FRESHWATER RESOURCE ECOLOGICAL ASSESSMENT FOR THE PROPOSED ANGLO PLATINUM DER BROCHEN EXPANSION PROJECT, LIMPOPO PROVINCE

Prepared for

SRK Consulting (Pty) Ltd

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SECTION A

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EXECUTIVE SUMMARY

Based on the findings of the ecological assessment and results of the impact assessment, it is the opinion of the ecologist that the proposed expansion project carries the potential to pose a significant risk to several ephemeral drainage lines and their associated riparian zones, which may in turn have an indirect impact on the functioning of downstream systems, most notably the Groot Dwars River.

Careful planning of the positioning and layout of the proposed infrastructure, taking into account the delineated freshwater resources and the applicable zones of regulation and wherever feasible, completely avoiding these drainage systems, will greatly reduce the impact significance of potential impacts. In addition, the adherence to cogent, well-conceived mitigation measures as well as general good construction practice will aid in reducing the impact significance to acceptable levels. However, it should be noted that the significance of some risks, such as possible decant from the shaft and loss of catchment yield could not be accurately assessed since the relevant specialist studies had not been completed at the time of this assessment.

Taking the above into account, it is therefore the opinion of the specialist that from a freshwater ecological perspective, certain aspects of the proposed expansion project (such as the footprint of the Dense Media Separation complex) be carefully considered, and that preferably, further refinement of the site layout plans takes place before the project be authorised.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater resource assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed Anglo Platinum Der Brochen Expansion Project, Limpopo Province, hereafter referred to as the “focus area”. The Anglo Platinum Der Brochen Mine is situated northeast of the R555 provincial road, and northwest of the R540 within the Limpopo Province approximately 24km south-west (40km by road) of the town of Steelpoort. Lydenburg is approximately 31km from the focus area in a southeast direction. The mine is located in the Greater Tubatse Local Municipality which forms part of the Greater Sekhukhune District Municipality.

The purpose of this report is to define the ecology of the focus area in terms of freshwater resource characteristics, mapping of the freshwater resources, defining areas of increased Ecological Importance and Sensitivity (EIS), and to define the Present Ecological State (PES) of the freshwater resources associated with the focus area, as well as to define the socio-cultural and ecological service provision of the freshwater resources and the Recommended Ecological Category (REC) for the various watercourses. It is a further objective of this study to provide detailed information to guide the proposed project activities in the vicinity of the freshwater resources, to ensure that the ongoing functioning of the ecosystem, such that local and regional conservation requirements and the provision of ecological services in the local area are supported while considering the need for sustainable economic development.

The assessment took the following approach:

- A desktop study was conducted, in which possible wetlands/freshwater resources were identified for on-site investigation, and relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 3 of this report;
- A field assessment took place in February 2018, in order to ground-truth the identified freshwater resources identified within the focus area; and
- Numerous freshwater resources, including the Groot Dwars River, were identified and assessed. For the purposes of discussion, these were grouped according to locality. The

detailed results of the field assessment are contained in Section 4 of this report and are summarised in the table below.

Table A: Summary of the results of the field assessment.

Freshwater Resource	PES	Ecoservices	EIS	REC
Groot Dwars River	B/C	Intermediate	Very High	C/D
Group 1 (south of Mototolo concentrator and west of Der Brochen Dam)	B/C	Intermediate	High	B/C
Group 2 (immediately south, north and east of Mototolo Concentrator)	C	Intermediate	High	C
Group 3 (eastern portion of Mareesburg farm in the vicinity of the new TSF)	C	Intermediate	High	C

Following the assessment of the freshwater resources, an impact assessment was undertaken in order to ascertain the significance of perceived impacts associated with the proposed activities on the receiving environment. The results of this assessment are contained in Section C (*Freshwater Resource and Aquatic Ecological Assessment for the Proposed Anglo Platinum Der Brochen Project, Limpopo Province. Section C: Integrated Impact Assessment and Mitigation.SAS, 2018)*. In summary however, the results of the assessment indicate that without mitigation, impact significance is likely to be moderate to high. This significance can be reduced firstly by ensuring that infrastructure does not encroach on drainage systems. However, should it not be feasible to avoid the drainage systems altogether, then some impacts (such as those associated with the construction of the Dense Media Separation [DMS] Complex will remain high. Nevertheless, the strict implementation of well-developed, cogent mitigation measures (as contained in Section C [SAS, 2018]) will need to take place in order to reduce the impact significance.

Based on the findings of the ecological assessment and results of the impact assessment, it is the opinion of the ecologist that the proposed expansion project carries the potential to pose a significant risk to several ephemeral drainage lines, which may in turn have an indirect impact on the functioning of downstream systems, most notably the Groot Dwars River. However, should careful planning of the positioning and layout of the proposed infrastructure take into account the locations of the drainage lines, taking care to avoid these systems as much as possible, impact significance can be greatly reduced. Furthermore, the adherence to cogent, well-conceived mitigation measures as well as general good construction practice will aid in reducing the impact significance to acceptable levels. However, it should be noted that the significance of some risks, such as possible decant from the South Decline Shaft, and loss of catchment yield could not be accurately assessed since the relevant specialist studies had not been completed at the time of this assessment. Taking the above into account, it is therefore the opinion of the specialist that from a freshwater ecological perspective, certain aspects of the proposed expansion project (such as the footprint of the DMS complex) be carefully considered, and that preferably, further refinement of the site layout plans takes place before the project be authorised.

DOCUMENT GUIDE

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix E
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix E
b)	A declaration that the specialist is independent	Appendix E
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.2
cA)	An indication of the quality and age of base data used for the specialist report	Section 2.1 and 3.1
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4.1 and 5.1
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 2.1
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Appendix C
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 4
g)	An identification of any areas to be avoided, including buffers	Section 4.3
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 4.3
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.3
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 5 Separate Integrated Impact Assessment report (Section C)
k)	Any mitigation measures for inclusion in the EMPr	Separate Integrated Impact Assessment report (Section C)
l)	Any conditions for inclusion in the environmental authorisation	Separate Integrated Impact Assessment report (Section C)
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Separate Integrated Impact Assessment report (Section C)
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 6
(iA)	Regarding the acceptability of the proposed activity or activities	Section 6
(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 6
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Base flow:	Long-term flow in a river that continues after storm flow has passed.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animans and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Ephemeral stream:	Ephemeral systems flow for less time than they are dry. Flow or flood for short periods of most years in a five-year period, in response to unpredictable high rainfall events. Support a series of pools in parts of the channel.
Episodic stream:	Highly flashy systems that flow or flood only in response to extreme rainfall events, usually high in their catchments. May not flow in a five-year period, or may flow only once in several years**.**
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the

	future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake 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
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius.
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CSIR	Council of Scientific and Industrial Research
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
DMS	Dense Media Separation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	General Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NOMR	New Order Mining Rights
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
RHP	River Health Program
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAS	Scientific Aquatic Services
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WRC	Water Research Commission
WULA	Water Use License Application

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater resource assessment as part of the amendment to the Anglo American Platinum (AAP)-Rustenburg Platinum Mines Limited (RPM) Der Brochen Mine's approved EMPr and associated Environmental Authorisation (EA), including an update of the existing Water Use Licence (WUL) to include various new activities. The proposed developments are summarised below and are collectively henceforth referred to as the 'focus area'. The Anglo Platinum Der Brochen Project is situated northeast of the R555 provincial road, and northwest of the R540, and approximately 24km south-west (40km by road) of the town of Steelpoort. Lydenburg is approximately 31km from the focus area in a southeast direction. The Anglo Platinum Der Brochen Mine is located in the Greater Tubatse Local Municipality which forms part of the Greater Sekhukhune District Municipality.

