Environmental Impact Assessment for the Proposed Elandsfontein Coal Mining Project

Mpumalanga Province, South Africa

Riverine Assessment

July 2020 (Updated November 2020)

CLIENT

EIMS ENVIRONMENTAL IMPACT MANAGEMENT SERVICES

Prepared by:

The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

Report Name	Environmental Impact Assessment for the Proposed Elandsfontein Coal Mining Project – Riverine Assessment 2020
Submitted to	EIMS ENVIRONMENTAL IMPACT MANAGEMENT SERVICES
Report Reviewer	**Andrew Husted** 
	Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.
Report Writer	**Dale Kindler** 
	Dale Kindler is Pr. Sci. Nat. registered (114743) in aquatic science and completed his M. Sc. in Aquatic Health at the University of Johannesburg. He has six (6) years' experience in conducting Aquatic Specialist Assessments and is SASS 5 Accredited with the Department of Water and Sanitation (DWS). Dale has completed numerous specialist studies locally and internationally, ranging from basic assessments to Environmental Impact Assessments (EIAs) following IFC standards.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

EXECUTIVE SUMMARY

GNR 326	Appendix 6 (n): Specialist Opinion

It is the specialist's opinion that no fatal flaws are presented for the project. In the event that underground mining is authorised, it is recommended that a subsidence assessment prescribe measures to avoid subsidence of the mined-out areas below the riverine and wetland areas and associated buffer zones. In the event that open cast mining of Seam 2 is authorised, it is recommended that the extent of the open cast area be amended to adhere to the buffer zone. Due to the expected loss and degradation of rivers and wetlands as a result of the project with either option, it is further recommended that on-site rehabilitation of the area be implemented to allow for some level of wetland compensation, this should be informed by an offset strategy.

Decommissioning of the current diverted watercourse is the preferred alternative, and the original watercourse should be reinstated.

If all recommendations made are met, it is the specialist's opinion that no fatal flaws exist and that the proposed activities should proceed as have been planned.

The Elandsfontein Colliery comprises of two Mining Right Areas (MR63 and MR314). The applicant plans to combine these two Mining Right Areas (MRAs) into one single MRA with an associated consolidated Environmental Management Programme (EMPR). In addition, the applicant plans to expand current mining areas and include new open cast and underground mining areas with the inclusion of Pollution control Dams (PCDs) and stormwater management infrastructure.

The purpose of the specialist study is to provide relevant input into the authorisation process and to provide a report for the proposed activities associated with mining and ancillary activities proposed to take place on site.

The watercourses associated with Elandsfontein Coal Mine are predominantly located in the B20G quaternary catchment and to a lesser extent the B11K quaternary catchment, within the Olifants Water Management Area and the Highveld - Lower ecoregion. The relevant Sub-Quaternary Reach is the B20G-1099, which is a reach of the Saalboomspruit, and flows north until it eventuates in the Wilge River. The land uses surrounding the project area includes extensive agricultural and mining activities and with urban development situated between watercourses. A total of eight aquatic sampling sites were selected for the study, including two water quality sites at E Seep and E Dam. These were located on the Elandsfontein tributary with drains the Elandsfontein Colliery project area and a tributary of the Saalboomspruit which the Elandsfontein tributary drains into.

The baseline riverine study established critically modified conditions in the Elandsfontein tributary, and further, largely modified conditions in the Saalboomspruit tributary. Both systems presented wetland conditions. The study indicated that a deterioration of water quality was occurring between the upstream T1 site, and the T2 and T3 sites, as indicated by a decrease in pH, resulting in acidic conditions, and elevated dissolved solids. The results further indicated contaminated water stemming from the Elandsfontein tributary, as indicated by results from the upstream E Dam, E1, E2, and E3 sites, which contributed to the deteriorated water quality conditions of the Saalboomspruit tributary, and likely downstream catchments. Further, extensive stands of alien invasive plant species occur within the Elandsfontein project area, reducing riparian habitat integrity.

The water quality perturbations stemming from the Elandsfontein project area requires immediate remediation as the poor water quality is impacting on the ecological integrity of downstream riverine and wetland reaches. Neither of the assessed tributary systems met the Sub-Quaternary Reach Resource Quality Objectives of moderately modified (class C), indicating the need for rehabilitation efforts.

The results of the impact assessment indicated that risks associated with the proposed project activities were determined to have two primary impacts to the associated Elandsfontein tributary (directly) and the Saalboomspruit tributary (indirectly). The first was determined to be related to physical make-up alterations of the considered river reaches due to subsidence and groundwater drawdown related to undermining of the rivers and wetlands. Groundwater drawdown would be expected to result in a loss of water volume in surface rivers and wetlands. The opencast mining (Seam 2) and proposed PCDs and stormwater management infrastructure would also result in the loss and fragmentation of riverine / wetland habitat through physical removal. These mining options would result in impacts to the riverine substrates, banks, riparian / marginal vegetation and the hydrological functioning of the assessed tributaries. These physical components of a watercourse are drivers responsible for the biodiversity associated with the aquatic habitats. Therefore, modification of these physical components would result in habitat integrity impacts and associated reduction in the ability to support a diversity of aquatic fauna and flora. The loss of aquatic habitat scored a “Medium” final significance rating for both Seam 1 and 2 and the PCDs and stormwater management infrastructure during the construction and operational phases.

Decommissioning of the current diverted watercourse is the preferred alternative, and the original watercourse should be reinstated. Ideally, the watercourse should be reinstated to a pre-destruction condition replicating (as close as possible) the original topography, features and extent to achieve the desired ecological class. This option would avoid further impacts to the Largely Modified (class D) hydrology, water quality and Present Ecological Status of the downstream Saalboomspruit reach. Positive impacts are expected which include the assimilation of upstream mining pollutants from the water column through phytoremediation of an improved river channel.

The baseline study indicated that further deterioration of the aquatic systems has occurred from the 2014 study. The proposed project activities have the potential to further degrade local ecological conditions, making the Resource Quality Objectives difficult to obtain. This indicates the necessity of implementation of the EMPR for the Elandsfontein project area. Furthermore, aquatic biomonitoring is recommended to determine ecological trends and further impacts stemming from the Elandsfontein project area.

Table of Contents

Tables

Figures

1 Introduction & Background

The Elandsfontein Colliery comprises of two mining rights (MR63 and MR314). The applicant plans to combine these two MRAs into one single MRA with a consolidated Environmental Management Programme (EMPR). In addition, the applicant plans to expand current mining activities and include new open cast and underground mining areas.

The purpose of the specialist study is to provide relevant input into the authorisation process and to provide a report for the proposed activities associated with mining and ancillary activities proposed to take place on site.

Two riverine surveys were conducted on watercourses associated with the Elandsfontein Colliery in September 2019 (low flow assessment) and March 2020 (high flow assessment). This study represents an update to riverine assessments conducted in 2014 by Digby Wells Environmental (Digby, 2017) for the proposed Elandsfontein coal mining developments. The Digby (2017) document was used as a baseline for comparative purposes. This report provides the findings of the respective assessments.

The purpose of this specialist study is to provide relevant input into the Environmental Impact Assessment (EIA) process and to provide a report for the proposed activities associated with open cast and underground mining. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological , risks, and potential mitigation measures for the proposed project with regards to the aquatic resources.

This riverine assessment has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 20 March 2020: “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation” (DWS, 2020a).

According to the National Web based Environmental Screening Tool the combined aquatic biodiversity for the area is classified as predominantly Low sensitivity, with an extent classified as Very High sensitivity (Figure 1-1). The wetland and riverine assessments should be jointly considered for the minimum report content requirements for a very high sensitivity rating.

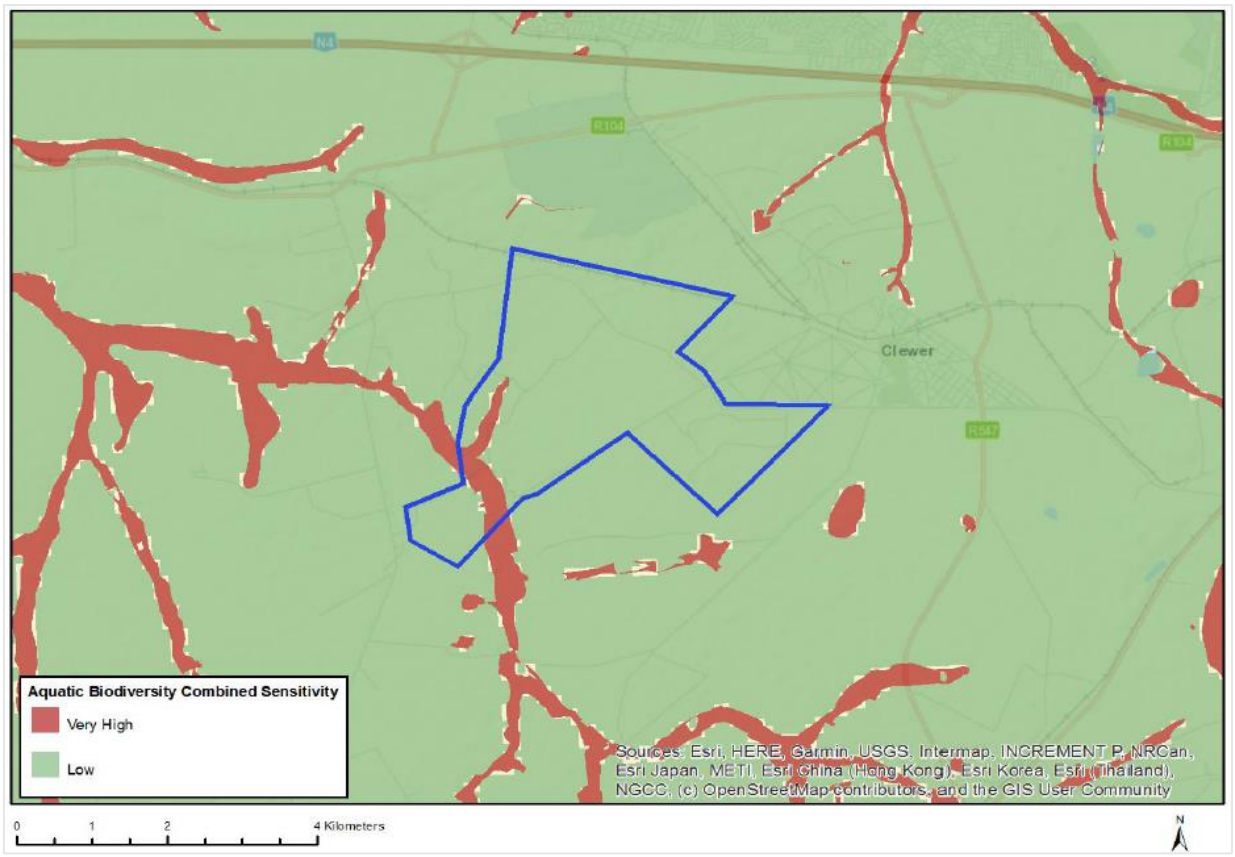

Figure 1-1 Map of relative aquatic biodiversity theme sensitivity (National Web based Environmental Screening Tool)

The project area has undergone modification, however despite the level of modification, the specialist agrees with the sensitivities presented in Figure 1-1. The areas with a very high sensitivity rating do maintain ecological integrity, and although modified do present sensitivity to further modification. The proposed development areas do overlap with the MBSP Freshwater Critical Biodiversity Areas (CBA – SANBI, 2011). This riverine baseline study presents the aquatic ecological findings.

2 Document Structure

The table below provides the NEMA (2014) Requirements for Ecological Assessments, and also the relevant sections in the reports where these requirements are addressed:

GNR 326	Description	Section in the Report
Specialist Report		
Appendix 6 (a)	A specialist report prepared in terms of these Regulations must contain— 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;	Page iv. Section 3 Appendix B
Appendix 6 (b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix A
Appendix 6 (c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 4
Appendix 6 (cA)	An indication of the quality and age of base data used for the specialist report;	Section 1 & 7
Appendix 6 (cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8 and 10
Appendix 6 (d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1 & 7
Appendix 6 (e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 7
Appendix 6 (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;	Section 9 & 10
Appendix 6 (g)	An identification of any areas to be avoided, including buffers;	Section 9 and 10
Appendix 6 (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;	Section 9
Appendix 6 (i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 13
Appendix 6 (j)	A description of the findings and potential implications of such findings on the impact of the proposed activity [including identified alternatives on the environment] or activities;	Section 9 and 10
Appendix 6 (k)	Any mitigation measures for inclusion in the EMPr;	Section 11
Appendix 6 (l)	Any conditions for inclusion in the environmental authorisation;	Section 12
Appendix 6 (m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	11 and 12
Appendix 6 (n)	A reasoned opinion— i. [as to] whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. 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;	Section 12
Appendix 6 (o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	None
Appendix 6 (p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
Appendix 6 (q)	Any other information requested by the competent authority.	None

3 Specialist Details

3.1 Report Writer and Fieldwork

Dale Kindler

Dale Kindler is Pr. Sci. Nat. registered (114743) in aquatic science and completed his M. Sc. in Aquatic Health at the University of Johannesburg. He has six (6) years' experience in conducting Aquatic Specialist Assessments and is SASS 5 Accredited with the Department of Water and Sanitation (DWS). Dale has completed numerous specialist studies locally and internationally, ranging from basic assessments to Environmental Impact Assessments (EIAs) following IFC standards.

3.2 Report Reviewer

Andrew Husted

Andrew Husted is Pr. Sci. Nat. registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.

4 Terms of Reference

The following tasks were completed in fulfilment of the terms of reference for this study:

- Review of existing desktop information and literature;
- Determining the ecological status of the local watercourses;
- Determine the Environmental Importance and Sensitivity (EIS) of watercourses;
- An impact assessment for the proposed activities; and
- The prescription of mitigation measures, and recommendations for identified risks.

5 Project Description

5.1 Project area

The project area is located approximately 14 km south-west of Emalahleni and approximately 13 km south-east of Balmoral, Mpumalanga, South Africa (Figure 5-1). A map illustrating the extent of the proposed open cast and underground mining areas is presented in Figure 5-2, while the proposed surface infrastructure, stockpiles and the related activities can be seen in Figure 5-3.

The watercourses associated with Elandsfontein Coal Mine are predominantly located in the B20G quaternary catchment and to a lesser extent the B11K quaternary catchment, within the Olifants Water Management Area (WMA) (NWA, 2016) and the Highveld - Lower ecoregion (Dallas, 2007) (Figure 5-1). The relevant Sub-Quaternary Reach (SQR) is the B20G-1099,

which is a reach of the Saalboomspruit, and flows north until it eventuates in the Wilge River (Figure 5-4).

The land uses surrounding the project area includes extensive agricultural and mining activities and with urban development situated between watercourses. A total of eight aquatic sampling sites were selected for the study (Figure 5-5), including two water quality sites at E Seep and E Dam. Site photographs and Global Positioning System (GPS) coordinates for the sampling sites are presented in Table 5-1.

