences higher evaporation than precipitation, giving rise to dry winters and wet summers with a negative natural water balance. The average monthly distribution of potential evaporation and rainfall can be seen in Figure 4-2.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Evaporation(mm)	181	171	188	184	154	152	167	98	80	87	116	150
Rainfall(mm)	66	105	107	114	88	84	39	17	7	6	6	20

Figure 4-2: Monthly Evaporation Distribution within Quaternary Catchment B20E

4.2. Topography and Drainage

The topography of the site is gentle with level to slightly undulating plains. The majority of the Mining Right Boundary is located on the eastern side of the watershed separating the Wilge and Bronkhorstspruit River catchments. Elevation within the Mining Right Boundary ranges from approximately 1540 to 1580 meaters above mean sea level (mamsl). The lowest elevation is situated along the southern and eastern boundary where tributaries to the Wilge River are encountered and the area of the highest elevation is located in the west.

The main surface drainage direction will be towards the Wilge River. The Wilge River and associated tributaries are perennial streams which flow in an overall northerly direction. Minor surface drainage from the west will flow towards the non-perennial Bronkhorstspruit tributary which drains in a northerly direction. This is located within the B20 Drainage Catchment of the Olifants Water Management Area (WMA 02). The quaternary catchment of the site is B20E. The quaternary catchment has been divided into sub-catchments as indicated Figure 4-3.

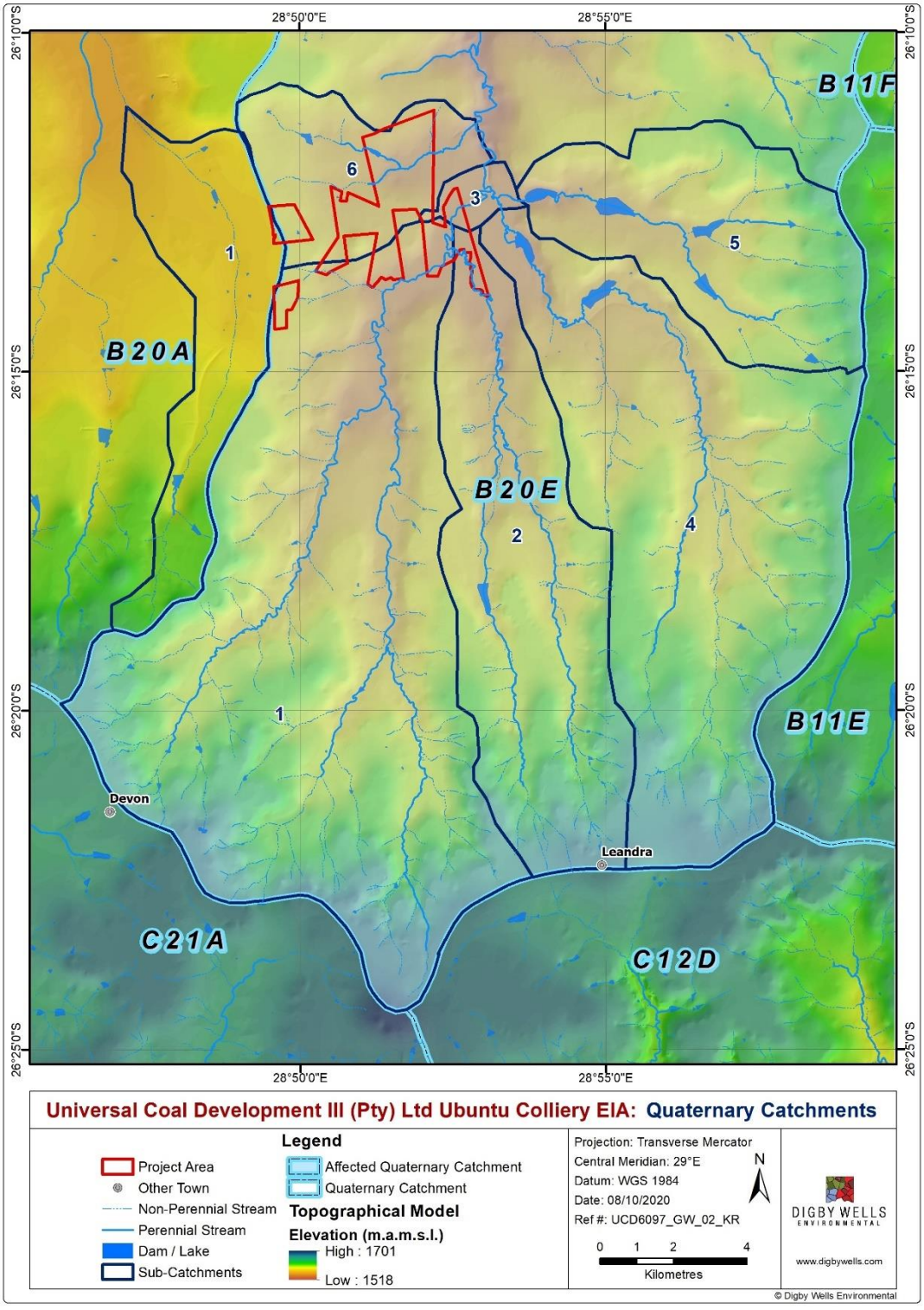


Figure 4-3: Surface Catchments

4.3. Geology

The Mining Right Boundary is located on the western extent of the Witbank Coalfield, located within the Ecca Group of the Karoo Supergroup.

The Pre-Karoo geology underlying the Witbank Coalfield comprises of the Transvaal Supergroup lithologies and Rooiberg Group felsite. Within the Mining Right Boundary, dolomite of the Malmani Subgroup (Transvaal Supergroup) was intersected below the Karoo Supergroup sequence. The Malmani Subgroup carbonate sequence developed under a tidal range of paleo-environments ranging from supra-tidal through intertidal to sub-tidal which results in a variety in chert content, intercalated shales and erosional surfaces (Johnson et al, 2006).