To identify all potential freshwater resources that may potentially be impacted by the proposed expansion project, a 500m "zone of investigation" around the focus area, in accordance with Regulation 509 of 2016 as it relates to the National Water Act (NWA), was used as a guide in which to assess possible sensitivities of the receiving environment. This area – i.e. the 500m zone of investigation around the focus area – will henceforth be referred to as the "investigation area" (Figures 1 & 2).

A previous assessment of the watercourses within the Der Brochen property (thus including those within the focus area of this study) was undertaken by SAS in 2014[1]. Therefore, although the primary purpose of this report is to define the ecology of the proposed mine expansion in terms of freshwater resource characteristics, including mapping of the freshwater resources, defining areas of increased Ecological Importance and Sensitivity (EIS) and defining the Present Ecological State (PES) of the freshwater resources associated with the mine expansion, the report simultaneously serves as a "status quo" update of the freshwater ecological conditions, and where deemed necessary, incorporates updated "best practice" methods of assessment.

[1] *Wetland and Aquatic Ecological Assessment for the Proposed Anglo Platinum Der Brochen Project, Limpopo Province*. Prepared by Scientific Aquatic Services for SRK Consulting (Pty) Ltd, 2014. Specialist report. Unpublished.

A pre-defined impact assessment method supplied by the Environmental Assessment Practitioner (EAP) was applied to determine the significance of the perceived impacts associated with the mining expansion activities. In addition, mitigatory measures were developed which aim to minimise the impacts, followed by an assessment of the significance of the impacts after mitigation, assuming that they are fully implemented. The results of the impact assessment and the mitigation measures are contained in Section C (*Freshwater Resource and Aquatic Ecological Assessment for the Proposed Anglo Platinum Der Brochen Project, Limpopo Province. Section C: Integrated Impact Assessment and Mitigation.SAS, 2018)*.

Please refer to Section 1.3 for the detailed scope of work encompassed by this study.

This study aims to provide detailed information to guide the proposed project activities in the vicinity of the freshwater resources, to ensure the ongoing functioning of the ecosystems, such that local and regional conservation requirements and the provision of ecological services in the local area are supported while considering the need for sustainable economic development. This report, after consideration of the above, must guide the relevant authorities, by means of a reasoned opinion and recommendations, as to the viability of the proposed mining activities from a freshwater resource management perspective.

1.2 Project Description

The focus area comprises the following additional mining-related infrastructure as part of the mine's development strategy (as per the Memorandum for the Der Brochen Amendment Project developed and provided by SRK Consulting, 23 July 2019, Project Reference 533247):

- One new decline shaft (South Decline Shaft) with associated infrastructure including water management infrastructure;
- The previously approved North Opencast Pit area with associated infrastructure as previously approved in 2015, i.e. water management infrastructure and waste rock stockpiles;
- Three up-cast ventilation shafts required for the underground workings associated with the South Decline Shaft;
- A Dense Medium Separation (DMS) Plant to be located within the existing footprint area of the Mototolo Concentrator area;
- A DMS Stockpile with associated water management infrastructure;

- The conversion of the existing Mototolo chrome plant from a final tailings' arrangement to an inter-stage arrangement;
- Additional Run of Mine stockpiles and associated silos;
- Change houses and office complex to be located at the proposed South Decline Shaft area;
- An explosive destruction bay area to be located near the proposed South decline shaft;
- Staff accommodation facilities to be located near the Der Brochen Dam; and
- Additional linear infrastructure, i.e.:
    - **Two conveyor systems.** *One conveyor belt system will be constructed to connect the proposed South Decline Shaft with the proposed DMS Plant that will be located in the existing footprint area of the Mototolo Concentrator Plant, for the purpose of transporting ore from the South Decline Shaft to the plant area. Another conveyor belt system will be required to transport DMS material from the proposed DMS Plant to the proposed DMS Stockpile area. It is currently anticipated that the DMS conveyor system will run along the existing Mareesburg tailings pipeline system.*
    - **Access and haul roads**. *New access roads to the proposed ventilation shafts will be required for maintenance purposes. Certain existing roads will also be required to be upgraded to provide sufficient access roads to the project related infrastructure such as the North Opencast Pit area, the South Decline Shaft and offices. The mine is also considering including a haul road within the proposed corridor associated with the ore conveyor belt system to transport ore from the proposed South Decline Shaft to the Mototolo Concentrator Plant area as an interim measure, whilst the conveyor belt system is being constructed*.

It should be noted that although the scope of this study does not include the previously authorized North Opencast Pit and associated infrastructure, where necessary, reference is made to the potential cumulative impact that the proposed North Opencast Pit may have on freshwater resources identified within the focus area.

The locality and layout of the proposed Der Brochen Amendment Project are depicted in Figures 1 to 3 below.