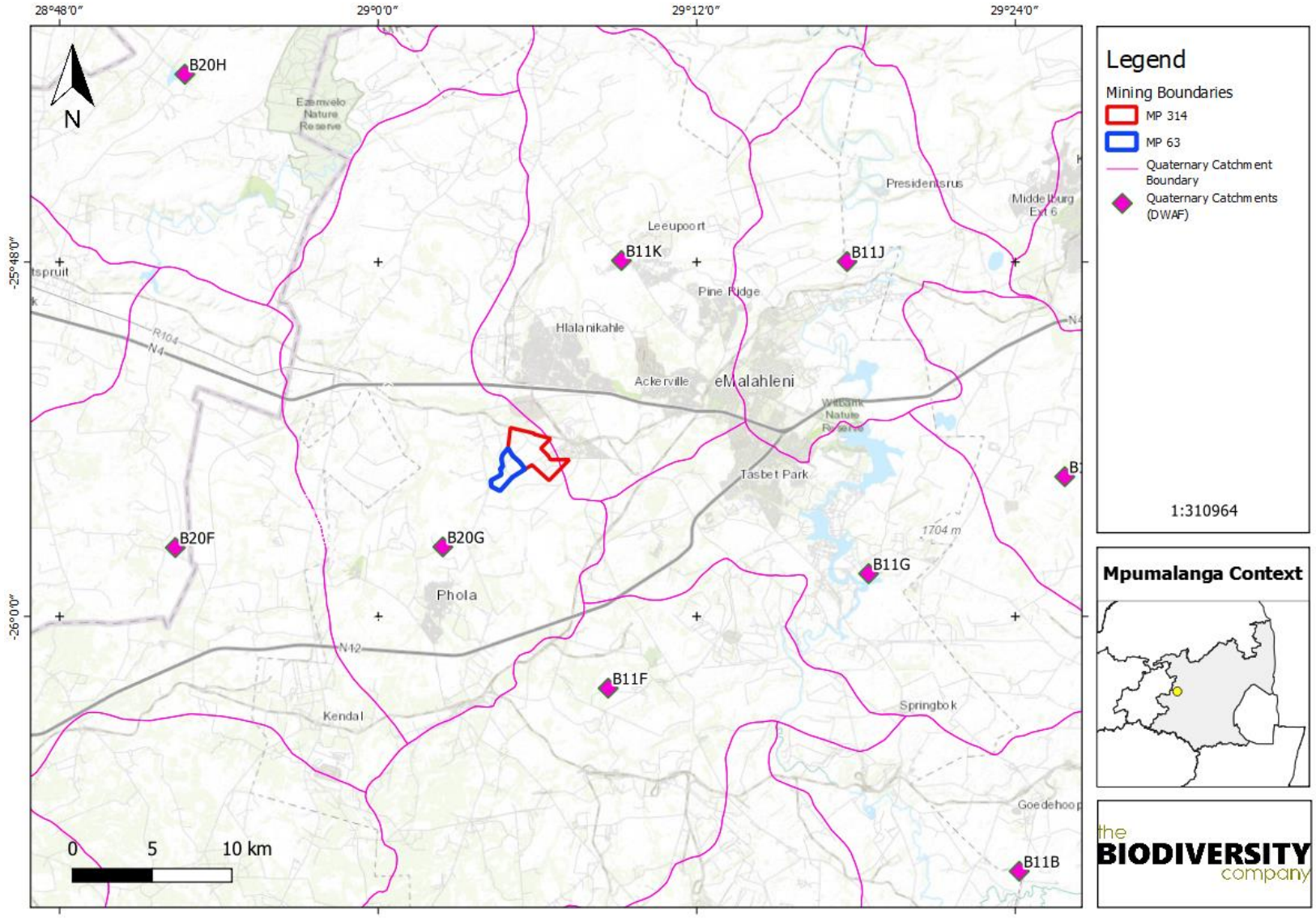

Figure 5-1 Locality map of the project area

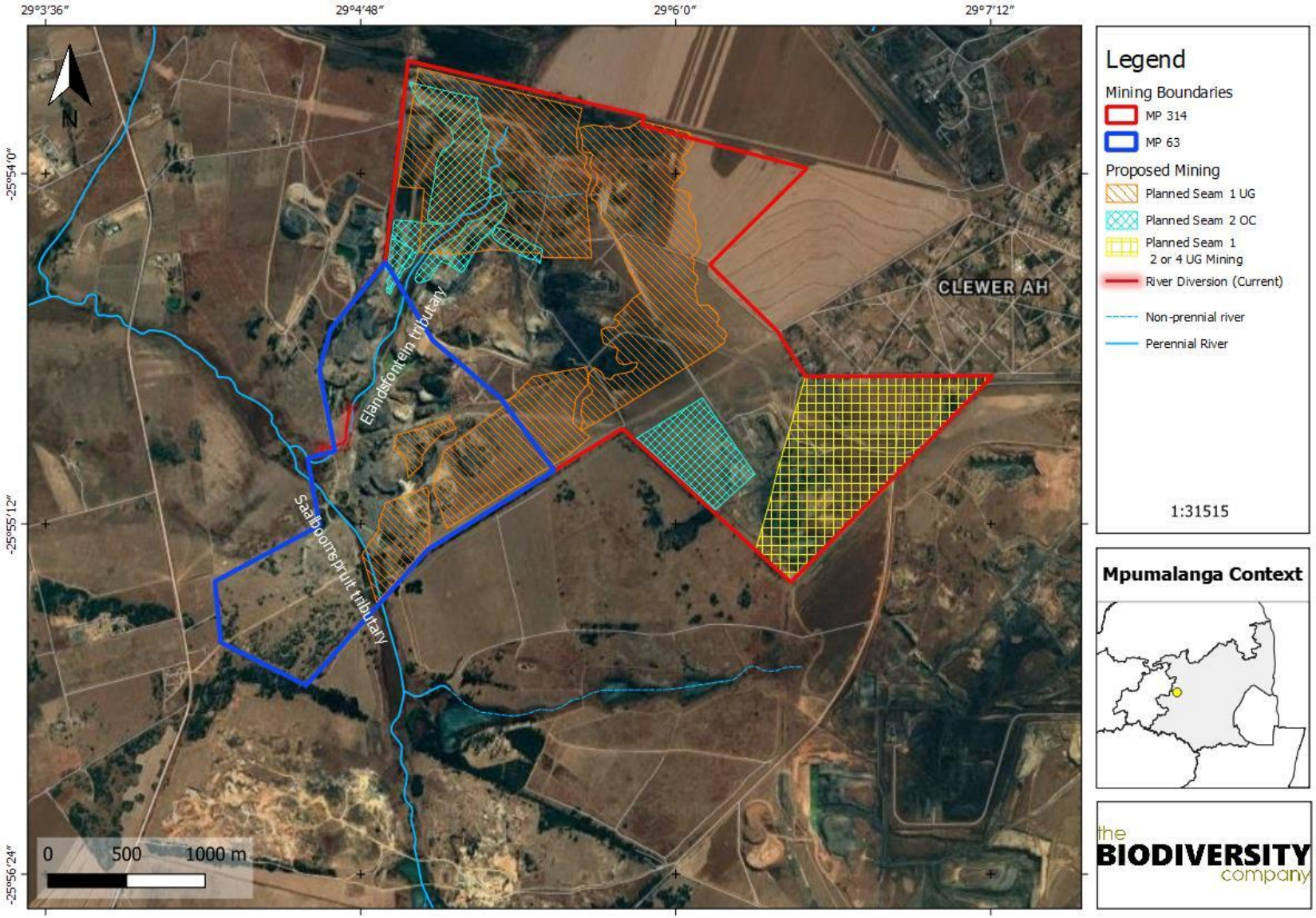

Figure 5-2 Extent of proposed open cast and underground mining areas with river diversion

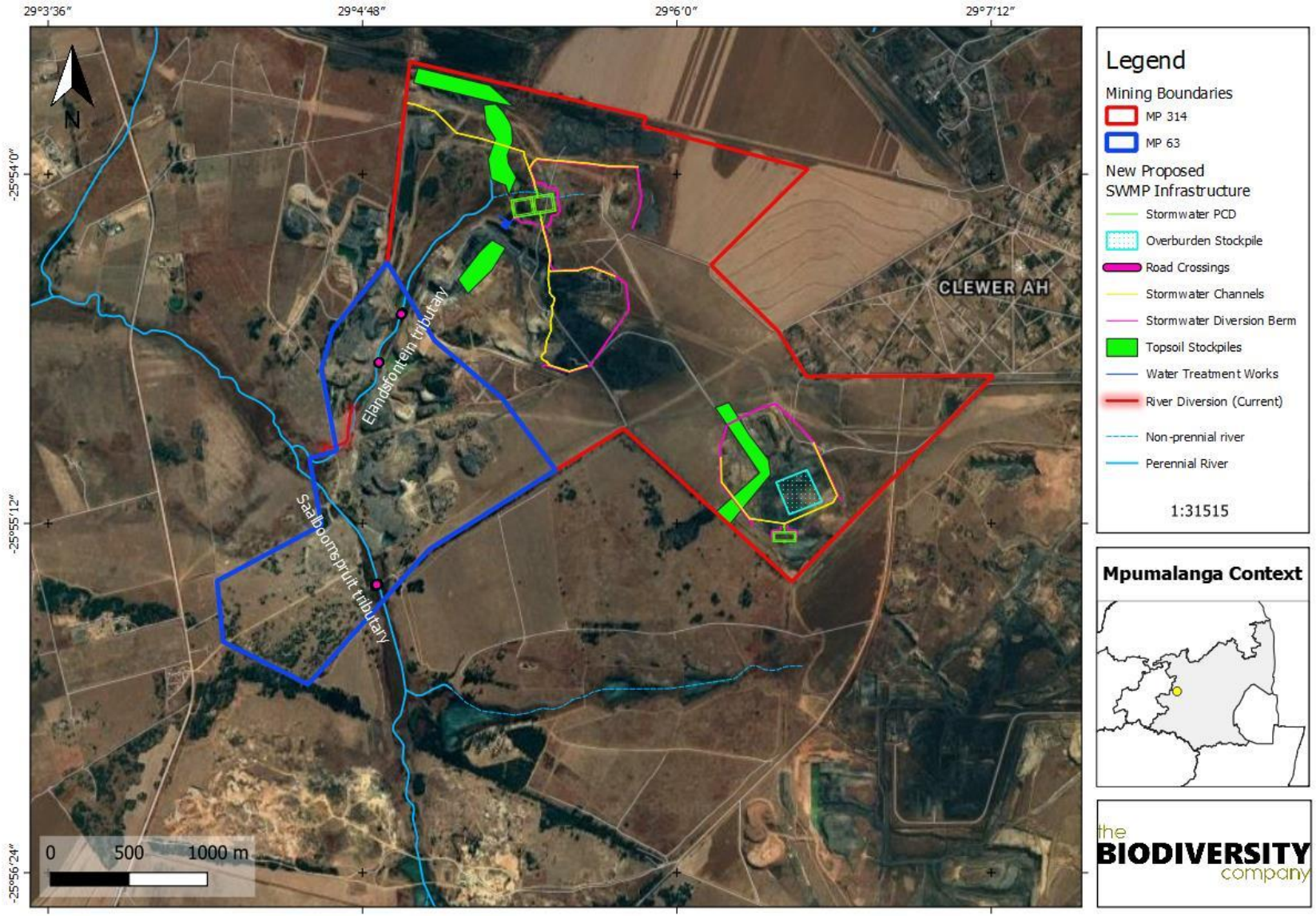

Figure 5-3 Layout map indicating new stormwater management infrastructure

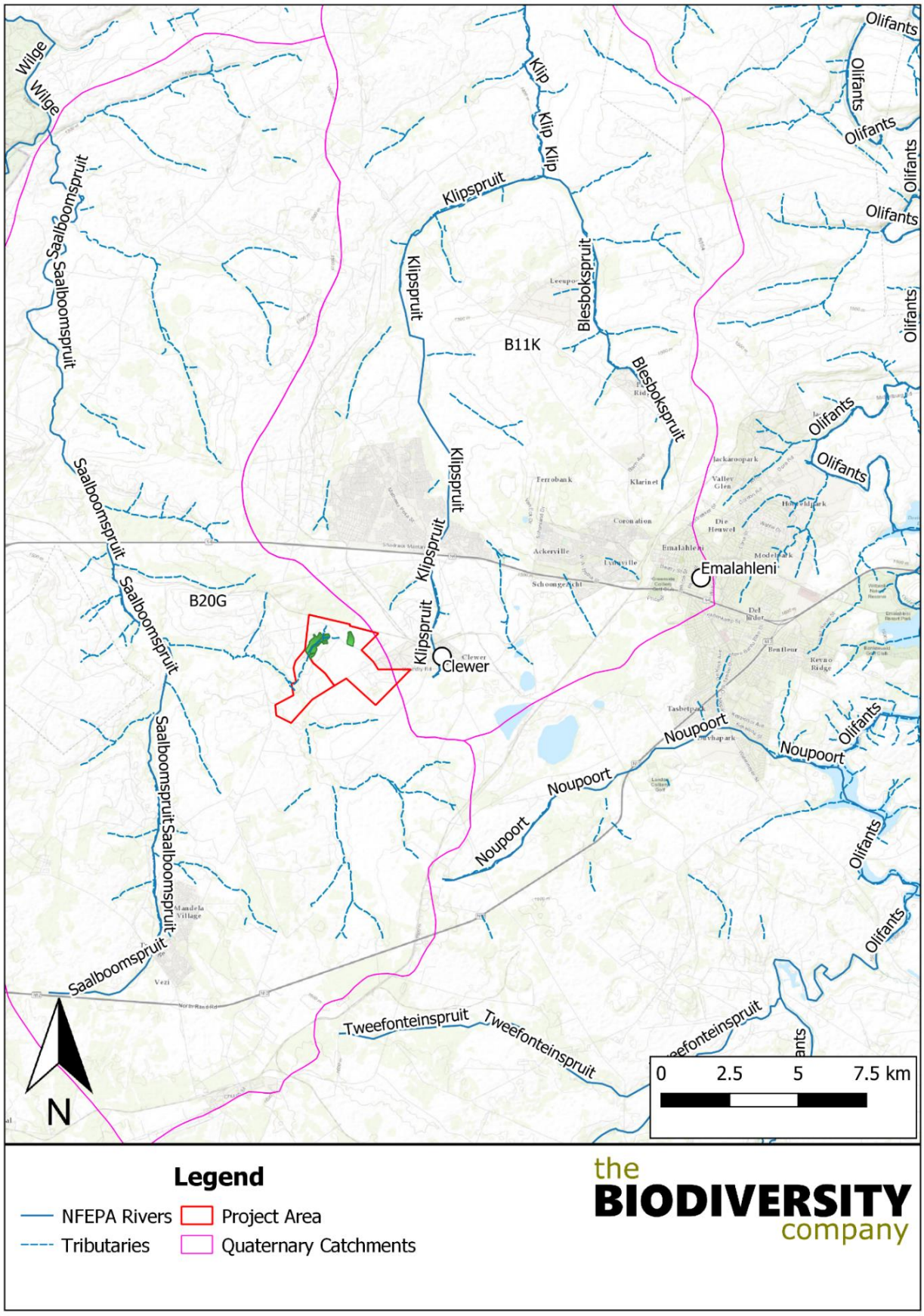

Figure 5-4 Elandsfontein Coal Mine project locality map (green presenting wetland areas)

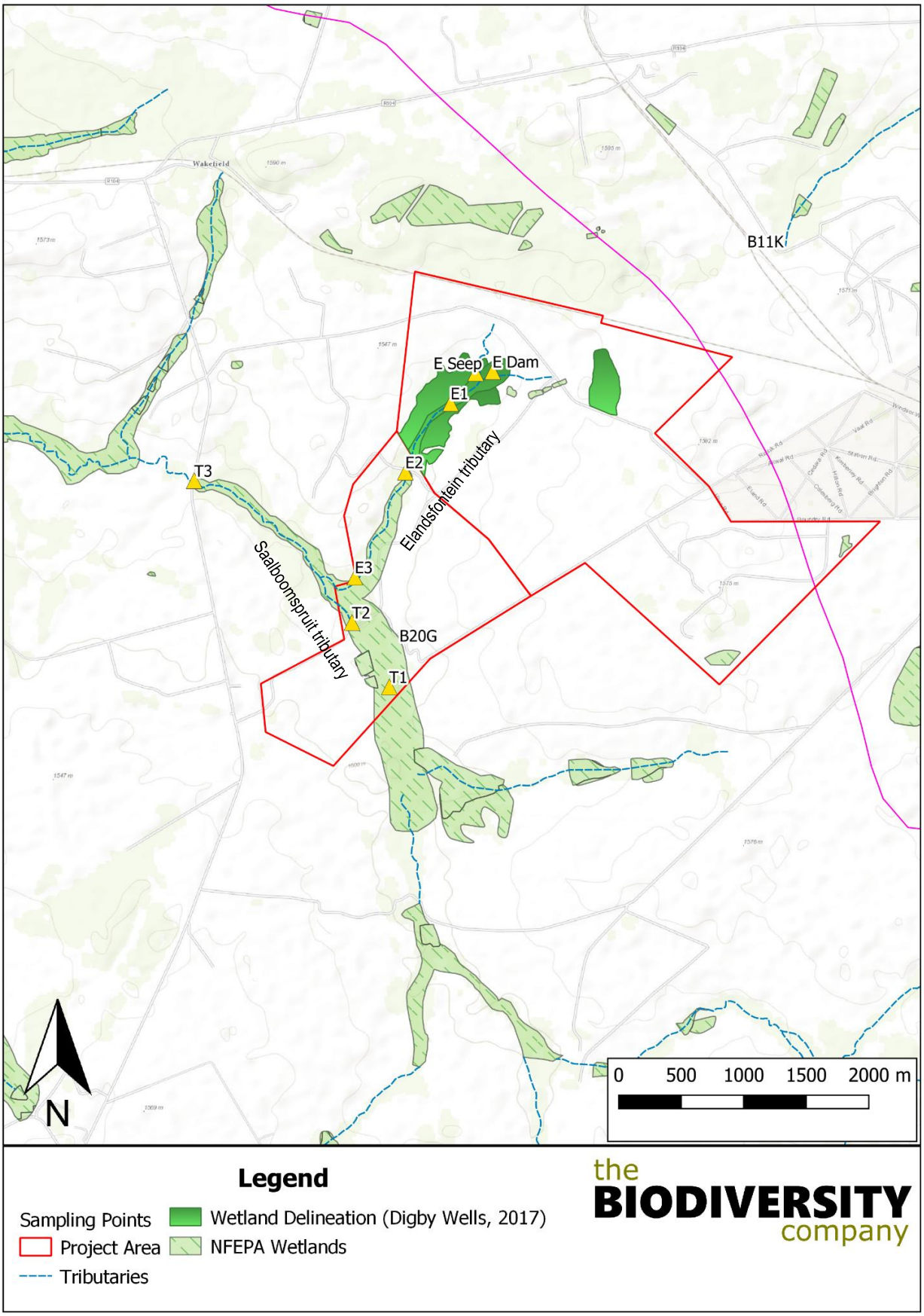

Figure 5-5 Aquatic sampling points for the Elandsfontein Coal Mine

Table 5-1 Photos and GPS coordinates for the sites sampled (photos taken September 2019)

Site	Upstream	Downstream
T1		
GPS	25°55'24.64"S; 29° 4'51.59"E	
T2		
GPS	25°55'7.92"S; 29° 4'40.85"E	
T3		
GPS	25°54'31.10"S; 29° 3'55.50"E	
E1		
GPS	25°54'10.97"S; 29° 5'9.14"E	

Site	Upstream	Downstream
E2		
GPS	25°54'28.87"S; 29° 4'56.15"E	
E3		
GPS	25°54'56.17"S; 29° 4'41.66"E	
E Seep		
GPS	25°54'3.11"S; 29° 5'16.34"E	
E Dam		
GPS	25°54'2.70"S; 29° 5'21.21"E	

5.2 Background

Elandsfontein Colliery is an existing mine with opencast and underground sections. Elandsfontein Colliery holds two mining rights, namely MP 314 MR (~593 ha) and MP 63 MR (~237 ha). It produces coal for the local and the export market, at a rate of ~500 000 tons/annum. Coal has been produced historically from the No. 1 Seam (underground bord and pillar operation) and an opencast operation on the No. 4 Seam and on the No. 2 Seam.

The roll over strip mining method is utilised to extract coal from the shallower No.2 coal seam. The existing opencast operations have an approximate extent of 257 ha (some of this area has already been mined and other areas are currently being mined in accordance with the previous approved mine plan) while the applicant wishes to authorise an additional 69.47 ha of opencast mining. Deeper coal will be extracted by underground bord and pillar mining using decline shafts to access the No. 1 coal seam. The historical underground footprint covers an approximate area of 182 ha, while the Elandsfontein Colliery wishes to authorise an additional 485 ha of underground mining and 249 ha of opencast mining. Associated infrastructure consists of a discard dump, coal RoM stockpiles, overburden stockpiles, pollution control dams (PCD) and slurry dam.

Elandsfontein Colliery is planning to add additional opencast and underground mining areas within the existing mining right areas to extend the life-of-mine (LoM). As such a MPRDA S102 amendment process is being undertaken by the mine, supported by the integrated EIA/WML and WULA applications. The EIA process will result in a consolidation of the numerous authorisation processes that have been undertaken to date to produce a single overarching EMPr for holistic management of the Colliery going forward. Elandsfontein Colliery will be applying for the relevant approvals to cover their extended LoM which will include future opencast and underground mining operations and associated infrastructure. Various amendments to the existing EA/EMP as well as IWUL will also be applied for to align the specific conditions with the current status of the mine as well as to provide more clarity on certain conditions.

The following rights, authorisations and approvals are currently in place and have been considered in the compilation of the report:

- Mining Right 63 MR renewal, granted to Elandsfontein Colliery (Pty) Ltd, in terms of Section 24 (3) of the MPRDA on 6 August 2019 which covers the following portions of the farm Elandsfontein 309 JS: Portion of the RE of Portion 6, Portion of the RE of Portion 8 and RE of Portion 1.
- Mining Right 314 MR renewal, granted to Elandsfontein Colliery (Pty) Ltd, in terms of Section 24 (3) of the MPRDA on 6 August 2019 which covering the following portions of the farm Elandsfontein 309 JS: RE of Portion 7, Portion of the RE of Portion 8, Portion 44 and Portion 14;
- An amended EMPr dated August 2017;
- Approved IWUL, File No. 16/2/7/B100/C11 granted on 20 October 2015 for various S21 (g), (c) and (i) which covers Portions 1, 7, 8 and 14 of Elandsfontein 309 JS (amended 23 July 2019).

The existing approved surface infrastructure at Elandsfontein Colliery consists of the following:

- Opencast pit;
- Underground mining areas;
- Stockpiles;
- Offices;
- Beneficiation Plant area (crushing and screening);
- Contractors yard;
- Weighbridge;
- Access and haul roads;
- Security point and fencing;
- Pumps and sumps;
- Clean water trenches;
- Dirty water trenches;
- 3 PCD's; and
- Storm water control trenches.

5.3 Description of Activities to Be Undertaken

This section describes the current authorization process activities as provided. The proposed project includes inter alia the following application processes with associated activities:

- New Integrated Environmental Authorisation (Scoping and Environmental Impact Report (S&EIR)) for:
    - New opencast and underground mining areas;
    - New PCDs and stormwater management infrastructure;
    - New residue deposits and/or residue stockpiles (requiring Waste Management Licence); and
    - Various activities including the primary processing of a mineral resource related to the extended LoM.
- Renewal of Integrated Water Use Licence (IWUL) and application for new water uses for:
    - Residue stockpiles/deposits;
    - Dewatering of pits and underground areas;
    - New PCD's and stormwater management infrastructure which includes river crossings; and
    - GN704 exemptions.
- MPRDA Section 102 Amendment:
    - Revised Mine Works Programme;

- Revised Social and Labour Plan;

- Revised Regulation 2.2 Plan; and
- Revised consolidated EMPr.