The coal containing Vryheid Formation was deposited directly on the uneven pre-Karoo and Dwyka Group lithologies resulting in variations in thickness of the deposit and pinching out of the formation against paleo-highs. The Dwyka Group sedimentary rocks were deposited in glacial environments and comprise predominantly of tillite. The Vryheid Formation was deposited during deltaic to fluvial events with general upward coarsening cycles comprising of shales, siltstones and sandstones. Northern sequences of the Vryheid Formation contain very coarse-grained sandstone deposited by fluvial events. Coal swamps formed in sheltered environments created by the pre-Karoo topography and glacial deposits (Johnson et al, 2006).

The Karoo Supergroup contains extensive dolerite intrusions, which represent the shallow feeder system for the flood basalt eruptions and occur as interconnected networks of dykes and sills (Duncan and Marsh, 2006). These intrusions are important geological structures for diverting and impeding groundwater flow. Sediments in contact with the intrusions become altered by contact metamorphism and are significant for their water bearing properties.

A surface geology map is shown as Figure 4-4. It is not the intention of the exploration and mining operations to penetrate the pre-Karoo basement during the relative activities but to cease penetration beneath the coal seam of interest.

4.3.1. Coal Seams

The coal seams within the Mining Right Boundary are contained within a 100 metre thick succession of the Vryheid formation (Karoo Supergroup). Three seams (namely, Seam No. 5, 2U and 4L) have been targeted for opencast mining whilst two seams (namely Seam No. 2 and 4) are targeted for underground mining. Seam No. 5 has a thickness varying between 0.5 to 2 metres, averaging at approximately 1.8 metres. Seam No. 4 varies from 2.5 to 6.5 metres thick however the seam continuity can be divided into three zones, No. 4 Lower, No. 4 Upper and No. 4 A which are separated by siltstone to mudstone partings. The mining horizon is restricted to the No. 4 Lower Seam where the coal has a quality suitable for power station feedstock. Poor quality coal is attributed to the remaining seams not included in the mining horizon. Seam No. 2 varies in thickness from 3 to 6.5 metres and contains some of the best quality coal.

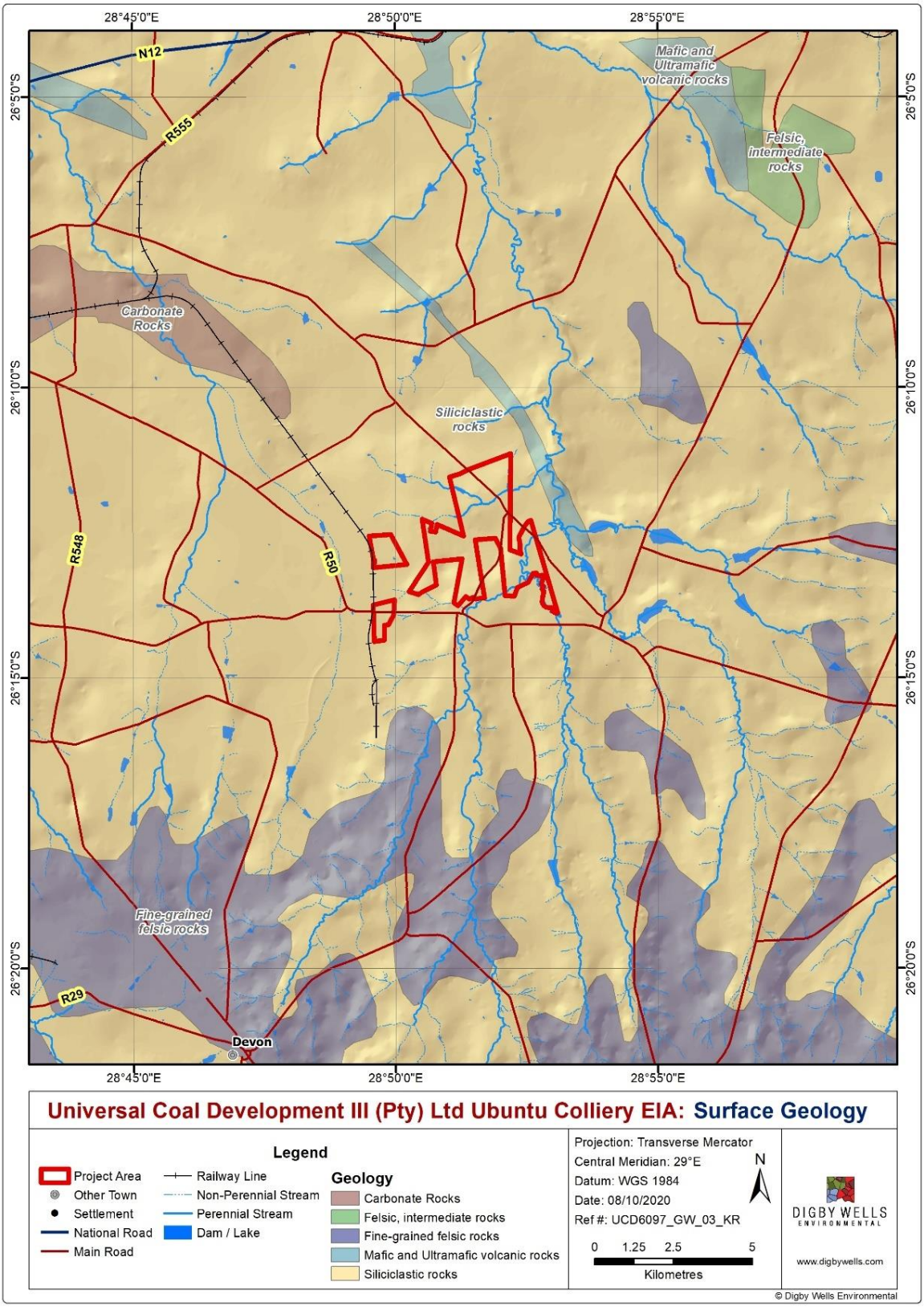


Figure 4-4: Surface Geology

4.4. Hydrogeology

The hydrogeology for the Mining Right Boundary is described based on the local aquifers and the current groundwater conditions.