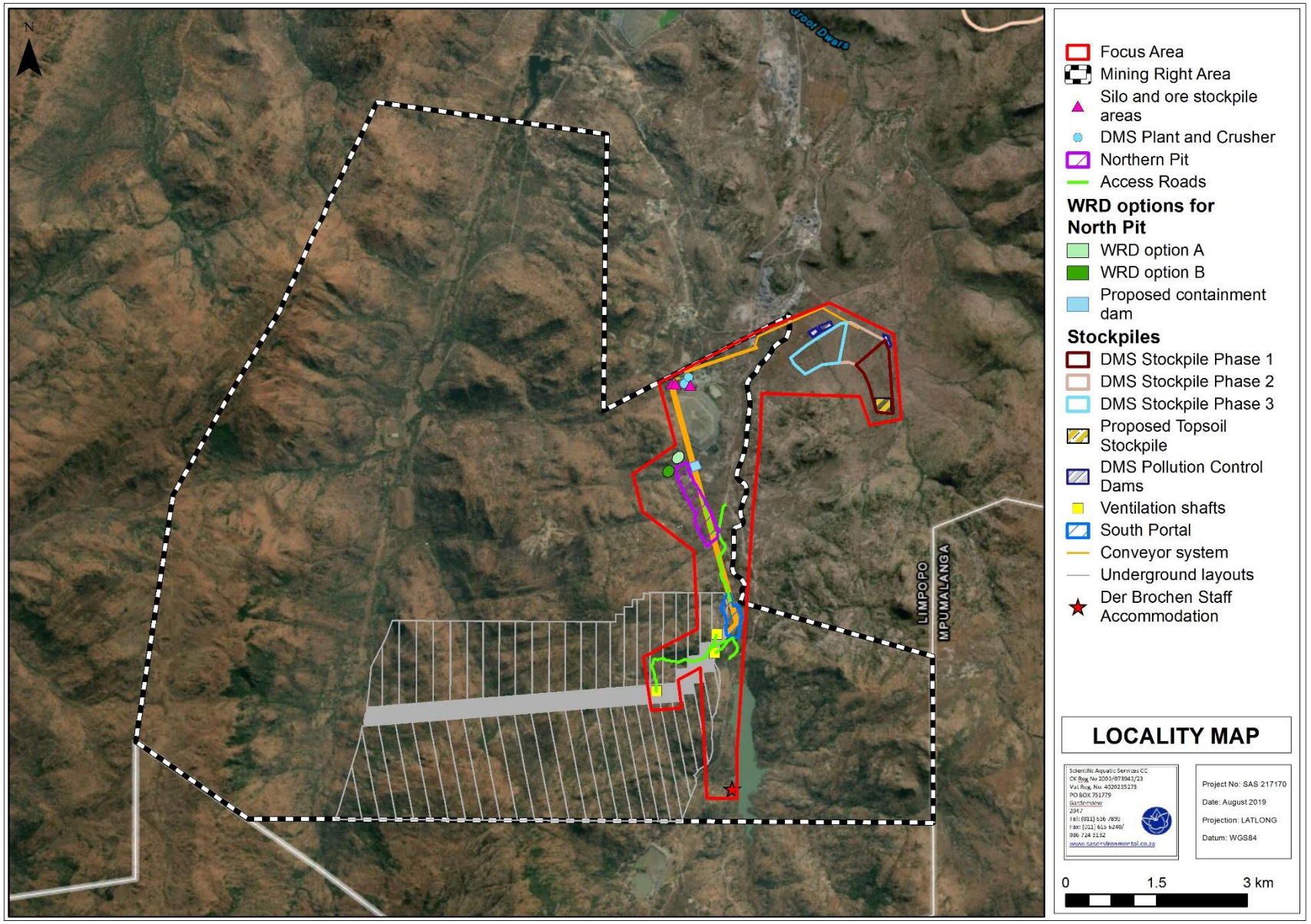


Figure 1: A digital satellite image depicting the location of the proposed Der Brochen mine expansion in relation to the greater MRA.

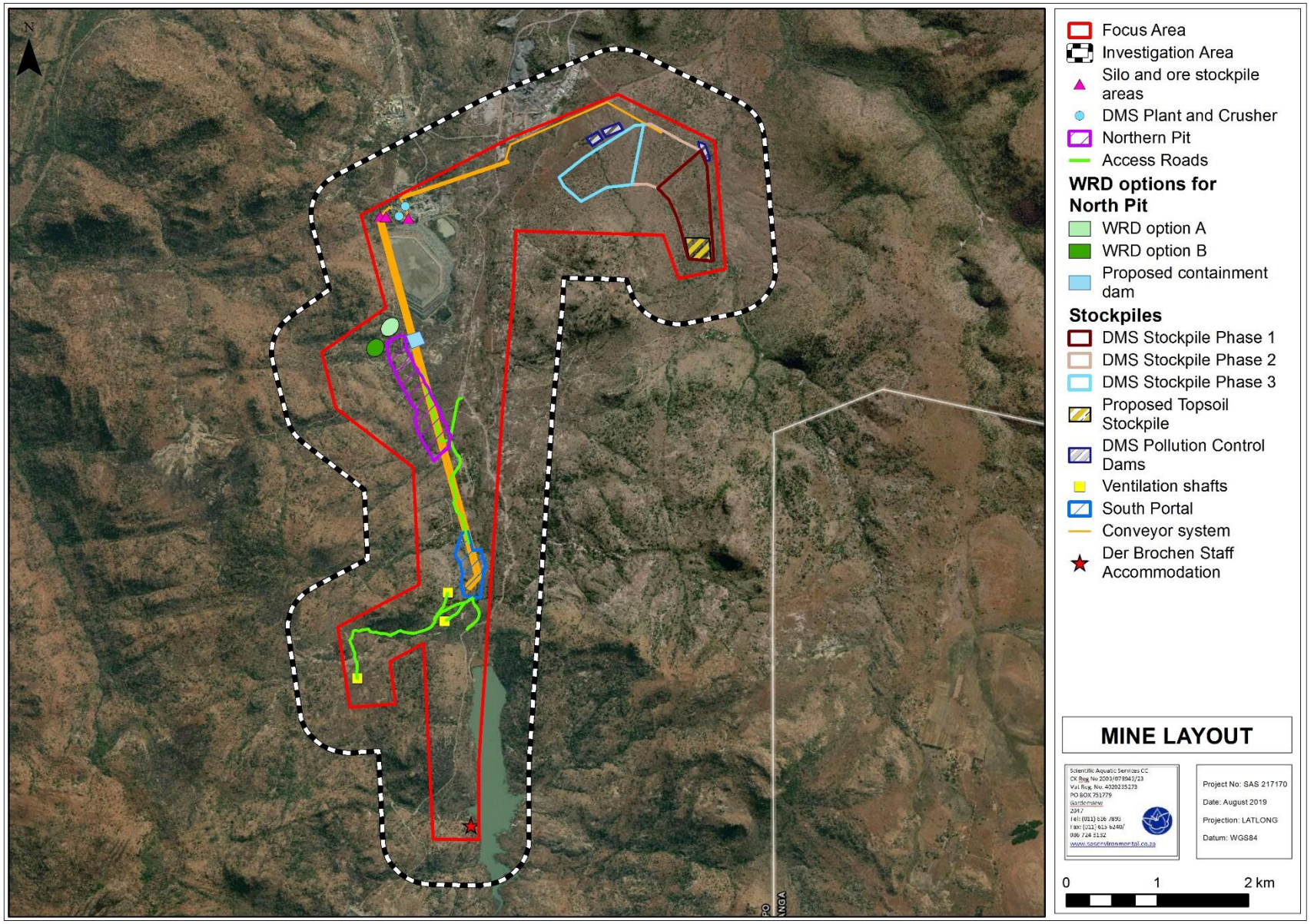


Figure 2: A digital satellite image depicting the location of the proposed Der Brochen mine expansion and the 500m investigation area in relation to the surrounding area.