6 Legislative and Policy Framework

6.1 National Water Act (Act No. 36 of 1998)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem, and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS.

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): "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".

Wetlands have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

6.2 National Environmental Management Act (Act No. 107 of 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the EIA process depending on the scale of the impact.

7 Methodologies

Two riverine surveys were conducted of the tributary of the Saalboomspruit system and west of the town of Clewer. The surveys were conducted in September 2019 (low flow assessment) and March 2020 (high flow assessment). A summary of assessments conducted during the study are presented in Table 7-1, followed by full methodology descriptions below.

Table 7-1 Methodologies applied during the study

Aspect	Analyses
Water Quality	*In situ* (DWAF, 1996)
Habitat	Intermediate Habitat Integrity Assessment (Kleynhans, 1998) Integrated Habitat Assessment System (McMillan, 1998) Biotope assessment (Tate and Husted, 2015)
Biotic indices	SASS5 (Dickens and Graham, 2002); The Average Score Per Taxon (ASPT); Macroinvertebrate Response Assessment Index (MIRAI); (Thirion,2007) Qualitative Fish Assessment

7.1 *In Situ* Water Quality

During the survey a portable Exstick 2 multimeter was used to measure the following parameters *in situ* pH, conductivity, Dissolved Oxygen (DO), and water temperature.

Water quality has a direct influence on aquatic life forms. Although these measurements only provide a “snapshot”, they can provide valuable insight into the characteristics and interpretation of a specific sample site at the time of the survey.

7.2 Habitat Assessment

Habitat availability and diversity are major attributes for the biota found in a specific ecosystem, and thus knowledge of the quality of habitats is important in an overall assessment of ecosystem health. Habitat assessment can be defined as the evaluation of the structure of the surrounding physical habitat that influences the quality of the water resource and the condition of the resident aquatic community (Barbour *et al*. 1996). Both the quality and quantity of available habitat affect the structure and composition of resident biological communities (USEPA, 1998). Habitat quality and availability plays a critical role in the occurrence of aquatic biota. For this reason, habitat evaluation is conducted simultaneously with biological evaluations to facilitate the interpretation of results.

7.2.1 Intermediate Habitat Integrity Assessment

The aim of the Intermediate Habitat Integrity Assessment (IHIA) is to make an intermediate assessment of the habitat integrity of rivers according to a modified Habitat Integrity approach which can be applied in intermediate determination of the ecological Reserve for rivers in South Africa (DWS, 1999). The methodology is based on the qualitative assessment of a number of pre-weighted criteria which indicate the integrity of the in-stream and riparian habitats available for use by riverine biota.

The criteria considered indicative of the habitat integrity of the river were selected on the basis that anthropogenic modification of their characteristics can generally be regarded as the primary causes of degradation of the integrity of the river (Table 7-2) (DWS, 1999). The study assessed 5 km of the Saalboomspruit and its tributary.

Table 7-2 Criteria used in the assessment of habitat integrity (from Kleynhans, 1996)

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of high flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon *et al*., 1993 in: DWS, 1999). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993 in: DWS, 1999) is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon *et al*., 1992 in DWS, 1999).
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river. Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

The assessment of the severity of impact of modifications is based on six descriptive categories which are described in Table 7-3.

Table 7-3 Descriptive classes for the assessment of modifications to habitat integrity (from Kleynhans, 1996)

Impact Category	Description	Score
None	No discernible impact, or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	**0**
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	**1 - 5**
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	**6 - 10**
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	**11 - 15**
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	**16 - 20**
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	**21 - 25**

The habitat integrity assessment takes into account the riparian zone and the instream channel of the river. Assessments are made separately for both aspects, but data for the riparian zone are primarily interpreted in terms of the potential impact on the instream component (Table 7-4). The relative weighting of criteria remain the same as for the assessment of habitat integrity (DWS, 1999).

Table 7-4 Criteria and weights used for the assessment of habitat integrity and habitat integrity (from Kleynhans, 1996)

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
Total	**100**	**Total**	**100**

The negative weights are added for the instream and riparian facets respectively and the total additional negative weight subtracted from the provisionally determined intermediate integrity to arrive at a final intermediate habitat integrity estimate. The eventual total scores for the instream and riparian zone components are then used to place the habitat integrity in a specific intermediate habitat integrity category (DWS, 1999). These categories are indicated in Table 7-5.

Table 7-5 Intermediate habitat integrity categories (From Kleynhans, 1996)

Category	Description	Score (% of Total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90

C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0

7.3 Aquatic Macroinvertebrates

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.,* 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.,* 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

7.3.1 South African Scoring System version 5

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Chironomidae) to highly sensitive families (e.g. Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made to family level (Thirion *et al.,* 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002).

Reference conditions reflect the best conditions that can be expected in rivers and streams within a specific area and reflect natural variation over time. These reference conditions are used as a benchmark against which field data can be compared. Modelled reference conditions for the Highveld - Lower Ecoregions were obtained from Dallas (2007). The biological bands for the Highveld - Lower Ecoregion are presented in Figure 7-1. Ecological categories based on biological banding are presented in Table 7-6.

Table 7-6 Biological Bands / Ecological categories for interpreting SASS data (adapted from Dallas, 2007)

Class	Ecological Category	Description
A	Natural	Unimpaired. High diversity of taxa with numerous sensitive taxa.
B	Largely natural	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.
C	Moderately modified	Moderately impaired. Moderate diversity of taxa.
D	Largely modified	Considerably impaired. Mostly tolerant taxa present.
E/F	Seriously Modified	Severely impaired. Only tolerant taxa present.

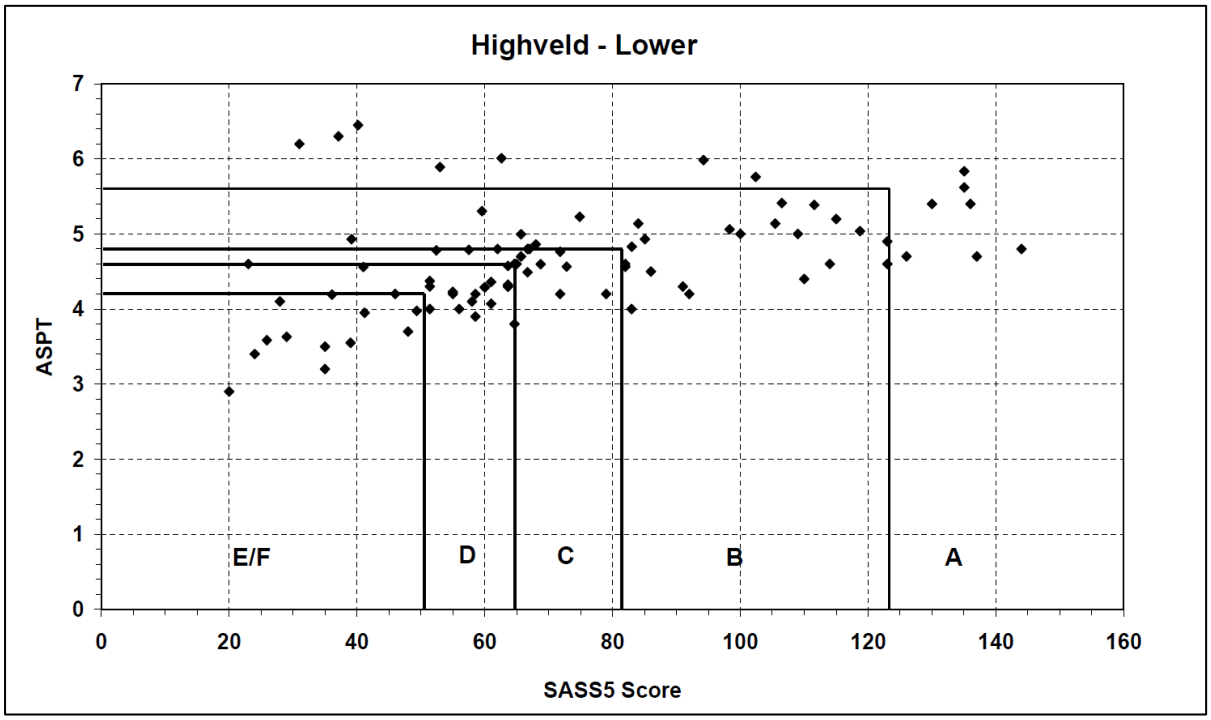

Figure 7-1 Biological Bands for the Highveld – Lower Ecoregion, calculated using percentiles (Dallas, 2007)

7.3.2 Macroinvertebrate Response Assessment Index

The Macroinvertebrate Response Assessment Index (MIRAI) was used to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community from the calculated reference conditions for the SQR. This does not preclude the calculation of SASS5 scores if required (Thirion, 2007). The major components of a stream system that determine productivity for aquatic macroinvertebrates are as follows:

- Flow regime;
- Physical habitat structure;
- Water quality;
- Energy inputs from the watershed; and
- Riparian vegetation.

The results of the MIRAI will provide an indication of the current ecological category and therefore assist in the determination of the Present Ecological Status (PES).

7.4 Present Ecological Status

Ecological classification refers to the determination and categorisation of the integrity of the various selected biophysical attributes of ecosystems compared to the natural or close to natural reference conditions (Kleynhans and Louw, 2007). For the purpose of this study ecological classifications have been determined for biophysical attributes for the associated water course. This was completed using the river ecoclassification manual by Kleynhans and Louw (2007).

7.5 Resource Quality Objectives

Results from the riverine assessment are compared to the Resource Quality Objectives (RQO) for the Olifants WMA, Integrated Unit of Analysis II, biophysical node HN28 (Saalboomspruit Quaternary Catchment B20G) (RSA, 2016).

8 Receiving Environment

8.1 Desktop Assessment

8.1.1 National Freshwater Ecosystem Priority Area Status

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach for the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA. This directly applies to the NWA, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*. 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (Act No.10 of 2004) (NEM:BA), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011). According to Nel *et al.* (2011), no river FEPAs are listed for the B20G-1099 SQR (Figure 8-1). However, as presented in Table 8-1, numerous NFEPA wetlands are present within the reach.

Table 8-1 NFEPAs listed for the B20G-1099 SQR

Type of FEPA map category	Biodiversity features
Wetland ecosystem type	Mesic Highveld Grassland Group 4_Channelled valley-bottom wetland
Wetland ecosystem type	Mesic Highveld Grassland Group 4_Depression
Wetland ecosystem type	Mesic Highveld Grassland Group 4_Flat
Wetland ecosystem type	Mesic Highveld Grassland Group 4_Seep
Wetland ecosystem type	Mesic Highveld Grassland Group 4_Unchannelled valley-bottom wetland
Wetland ecosystem type	Mesic Highveld Grassland Group 4_Valleyhead seep

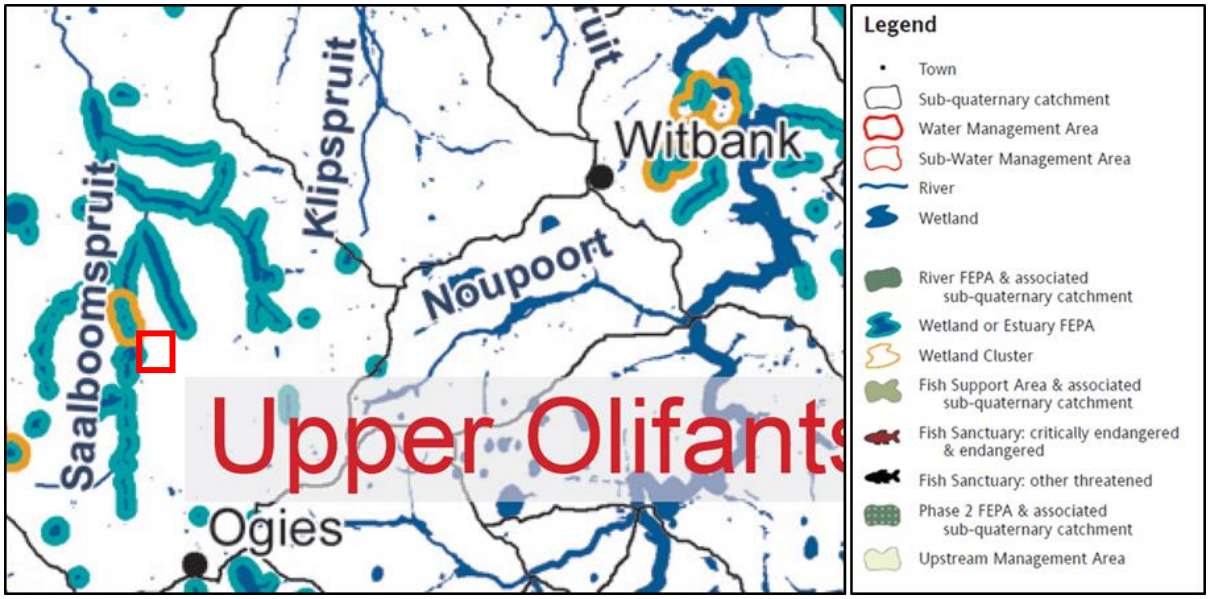

Figure 8-1 Illustration of absence of river NFEPAs within the project area (indicated by red square)

8.1.2 Desktop Present Ecological State

Desktop information was obtained from DWS (2020b) for the Saalboomspruit SQR and is summarised in Table 8-2. The desktop PES of the reach of the Saalboomspruit associated with the Elandsfontein Colliery area is a class C or moderately modified. The confidence in this classification is low due to the long distance of the considered SQR (42 km). The ecological importance and sensitivity of the river reach was rated as high. The defined Default Ecological Category for the SQR was class B or largely natural, and according to the RQOs for the reach, the Ecological Category to be maintained is a class C. The gradient of the considered river reach in proximity to the project area was found to be a class E geoclass (Rountree *et al.,* 2000). This places the river as a lower foothills river reach. The Elandsfontein project area presented wetland characteristics, which is typical for the gentle sloped upper reaches of many river systems on the highveld. This agrees with the wetland NFEPAs presented in Table 8-1. Based on this, it is recommended that the Elandsfontein wetland report (TBC, 2020b) be considered jointly with this study. Typically, wetlands offer a host of ecosystems services which includes purification of water quality through phytoremediation by the wetland vegetation. The wetlands assessed in this study are expected to provide cleansing effects from the current and proposed mining operations.

Table 8-2 The desktop information pertaining to the B20G-1099 Sub Quaternary Reach

Component/Catchment	Saalboomspruit
Present Ecological Status	Moderately Modified (class C)
Ecological Importance Class	High
Ecological Sensitivity	High
Default Ecological Category (DWS, 2019)	Largely Natural (class B)
Resource Quality Objectives (RSA, 2016)	Moderately Modified (class C)

8.2 *In situ* Water Quality

In situ water quality analyses was conducted at all sites with adequate surface water during the low and high flow surveys. These results are important to assist in the interpretation of biological results due to the direct influence water quality has on aquatic life forms. The results of the respective surveys are presented in Table 8-3. Results were compared to Target Water Quality Range (TWQR) for aquatic ecosystems (DWAF, 1996).

Table 8-3 In situ water quality results (2019/2020)

Site	pH	Conductivity (µS/cm)	Dissolved Oxygen (mg/l)	Temperature (°C)
TWQR*	**6.5-9.0**	**-**	**>5.00**	**5-30**
Low flow - September 2019				
Saalboomspruit Tributary				
T1	7.06	308	5.46	20.0
T2	**3.53**	941	**3.93**	22.1
T3	**4.71**	**2280**	**3.34**	15.5
Elandsfontein tributary (Confluence with Saalboomspruit tributary between T2 and T3)				
E Seep	6.59	**2580**	**1.62**	24.0
E Dam	7.08	**3180**	5.80	21.0
E1	7.35	**3030**	6.05	23.2
E2	7.36	**3280**	7.54	21.2
E3	7.78	**2290**	6.60	21.1
High Flow - March 2020				
Saalboomspruit tributary				
T1	6.86	931	5.02	21.5
T2	6.53	**1009**	5.20	20.2
T3	**3.84**	**9770**	6.20	24.4
Elandsfontein tributary				
E Seep	**5.54**	**2490**	3.16	21.8
E Dam	**4.07**	**2560**	4.18	20.6
E1	**6.06**	**2750**	6.31	19.1
E2	**4.38**	**9720**	4.96	22.9
E3	**4.20**	**2450**	6.70	22.5

Parameters of concern to aquatic biota are indicated in red
***TWQR-Target Water Quality Range**

Findings from the low flow *in situ* water quality results indicate a marked decrease in pH levels between site T1 and T2, which persists to downstream reaches at site T3 (Table 8-3). The change in pH and acidic levels would present adverse conditions to local aquatic biota and limit the diversity and abundances of sensitive biota. The pH levels stemming from the Elandsfontein tributary fell within the TWQR. Slight acidity was observed from E Seep; however, the pH normalises at site E1. Modifications between site T1 and T2 are likely stemming cumulative active and historical activities located east of the tributary (Figure 8-2).

High flow results indicate a decrease in pH levels from the upstream T1 and T2 sites (6.86 and 6.53 respectively) to the downstream T3 site (3.84). Low pH levels were stemming from the Elandsfontein mining rights, as indicated by site E3 pH levels of 4.20. The low pH levels were stemming from the upstream reaches within Elandsfontein, with acidic levels recorded at E Seep and E Dam.

Low flow results indicated a linear increase in dissolved solid concentrations between sites T1, T2, and T3. The increases indicate that an influx of dissolved solids enter the system between T1 and T2, and a influx of dissolved solids arising from the Elandsfontein project area, as indicated by elevated levels at site E3. Elevated dissolved solid levels were observed throughout the Elandsfontein project area (Table 8-3). The change in dissolved solids observed between sites T1, T2, and T3 would negatively affect local aquatic biota, and be considered limiting factors to local aquatic biota.

High flow results indicated elevated dissolved solids at all sites assessed during the survey. Increases in dissolved solids were observed between sites T1 and T2, however, were marginal, and marked increases occurred between sites T2 and T3. Dissolved solid levels within the Elandsfontein project area were elevated, with a recording of 9720 µS/cm at site E2.

Low Dissolved Oxygen (DO) levels were observed at sites T2, T3, E2, E Dam and E Seep during the 2019/2020 study. Sites T2 and T3 were characterised as wetlands, and some degree of suppressed DO would be expected. However, site T1 presented similar conditions, and therefore, an increase in chemical oxygen demand contributes to low DO levels. Chronically low DO levels would present adverse conditions, and limit aquatic biota diversity and abundances.

The water temperature levels recorded throughout the project area fell within recommended levels for the ecoregion, and no marked fluctuations occurred.

The *in situ* water quality results indicate critical water quality perturbations in the aquatic systems assessed during the low and high flow surveys. The poor water quality conditions would negatively impact on the diversity and abundances of local aquatic biota.