4.4.1. Aquifers

The aquifers situated within the Mining Right Boundary are conceptualised to consist of four units, namely the shallow weathered aquifer, the intermediate fractured aquifer, the Dwyka tillite aquifer and the Malmani dolomite aquifer.

4.4.1.1. Shallow Weathered Aquifer

The weathered material in the shallow weathered aquifer consists mostly of decomposed and highly weathered coarse-grained sandstones, with shales and siltstone.

The sustainability of the shallow weathered aquifer is dependent on seasonal recharge from rainfall. The rainwater infiltrates the soil and a portion of it eventually reaches the saturated zone (effective recharge).

From the five boreholes drilled around the Mining Right Boundary the weathered aquifer ranges from 6 to 12 meters below ground level (mbgl), averaging at 9 mbgl. The aquifer transmissivity of the weathered material is estimated between 0.5 and 1.5 m²/day (Hodgson and Krantz, 1998).

4.4.1.2. Fractured Aquifer

The fractured aquifer consists of un-weathered sequences of sandstone, siltstone, shale, carbonaceous shale and coal. The pores within these sediments are too well cemented to allow any significant permeation of water. Groundwater movement therefore predominantly occurs along secondary structures such as fractures, cracks and joints within the sediments. However, not all secondary structures within the fractured aquifer are water-bearing. Of all un-weathered sediments in the fractured aquifer, the coal seam often has the highest hydraulic conductivity.

4.4.1.3. Dwyka Tillite

The Dwyka tillite forms a hydraulic barrier between the overlying mining activities and the basement aquifer, due to its low hydraulic conductivity. The aquifer permeability of the Dwyka tillite is estimated to be between 0.0002 and 0.0148 m/d (Hodgson and Krantz, 1998). The thickness of this unit varies from 0.5 to 30 m thick averaging at 8 m.

4.4.1.4. Malmani Dolomite Aquifer

The basement aquifer comprises of Malmani dolomites, characterised as part of the chert bearing to chert poor chemically derived sediments of the Chuniespoort Group. The Chuniespoort Group dolomites represent the most important aquifer in South Africa due to the high storage and permeability characteristics of the rock type. The continuity of the dolomite

aquifer is interrupted by vertical to sub-vertical geological structures such as dykes which create low permeability to impermeable compartmental barriers.

Dolomitic areas can have high recharge and significant groundwater flow characteristics (Hodgson and Krantz, 1998; and Barnard, 2000). Unlike most other formations, the groundwater gradient in dolomitic aquifers does not necessarily follow topography. More often than not, it occurs as nearly horizontal surface indicative of a low hydraulic gradient and permeable formations (Barnard, 2000).

4.4.2. Current Groundwater Conditions

The current groundwater conditions are defined based on the Ecosolve Consulting (2020) monitoring report. These conditions are defined in terms of groundwater quality and groundwater levels. The groundwater monitoring locations are presented in Figure 4-5.

4.4.2.1. Groundwater Quality

As per the existing WUL requirements, groundwater quality is benchmarked against the standards given in Table 4-1.

Table 4-1: WUL Standards for Groundwater Quality

Variables	Groundwater Quality Objectives
pH	6.4 – 9.0
Electrical Conductivity in mS/m (EC)	150
Total Alkalinity in mg/L	260
Chloride (Cl) in mg/L	200
Fluoride (F) in mg/L	1.56
Sulphate (SO_4) in mg/L	250 – 400
Nitrate (NO3) in mg/L	10
Calcium (Ca) in mg/L	150
Magnesium (Mg) in mg/L	45
Sodium (Na) in mg/L	200
Potassium (K) in mg/L	140
Total Suspended Solids (TDS) in mg/L	545
Ortho-Phosphate (PO_4^{3-}) in mg/L	0.128
Iron (Fe) in mg/L	0.2
Manganese (Mn) in mg/L	0.11

Water quality in and around the Mining Right Boundary is found to be within the WUL standards (Table 4-1) at all groundwater monitoring locations (Figure 4-5), except for VABH01

in which a total alkalinity of 269 mg/L slightly exceeds the WUL standard (260 mg/L). The slight exceedance is not an environmental concern, additionally, the pH is found neutral for all monitoring locations. The water quality trends for all monitoring sites are observed to be stable. Reference can be made to Ecosolve Consulting (2020) for in-depth details.

Groundwater is characterized according to the Piper, Durov, Scholler and Sodium Adsorption Ration (S.A.R) diagrams.

According to the Piper diagram (Figure 4-6), the groundwater found in all the monitoring locations lies within the upper left portion of the diagram, and this groundwater is classified as calcium-chloride water.

According to the Durov diagram (Figure 4-7), the groundwater found at the Project Area is dominant in chloride which is congruent with the Piper Diagram interpretation. Additionally, a dominance in calcium/magnesium and bicarbonate is observed.

The Sodium adsorption ratio (S.A.R.) diagram is used to determine if water is suitable for irrigation uses. Water with SAR values of 18 and above will result in an excess of sodium in the soil. Water with SAR values of 10 and below is safe and suitable for irrigation. According to the S.A.R diagram (Figure 4-8), the groundwater samples in the Project Area have SAR values that are below 10 which is safe and suitable for irrigation.