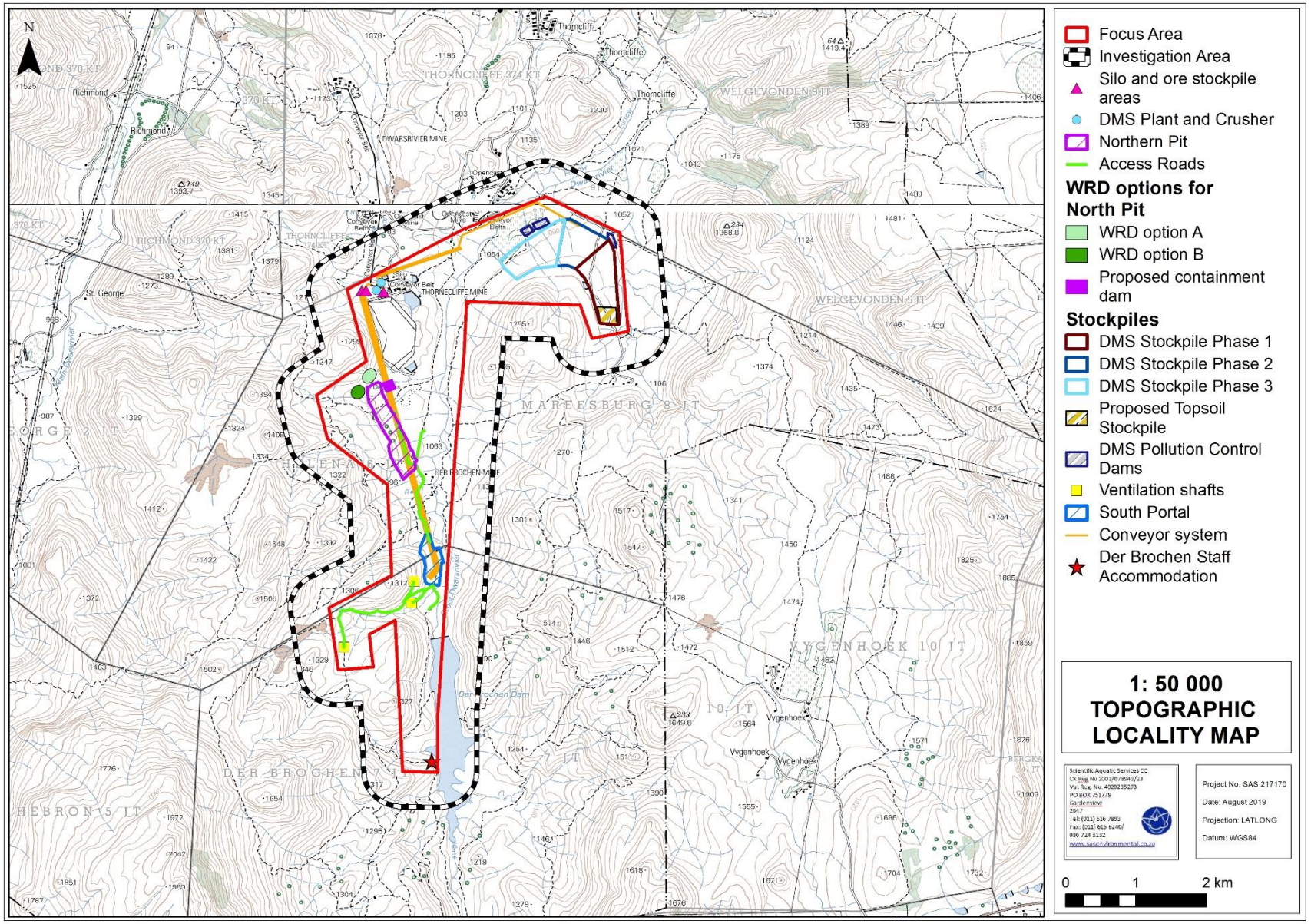


Figure 3: The proposed Der Brochen mine expansion and investigation area depicted on a 1:50 000 topographical map in relation to the surrounding area.

1.3 Scope of Work

Specific outcomes in terms of this report are outlined below:

- A background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database; the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS] 2014 database) and the Limpopo Conservation Plan Version 2 (2013) was undertaken to aid in defining the PES and EIS of the freshwater resources;
- Freshwater resources were delineated according to "DWAF[2], 2008: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". Aspects such as soil morphological characteristics, vegetation types and wetness were used to delineate the freshwater resources;
- All freshwater resources within 500m of the focus area were delineated on a desktop basis in accordance with Regulation 509 of 2016 as it pertains to the NWA, 2016;
- The wetland classification assessment was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The EIS of the freshwater resources were determined according to the method described by Rountree & Kotze, (2013);
- The services provided by the freshwater resources associated with the focus area were assessed according to the method of Kotze *et al.* (2009) in which services to the ecology of the site as well as services to the people of the area were defined;
- The PES of the freshwater resources was determined according to the Wetland Index of Habitat Integrity according to the method described by the DWA (2007);
- Freshwater resources were mapped according to the ecological sensitivity of the hydrogeomorphic unit in relation to the focus area. In addition to the freshwater resource boundaries, the appropriate provincial recommended buffers and legislated zones of regulation were depicted where applicable;
- Allocation of a suitable REC to the freshwater resources based on the results obtained from the PES, Ecoservices and EIS assessments;
- To determine the impact that the project might have on the freshwater resources as a result of the proposed mining activities and to aim to quantify the significance thereof; and

[2] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA). At present, the Department is known as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving environment.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The determination of the freshwater resource boundaries and the assessment thereof, is confined to the focus area. The freshwater resources within 500m of the focus area were delineated in fulfilment of Regulation GN509 of the NWA using various desktop methods including use of topographic maps, historical and current digital satellite imagery and aerial photographs. The general surroundings were, however, considered in the desktop assessment of the focus area;
- Due to the terrain, portions of some drainage systems were inaccessible particularly in the eastern portions of the focus area. Nonetheless, sufficient data was gathered during the site assessment to enable accurate delineations using desktop methods where necessary to augment the delineations undertaken in the field;
- Similarly, portions of the investigation area, particularly in the north and west were inaccessible due to these being restricted areas (active mining areas). Thus, whilst every effort was made to ensure that all freshwater resources potentially within the 500m investigation area were identified and delineated, less distinct features within these access-controlled areas may not have been identified. Nevertheless, where information had been obtained during the course of previous studies in these areas, such data was utilised in this report where necessary;
- It is stated in Section 4 of this report that numerous poorly defined preferential surface flow paths (PSFPs) were identified within the focus area. It should be noted that in the previous assessment undertaken by SAS (2014), these preferential surface flow paths were indicated on the various figures depicting the locality of identified drainage systems, however, since these weakly defined PSFPs were not assessed in this study as they are not considered to have characteristics associated with either wetland or riparian resources, they have not been depicted on the figures contained in this report;
- The delineations as presented in this report are thus regarded as a best estimate of the riparian zones associated with ephemeral drainage lines and the Groot Dwars River based on the site conditions present at the time of assessment;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more

accurate assessments are required the wetland will need to be surveyed and pegged according to surveying principles and with survey equipment;