Figure 8-2 Potential point source pollutants between sites T1 and T2 indicated by red arrow (Google Earth Imagery, 9/2019)

Comparative water quality results for the 2014 and current surveys are presented in Table 8-4. Historical trends indicate a deterioration of water quality from the 2014 to 2019 survey, as indicated by a decrease in pH levels at sites T2 and T3, which is attributed to an increase in acid mine drainage in the area. Further, an increase in dissolved solid levels within the reach was observed at all sites assessed during the study. Chronically elevated dissolved solid levels were observed from the Elandsfontein tributary, as observed by the E1 and E3 results. A decrease in dissolved oxygen levels was observed from the 2014 study at sites T2 and T3. The results indicate a deterioration in water quality from the 2014 study, particularly below site T1, indicating an influx of pollutants between sites T1 and T3. The water quality perturbations from the Elandsfontein project area are negatively impacting on the aquatic systems within the catchment and requires urgent remediation.

Table 8-4 Temporal in situ water quality results (TBC, 2020a and Digby, 2017)

Site	pH	Conductivity (µS/cm)	DO (mg/l)	Temperature (°C)
TWQR	**6.5-9.0**	**-**	**>5.00**	**5-30**
		T1		
2019 Low flow	7.06	308	5.46	20.0
2020 High Flow	6.86	931	5.02	21.5
2017 (E01)	7.0	165	7.03	22.1
		T2		
2019 Low flow	**3.53**	941	**3.93**	22.1
2020 High Flow	6.53	**1009**	5.20	20.2
2017 (E02)	6.6	500	6.95	20.2
		T3		
2019 Low flow	**4.71**	**2280**	**3.34**	15.5
2020 High Flow	**3.84**	**9770**	6.2	4.4
2017 (E04)	6.7	**2150**	7.48	27.1
		E1		
2019 Low flow	7.35	**3030**	6.05	23.2
2020 High Flow	**6.06**	**2750**	6.31	19.1
2017 (E05)	6.5	**3020**	6.51	27.1
		E3		
2019 Low flow	7.36	**3280**	7.54	21.2
2020 High Flow	**4.20**	**2450**	6.7	22.5
2017 (E03)	8.2	**2620**	9.6	22.5

8.3 Riverine Habitat

8.3.1 Intermediate Habitat Integrity Assessment

The results for the instream and riparian habitat integrity assessment for the tributary of the Saalboomspruit and the Elandsfontein tributary are presented in Table 8-5. The reach includes 5 km of the aquatic systems assessed during the study and integrated into the IHIA assessment.

Table 8-5 Results for the habitat integrity assessment

Instream Habitat	Saalboomspruit tributary	Elandsfontein Tributary	Total Score
Water abstraction	14	8	6,16
Flow modification	16	18	8,84
Bed modification	13	20	8,58
Channel modification	10	20	7,8
Water quality	18	18	10,08
Inundation	12	13	5
Exotic macrophytes	8	8	2,88
Exotic fauna	5	0	0,8
Solid waste disposal	6	3	1,08
Total Instream			**48,8**
Category			**D**
Riparian Habitat	**Saalboomspruit tributary**	**Elandsfontein Tributary**	**Total Score**
Indigenous vegetation removal	15	14	7,54
Exotic vegetation encroachment	16	17	7,92
Bank erosion	11	11	6,16
Channel modification	8	13	5,04
Water abstraction	9	7	4,16
Inundation	9	9	3,96
Flow modification	12	10	5,28
Water quality	12	9	5,46
Total Riparian			**54.5**
Category			**D**

*Brown highlighted blocks indicate predominant modifying drivers in the reaches assessed

The results of the instream integrity assessment derived a class D (largely modified) status for the watercourses associated with Elandsfontein Colliery, indicating a large loss of natural habitat, biota and basic ecosystem functions has occurred. The dominant factors negatively influencing the water quality and habitat are attributed to Acid Mine Drainage (AMD) and flow modification within the reach. AMD was observed at T2 on the Saalboomspruit tributary during the March 2020, with yellow boy smothering instream habitat (Figure 8-3). Several impoundments and low water crossings occurring within the reach have altered the riverine habitat characteristics from natural conditions (Figure 8-4 and Figure 8-5). These have further resulted in bed and channel modification, resulting in instream sedimentation and a loss of marginal habitat due to channel erosion and inundation. Several alien invasive vegetation species were observed within the reach, including extensive stands of alien invasive *Populus alba* (White Poplar) (Figure 8-6 and Figure 8-7). Direct channel modifications within the Elandsfontein reach due to a river diversion has resulted in extensive instream and riparian modifications within the reach (Figure 8-6).

Figure 8-3 Yellow boy associated with Acid Mine Drainage (T2 – March 2020)

Figure 8-4 Instream impoundments and low water crossing within the Saalboomspruit tributary (Google Earth Imagery, 9/2019)

Figure 8-5 Low water crossings and indigenous vegetation clearing (Google Earth, 9/2019)

Figure 8-6 Additional modifications within the Elandsfontein tributary (Google Earth Imagery, 2019)

Figure 8-7 Populus alba stands within the Elandsfontein project area (September 2019)

8.3.2 Macroinvertebrate Habitat and Biotope Assessments

A biotope rating of available habitat was conducted at each site assessed to determine the suitability of habitat to macroinvertebrate communities. The Saalboomspruit system within the project area was classed as a lower foothills river reach. Sites E3 and M5 were classified as wetland systems and typical riverine characteristics were not present. Each geoclass has different weightings for the various biotopes according to importance value (Table 8-6). The categories were calculated according to the biotope rating assessment as applied in Tate and Husted (2015). The results of the biotope assessment are presented in Table 8-7 and Table 8-8. A rating system of 0 to 5 was applied, 0 being not available and 5 being abundant and diverse.

Table 8-6 Biotope weightings for lower foothill geoclass

Biotope	Lower Foothills
Stones in current (SIC)	18.0
Stones out of current (SOOC)	12.0
Bedrock	3.0
Aquatic vegetation	1.0
Marginal vegetation in current	2.0
Marginal vegetation out of current	2.0
Gravel	4.0
Sand	2.0
Mud	1.0

Table 8-7 Biotope scores at each site during the low flow survey (September 2019)

Biotope	T1	T2	T3	E1	E2	E3
Stones in current	1	0.5	0	0	0	0
Stones out of current	0	0	0	0	0	0
Bedrock	0	0	0	0	0	0
Aquatic Vegetation	3	3	2	0	2	1.5
Marginal Vegetation in Current	1	1	2	2	0	1
Marginal Vegetation Out of Current	3.5	2.5	3	2	3	2.5
Gravel	2	2	1	1	0	1
Sand	2	1	2	0	0	1
Mud	3	2.5	2	1	1	2.5
Biotope Score	15,5	12,5	12	6	6	9,5
Weighted Biotope Score (%)	20	14	10	6	4	8
Biotope Category (Tate and Husted, 2015)	F	F	F	F	F	F

Table 8-8 Biotope scores at each site during the high flow survey (March 2020)

Biotope	T1	T2	T3	E1	E2	E3
Stones in current	2	1.5	1.5	0	0	0
Stones out of current	1	0.5	1	0	2	1
Bedrock	0	1	0	0	1	0
Aquatic Vegetation	1	3	0	0	0	0
Marginal Vegetation in Current	3	2	2	3.5	0	2
Marginal Vegetation Out of Current	2	2	2	3	3	3
Gravel	2	2	2	0	1.5	0
Sand	1	2	1	0	1	0
Mud	2	2.5	2	2.5	1	3
Biotope Score	16	16.5	11.5	9	9.5	9
Weighted Biotope Score (%)	30	27	26	7	19	11
Biotope Category (Tate and Husted, 2015)	E	F	F	F	F	F

Low flow biotope diversity present at all sites assessed during the low and high flow surveys were assigned a class F, indicating limited habitat diversity within the systems assessed and that habitat diversity was a limit the macroinvertebrate community diversity. Further, macroinvertebrate diversity with a preference for flow and stones in current was expected to be limited during the study. The low habitat diversity was expected for the system due to the wetland nature of sites, bar site E2 which was an impoundment, and site E3 which is artificial and within the river diversion.

8.4 Macroinvertebrate Assessment

8.4.1 South African Scoring System (version 5)

The aquatic macroinvertebrate results for the study are presented in Table 8-9.

Table 8-9 Macroinvertebrate assessment results

Site	T1	T2	T3	E1	E2	E3
Low flow - September 2019						
SASS5 Score	97	42	39	15	55	40
No. of Taxa	20	8	7	2	9	9
ASPT*	4.9	5.2	5.6	7.5	6.1	4.4
Category (Dallas, 2007)**	B	E/F	E/F	E/F	D	D
Category Digby 2014	B	N/A	B	N/A	N/A	B
High flow - March 2020						
SASS5 Score	112	44	39	32	70	41
No. of Taxa	22	9	8	7	15	11
ASPT*	5.1	4.9	4.9	4.6	4.7	3.7
Category (Dallas, 2007)**	B	E/F	E/F	E/F	C	E/F

*ASPT: Average score per taxon; **Highveld-Lower Ecoregion

Based on the ASPT (average sensitivity) the aquatic macroinvertebrate communities within the tributary of the Saalboomspruit ranged from 4.9 to 5.6 at sites T1 and T3 during the 2019/2020 study. A marked decrease in total sensitivity score (SASS5 scores) was observed during the low and high flow surveys between site T1 to sites T2 and T3, with a corresponding decrease in number of taxa. Ecological categories decreased from largely natural at site T1 to seriously modified at site T2 and T3. The marked decrease in the macroinvertebrate community is attributed to water quality deterioration, as habitat diversity within the reach was comparative at all sites.

The macroinvertebrate community within the Elandsfontein tributary was considered modified, as indicated by the low number of taxa collected at sites E1, E2 and E3. The habitat within the reach was able to sustain Hemiptera, Odonata, and Coleoptera, however, many of these taxa were absent during the study.

Comparative results to the Digby 2014 study indicated a decrease in ecological category at sites T3 and E3, however, the upstream site remained stable at a class B (largely natural). The decrease in ecological categories is attributed to water quality deterioration within the river reaches.

8.4.2 Macroinvertebrate Response Assessment Index

The MIRAI methodology was conducted according to Thirion, (2007). Data collected from the SASS5 method was applied to the MIRAI model. Data from sites T1, T2 and T3 on the tributary of the Saalboomspruit was used to determine the ecological category, and likewise E1, E2 and E3 for the Elandsfontein tributary. The MIRAI model provides a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community (assemblage) from the reference condition (unmodified river). Results for the tributary of the Saalboomspruit reach assessed are presented in Table 8-10, and for the Elandsfontein tributary in Table 8-10. It should be noted that the reference conditions generated for the ecoregion were adapted for Highveld ecoregion source zone, with the absence of typical instream riverine features.

The MIRAI results indicates a largely modified state (class D) for the assessed Saalboomspruit tributary reach. The drivers predominantly contributing to the modified state is flow and water

quality impairment within the reach. The limited habitat diversity and influence of sedimentation within the reach was likely driving the decrease in the habitat metric.

The MIRAI results indicates a seriously modified state (class E) for the Elandsfontein tributary. The driver predominantly contributing to the modified state is water quality impairment within the reach, followed by flow modifications contributing to the poor macroinvertebrate community.

Table 8-10 MIRAI Score for the Saalboomspruit tributary reach

Invertebrate Metric Group	Tributary of Saalboomspruit
Flow Modifications	40.5
Habitat	62.2
Water Quality	49.4
Ecological Score	50.5
Category	**D**

Table 8-11 MIRAI Score for the Elandsfontein tributary reach

Invertebrate Metric Group	Elandsfontein Tributary
Flow Modifications	39.3
Habitat	49.4
Water Quality	26.0
Ecological Score	37.8
Category	**E**

8.5 Fish Assessment

Two fish were collected within the reach, including *Clarias gariepinus* (Sharptooth catfish) and *Tilapia sparrmanii* (Banded Tilapia). Neither of the species collected or expected for the reach are of conservational concern (Skelton, 2011; IUCN, 2020).

8.6 Present Ecological State

The PES of the Saalboomspruit tributary reach is presented in Table 8-12, while the Elandsfontein reach is presented in Table 8-13. The findings of the study were based on the 2019 low flow and 2020 high flow surveys.

The results indicate that the Saalboomspruit tributary reach was in a largely modified state during the 2019/2020 study (Table 8-12). This was attributed to modifications to drivers within the system, predominantly flow modification and water quality deterioration, with further modifications to the riparian zones due to livestock, mining and agricultural activities. Instream habitat modifications were observed during the study, predominantly due to erosion in the reach, resulting in instream sedimentation, and the presence of instream impoundments which reduced instream and marginal habitat diversity. Furthermore, alien invasive vegetation encroachment has decreased the ecological integrity of the Saalboomspruit.

The PES of the Elandsfontein reach was rated as seriously modified (class E) (Table 8-13). Modifications to water quality, flow and habitat due to the activities within the reach contributed to the seriously modification biotic community sampled within the reach.

The modifications to drivers within both reaches were reflected by the modified local aquatic biota communities observed during the study. Neither of the assessed systems met the RQOs of moderately modified (class C), indicating the need for rehabilitation efforts.

Table 8-12 The PES of the Saalboomspruit tributary reach (2019/2020)

Category	Ecological Category
Instream Assessment	D
Riparian Assessment	D
Macroinvertebrate Response Assessment Index	D
EcoStatus	Largely Modified (class D)
Recommended Ecological Category (RQOs)	Moderately Modified (class C)

Table 8-13 The PES of the Elandsfontein reach (2019/2020)

Category	Ecological Category
Instream Assessment	D
Riparian Assessment	D
Macroinvertebrate Response Assessment Index	E
EcoStatus	Seriously Modified (class E)

8.7 Riparian Habitat

Characteristic of Highveld ecoregion riverine systems, the sampled tributaries presented wetland features (Figure 8-9) with the absence of typical riparian features. Therefore, the typical riparian delineation according to DWAF (2005a) as presented in Figure 8-8 was not applicable to this study. Therefore, the riparian delineation should follow the wetland delineation for the project area. Figure 8-10 illustrates the NFEPA wetlands associated with the project area, and wetlands delineated by Digby Wells Environmental (Digby, 2017).

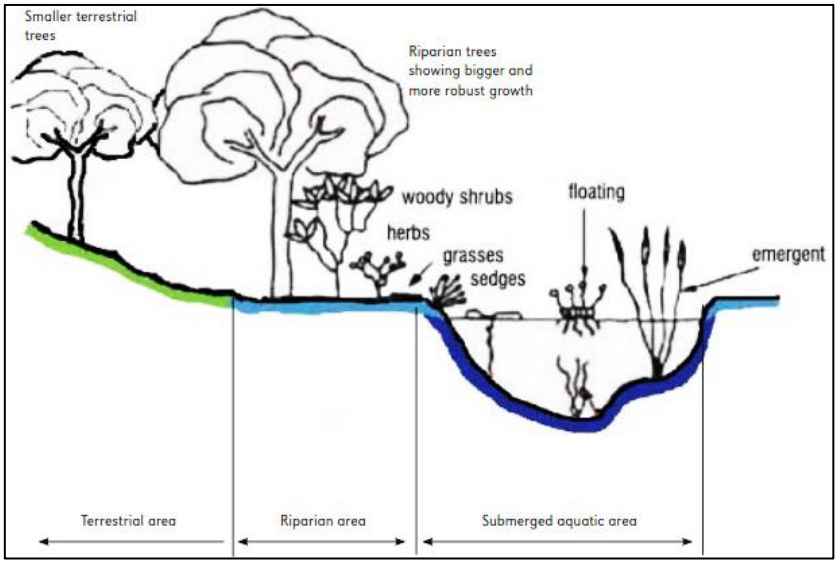

Figure 8-8 Riparian Habitat Delineations (DWAF, 2005a)

Figure 8-9 Typical source zone features of the aquatic system in the Highveld ecoregion (Site E1, September 2019)

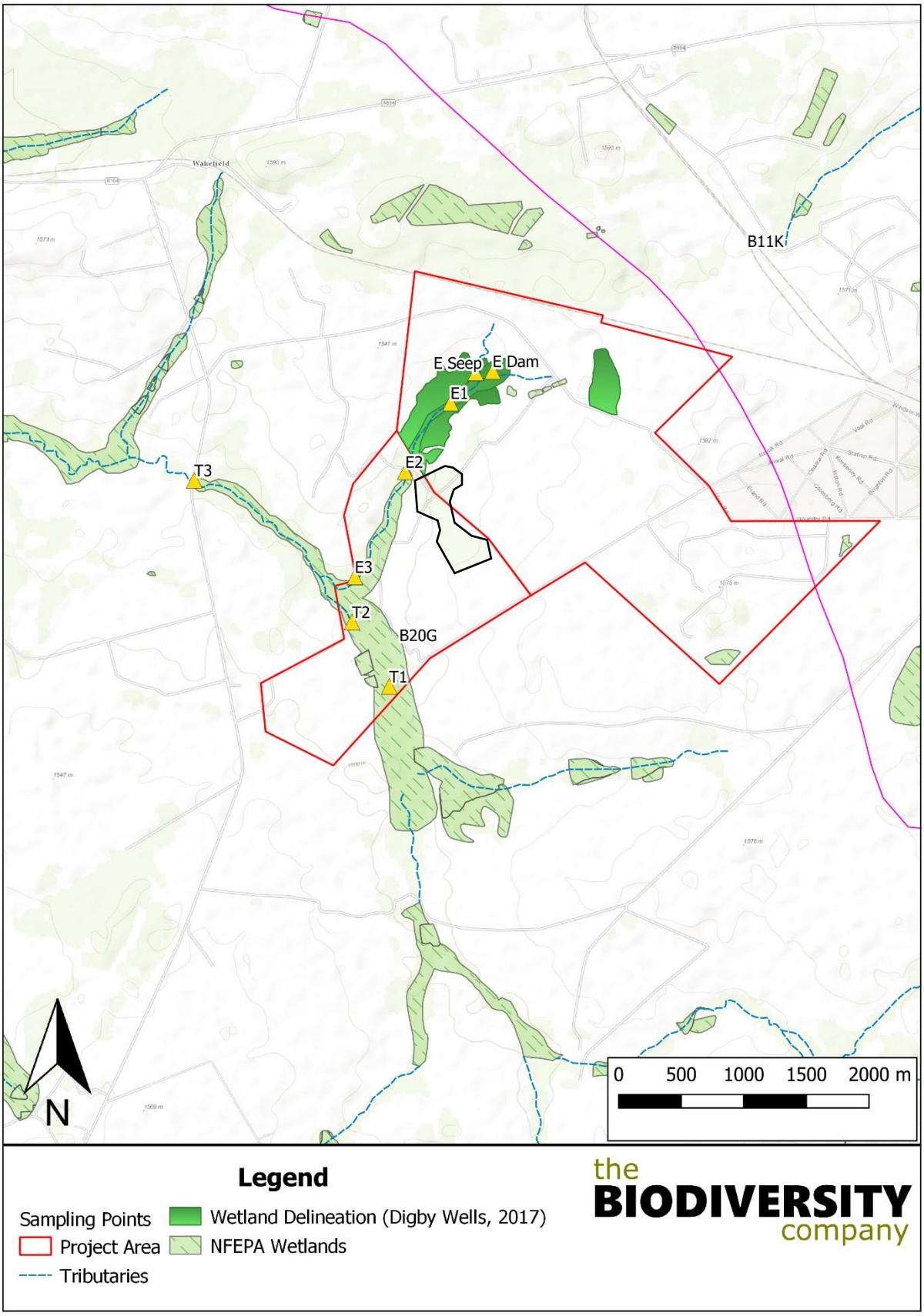

Figure 8-10 Map of the delineated and classified wetlands within the project area

9 Spatially Sensitive Mapping

EIMS has developed a comprehensive sensitivity mapping methodology for use by all specialists in order to standardise the scoring system which allows for a comparative assessment of all impacts. The methodology utilises a revised scoring table as well as including a base score for the entire prospecting area in question. This methodology includes the compilation of detailed shapefiles with specific attributes. Three main components form part of this methodology, namely;

- Feature layer;
- Overall sensitivity layer; and
- Legislative constraint layer.