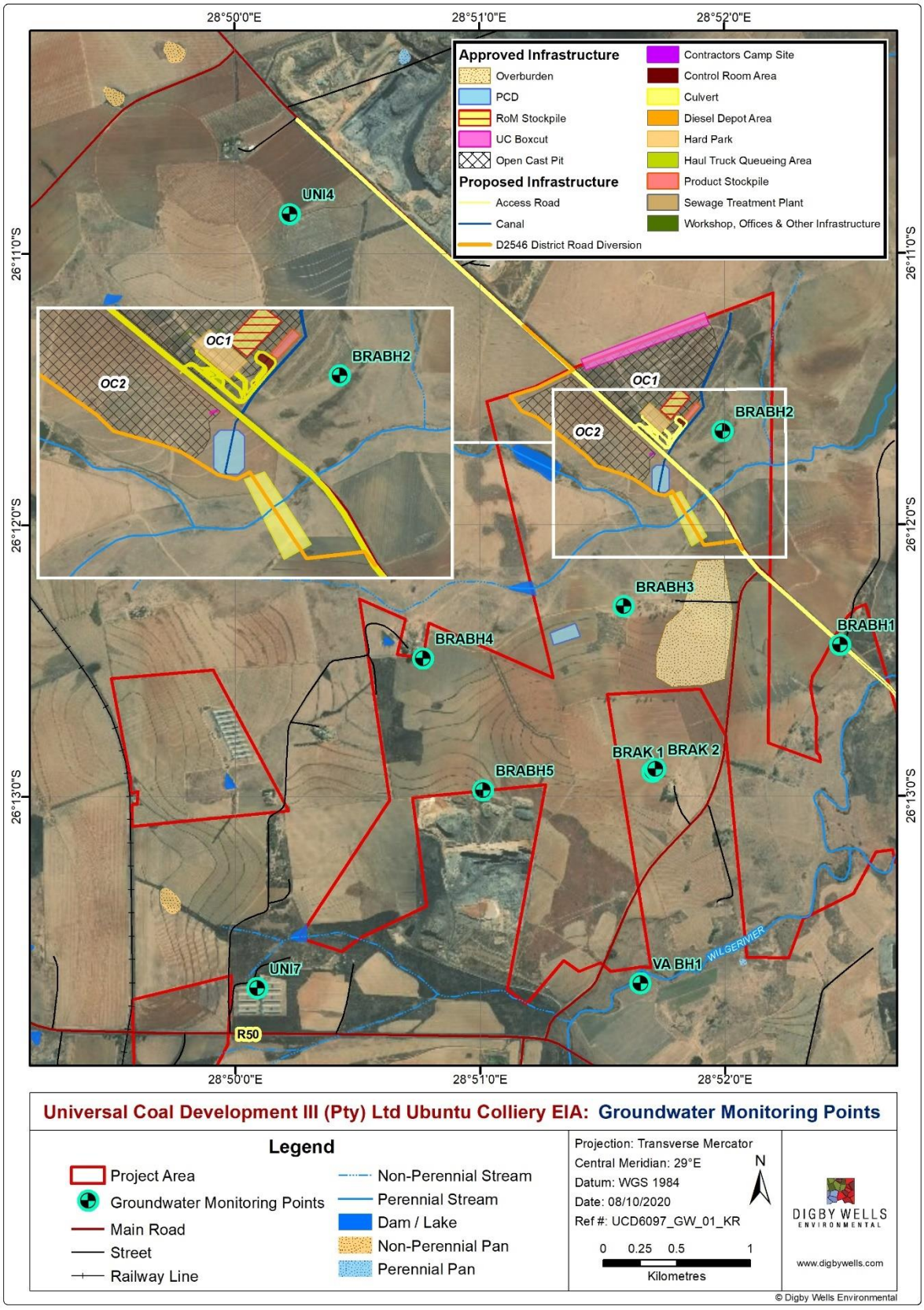


Figure 4-5: Groundwater Monitoring Locations

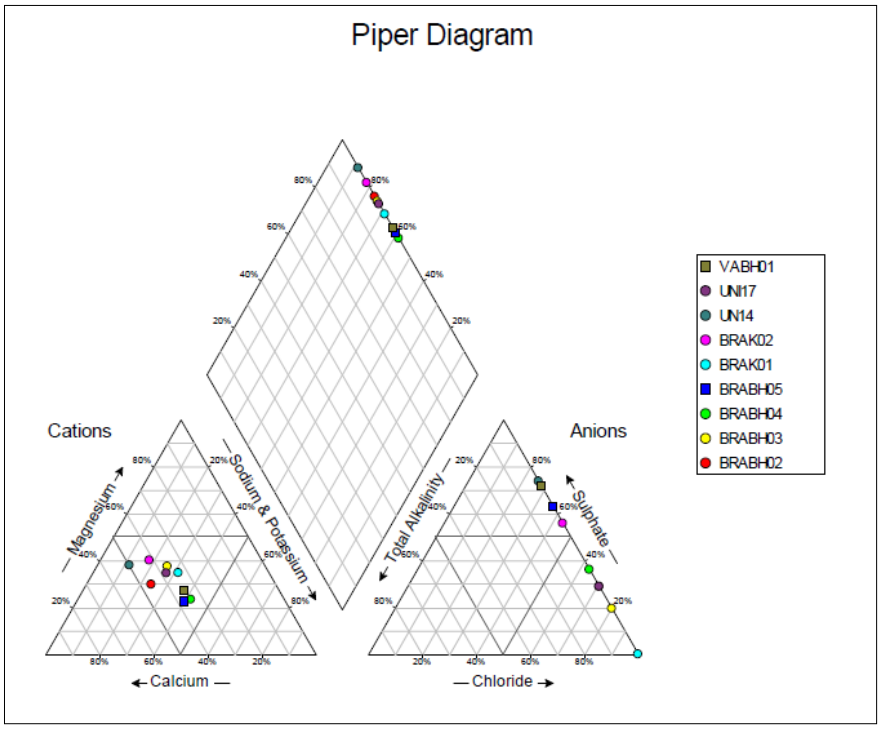


Figure 4-6: Piper Diagram

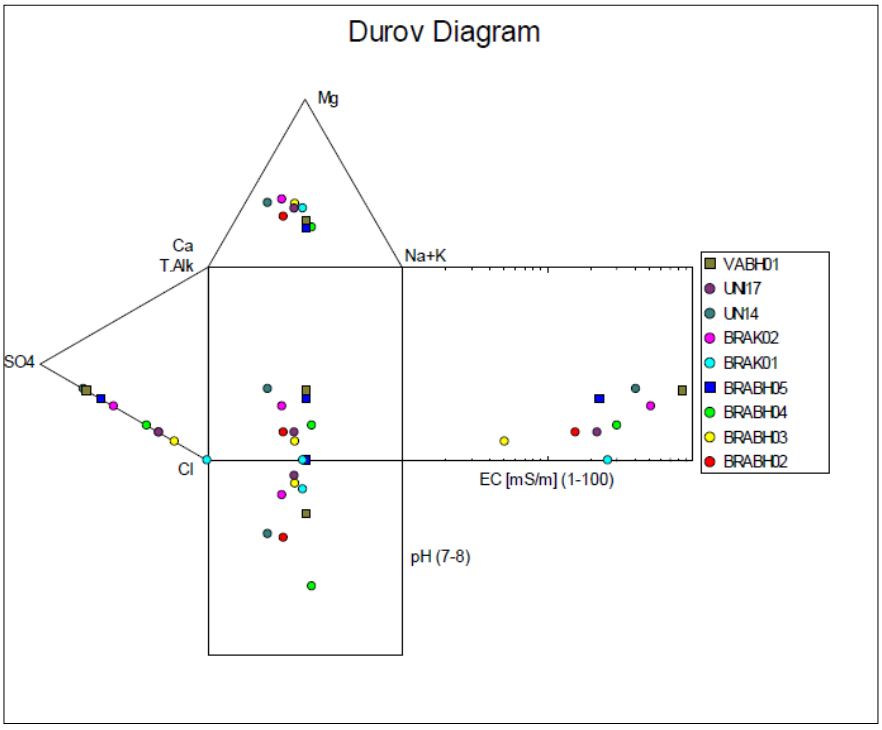


Figure 4-7: Durov Diagram

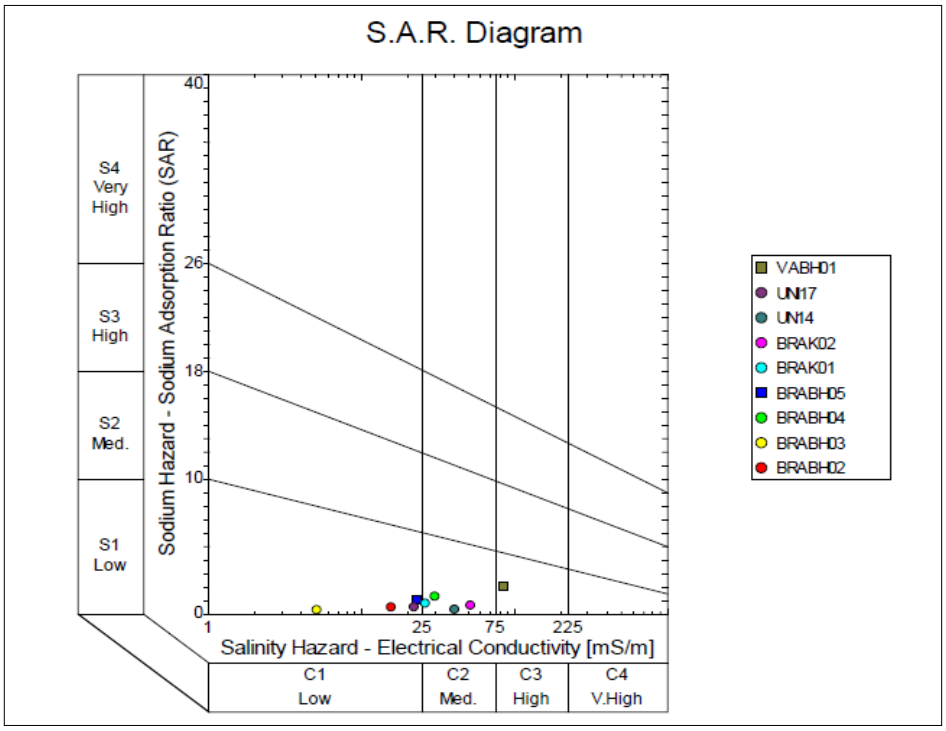


Figure 4-8: S.A.R Diagram

4.4.2.2. Groundwater Levels

The groundwater level depth ranges between 2.24 mbgl at UN17 and 47.97 mbgl at BRAK2 It is observed that the hydraulic head is higher in the southwest and lower in the northeast and the groundwater flow direction is thus derived to generally be from south-west to north-west. The flow direction of the groundwater in the Mining Right Boundary correlates with the surface topography. Localised depression of the hydraulic head is due to groundwater abstractions for agricultural irrigations purposes.