- Wetland, riparian and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the freshwater resource boundary may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results;
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the proposed development activities have been accurately assessed and considered, based on the field observations and the consideration of existing studies and monitoring data in terms of riparian and wetland ecology;
- The results of the integrated impact assessment undertaken for the aquatic and freshwater (riparian) resources are presented in Section C[3]; and
- In addition to the above, it should be noted that at the time that this study was conducted neither a geohydrological study or a surface water study had been completed for the proposed Der Brochen Amendment project. Therefore, whilst potential risks such as decant from the proposed underground shaft, the development of a groundwater pollution plume, and loss of catchment yield were considered in the impact assessment, accurate assessment of the significance thereof could not be determined since the aforementioned data had not been generated.

1.5 Legislative Requirements and Provincial Guidelines

The following legislative requirements and relevant provincial guidelines were taken into consideration during the assessment. A detailed description of these legislative requirements is presented in Appendix B:

- Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA)
- National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA)
- National Water Act, 1998 (Act 36 of 1998) (NWA);
- General Notice (GN) 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA, 1998 (Act 36 of 1998); and

[3] *Freshwater Resource and Aquatic Ecological Assessment for the Proposed Anglo Platinum Der Brochen Project, Limpopo Province. Section C: Integrated Impact Assessment and Mitigation. SAS,* 2018. Prepared by Scientific Aquatic Services for SRK Consulting (Pty) Ltd. Specialist report. Unpublished.

- Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the NWA, 1998 (Act 36 of 1998) regarding the use of water for mining and related activities aimed at the protection of water resources.

2 ASSESSMENT APPROACH

2.1 Freshwater Resource Field Verification

For the purposes of this investigation, the definition of watercourses, wetland and riparian systems was taken as per that in the National Water Act (1998). The definitions are as follows:

A **watercourse** means:
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) 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.

Wetland habitat is “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.”

Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure **distinct** from those of adjacent areas.

As mentioned in Section 1.4 use was made of historical aerial photographs, historical and current digital satellite imagery, topographic maps and available provincial and national wetland databases to aid in the delineation of the freshwater resources located within 500m of the focus area following the field assessment. The following was taken into consideration when utilising the above during delineation:

- Hydrophytic and riparian vegetation: a distinct increase in density, changes in species composition, as well as tree size near drainage lines;

- Hue: with wetlands, riparian areas and drainage lines displaying varying chroma created by varying vegetation cover and soil conditions in relation to the adjacent terrestrial areas; and
- Texture: with wetland and riparian areas displaying various textures which are distinct from the adjacent terrestrial areas, created by varying vegetation cover and soil conditions within the watercourse.

The freshwater resource delineation was verified in the field, and this delineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). The foundation of the method is based on the fact that freshwater resources have several distinguishing factors including the following:

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

A field assessment was undertaken in February 2018, during which the presence of any riparian or wetland characteristics as defined by DWAF (2008) and by the NWA, were noted (please refer to Section 4 of this report). In addition to the delineation process, detailed assessments of the delineated freshwater resources were undertaken, at which time factors affecting the integrity of the freshwater resources were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the freshwater resource. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

2.2 Sensitivity Mapping

All freshwater resources associated with the focus area were delineated with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project these features onto digital satellite imagery and topographic maps. The sensitivity map presented in Section 4.4 should guide the design and layout of the development.

2.3 Risk and Impact Assessments and Recommendations

Following the completion of the assessment, a risk assessment as well as a pre-defined impact assessment supplied by the EAP was conducted (please refer to Section C [SAS, 2018] for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed mining activities.

3 RESULTS OF THE DESKTOP ANALYSIS

The following section contains data accessed as part of the desktop assessment and are presented as a "dashboard" style report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided, and information that was considered of particular importance was emboldened.

It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the focus area's actual site characteristics at the scale required to inform the environmental authorisation and/or water use licencing processes. However, this information is considered useful as background information to the study. Thus, this data was used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance.

Table 1: Desktop data relating to the character of freshwater resources within the focus area and surrounding region.

Aquatic ecoregion and sub-regions in which the focus area is located	
Ecoregion	Eastern Bankenveld
Catchment	Olifants North
Quaternary Catchment	B41G
WMA	Olifants
subWMA	Steelpoort
Dominant characteristics of the Eastern Bankenveld (9.03)	
Dominant primary terrain morphology	Closed hills, mountains, moderate and high relief, low mountains
Dominant primary vegetation types	Mixed Bushveld,
Altitude (m a.m.s.l)	500-2300
MAP (mm)	400-700
Coefficient of Variation (% of MAP)	20-34
Rainfall concentration index	55-64
Rainfall seasonality	Early Summer
Mean annual temp. (°C)	14-22
Winter temperature (July)	2-20
Summer temperature (Feb)	12-30
Median annual simulated runoff (mm)	20-150

Detail of the focus area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The focus area falls within a sub quaternary catchment reach considered to be Freshwater Ecosystem Priority Area (FEPA). River FEPAs achieve biodiversity targets for river ecosystems and threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). Although the FEPA status applies to the actual river reach, the status indicates that the surrounding land and smaller stream network needs to be managed in a way that maintains the good condition of the river reach.
NFEPA Wetlands	An artificial channelled valley bottom wetland with small areas considered to be natural is indicated by NFEPA at the southern end of the focus area. This wetland is indicated by NFEPA to be heavily to critically modified (Figure 3) and was verified during the site assessment as the Der Brochen Dam.
Wetland Vegetation Type	The focus area falls within the Critically Endangered Central Bushveld Group 1 WetVeg group.
NFEPA Rivers (Figure 3)	The Groot Dwars River traverses the central portion of the focus area in a south to north direction. According to the NFEPA database the Groot Dwars River is in a natural and unmodified or largely natural with few modifications (RIVCON AB), and the DWS PES 1999 data indicate this river to be in a largely natural condition (PES 1999 Class B). An unnamed tributary of the Groot-Dwars River traverses the north-eastern portion of the investigation area and is indicated by NFEPA to be in a natural condition with few modifications.
Detail of the focus area in terms of the Limpopo Conservation Plan (2013) (Figure 4)	
Critical Biodiversity Area 1 (CBA1)	The majority of the focus area falls within an area considered to be a CBA1. These are irreplaceable areas required to meet biodiversity pattern and/or ecological process targets, and no alternative sites are available to meet targets.
Ecological Support Areas (ESA)	A small area located in the north western portion of the focus area (in the region of the existing Mototolo Concentrator) is considered to be an ESA2. These are areas where no natural habitat remains but that important for meeting ecological processes.

Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 6)			
Sub-quaternary reach	B41G – 00721 (Groot Dwars River)	B41G – 00726 (unnamed tributary of Groot Dwars River)	B41G – 00674 (Groot Dwars River)
Proximity to focus area	Traversing central portion of focus area	Traversing upper Eastern portion of focus area	Approximately 1km north of focus area
Assessed by expert?	Yes	Yes	Yes
PES Category Median	C (Moderate)	B (High)	D (Low to very low)
Mean Ecological Importance (EI) Class	High	High	High
Mean Ecological Sensitivity (ES) Class	Very High	Very High	Very High
Stream Order	1.0	1.0	2.0
Default Ecological Class (based on median PES and highest EI or ES mean)	A (Very High)	A (Very High)	A (Very High)

Importance according to the Mining and Biodiversity Guidelines (2013) Figure 5	
Highest Biodiversity Importance	The entire focus area is situated within an area currently considered to be of highest biodiversity importance. Highest Biodiversity Importance areas include areas where mining is not legally prohibited, but where there is a very high risk that due to their potential biodiversity significance and importance to ecosystem services (e.g. water flow regulation and water provisioning) that mining projects will be significantly constrained or may not receive necessary authorisations.

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State WMA = Water Management Area.

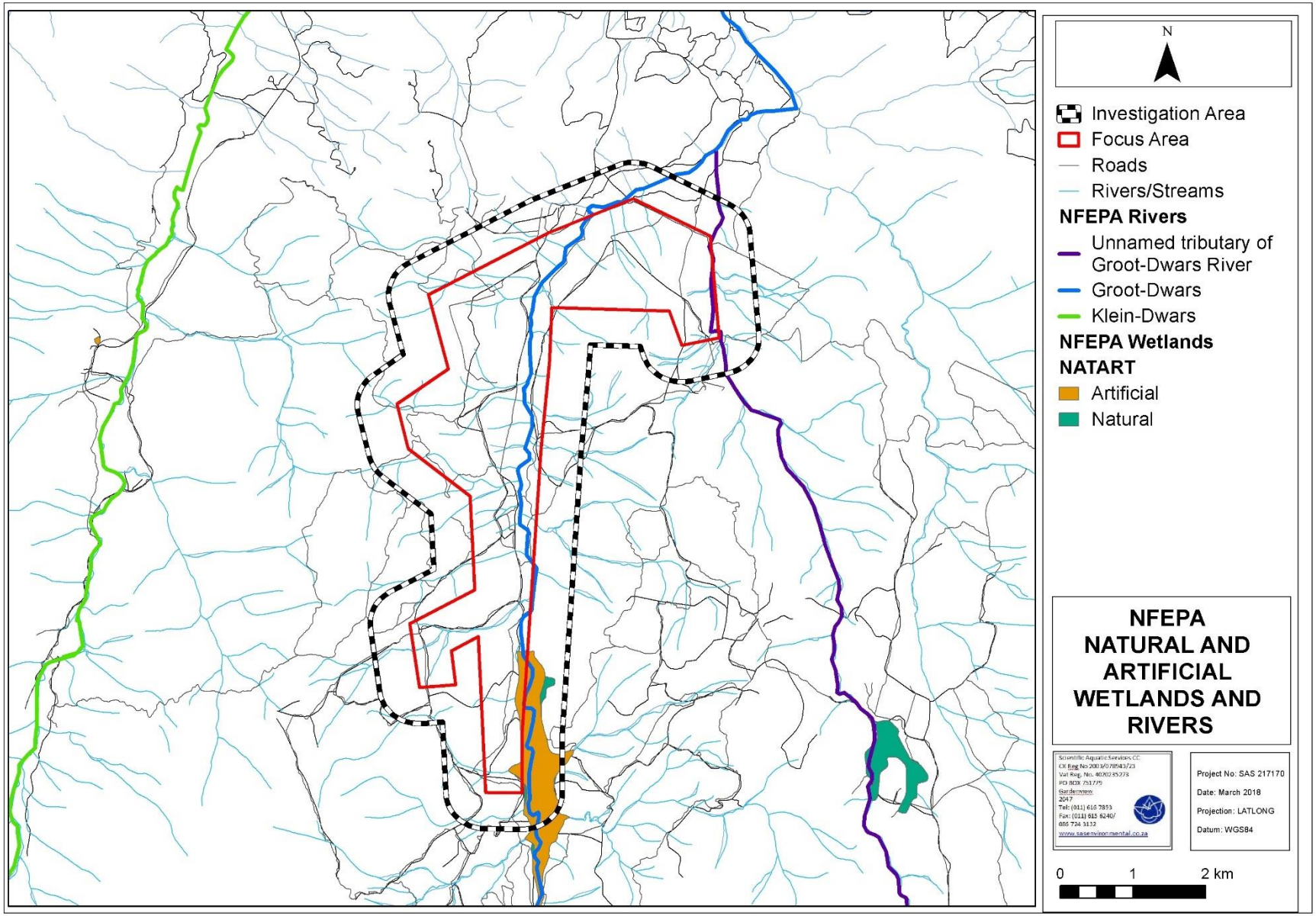


Figure 4: Wetland features and river systems associated with the focus area, according to the NFEPA Database (2011).