All identified features will be rated according to the sensitivity of the feature as well as threats posed by proposed activities. These sensitivity rankings are described in Table 9-1.

Table 9-1 Sensitivities relevant to the EIMS methodology

	Sensitivities				
	Least Concern	Low	Medium	High	No-Go
Broad Class Description	The inherent feature status and sensitivity is already degraded. The proposed development will not affect the current status and/or may result in a positive impact. These features would be the preferred alternative for the project or infrastructure placement.	The proposed development will have not had a significant effect on the inherent feature status and sensitivity.	The proposed development will negatively influence the current status of the feature.	The proposed development will negatively significantly influence the current status of the feature.	The proposed development cannot legally or practically take place.
Scoring	0	1	2	3	+99

As per section 8.7, the sampled the Elandsfontein and Saalboomspruit tributaries presented typical wetland features, therefore the sensitivities associated with the sampled aquatic systems would be aligned with those presented in the Wetland Assessment report (TBC, 2020b). The Wetland Assessment classed the Elandsfontein and Saalboomspruit tributaries with medium to high sensitivity ratings despite the degraded state of these areas. The wetland sensitivities within the project area can be seen in Figure 9-3 with planned mining superimposed.

According to the Legislative constraint layers as presented in Figure 9-4 and Figure 9-5, the proposed development areas will impede into wetlands areas requiring a WUL for the proposed mining activities, furthermore the layouts overlap with the MBSP Freshwater CBA (SANBI, 2011) placing high sensitivity where proposed activities overlap. According to the National Web based Environmental Screening Tool the combined aquatic biodiversity for the area is classified as predominantly Low sensitivity, with an extent classified as Very High sensitivity (Figure 9-1). The wetland and riverine assessments should be jointly considered for the minimum report content requirements for a very high sensitivity rating.

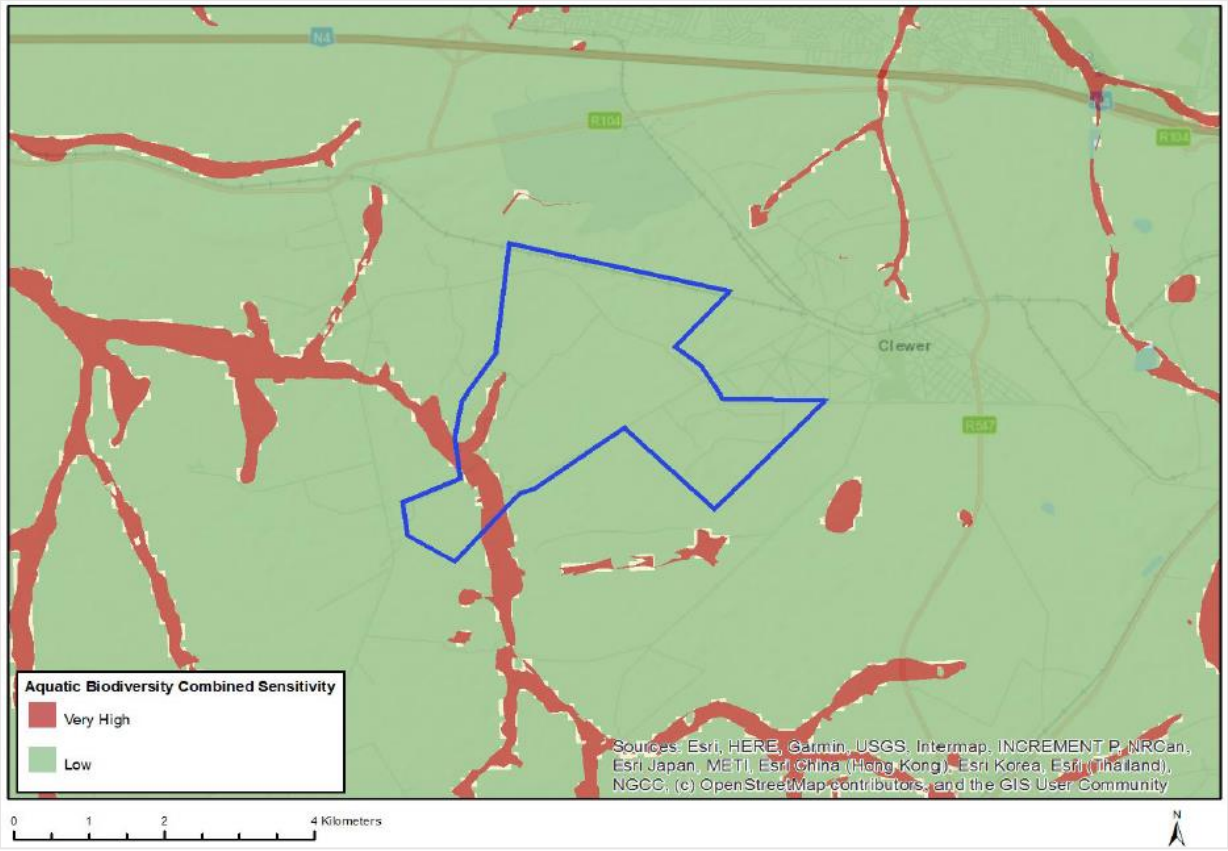

Figure 9-1 Map of relative aquatic biodiversity theme sensitivity (National Web based Environmental Screening Tool)

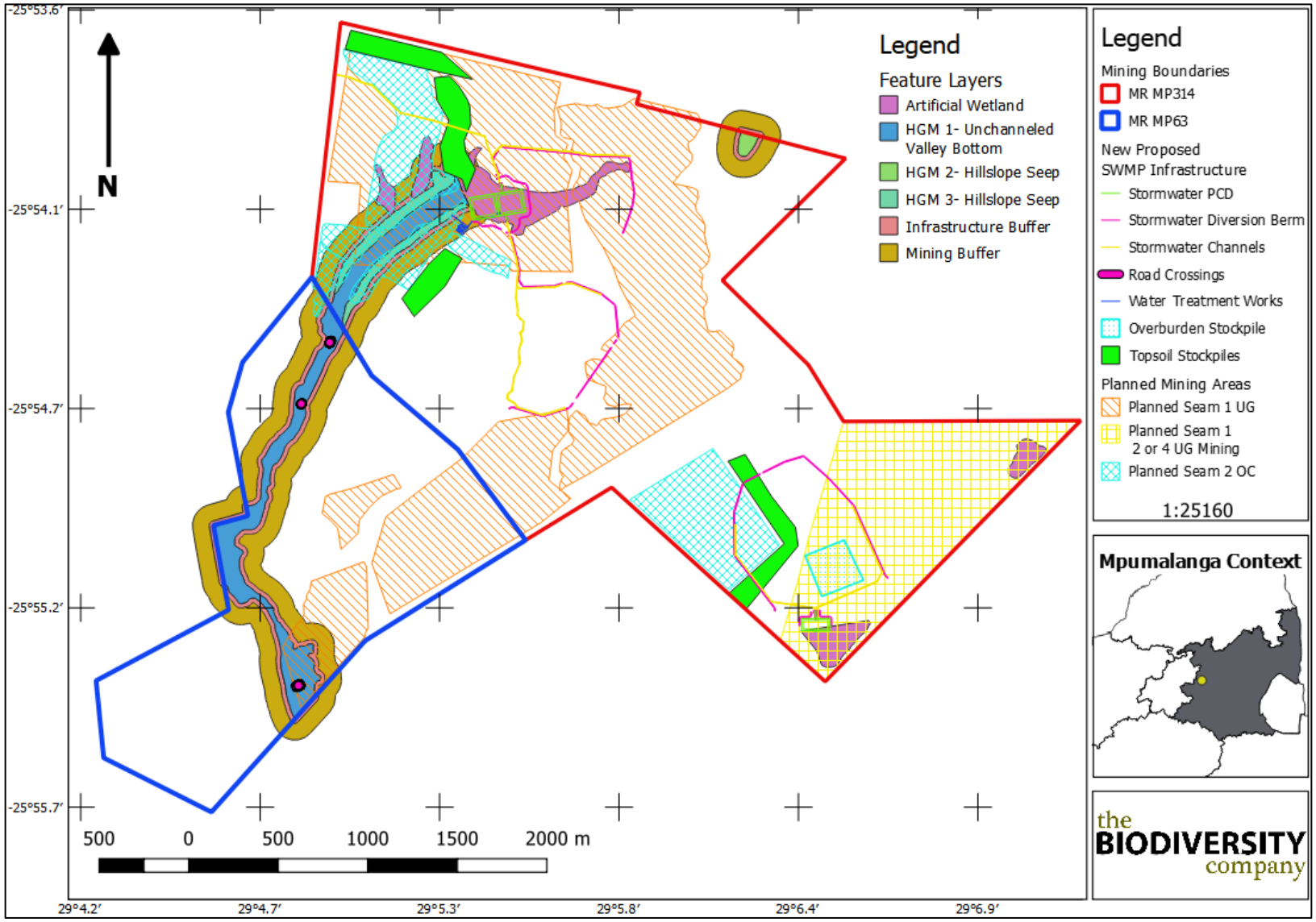

Figure 9-2 Wetlands within the mining boundaries (TBC, 2020b)

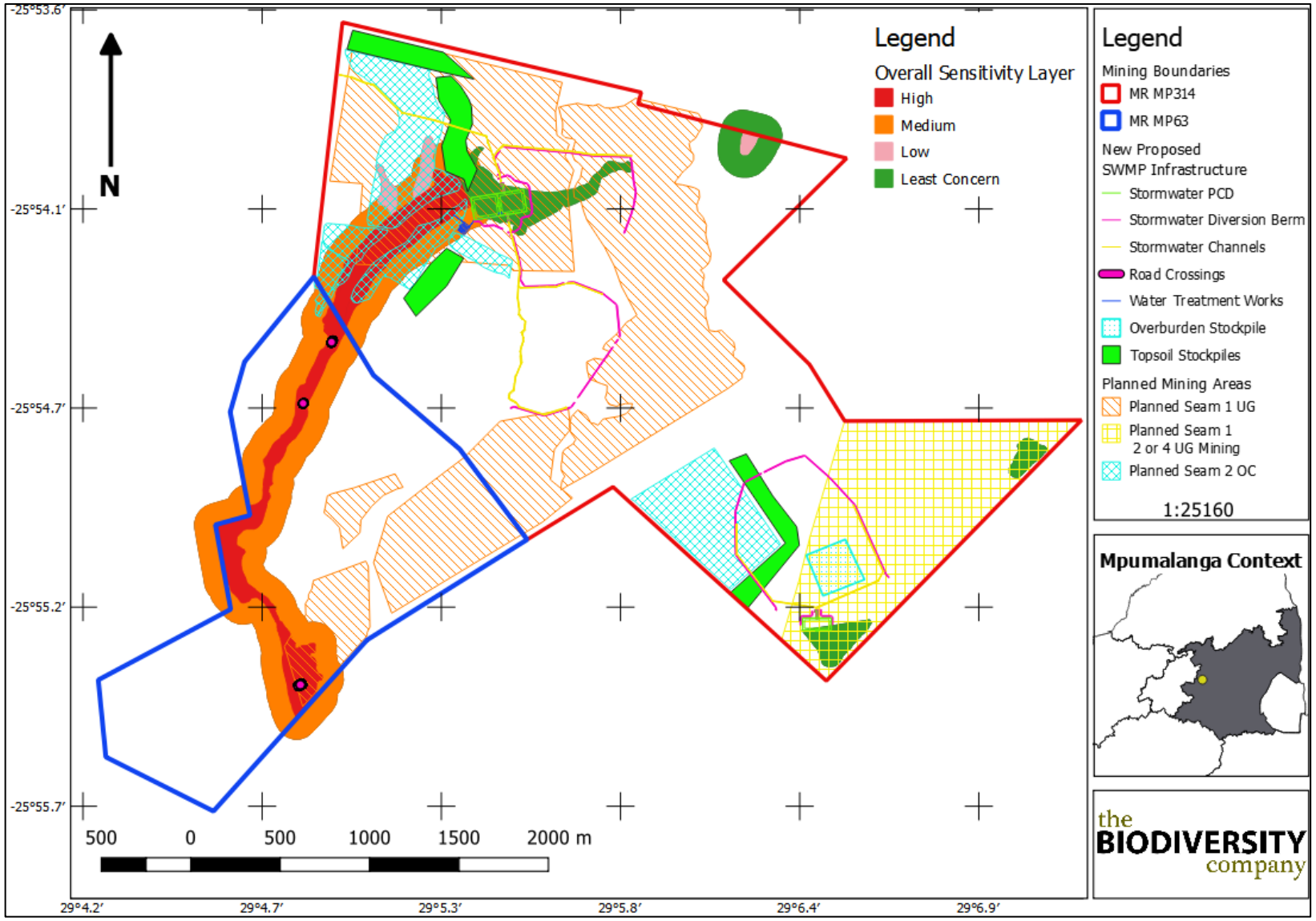

Figure 9-3 Overall sensitivity of identified wetland features (TBC, 2020b)

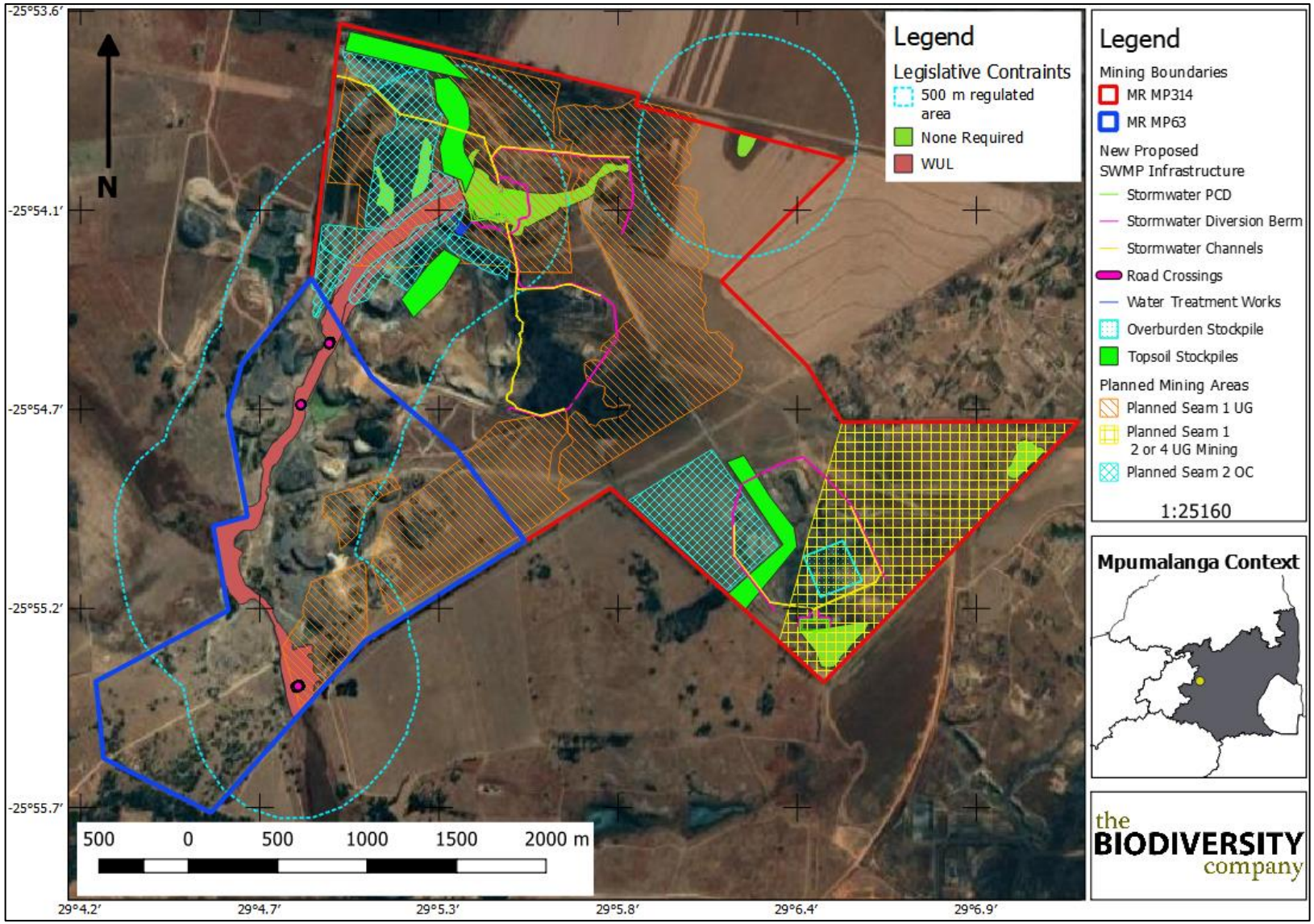

Figure 9-4 Legislative constraints relevant to identified features

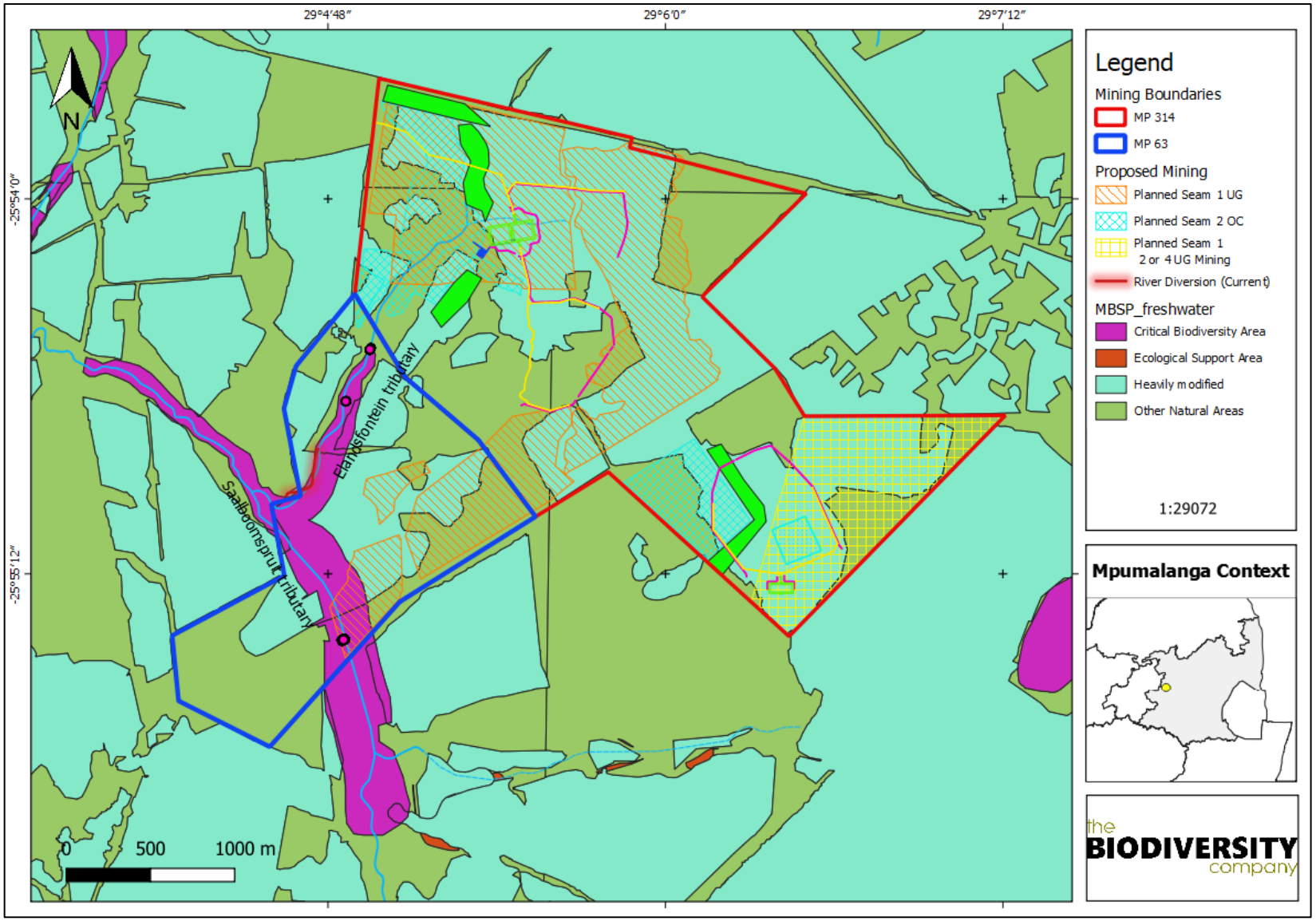

Figure 9-5 Elandsfontein project area superimposed on the MSBP freshwater CBA map

10 Impact Assessment

For this section, “Planned Seam 1, 2 or 4 Underground” has been excluded from the impact assessment as the proposed infrastructure is located away from the watercourses.