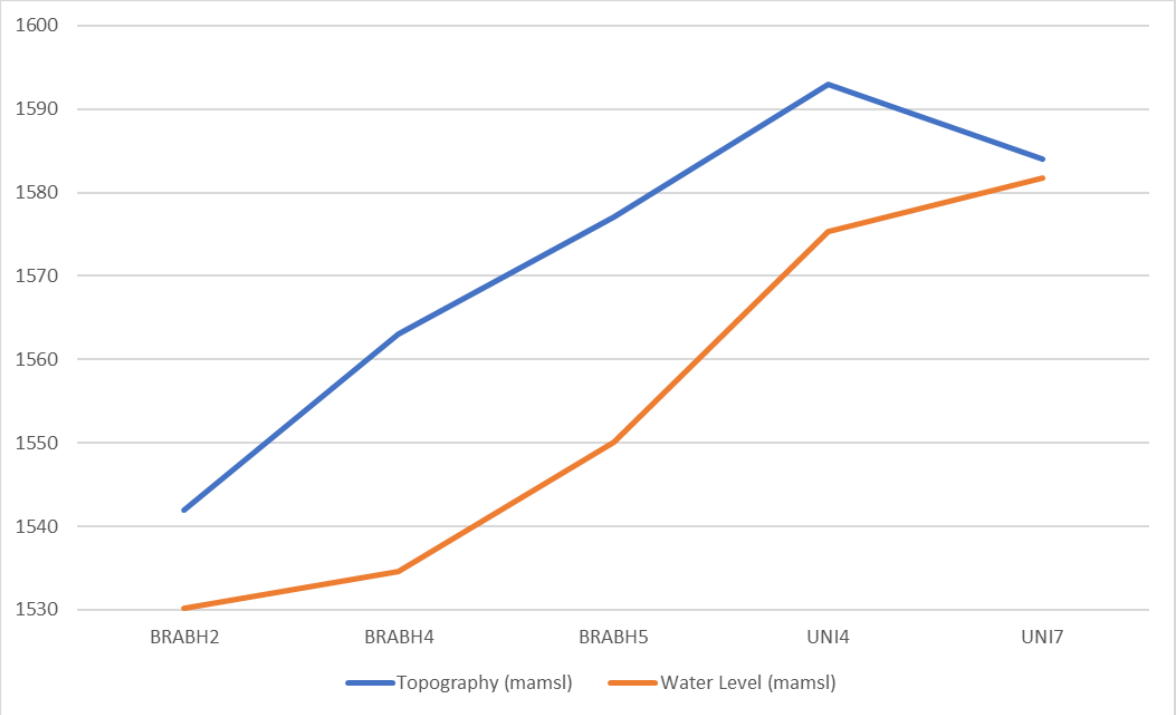


Figure 4-9: Correlation between Groundwater Level and Topography

5. Methodology

The groundwater impact assessment was conducted at a desktop level. During this task, relevant data in and around the Mining Right Boundary was collected including geological, and hydrogeological baseline information and mine infrastructure plans. A review of this information was conducted and interpretations performed to establish a conceptual idea of the hydrogeological dynamics. The proposed activities were reviewed against the hydrogeological conceptual understanding of the Project Area to inform the expected impacts.

6. Findings and Discussion

The desktop review of the proposed activities indicates no requirements for further in-field investigations. The groundwater baseline conditions were obtained at a desktop level as reported in Section 4.4.2. The expected impacts are regarded as negligible, on condition that the management actions provided in Section 7 are correctly implemented.

7. Impact Assessment

A high-level impact assessment is undertaken in this section considering the proposed activities for construction, operational and closure phases. This approach is the most appropriate taking into consideration the predicted extent of the impacts.

7.1. Construction Phase

Activities during the Construction Phase that may have potential impacts are indicated in Table 7-1.

Table 7-1: Interactions and Impacts of Activity

Interaction	Impact
Site clearance and topsoil removal and limited excavations	Potentially increased risk to the groundwater should spillage events occur and introduce contaminants into the groundwater environment.
Potential small-scale dewatering (if required)	Lowering of the local water levels

7.1.1. Impact Description

Excavation may be undertaken during site clearance and topsoil removal at the location of proposed infrastructural developments within the Project Area (stated in Section 2.2). The extent of excavation in relation to the local water level is a factor influencing the potential impacts to the groundwater. The risk arises as the distance between the two entities of the system reduces i.e. in the event of a spillage that may potentially introduce contaminants into the groundwater environment the risk to the local groundwater is increased if shallow groundwater levels are encountered at the location of the incident.

No impact on the groundwater is expected if the activities take place above the groundwater table. The shallowest measured water level was 2,24 mbgl at UNI7. However, the average groundwater level on site is 19 mgbl, and therefore this impact is expected to be negligible.

7.1.1.1. Management Objectives

The management objectives are the following:

- The possibility of spillages to occur should be minimised; and
- If any excavations are planned to take place below the local groundwater level, the management objective is to limit any interaction between excavation activities and local water table.

7.1.1.2. Management Actions

Construction activities are expected to mainly take place above the groundwater table. However, if required, localised groundwater abstraction and subsequent lowering of the water table should be kept to a minimum. However, water level recovery is expected to occur within the construction phase, with no residual impacts expected during the operational phase.

7.2. Operational Phase

Activities during the Operational Phase that may have potential impacts are indicated in Table 7-2

Table 7-2: Interactions and Impacts of Activity

Interaction	Impact
Storage or stockpiling of potentially contaminating fluid or material within surface infrastructure	Potential groundwater contamination if the various potential sources infiltrate into the groundwater environment.

7.2.1. Impact Description

Operation of the diesel depot area, STP, product stockpile, WTP and crushing facilities may pose an impact to the groundwater environment if contaminated water from these various potential sources infiltrate into the groundwater environment.

7.2.1.1. Management Objectives

Avoiding infiltration of fluid or material from surface infrastructure into the groundwater environment.

7.2.1.2. Management Actions

The following actions are recommended:

- The infrastructure listed below should be lined:
  - STP;
  - Product Stockpile;
  - WTP; and
  - Crushing facilities and stockpile area;
- Hydrocarbons and hazardous materials must be stored in bunded areas (diesel depot area).

If a considerable amount of fluid is accidentally spilled, the contaminated soil should be collected and disposed of at an appropriately registered waste facility. The excavation should be backfilled with good quality soil.

7.3. Decommissioning Phase

Activities during the Decommissioning Phase that may have potential impacts are indicated in Table 7-3

Table 7-3: Interactions and Impacts of Activity

Interaction	Impact
Demolition and or removal of all infrastructure and rehabilitation of the disturbed areas.	Removal of potential contamination sources

7.3.1. Impact Description

Demolition and or removal of all infrastructure and rehabilitation of disturbed area will be undertaken in the decommissioning phase. These activities will result in the removal of potential contamination sources, this reduces the risk to the receiving environment; therefore, no negative impacts are anticipated.

7.3.1.1. Management Objectives

No management objectives are required.

7.3.1.2. Management Actions

No management actions are required.

7.4. Cumulative Impacts

The expected impacts from the new infrastructure are of negligible significance. Furthermore, no mining activities are observed within and in the immediate surroundings of the proposed infrastructure area (Figure 7-1). Therefore, no cumulative impacts are expected in the proposed infrastructure area within the Project area.