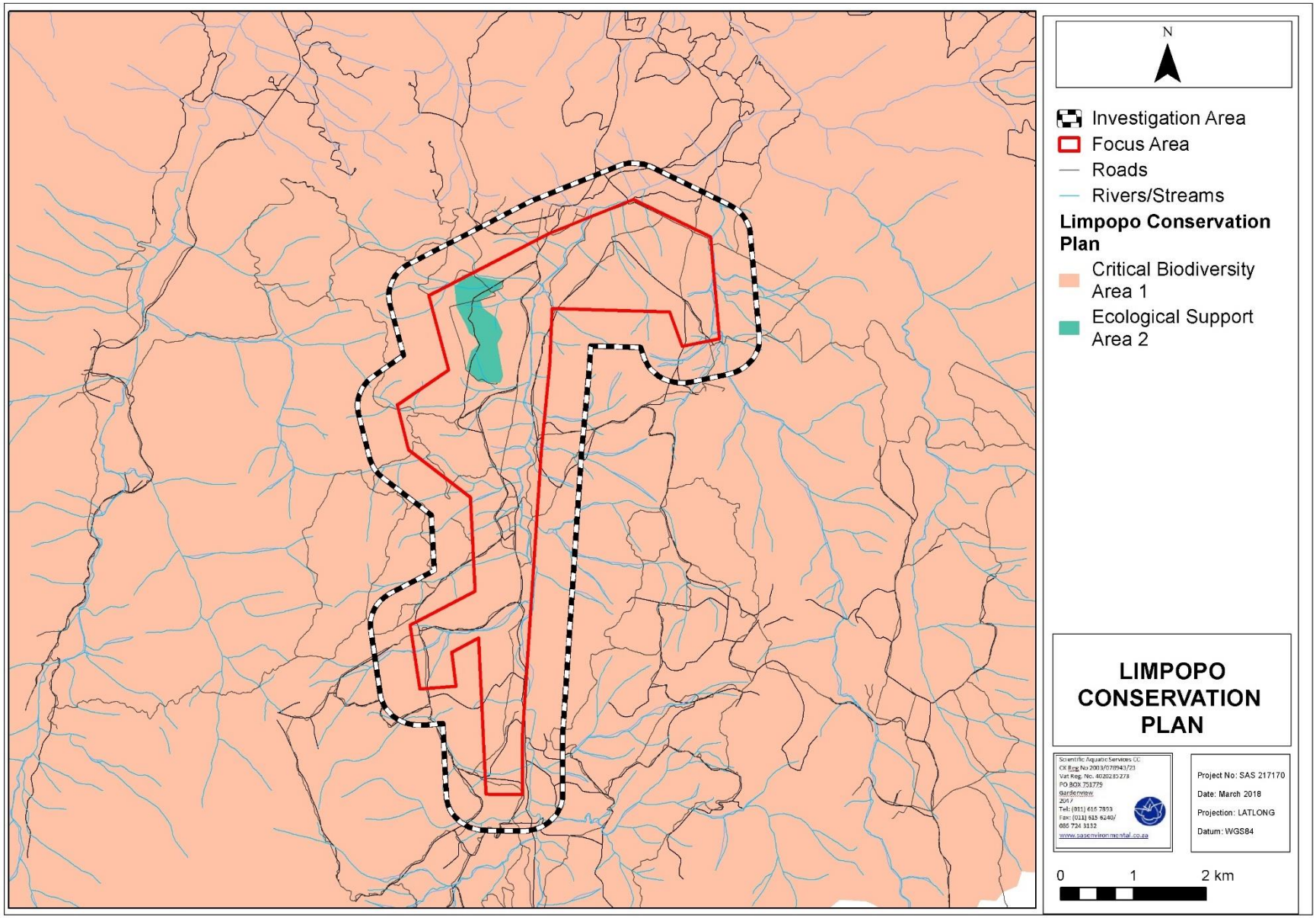


Figure 5: Critical Biodiversity Areas (CBAs) and an Ecological Support Area (ESA) associated with the focus area (Limpopo C-Plan, 2013).

4 RESULTS: FRESHWATER RESOURCE ASSESSMENT

4.1 Freshwater Resource System Characterisation

As noted by SAS (2014), numerous drainage systems occur within the Der Brochen mine property, including the Groot Dwars River and an unnamed tributary of the Groot Dwars River, known locally as the Mareesburgspruit. Several of these drainage systems, including a portion of the Groot Dwars River, are within or partially within the focus area and were defined as ephemeral drainage lines (EDLs) with associated riparian vegetation.

Although hillslope seepage and bench wetlands were identified within the greater Der Brochen property, none were identified directly within the areas identified for development of the proposed mining infrastructure or within 500m of the proposed activities and were therefore not assessed during this study.

In addition to the ephemeral drainage lines, numerous smaller, poorly-defined preferential surface flow paths were identified. From an ecological perspective these are not considered to have riparian characteristics associated with true riparian zones; however, it must be noted that should it be determined by a suitably qualified hydrologist that floodlines are applicable to any of these features, they will be legally defined as watercourses and as such will enjoy legal protection. However, for the purposes of this study, the preferential surface flow paths were not assessed nor indicated on the figures within this report.

Due to the numerous drainage systems identified, as well as the relatively homogenous characteristics of these systems, for assessment and discussion purposes, the drainage systems were grouped according to their location in relation to the proposed focus area as follows:

- Group 1: all systems situated to the west of the Der Brochen dam and approximately 1.4km to 4.7km south of the Mototolo concentrator. These were previously assessed as Groups 1 and 2 by SAS (2014);
- Group 2: systems located immediately north, south and east of the Mototolo concentrator (previously included in Group 2 by SAS [2014]); and
- Group 3: systems located in the north-west of the property, on the Mareesburg farm, west of the Tailings Storage Facility (TSF) that is currently under construction (previously assessed by SAS [2014] as Group 3).

The Groot Dwars River was not included in any of the above groupings and was assessed separately. Please refer to Figure 6 below for the location of these freshwater resources and the groupings in which they were assessed and discussed.

Table 2: Characterisation of the drainage systems associated with the focus area according to the Classification System (Ollis *et. al.,* 2013)

Freshwater Resources	Level 3: Landscape unit	Level 4: HGM Type
Group 1: those between 1.5km-4.7km south of Mototolo concentrator and west of the Der Brochen dam	**Valley floor:** The base of a valley, situated between two distinct valley side-slopes.	**River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
Group 2: immediately south, north and east of the Mototolo concentrator		
Group 3: Mareesbug farm, in the vicinity of the TSF		
Groot Dwars River		