The following proposed alternatives were considered for the impact assessment:

- Activity Alternative A1:
    - Open Cast Mining (Seam 2);
    - Underground Mining (Seam 1); and
    - New PCDs and stormwater management infrastructure which includes 3 river crossings.
- Activity Alternative A2 (No-go option).
- River diversion (Elandsfontein tributary):
    - Reinstatement of the river diversion to its original position (Height and width 5 m, respectively; Length 280 m); and
    - Retain channel in the current diverted position.

10.1 Impact Assessment Methodology

An impact assessment methodology was provided by EIMS to determine the environmental risk associated with various aspects related to the proposed activities (open cast and underground mining with ancillary infrastructure). This impact assessment takes the following components into consideration;

- The nature of the associated impact (positive or negative);
- The extent of the proposed activities;
- The duration of the proposed activities;
- The magnitude of the effects caused by the proposed activities;
- The reversibility of associated impacts; and
- The probability of relevant aspects affecting sensitive receptors.

Each one of the above-mentioned components are given a rating, which cumulatively provides the specialist with a pre-mitigation environmental risk rating. These components are then scored again taking into consideration mitigating factors. The cumulative impact and irreplaceable loss to sensitive receptors are then scored to ultimately indicate a “Priority Factor” score.

10.2 Unplanned Events

The planned activities will have known impacts as discussed above; however, unplanned events may occur on any project and may have potential impacts which will need mitigation and adaptive management. A summary of the findings from an aquatic ecology perspective is

presented in Table 10-1. Please note that not all potential unplanned events may be captured herein and this must therefore be managed throughout all phases of the project lifecycle.

Table 10-1 Unplanned Events, Risks and their Management Measures

Unplanned Event	Potential Impact	Mitigation
Hydrocarbon spill into aquatic areas/ wetland habitat	Contamination of sediments and water resources associated with the spillage. Subsequent loss of aquatic biota	A spill response kit must be available at all times. The incident must be reported on and if necessary, a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Uncontrolled erosion	Sedimentation of downstream watercourses and loss of instream habitat diversity.	Erosion control measures must be put in place.
PCD overflow or failing	The degradation of downstream water quality and loss of aquatic biota.	The overflow must be stopped immediately, and the impacted area remediated. Spill protection berms must be in place regardless of whether an overspill event has occurred.

10.3 No-Go Option (Activity Alternative A2)

The baseline aquatic assessment conducted in 2019/2020 indicated moderate to extensive modifications to habitat, flow and water quality (ecological drivers) which have rendered the local aquatic biota critically modified (depauperate). Further, a deterioration in water quality and macroinvertebrate community was observed from the Digby (2014) study. It is anticipated that there will be a further increase in pollutants within the considered river reaches and an increase in surface run-off from current mining operations. This will further exacerbate the water quality and associated acid mine drainage conditions within the assessed reaches.

In conclusion, the no-go option (no implementation of the proposed activities) will result in zero additional impacts, however further gradual degradation of the Elandsfontein and Saalboomspruit tributary systems is expected from current mining activities, unless significant anthropogenic interventions take place. According to the precautionary principle, the no-go option will be the best option to avoid further environmental degradation.

10.4 Planning Phase

This section pertains to Activity Alternative A1, the PCDs and stormwater management infrastructure, as well as the river diversion.

The planning phase activities are considered a low risk as they typically involve desktop assessments and initial site inspections. This would include compiling of mine and waste management plans, obtaining of necessary permits, environmental and social impact assessments, characterisation of baseline site conditions, design of mine layouts and facilities and consultation with various contractors involved with a diversity of proposed project related activities going forward. Additionally, an existing road network is present throughout the project area, which will be utilised during the planning phase posing no additional risks to the watercourses. The planning phase activities will not result in cumulative impacts or the irreplaceable loss of resources, therefore no special mitigation is required.

10.5 Construction Phase Impacts

This section pertains to Activity Alternative A1 as well as the river diversion.

10.5.1 Open Cast Mining (Seam 2)

The final significance ratings for the construction phase of the open cast activities were determined to be “Medium” despite the current level of transformation and disturbance within the proposed opencast layout area. Recommended mitigation measures are expected to ensure a decrease in final significance ratings however they remain “Medium” due to their location within the watercourse and buffer areas.

The construction phase activities have the potential to degrade water and habitat quality within the sampled tributary systems, with direct impacts expected within the Elandsfontein tributary. Water quality impacts may include an influx of pollutants through runoff from a modified catchment, resulting in further deterioration of water chemistry.

The proposed opencast layout area overlaps with delineated medium sensitivity areas which serve as buffer zones to the high sensitivity areas presented in Figure 9-3. The construction phase activities have the potential to degrade water and habitat quality within the sampled tributary systems. Water quality impacts may include an influx of pollutants through runoff from an exposed un-weathered material, resulting in further deterioration of water chemistry. Further modification of the Elandsfontein tributary is associated with the destruction, loss and fragmentation of riverine/wetland habitat due to clearing for opencast infrastructure which includes clearing and placement of waste (overburden) and topsoil stockpiles where resultant sedimentation of instream areas is anticipated.

Although the PES (baseline) of the river reach assessed was derived to be modified from reference conditions, further deterioration is possible and thus a potential decline in the PES could be observed. Thus, impacts described above will result in reduced biodiversity on a catchment scale.

10.5.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.5.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the wetlands (Wetland Report - TBC, 2020b) as well as the expected degradation of the tributaries/wetlands as a result of mining activities.

10.5.1.3 Irreplaceable loss of Resources

The construction phase of the relevant activities is likely to result in a loss of river and wetland habitat, unless buffers are implemented.

10.5.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities there for Seam 2 due to the fact that only open cast mining has been proposed.

10.5.2 Underground Mining (Seam 1)

The final significance ratings were determined to range from “Low” to “Medium” given the duration of construction activities, as well as the current level of above ground transformation and disturbance within the proposed underground layout area. Recommended mitigation

measures are expected to decrease final significance ratings, remaining “Low” to “Medium” impacts.

A section of the proposed underground area undermines the upper reaches of the Elandsfontein tributary. The construction phase activities such as the construction of underground access portals (shafts) and the pumping of underground water into nearby watercourses, have the potential to degrade water quality within the sampled tributary systems, with indirect water quality impacts expected within the Elandsfontein tributary. Water quality impacts may include an influx of pollutants, resulting in further deterioration of water chemistry. There is potential for subsidence following the undermining of the rivers and wetlands. Furthermore, groundwater drawdown would be expected with a resultant loss of water volume in surface rivers and wetlands, with the associated loss of riverine and wetland habitat.

Although the PES (baseline) of the river reach assessed was derived to be modified from reference conditions, further deterioration is possible and thus a potential decline in the PES could be observed. Thus, impacts described above will result in reduced biodiversity on a catchment scale.

10.5.2.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.5.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the wetlands (Wetland Report - TBC, 2020b) as well as the expected degradation of the tributaries/wetlands as a result of mining activities.

10.5.2.3 Irreplaceable loss of Resources

The construction phase of the relevant activities is unlikely to result in a loss of natural resources owing to the fact that the area is an existing mine with infrastructure and services in place.

10.5.2.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 1 due to the fact that only open cast mining has been proposed.

10.5.3 New PCDs and stormwater management infrastructure

The final significance ratings were determined to be “Medium” given the extent and duration of construction activities the across the project area. Recommended mitigation measures are expected to decrease final significance ratings, remaining “Low” to “Medium” impacts.

The construction phase activities notably associated with the disturbance of soils (erosion and sedimentation) across the project area for stormwater infrastructure and the installation of river crossing infrastructure within the watercourses (2 crossings within the Elandsfontein tributary and a single crossing within the Saalboomspruit tributary), will have the potential to degrade water and habitat quality within the sampled tributary systems, with direct impacts expected within the watercourses. Water quality impacts may include an influx of pollutants through runoff from a modified catchment, resulting in further deterioration of water chemistry.

The proposed PCDs and stormwater management infrastructure layout overlaps with delineated medium sensitivity areas which serve as buffer zones to the high sensitivity areas presented in Figure 9-3. The river crossing are located within the high sensitivity areas which is unavoidable, requiring strict mitigation to lesson impacts to the watercourses. Further modification of the Elandsfontein tributary is associated with the destruction, loss and fragmentation of riverine/wetland habitat due to clearing for PCDs and stormwater infrastructure which includes clearing and placement of topsoil stockpiles where resultant sedimentation of instream areas is anticipated.

Although the PES (baseline) of the river reach assessed was derived to be modified from reference conditions, further deterioration is possible and thus a potential decline in the PES could be observed. Thus, impacts described above will result in reduced biodiversity on a catchment scale.

10.5.3.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.5.3.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the wetlands (Wetland Report - TBC, 2020b) as well as the expected degradation of the tributaries/wetlands as a result of mining activities.

10.5.3.3 Irreplaceable loss of Resources

The construction phase of the relevant activities is likely to result in a loss of natural resources owing to the fact that new infrastructure are proposed within watercourses.

10.5.3.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed activities for new PCDs and stormwater management infrastructure.

10.5.3.5 River diversion (Reinstatement to original position)

The final significance ratings for the reinstatement of the river to the original position were determined to be “Medium”. Construction activities impacts include modifications to hydrological characteristics, water quality and an increase in erosion and sedimentation of downstream riverine/wetland habitat due to reconstruction of a new (original) channel. Recommended mitigation measures are expected to decrease final significance ratings from “Medium” to “Low” impacts. Despite mitigation erosion and sedimentation impacts are expected to remain “Medium” due to the level of the exposed earth in the newly aligned channel.

The construction phase activities have the potential to degrade water and habitat quality within the sampled tributary systems, with direct impacts expected in both systems. Water quality impacts may include an influx of pollutants released from exposed earth works and spills and leaks from excavation machinery. Although the PES (baseline) of the river reach assessed was derived to be modified from reference conditions, further deterioration is possible and thus a potential decline in the PES could be observed. Thus, impacts described above will result in reduced biodiversity on a catchment scale.

10.5.3.6 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.5.3.7 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the wetlands (Wetland Report - TBC, 2020b) as well as the expected degradation of the tributaries/wetlands as a result of mining activities. The sedimentation of downstream areas is expected to negatively influence the integrity of the downstream riverine/wetland habitat.

10.5.3.8 Irreplaceable loss of Resources

The construction phase of the river reinstatement is unlikely to result in a loss of natural resources provided mitigation measures are implemented.

10.5.3.9 Impact on Alternatives Considered

The alternative to retain the channel in the current diverted position has been considered in the section below.

10.5.4 River diversion (Retain channel in current diverted position)

The final significance ratings for the retainment of the river in the current diverted position were determined to be “Low positive”. Due to the absence of construction related activities no impacts are expected. However, as an offset it is recommended that low cost, easily achievable rehabilitation measures be implemented during the construction phase to improve the integrity of the diverted channel and alleviate the recorded water quality impacts stemming from Elandsfontein mining operation. Construction phase rehabilitation activities include reshaping steep banks to a gentle profile together with the revegetation of exposed banks. This will improve the vegetation extent and establishment potential to improve the phytoremediation (natural cleaning of water by vegetation) capacity of channel. The river channel topography must confirm to natural topography to ensure natural drainage of the project area that is self-sustaining long term. The rehabilitation design must ensure the channel will remain self-sustaining in excess of 50 years post closure. Ideally, the diversion should be re-established to pre diversion condition presenting the original wetland topography, features and extent.

The existing channel has been used for diversion for over 10 years and presents a basic level of ecological stability. The original channel position has been mined out and therefore now has a complex/disturbed subsoil/geology which if utilised for the diversion may result in an influx of contaminated water into the downstream river and wetland reaches and would therefore contribute to AMD.

The construction phase rehabilitation activities have the potential to improve water and habitat quality within the sampled tributary systems, that are projected to last the operation life cycle of the mine. Activities are expected to improve the baseline PES post construction. Illustrations of the river channel and the wetland vegetation extent are illustrated for pre-diversion (original position) in Figure 10-1 and post-diversion (current position) in Figure 10-2.

Figure 10-1 Original position with large wetland vegetation extent (Google Earth Imagery 11/2004)

Figure 10-2 Current position with channelized and incised channel with poor wetland vegetation extent (Google Earth Imagery 5/2019)

10.5.4.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.5.4.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” as the potential cumulative impact is expected to have positive impacts on aquatic biota.

10.5.4.3 Irreplaceable loss of Resources

The construction phase of the retainment of the river in the current diverted position is unlikely to result in a loss of natural resources. Instead, provided construction rehabilitation is implemented, an improvement of natural resources is expected.

10.5.4.4 Impact on Alternatives Considered

The alternative for the reinstatement of the river to the original position has been considered in the previous section.

10.6 Operational Phase Impacts

This section pertains to Activity Alternative A1 as well as the river diversion.

10.6.1 Open Cast Mining (Seam 2)

The final significance ratings were determined to range from “Low” to “High” given the duration of operational activities, the higher magnitude of impacts and the fact that upper reaches of the Elandsfontein tributary are expected to completely be lost in some areas. No mitigation is expected to decrease the final significance ratings for this phase due to the direct loss of instream areas.

As discussed in the construction phase, the operational phase activities and interactions have the potential to degrade water and habitat quality within the tributary systems. Activities include the potential for indiscriminate dumping/placement of overburden and topsoil near watercourses together with leaching from stockpiles, surface runoff of carboniferous material from Run of Mine (RoM) areas, discharges from flooded opencast pits and potential leaks from pollution control facilities. As a result, a degradation in the baseline PES through the loss of instream habitat and sensitive aquatic biota would be expected on a catchment scale.

10.6.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects. Mitigation is however expected not to decrease the final significance ratings of this phase.

10.6.1.2 Cumulative Impacts

The cumulative impact rating has been scored “High” given the extent of existing mining activities within 500 m of the wetlands (Wetland Report - TBC, 2020b) as well as the expected degradation of the tributaries/wetlands as a result of mining activities.

10.6.1.3 Irreplaceable loss of Resources

The operational phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources are of high sensitivity. Loss of these wetland systems would require a form of compensation in the form of wetland offsets.

10.6.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed. It is however worth noting that as an alternative, the extent of proposed mining area can be amended to adhere to the assigned wetland buffer area (Wetland Report - TBC, 2020b) to ensure a considerable decrease in final significance ratings.

10.6.2 Underground Mining (Seam 1)

The final significance rating has been determined to be “High” given the duration of operational activities, the higher magnitude of impacts and the fact that the Elandsfontein tributary is expected to be undermined during this phase which could result in degradation by means of subsidence. Mitigation in the form of subsidence investigation and assurance of a suitable safety factor to avoid subsidence is expected to decrease the significance rating of this aspect.

The operational phase underground activities have the potential to degrade water and habitat quality within the tributary systems and further downstream river systems. Activities include the potential for surface runoff of carboniferous material from RoM areas, decant of contaminated underground water and potential leaks from pollution control facilities. Water quality impacts are expected to be substantial as current water chemistry is considered poor with AMD observed during the study and expected for the proposed mining with associated increased levels of decant. As a result, a degradation in the baseline PES is expected with a catchment scale loss of sensitive aquatic biota.

10.6.2.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects. Mitigation is however expected not to decrease the final significance ratings of this phase.

10.6.2.2 Cumulative Impacts

The cumulative impact rating has been scored “High” given the extent of existing mining activities within 500 m of the wetlands as well as the expected degradation of the water quality on a regional scale as a result of mining activities.

10.6.2.3 Irreplaceable loss of Resources

The operational phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources are of high sensitivity. Loss of these wetland systems would require a form of compensation.

10.6.2.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 1 due to the fact that only open cast mining has been proposed. It is however worth noting that as an alternative, the proposed mining area can be moved outside of the delineated wetland areas to ensure a significance decrease in final significance ratings.

10.6.3 New PCDs and stormwater management infrastructure

The final significance ratings have been determined to be “Moderate” given the duration of operational activities, and extent of the stormwater infrastructure across the project area.

The operational phase for storm and dirty water related activities have the potential to degrade water and habitat quality while altering the hydrological regime within the tributary systems and further downstream river systems. Activities include the potential for surface runoff of carboniferous material from RoM areas and haul roads, contaminated water and potential leaks and seepage from failing pollution control facilities and stormwater infrastructure entering the watercourses. Water quality impacts are expected to be substantial as current water chemistry is considered poor with AMD observed during the study and expected for the proposed mining with associated increased levels of decant. As a result, a degradation in the baseline PES is expected with a catchment scale loss of sensitive aquatic biota.

10.6.3.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects. Mitigation is however expected not to decrease the final significance ratings of this phase to a large degree.

10.6.3.2 Cumulative Impacts

The cumulative impact rating has been scored from “Moderate” to “High” given the extent of storm and dirty water within 500 m of the wetlands as well as the expected degradation of the water quality on a regional scale as a result of mining activities.

10.6.3.3 Irreplaceable loss of Resources

The operational phase of the relevant activities could result in a loss of natural resources in areas such as the discharge points at road crossings. It is however worth noting that the relevant resources are of high sensitivity. Loss of these wetland systems would require a form of compensation with rehabilitation efforts required during the operational phase to mitigate losses.

10.6.3.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed activities for new PCDs and stormwater management infrastructure.