7.5. Unplanned and Low Risk Events

Addressed in Section 7.1.

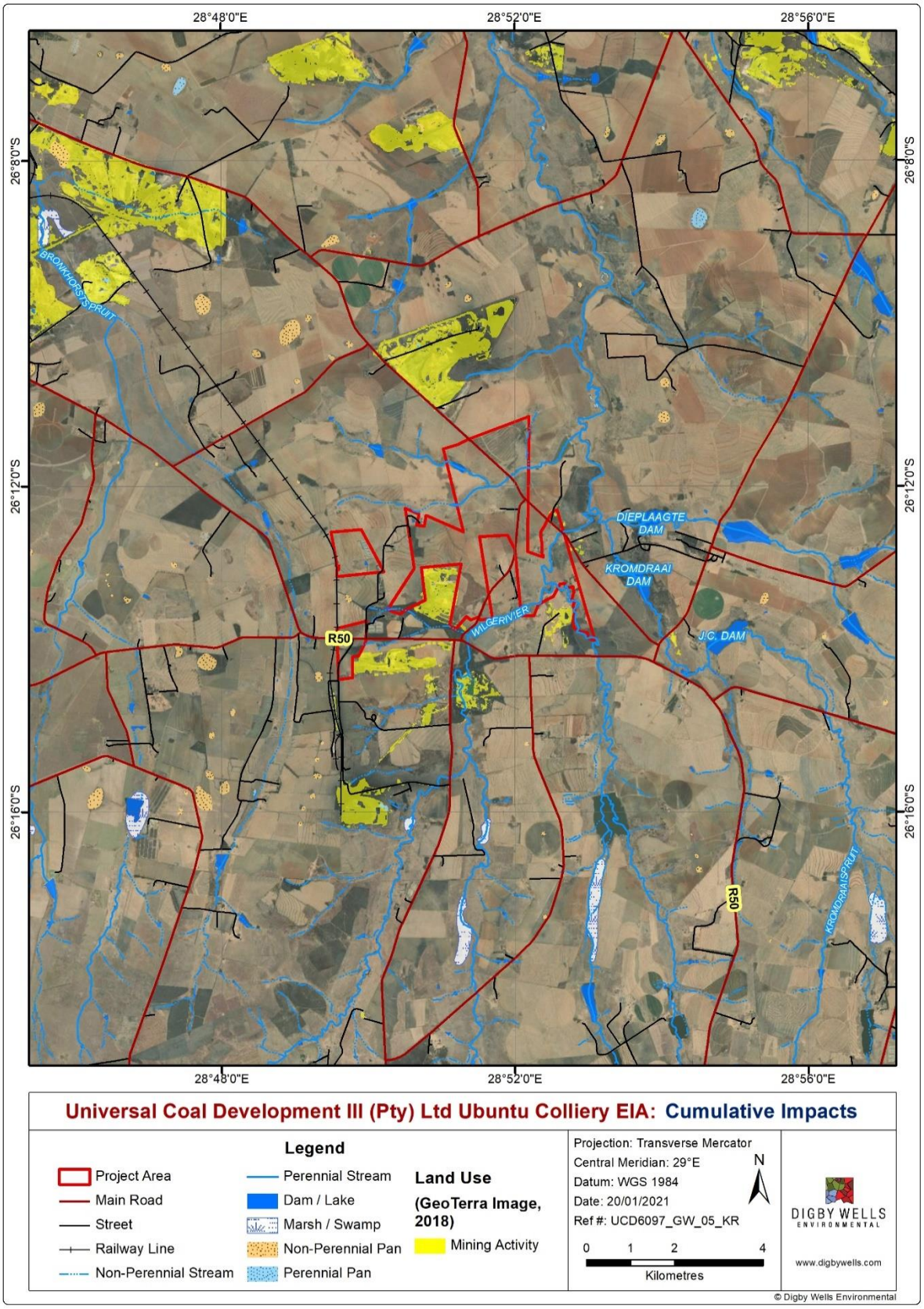


Figure 7-1: Cumulative Impacts

8. Monitoring Programme

Groundwater monitoring must be undertaken during all phases of the mine operation to identify impacts on the groundwater environment over time (if any), and effective measures can be undertaken at the early stage before negative impacts to the environment takes place.

There is ongoing monitoring at the Project Area. In addition to the monitoring network, two new boreholes (PBH1 and PBH2) are proposed (Figure 8-1). The proposed boreholes are located downgradient of the proposed new infrastructure. The proposed boreholes are important as they are intended to play a dual purpose of monitoring downgradient of the proposed pits (OC1 and OC2) which is not part of the activities under assessment however it is crucial that this gap in the current water monitoring network is covered. The pit is a potentially significant contamination source, and it is important that these impacts (if any) are monitored.

The location of the boreholes is a preliminary indication of the area of interest. Geophysical surveys will be required to identify more suitable locations that take into consideration preferential groundwater flow paths in that area.

Monitoring should be undertaken according to Table 8-1.

Table 8-1: Groundwater Monitoring Guidelines

Monitoring Element	Comment	Frequency	Responsibility	Reporting
Water quality	Ensure water quality monitoring as per sampled and proposed monitoring locations (See Figure 8-1). Parameters should include (WUL Limits) but not limited to pH; Electrical Conductivity; Sulphate; major cations (K, Ca, Mg & Na); trace metals (Fe & Mn); Anions (NO_3, Cl, PO_4); Total Dissolved Solids & Alkalinity.	-Quarterly (first to third quarters) and monthly (fourth quarter) groundwater sampling and groundwater level measurements.	Environmental Officer	The following external reports are required: -Quarterly reports; and -An annual report.