10.6.4 River diversion (Reinstatement to original position)

The final significance ratings for the operation of the reinstated river position were determined to be “Medium”. Operational activity impacts include an increase in erosion and sedimentation of downstream riverine/wetland habitat due to operation of a new (original) channel and exposed river bank, with an initial decline in riverine/wetland PES through the loss of instream habitat and sensitive aquatic biota until the system can establish itself through revegetation. Recommended mitigation measures are expected to decrease final significance ratings from “Medium” to “Low” impacts. Despite mitigation erosion and sedimentation impacts are expected to the level of the exposed earth in the newly aligned channel.

10.6.4.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.6.4.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” as the potential cumulative impact is expected to have positive impacts on aquatic biota once the system has stabilised in the new position.

10.6.4.3 Irreplaceable loss of Resources

The operational phase of the river reinstatement is unlikely to result in a loss of natural resources provided mitigation measures are implemented.

10.6.4.4 Impact on Alternatives Considered

The alternative to retain the channel in the current diverted position has been considered in the section below.

10.6.5 River diversion (Retain channel in current diverted position)

The final significance ratings for the operation of the river in the current diverted position were determined to be “Low positive” with be “Medium positive” rating expected provided adaptive

and on-going rehabilitation of the channel take place. Adaptive rehabilitation would include the revegetation of exposed banks to increase the phytoremediation capacity of channel and increased PES.

10.6.5.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.6.5.2 Cumulative Impacts

The cumulative impact rating has been scored “High” as the potential cumulative impact is expected to have positive impacts on aquatic biota for the duration of the operational phase.

10.6.5.3 Irreplaceable loss of Resources

The operation of the river in the current diverted position is unlikely to result in a loss of natural resources. Instead, provided construction rehabilitation and adaptive operational rehabilitation is implemented, an improvement of natural resources is expected.

10.6.5.4 Impact on Alternatives Considered

The alternative for the reinstatement of the river to the original position has been considered in the previous section.

10.7 Decommissioning Phase Impacts

This section pertains to Activity Alternative A1.

10.7.1 Open Cast Mining (Seam 2)

The final significance ratings for the decommissioning of the opencast area were determined to range from “Low” to “High”. As per the construction phase, the removal of infrastructure and rehabilitation activities will be a large-scale operation and thus has the potential to contaminate surface water. Particular areas which will require attention includes the RoM stockpiles, screening areas and pollution control facilities. The rehabilitation of these areas will require special attention to avoid contamination of the surrounding watercourses. Despite mitigation water quality contamination remains “High” due to the potential regional extent of contamination. Although the PES (baseline) of the river reach assessed was derived to be modified from reference conditions, further deterioration is possible and thus a potential decline in the PES could be observed. Thus, impacts described above will result in reduced biodiversity on a catchment scale. However, this phase of the project has the potential to provide rehabilitation of the wetlands and correct closure of the area.

10.7.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.7.1.2 Cumulative Impacts

The cumulative impact ratings ranged from “Low” to “High” with altered water quality related to AMD having far reaching downstream impacts.

10.7.1.3 Irreplaceable loss of Resources

The decommissioning phase of the relevant activities could result in a cessation of the loss of natural resources, but continued degradation of the systems due to the altered landscape and hydrology of the catchment.

10.7.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

10.7.2 Underground Mining (Seam 1)

The final significance ratings for the decommissioning of the underground area were determined to range from predominantly “Medium” to “High”. As per the construction phase, the removal of infrastructure and rehabilitation activities will be a large-scale operation and thus has the potential to contaminate surface water. Particular areas which will require attention includes the RoM stockpiles, screening areas and pollution control facilities. Following the cessation of underground mining activities groundwater returns to the voids created by the mining process, resulting in the contamination of groundwater. Following this influx of groundwater, seepage and decant at specific locations can result in the ingress of contaminated water in downstream river systems, thus severely degrading the local PES. Despite mitigation water quality contamination remains “High” due to the potential regional extent of contamination.

In addition, in line with the precautionary principle, it is anticipated that the undermining of wetlands and river systems within the project area will result in the subsidence of the surface. The resultant potential impacts include serious changes to hydrology resulting in the significant alteration of catchment areas and subsequent habitat levels impacts.

10.7.2.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.7.2.2 Cumulative Impacts

The cumulative impact ratings ranged from “Low” to “High” with altered water quality related to AMD having far reaching downstream impacts.

10.7.2.3 Irreplaceable loss of Resources

The decommissioning phase of the relevant activities could result in a cessation of the loss of natural resources, but continued degradation of the systems due to the altered landscape and hydrology of the catchment is expected.

10.7.2.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 1 due to the fact that only open cast mining has been proposed.

10.7.3 New PCDs and stormwater management infrastructure

The final significance ratings for the decommissioning of the storm and dirty water infrastructure were determined to range from “Low” to “Medium”. As per the construction

phase, the removal of infrastructure and rehabilitation activities will be a large-scale operation and thus has the potential to contaminate surface water. Particular areas which will require attention includes the stormwater infrastructure around RoM stockpiles and screening areas and removal of pollution control facilities. Despite mitigation water quality contamination remains “Moderate” due to the potential extent of contamination. The resultant potential impacts include changes to hydrology resulting from the alteration of catchment areas and subsequent habitat level impacts. This together with water quality impacts are expected to degrade PES of the watercourses.

10.7.3.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.7.3.2 Cumulative Impacts

The cumulative impact ratings were “Moderate” with altered water quality expected to contribute to AMD having far reaching downstream impacts.

10.7.3.3 Irreplaceable loss of Resources

The decommissioning phase of the relevant activities could result in a cessation of the loss of natural resources, but continued degradation of the systems due to the altered landscape and hydrology of the catchment is expected.

10.7.3.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for new PCDs and stormwater management infrastructure.

10.7.4 River diversion (Both Alternatives)

The river diversion alternatives are not expected to be decommissioned. Therefore, impact ratings, mitigation and cumulative impacts associated with the operational phase of the two alternatives should be considered going forward. It is recommended that final rehabilitation take place on the preferred alternative to reinstate the river to near natural conditions.

10.8 Rehabilitation Phase Impacts

This section pertains to Activity Alternative A1.

10.8.1 Open Cast Mining (Seam 2)

The final significance ratings for the decommissioning of the opencast area were determined to range from “Medium” to “High” despite mitigation. Impacts are associated with erosion and sedimentation of watercourses and water quality impairment. As per the decommissioning phase, water quality contamination impacts associated with AMD remain a high risk.

Rehabilitation is intended to restore the landscape and the associated functioning to an acceptable level. Rehabilitation of the area also has the potential to address some of the legacy issues associated with the project area.

10.8.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.8.1.2 Cumulative Impacts

The cumulative impact ratings ranged from “Low” to “High”. Due to the implementation of rehabilitation impacts are expected to be low, however, further alteration of water quality related to AMD and salt loading of the Elandsfontein tributary is expected to have far reaching downstream impacts.

10.8.1.3 Irreplaceable loss of Resources

The rehabilitation phase of the relevant activities is not expected to result in a loss of natural resources.

10.8.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

10.8.2 Underground Mining (Seam 1)

The final significance ratings for the decommissioning of the underground area were determined to range from “Medium” to “High” despite mitigation. Impacts are predominantly associated with further water quality impairment with the assessed tributary systems. As per the decommissioning phase, water quality contamination impacts associated with AMD remain a high risk. The risk of subsidence can be lowered by avoiding the undermining of the wetlands and river systems within the project area.

10.8.2.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.8.2.2 Cumulative Impacts

The cumulative impact ratings ranged from “Low” to “High”. Due to the implementation of rehabilitation impacts are expected to be low, however, further alteration of water quality related to AMD and salt loading of the Elandsfontein tributary is expected to have far reaching downstream impacts.

10.8.2.3 Irreplaceable loss of Resources

The rehabilitation phase of the relevant activities is not expected to result in a loss of natural resources.

10.8.2.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 1 due to the fact that only open cast mining has been proposed.

10.8.3 New PCDs and stormwater management infrastructure

The final significance ratings for the rehabilitation and closure of the storm and dirty water infrastructure was determined to be “Medium”. Impacts are predominantly associated with habitat disturbance during reshaping and landscaping of the catchment through erosion and sedimentation. Rehabilitation is intended to restore the landscape and the associated functioning to an acceptable level. Rehabilitation of the area also has the potential to improve

the watercourses as through responsible mitigation risks can be lowered and are expected to be positive.

10.8.3.1 Mitigation Measures

See Section 11 for detailed mitigation measures pertaining to all alternatives and aspects.

10.8.3.2 Cumulative Impacts

The cumulative impact ratings were ‘medium”. Due to the implementation of rehabilitation impacts are expected to be low, however, further alteration of habitat and water quality is expected to have downstream impacts.

10.8.3.3 Irreplaceable loss of Resources

The rehabilitation phase of the relevant activities is not expected to result in a loss of natural resources.

10.8.3.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed

10.8.4 River diversion (Both Alternatives)

It is recommended that final rehabilitation take place on the preferred alternative to reinstate the river to near natural conditions. The rehabilitation design must ensure the channel will remain self-sustaining in excess of 50 years post closure. The potential cumulative impact of rehabilitation is expected to have positive impacts on aquatic biota for the life of the river.

10.9 Associated Impact Considerations

In alignment with the Environmental Authorisation Minimum Criteria for Reporting (DWS, 2020a), several aspects not covered in this riverine assessment can be found in the wetland report (TBC, 2020b). Aspects covered by the wetland report include:

Impacts on key ecosystems regulating and supporting services especially:

- flood attenuation;
- streamflow regulation;
- sediment trapping;
- phosphate assimilation;
- nitrate assimilation;
- toxicant assimilation;
- erosion control; and
- carbon storage?

11 Specialist Management Plan

Table 11-1 presents the recommended mitigation measures and the respective timeframes, targets and performance indicators for mining of the area. The mitigations within this section have been taken into consideration during the impact assessment in cases where the post-mitigation environmental risk is lower than that of the pre-mitigation environmental risk. It is advisable that these measures be re-considered and amended if required on selection of a preferred alternative, if applicable.

The Subsidence Risk Assessment completed for the project area did not cover the upper reaches of the Elandsfontein tributary marked for underground mining. Therefore, it is recommended that an updated Subsidence Risk Assessment is completed to define areas of high subsidence risk. Areas where high risk has been determined should be completely avoided to reduce the risk for surface hydrology alterations with the Elandsfontein tributary. Should unavoidable subsidence occur, rehabilitation actions must be implemented to avoid further effects to downstream riverine and wetland reaches.

A hydrology assessment is required to determine the 1 in 100 year floodline extent for the watercourses associated with the Elandsfontein Colliery project area.

Table 11-1 Mitigation measures including requirements for timeframes, roles and responsibilities

Mitigation Measures	Phase	Timeframe	Responsible Party for Implementation	Monitoring (Frequency)	Target	Performance Indicators (Monitoring Tool)
• Underground workings must adhere to a safety factor that will avoid subsidence; • Any loss/alteration of flow dynamics must be quantified, and mitigation options to re-introduce water in a safe and environmentally friendly way must be assessed; • Monitoring of adjacent watercourses must be undertaken to assess the impact of AMD to these systems; • Cut-off trenches must be incorporated into the open cast mining areas' design to decrease contamination of watercourses via AMD; and • Make use of passive or active water treatment of mine water decant.	Operation & Closure	Permanent	Applicant / Contractor	Monthly surface and groundwater quantity and quality	Avoid or minimise the loss of water input, and impaired water quality	Water quality guidelines (DWAF,1996)
• Separate clean and dirty water; • Construct diversion berms and drains around working areas; • Incorporate green /soft engineering storm water measures. Avoid unnecessary vegetation clearing and avoid preferential surface flow paths; • No cleaning of vehicles, machines and equipment in water resources; • No servicing of machines, vehicles and equipment on site; • Storage of potential contaminants in bunded areas; • All contractors must have spill kits available and be trained in the correct use thereof; • All released water must be within WUL special limits and discharge must be managed to avoid scouring and erosion of the receiving systems; • Contain wastewater in a PCD. Contaminated water must not be discharged into the watercourses; • Clean and dirty water must be separated. This water should be looked at for treatment and then re-introduced to mitigate losses to the catchment water hydro-dynamics; • All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping";	Construction & Operation	Ongoing	Applicant / Contractor	Biomonitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain WUL water quality standards	Water quality guidelines (DWAF,1996)

• Adequate sanitary facilities and ablutions must be provided for all personnel throughout the project area. • Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems; • All waste generated on-site must be adequately managed; and • Separation and recycling of different waste materials should be supported.						
• Implement a suitable stormwater management plan; • Use existing roads and infrastructure as much as possible; • Make use of correct stockpile and soil management strategies for later rehabilitation; • Implement concurrent rehabilitation and backfilling of voids to reduce surface loss; • Construct cut-off berms downslope of working areas; • Demarcate footprint areas to be cleared to avoid unnecessary clearing; • Exposed areas must be ripped and vegetated to increase surface roughness; • Ensure river crossing structures cater for high and low flows; • Create energy dissipation at discharge areas to prevent scouring; and • Temporary and permanent erosion control methods may include silt fences, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed areas, erosion mats, and mulching.	Construction, Operation & Closure	Ongoing	Applicant / Contractor	Biomonitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain WUL water quality standards	Water quality guidelines (DWAF,1996)
• Separate clean and dirty water continue with surface water and biomonitoring programmes; • All chemicals and toxicants during construction must be stored in bunded areas; • All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site; • All contractors and employees should undergo induction which is to include a component of environmental awareness; • The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”; • Adequate sanitary facilities and ablutions must be provided for all personnel throughout the project area;	Construction, Operation & Closure	Ongoing	Applicant / Contractor	Biomonitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain WUL water quality standards	Water quality guidelines (DWAF,1996)

• Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems; and • All waste generated on-site must be adequately managed. Separation and recycling of different waste materials should be supported.						
• Clean vehicles on-site, and prioritise vehicles gaining access from surround areas. • Alien invasive vegetation management plan	Construction, Operation & Closure	Ongoing	Applicant / Contractor	Monthly inspections, with removal to be determined on a needs basis	Maintain WUL water quality standards	National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA): Category 1a/b: Invasive species requiring compulsory control. Remove and destroy.
• All surface infrastructure must be removed from the site; • Compacted areas must be ripped (perpendicularly) to a depth of 300 mm; • A seed mix must be applied to rehabilitated and bare areas; • Any gullies or dongas must also be backfilled; • The area must be shaped to a natural topography; • Trees (or vegetation stands) removed must be replaced; • No grazing must be permitted to allow for the recovery of the area; and • Attenuation ponds may be created in channels to retain water in the catchment.	Closure	Ongoing	Applicant	Biomonitoring (bi-annual) Wetland monitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain WUL water quality standards	Water quality guidelines (DWAF,1996)
• For the river diversion alternative, the steep river channel banks must be reshaped to a gentle gradient (35 degrees or less) to allow for natural revegetation while avoiding erosion of the banks; • Revegetation of all exposed river banks must take place. Plants must carefully be removed from the river banks designated for reshaping, and must be stored for replanting post reshaping; • River bank reprofiling activities should take place with a downstream approach, beginning with upstream areas and moving in a downstream direction. Construction should only excavate, complete the rehabilitation (with revegetation) for small sections of project area at a time, rather than the entire river at once, to curb the level of erosion and sedimentation of downstream areas at once. This will	Construction phase (for river diversion) & Closure	Ongoing	Applicant	Water quality monitoring, frequency to be advised by hydrology specialist	Maintain WUL water quality standards	Water quality guidelines (DWAF,1996)

further allow the recovery process to begin immediately, without further disturbance from upstream construction works; • Signs of erosion must be addressed immediately to prevent further erosion of the watercourse banks; • Rehabilitation of the area and shaping of the topography must minimise the ingress of water into the mining area; • Additionally, measures must also be considered to implement constructed wetlands at likely decant areas, and the planting of trees to reduce groundwater recharge; • Decommission cut-off berms and drains last.; • Uncontaminated debris must be placed in preferential flow paths; • Compacted areas must be ripped (perpendicularly) to a depth of 300 mm; • A seed mix must be applied to rehabilitated and bare areas; • Any gullies or dongas must also be backfilled; and • The area must be shaped to a natural topography.						

12 Conclusion

12.1 Baseline Ecology

The baseline riverine study established critically modified conditions in the Elandsfontein tributary, and further, largely modified conditions in the Saalboomspruit tributary. Both systems presented wetland conditions. The study indicated that a deterioration of water quality was occurring between the upstream T1 site, and the T2 and T3 sites, as indicated by a decrease in pH, resulting in acidic conditions, and elevated dissolved solids. The results further indicated contaminated water stemming from the Elandsfontein tributary, as indicated by results from the upstream E Dam, E1, E2, and E3 sites, which contributed to the deteriorated water quality conditions of the Saalboomspruit tributary, and likely downstream catchments. Further, extensive stands of alien invasive plant species occur within the Elandsfontein project area, reducing riparian habitat integrity.

12.2 Impact Assessment

The proposed project activities were determined to have two primary impacts to the associated Elandsfontein tributary (directly) and the Saalboomspruit tributary (indirectly). The first was determined to be related to physical make-up alterations of the considered river reaches due to subsidence and groundwater drawdown related to undermining of the rivers and wetlands. Groundwater drawdown would be expected to result in a loss of water volume in surface rivers and wetlands. The opencast mining (seam 2) and proposed PCDs and stormwater management infrastructure would also result in the loss and fragmentation of riverine/ wetland habitat through physical removal. These mining options would result in impacts to the riverine substrates, banks, riparian/marginal vegetation and the hydrological functioning of the assessed tributaries. These physical components of a watercourse are drivers responsible for the biodiversity associated with the aquatic habitats. Therefore, modification of these physical components would result in habitat integrity impacts and associated reduction in the ability to support a diversity of aquatic fauna and flora. The loss of aquatic habitat scored a “Medium” final significance rating for both Seam 1 and 2 and the PCDs and stormwater management infrastructure during the construction and operational phases.

The second impact was determined to be related to the chemical properties of water due to the potential of acid mine drainage during the operational and post closure phases. As observed at site E Seep, water arising from underground sources are slightly acidic and contain elevated levels of dissolved solids. The water quality impacts aspect for the proposed expansion of mining activities scored a “High” final significance rating due to the potential to exacerbate the acid mine drainage within the project area with regional downstream water quality contamination and associated reduction in aquatic biota diversity and abundances. The storm and dirty water related activities are expected to contribute towards water quality contamination and therefore scored a “Moderate” final significance rating.

The mitigation hierarchy (Figure 12-1) has been considered for the proposed activities, of which avoidance (step 1) and minimising impacts (step 2) were achieved for all aspects except for the latter two (operational phases of seam 1 and 2). Given the fact that rehabilitation (step 3) will not be sufficient due to the direct loss of riverine and wetland areas, the last step will have to be adhered to by the responsible party, which is wetland offsets.

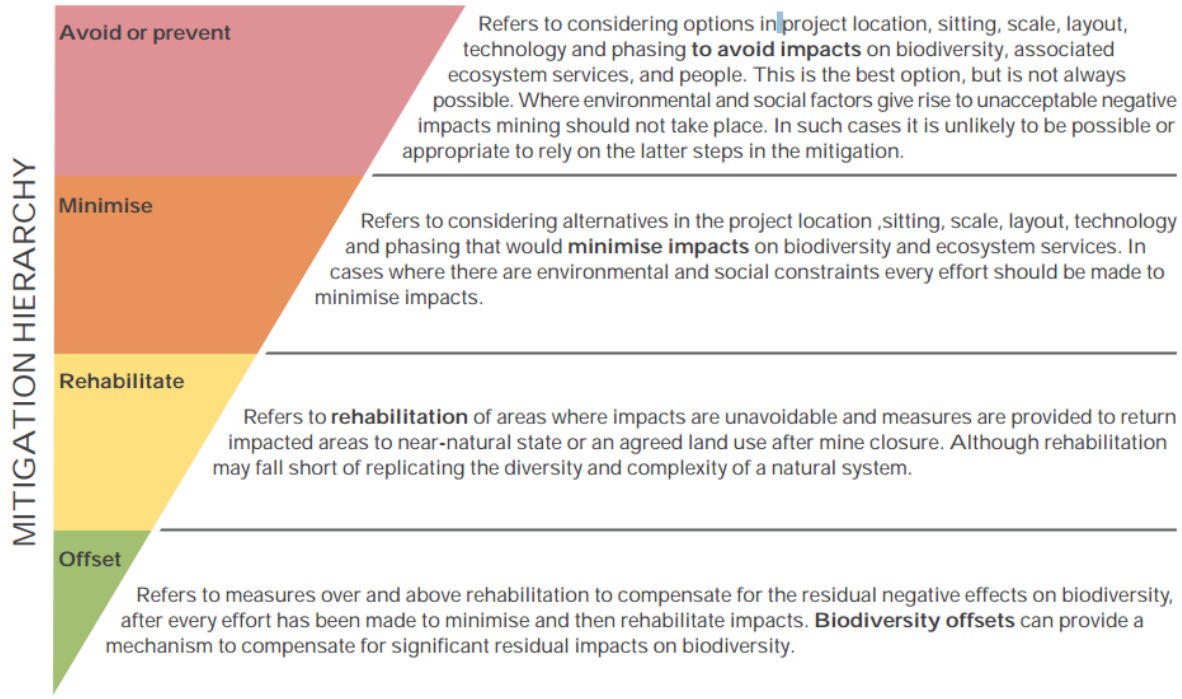

Figure 12-1 The mitigation hierarchy as described by the DEA (2013)

It is firstly recommended that the proposed open cast mining areas (Seam 2) be amended to adhere to the delineated wetland's buffer zone and that a subsidence assessment prescribe measures to avoid subsidence of the underground mining areas (Seam 1) to be permitted to proceed. If either of these requirements are not deemed feasible for the selected alternative, it is recommended that a wetland offset strategy (which according to DEA (2013) is the last resort) be compiled for the project. The wetland offset must be focussed on the extent of the wetland and associated buffer zone that will be lost, as indicated in the sensitivity sections (see Figure 9-3 specifically). The proposed wetland offset must incorporate onsite rehabilitation and must be implemented from the onset of the project until closure.

Decommissioning of the current diverted watercourse is the preferred alternative, and the original watercourse should be reinstated. Ideally, the watercourse should be reinstated to a pre-destruction condition replicating (as close as possible) the original topography, features and extent to achieve the desired ecological class. This option would avoid further impacts to the Largely Modified (class D) hydrology, water quality and Present Ecological Status of the downstream Saalboomspruit reach. Positive impacts are expected which include the assimilation of upstream mining pollutants from the water column through phytoremediation of an improved river channel

The baseline study indicated that further deterioration of the aquatic systems has occurred from the 2014 study conducted by Digby Wells (Digby, 2017). The proposed project activities have the potential to further degrade local ecological conditions, making the Resource Quality Objectives difficult to obtain. This indicates the necessity of implementation of the EMPR for the Elandsfontein project area. Furthermore, aquatic biomonitoring is recommended to determine ecological trends and further impacts stemming from the Elandsfontein project area.

12.3 Specialist Recommendation

It is the specialist's recommendation that the project does not present any fatal flaws. In the event that underground mining is authorised, it is recommended that a subsidence assessment prescribe measures to avoid subsidence of the mined-out areas below the wetlands and buffer zones. In the event that open cast mining of Seam 2 is authorised, it is recommended that the extent of the open cast area be amended to adhere to the buffer zone. Due to the expected loss and degradation of rivers and wetlands as a result of the project with either option, it is further recommended that on-site rehabilitation of the area be implemented to allow for some level of wetland compensation, this should be informed by an offset strategy. If all recommendations made are met, it is the specialist's opinion that no fatal flaws exist and that the proposed activities should proceed as have been planned.

13 Assumptions, Uncertainties and Gaps in Knowledge

The following aspects were considered as limitations:

- The Subsidence Risk Assessment completed for the project area did not cover the upper reaches of the Elandsfontein tributary marked for underground mining;
- The depths of the proposed mining operation were not defined at the time of writing this report. Considering this, the potential and risk for subsidence is unknown. Thus, based on the precautionary principle, it is assumed that mining will be shallow and there is a risk for subsidence to occur;
- The proposed activities listed in this study are based on the assessment of several existing underground coal mine activities. A number of assumptions have been made through the compilation of the activity list; and
- No proposed river diversion shapefiles were available at the time of the study, therefore the impact assessment was based on the areas presented within this report.

14 References

Barbour, M.T., Gerritsen, J. & White, J.S. 1996. Development of a stream condition index (SCI) for Florida. Prepared for Florida Department of Environmental Protection: Tallahassee, Florida.

Dallas, H.F. 2007. River Health Programme: South African Scoring System (SASS) Data Interpretation Guidelines. Report produced for the Department of Water Affairs and Forestry (Resource Quality Services) and the Institute of Natural Resources.

Department of Water Affairs and Forestry (DWAF). 1996. South African Water Quality Guidelines. Volume 7: Aquatic Ecosystems. Department of Water Affairs and Forestry, Pretoria.

Department of Water and Sanitation (DWS). 1999. Resource Directed Measures for Protection of Water Resources. Volume 2: Integrated Manual (Version 1). Department of Water Affairs and Forestry, Pretoria.

Department of Water and Sanitation (DWS). 2005. River Ecoclassification: Manual for Ecostatus Determination. First Draft for Training Purposes. Department of Water Affairs and Forestry.

Department of Water and Sanitation (DWS). 2020a. National Environmental Management Act (NEMA). Act 107 of 1998. Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation. National Gazettes, No. 320 of 20 March 2020

Department of Water and Sanitation (DWS). 2020b. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Draft. Compiled by RQS-RDM.

Dickens, C. W. S. and Graham, P.M. 2002. The South African Scoring System (SASS) Version 5: Rapid bioassessment method for rivers. African Journal of Aquatic Science. 27 (1): 1 -10.

Digby Wells Environmental. 2017. Environmental Regulatory Processes relating to the amendment of the Environmental Management Programme for its Elandsfontein Operations. Aquatic Ecological Baseline and Impact Assessment. Report. Pp 64.

International Union for Conservation of Nature and Natural Resources (IUCN). 2020.2. Red list of threatened species. www.iucnredlist.org. Accessed 14th July 2020.

Kleynhans, CJ. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo System, South Africa) Journal of Aquatic Ecosystem Health 5:41-54.

Kleynhans CJ, Louw MD. 2007. Module A: EcoClassification and EcoStatus determination in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No.

National Water Act (NWA). 1998. Act 39 of 1998. Regulation GN1199

National Water Act (NWA). 2016. Act 36 of 1998. New Nine (9) Water Management Areas of South Africa. National Gazettes, No. 40279 of 16 September 2016

Nel JL, Murray KM, Maherry AM, Petersen CP, Roux DJ, Driver A, Hill L, Van Deventer H, Funke N, Swartz ER, Smith-Adao LB, Mbona N, Downsborough L and Nienaber S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Republic of South Africa (RSA). 2016. Proposed classes and resource quality objectives of water resources for catchment of the Olifants Catchment. 4. No. 39004.

Rountree KM, Wadeson RA and O'Keeffe J. 2000. The Development of a Geomorphological Classification System for the Longitudinal Zonation of South African Rivers. South African Geographical Journal 82 (3): 163-172.

South African National Biodiversity Institute (SANBI). 2011. GIS metadata for South African MBSP Freshwater Assessment.

Skelton, P.H. 2001. A complete guide to the freshwater fishes of southern Africa. Struik Publishers, South Africa.

The Biodiversity Company (TBC). 2018. Aquatic Ecology (Update) for the Eskom activities in the tributary of the Saalboomspruit between the Craighall and Sandpark substations. Specialist Report. Pp. 22.

The Biodiversity Company (TBC). 2019. Elandsfontein Aquatic Baseline & Risk Assessment 2019.

The Biodiversity Company (TBC). 2020a. Elandsfontein Colliery Aquatic Biomonitoring Assessment 2019-2020.

The Biodiversity Company (TBC). 2020b. TBC Wetland Assessment Elandsfontein Project. November 2020 update.

Thirion, C.A., Mocke, A. & Woest, R. 1995. Biological monitoring of streams and rivers using SASS4. A User's Manual. Internal Report No. N 000/00REQ/1195. Institute for Water Quality Studies. Department of Water Affairs and Forestry. 46.

Thirion, C. 2007. Module E: Macroinvertebrate Response Assessment Index in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 332/08

United States Environmental Protection Agency (USEPA), 1998. Rapid Bioassessment Protocols for Use in Streams and Rivers. US Environmental Protection Agency, Office of Water. Washington, DC.

15 Appendix A: Specialist declaration

I, Dale Kindler, 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 71 and is punishable in terms of Section 24F of the Act.

Dale Kindler

Aquatic Specialist

The Biodiversity Company

July 2020

16 Appendix B: Specialist CV

Dale Kindler

M.Sc Aquatic Health (*Pr Sci Nat*)

Cell: +27 82 592 1970
Email: dale@thebiodiversitycompany.com
Identity Number: 8901135071083
Date of birth: 13 January 1989

Profile Summary

Experience with the mining and civil engineering sector in South Africa, providing specialist input into EIAs.

Providing aquatic ecological expertise for the assessment and management of freshwater systems.

The implementation of aquatic biomonitoring programmes in accordance with licensing.

Areas of Interest

Aquatic Ecology and Water Resource Management.

Renewable Energy & Infrastructure Development Projects, Sustainability and Conservation.

Fish Health and Histopathology.

Publication of scientific journals and articles.

Dragonflies

Key Experience

- Fish population structure assessments
- The use of macroinvertebrates to determine water quality
- Aquatic Ecological Assessments
- Monitoring Programmes (Baseline studies, water quality and biomonitoring)

Countries worked in

Guinea

Mozambique

South Africa

Lesotho

Swaziland

Angola

Zimbabwe

Nigeria

Nationality

South African

Languages

English – Proficient

Afrikaans – Conversational

Qualifications

- MSc (University of Johannesburg) – Aquatic Health.
- BSc Honours (University of Johannesburg) – Zoology
- BSc Zoology & Environmental Management
- SASS 5 Accredited – Department of Water Affairs and Forestry for the River Health Programme
- Professional Natural Scientist: Aquatic Health (Reg. No: 114743)

SELECTED PROJECT EXPERIENCE

Project Name: Water Quality Testing and Aquatic biomonitoring of the Aquatic Systems Associated with Various Waste Water Treatment Works Facilities within the eThekwini Municipality, in KwaZulu-Natal Province.

Client: EnviroPro.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (KwaZulu-Natal) – March 2020

Main project features: To conduct water quality testing and aquatic biomonitoring of the aquatic systems to assess the impacts of the various Waste Water Treatment Works on the river systems and aquatic biota.

Project Name: Aquatic biomonitoring of the aquatic systems for the Uitkomst Coal Mine and Associated Wykom Siding, in KwaZulu-Natal Province.

Client: Cabanga Environmental.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (Newcastle) – 2017 to 2020

Main project features: To conduct annual aquatic biomonitoring of the aquatic systems to assess the impacts of the mine on the river systems and aquatic biota.

Project Name: An aquatic specialist baseline and impact assessment for the Beitbridge Border Crossing upgrade, in the Beitbridge Town, Zimbabwe.

Client: Kongiwe.

Personal position / role on project: Aquatic Specialist.

Location: Zimbabwe (Beitbridge) – October 2019

Main project features: To conduct a dry season (winter) ecological baseline and impact assessment of the watercourses for the proposed project.

Project Name: An aquatic specialist baseline and impact assessment for the NdPr rare earth metals mine, in the Huambo Province, Angola.

Client: Pensana Metals.

Personal position / role on project: Aquatic Specialist.

Location: Angola (Longonjo) – April 2019

Main project features: To conduct a wet season (Summer) ecological baseline and impact assessment of the watercourses for the proposed mining project.

Project Name: Aquatic biomonitoring of the aquatic systems for the Ilima Coal Mine, in Mpumalanga Province.

Client: GSW.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (Carolina) – 2016 to 2018

Main project features: To conduct annual aquatic biomonitoring of the aquatic systems to assess the impacts of the mine on the river systems and aquatic biota.

Project Name: Aquatic biomonitoring of the aquatic systems for the National River Health Programme/ River Ecostatus Monitoring Programme, in KwaZulu-Natal Province.

Client: Umgeni Water in association with the University of KwaZulu-Natal.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (Extensive areas across KwaZulu-Natal) – 2016 to 2017

Main project features: To conduct annual aquatic biomonitoring of the aquatic systems to assess the current health status of the river systems and aquatic biota within the province.

Project Name: An aquatic specialist baseline and impact assessment for the Berg River/Voëlvlei Dam Augmentation Scheme., in Western Cape Province.

Client: Nemai.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (Western Cape) - 2016

Main project features: To conduct an aquatic ecological baseline and impact assessment of the Berg River for the proposed Berg River/Voëlvlei Dam Augmentation Scheme. Impacts assessed include the risk of construction of a low level weir with pumps and pipelines transferring water from the Berg River to the Voëlvlei Dam.

Project Name: An aquatic specialist baseline and impact assessment for the Umlalazi River bridge, in KwaZulu Natal Province.

Client: EnviroPro.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (KwaZulu Natal) - 2016

Main project features: To conduct a wet season (Summer) ecological baseline and impact assessment of the watercourses for the proposed bridge construction project.

Project Name: An aquatic specialist baseline and impact assessment for the Diphini road upgrade, in KwaZulu Natal Province.

Client: EnviroPro.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (KwaZulu Natal) - 2016

Main project features: To conduct a dry season (Winter) ecological baseline and impact assessment of the watercourses for the proposed road upgrade project.

Project Name: Aquatic biomonitoring of the Limpopo River for the Boikarabelo Coal Mine, in Limpopo Province.

Client: Ledjadja Coal.

Personal position / role on project: Aquatic Specialist.

Location: South Africa (Limpopo) – 2016 to present

Main project features: To conduct annual aquatic biomonitoring of the Limpopo River to assess the impacts of the mine on the river system and aquatic biota.

Project Name: Alien invasive fish assessment of the Groot Marico River, in North West Province

Client: National Research Foundation

Personal position / role on project: Aquatic Specialist.

Location: South Africa (Groot Marico, North West) - 2013

Main project features: To conduct a fish community structure assessment specifically looking at the impact of alien invasive species on native species in the Groot Marico River for research purposes for the National Research Foundation

Project Name: Aquatic biomonitoring of the Zambezi River for the Rio Tinto Coal Mine, in Tete, Mozambique.

Client: Rio Tinto.

Personal position / role on project: Aquatic Specialist.

Location: Mozambique (Tete) - 2013

Main project features: To conduct annual aquatic biomonitoring of the Zambezi River to assess the impacts of the mine on the river system and aquatic biota.

Please take note that this represents only a selection of project background and expertise.

OVERVIEW

An overview of the specialist technical expertise include the following:

- Aquatic ecological state and functional assessments of rivers and dams.
- Monitoring plans for rivers.
- Toxicity and metal analysis of water, sediment and biota.
- Implementation of recognised biotic indices: Fish, Macroinvertebrates, Diatoms and Vegetation studies.

- Implementation of recognised abiotic indices: Intermediate Habitat Integrity Assessment (IHIA). Interpretation of Chemical Analyses and Toxicity Tests.
- Assistance with faunal surveys which includes mammals and reptiles.

TRAINING

Some of the more pertinent training undergone include the following:

- SASS 5 Accredited – Department of Water Affairs and Forestry.
- Bioaccumulation assessment of fish communities.
- Safe removal and relocation of Baboon spiders – Boikarabelo Coal Mine (2012).
- Advanced 4 x 4 driving course – Through the University of Johannesburg (2012).
- Air Quality - Dust bucket and passive sample collection and lab submissions (2013).
- Trained in Health and Safety - Level 1 First Aid (2013)

EMPLOYMENT EXPERIENCE

CURRENT EMPLOYMENT: The Biodiversity Company (October 2015 – Present)

I am an aquatic ecologist at The Biodiversity Company and have conducted stand-alone specialist studies, and provided overall guidance of studies with a pragmatic approach for the management of biodiversity that takes into account all the relevant stakeholders, most importantly the environment that is potentially affected. We manage risks to the environment to reduce impacts with practical, relevant and measurable methods. These services are offered to numerous sectors, such as mining, agriculture, construction and natural resources.

EMPLOYMENT: Prism EMS (January 2015 - September 2015)

As an aquatic ecologist at Prism my responsibilities included conducting specialist assessments of aquatic ecosystems, compilation of reports, and equipment maintenance and calibrations.

EMPLOYMENT: Golder Associates Africa (January 2013 – June 2014)

As an aquatic ecologist at Golder my responsibilities included assisting with specialist assessments of aquatic ecosystems, compilation of reports, equipment maintenance and calibrations, and management of samples. My role included assisting in: Ecological, Surface Water; Ground Water; and Air Quality Monitoring for the other divisions within the company.

Demonstrator and tutor: 2012 -University of Johannesburg, Gauteng

ADDITIONAL EXPERIENCE

Public consultation	The provision of specialist input in order to communicate project findings as well as assist with providing feedback if and when required.
Water use licenses	Consultation with the relevant authorities in order to establish the project requirements, as well as provide specialist (aquatics/wetland) input for the application in order to achieve authorisation.

ACADEMIC QUALIFICATIONS

University of Johannesburg, Johannesburg, South Africa (2015): MAGISTER SCIENTIAE (MSc) - Aquatic Health:

Title: Assessment of the reproductive status of *Barbus motebensis* (Marico Barb) from the upper Groot Marico River catchment, North West Province, South Africa.

University of Johannesburg, Johannesburg, South Africa (2012): BACCALAUREUS SCIENTIAE CUM HONORIBUS (Hons) – Zoology

Title: The identification and description of two spider species including an assessment of their behavioural and distributional pattern in Bakwena Cave, Irene, Pretoria, Gauteng, South Africa.

University of Johannesburg, Johannesburg, South Africa (2009 - 2011): BACCALAUREUS SCIENTIAE IN NATURAL AND ENVIRONMENTAL SCIENCES. Majors: Zoology and Environmental Management.

CONFERENCES

Southern African Society of Aquatic Sciences Congress July 2019, Held at Zebula Golf Lodge, Bela-Bela, Limpopo Province. Fish species composition of the upper reaches of the Limpopo River and water quality trends, Lephalale, South Africa.

PUBLICATIONS

Kindler D, Wagenaar GM, Weyl OLF. 2015. An assessment of the reproductive biology of the Marico barb *Barbus motebensis* from the upper Groot Marico catchment, South Africa. African Journal of Aquatic Science; 40(4):425-431. http://dx.doi.org/10.2989/16085914.2015.1106400