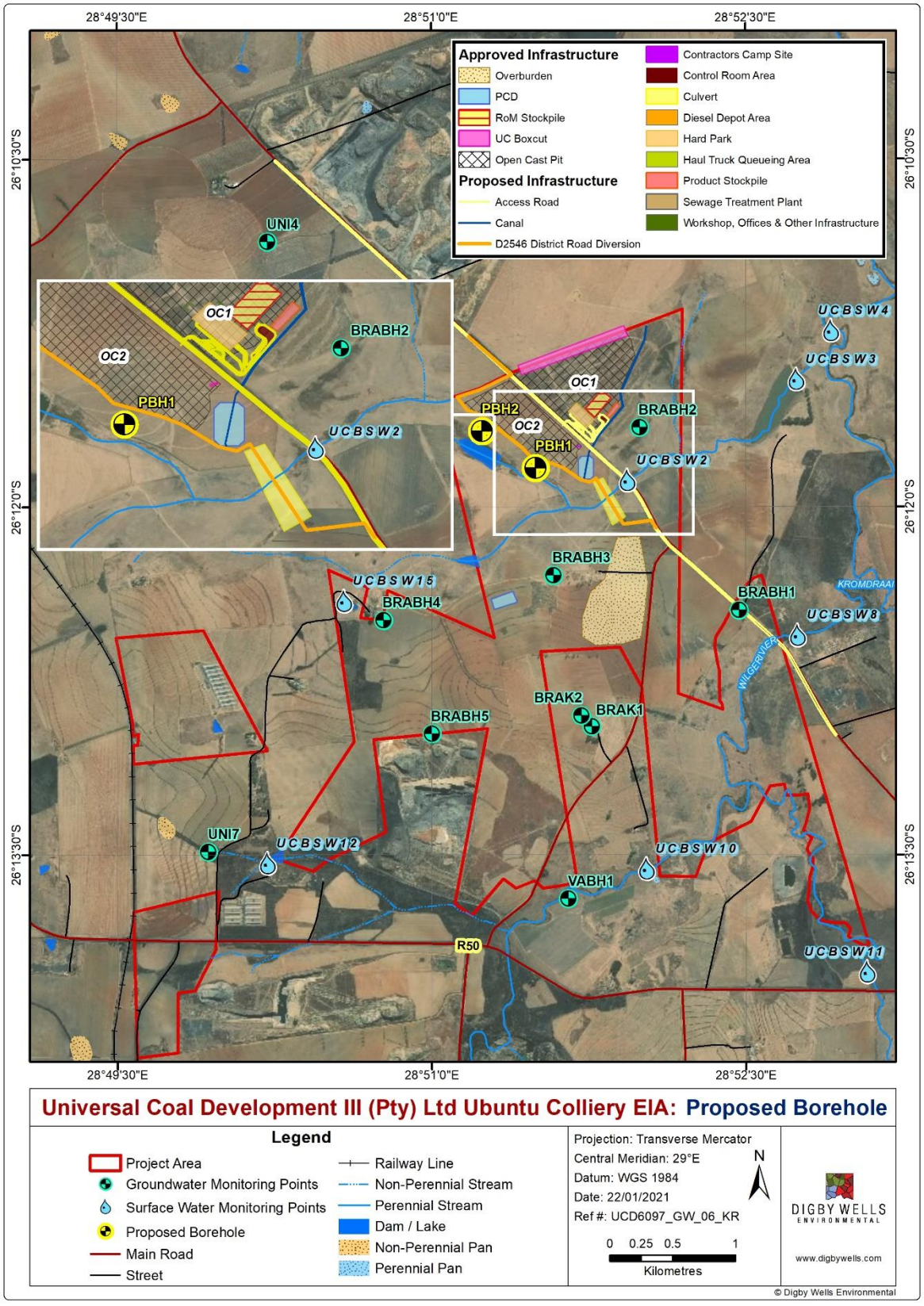


Figure 8-1: Proposed Monitoring Points

9. Stakeholder Engagement Comments Received

Public participation was undertaken during the Scoping Phase of the Project during which no groundwater related comments were received.

10. Reasoned Opinion Whether Project Should Proceed

From a groundwater perspective, Digby Wells recommends that the proposed infrastructure should be authorized, on condition that the management actions in Section 7 are implemented.

11. Conclusion

The following conclusions can be drawn from the desktop assessment:

- The additional infrastructure is not anticipated to cause significant changes to previously determined groundwater impacts from existing/planned activities that have already been addressed in previous studies (i.e. Current EMP). The additional proposed activities will only be a short-term, local impact during the construction and operational phase. The assumption is that the STP, product stockpile, WTP, crushing facilities and stockpile area will be lined and the diesel deport will be bunded. Therefore the impact will be localized and insignificant if it does occur;
- Water quality in and around the Mining Right Boundary is found within the WUL standards at all groundwater monitoring locations, except for VABH01 which slightly exceeds the WUL standards for total alkalinity (260 mg/L), showing alkalinity of 269 mg/L. The slight exceedance is not an environmental concern. Additionally, the pH was neutral for all monitoring locations;
- Groundwater levels indicate a good correlation with topography; and
- The significance of potential impacts caused by the proposed infrastructure is regarded negligible because impacts predicted to emanate from the proposed activities are minimal, if any.

12. Recommendations

It is recommended that two new monitoring boreholes are drilled; the boreholes are located downgradient of the proposed infrastructure.

During the construction phase it is recommended that site clearance and topsoil removal activities may involve excavation which should take place above the water table, which is observed to be highly likely. No impacts on the groundwater environment are expected if the activities take place above the groundwater table.

During the operational phase the following recommendations are made:

- Lining the of diesel depot area, STP, product stockpile, WTP, crushing facilities and stockpile area;
- Hydrocarbons and hazardous materials must be stored in bunded areas; and

- If a considerable amount of fluid is accidentally spilled, the contaminated soil should be scraped off and disposed of at an acceptable dumping facility. The excavation should be backfilled with soil of good quality.

During the closure phase no mitigation measures are expected to be required. as the removal of potential sources and site rehabilitation will reduce the risk of impact to the groundwater environment.

An update to the currently monitoring network is recommended and geophysical surveys should be conducted to identify more suitable locations that take into consideration preferential groundwater flow paths in the area where boreholes are recommended.

13. References

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