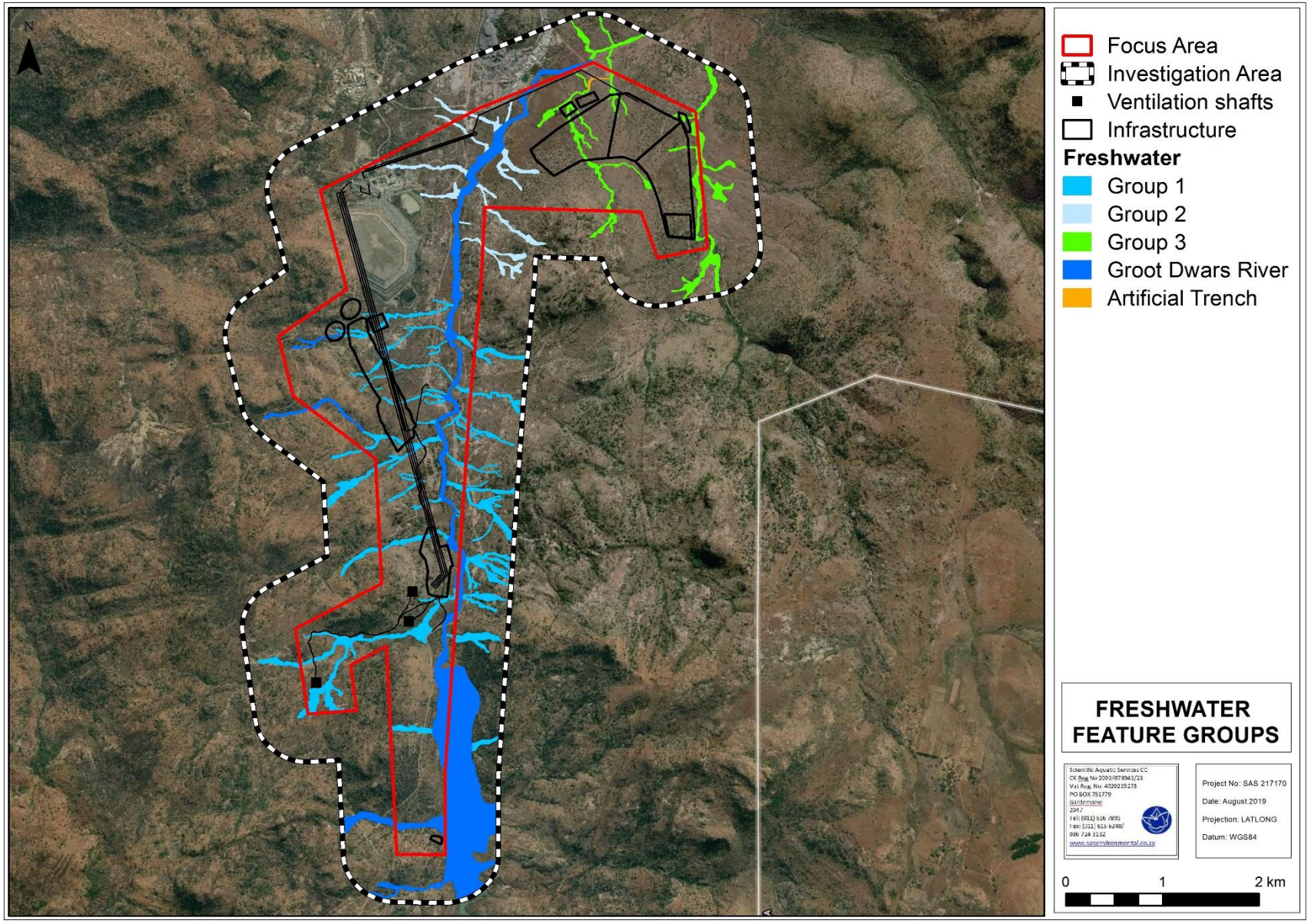


Figure 6: The location of the various drainage systems (and their groupings) identified within the focus area and investigation area.

4.2 Field Verification Results

The tables below summarise the findings of the field verification in terms of relevant aspects (hydrology, geomorphology and vegetation components) of freshwater ecology, for the identified freshwater resources. The details pertaining to the method of assessment used to assess the various resources is contained in Appendix C of this report.

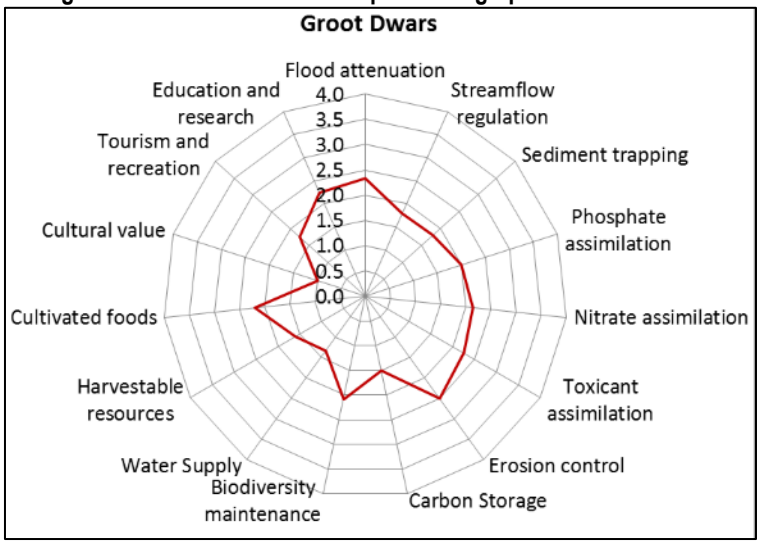
It should be noted that whilst consideration is given to water quality in line with the requirements of the DWS, comprehensive water quality testing did not form part of the scope of this study although testing of basic water quality parameters (pH, temperature and Electrical Conductivity [EC]) did take place at various points throughout the focus area, where sufficient surface water was present. In addition, SAS has undertaken aquatic biomonitoring on the Groot Dwars and Klein Dwars Rivers bi-annually since 2008 and was also appointed to undertake an aquatic ecological assessment of the Groot Dwars River as part of the environmental authorisation process for the proposed expansion, and therefore, this data was taken into account in this study. Consideration was also given to water quality information contained within available databases, as well as the anticipated impacts of the surrounding land uses within the catchment on water quality.

Furthermore, it should be noted that although the WET-Health (Macfarlane *et. al*, 2008) method of assessment is a widely accepted and more recent method of assessment, the Wetland Index of Habitat Integrity (WET-IHI) method developed by DWAF (2007) was utilised for the purposes of this study, in order to provide comparable results with the previous assessment undertaken by SAS (2014). The WET-IHI method also takes into account water quality considerations, which WET-Health does not. The Groot Dwars River was assessed using the IHI and VEGRAI tools.

Figures 7 and 8 following the “dashboard” reports below conceptually depict the PES and EIS of the various resource groups.

Table 3: Summary of the assessment of the Groot Dwars River.

Ecological & socio-cultural service provision graph:



PES discussion

PES Category: Instream IHI PES Category B, Riparian IHI PES Category C

The Dwars River has been subjected to a variety of impacts over several decades, most obviously impoundment (i.e. the Der Brochen Dam). This will have impacted flow regimes; however the dam will also play a significant role in sediment trapping. Several road crossings of the Dwars River were observed, and although not observed during the site assessment, weirs were noted during analysis of digital satellite imagery approximately 1,3km upstream and 2km downstream of the Der Brochen Dam. Vegetation community composition remains largely natural, although alterations to species composition was also noted within the more disturbed areas (for example, around road crossings).

In Government Gazette Number 39943 issued 22 April 2016, it is indicated that the Klein Dwars River at the confluence with the Groot Dwars River (quaternary catchment B41G), should be maintained at Ecological Category D. For the overall Steelpoort River (quaternary catchment B41K), it is also stated that an Ecological Category D should be maintained. It is thus clear that catchment wide impacts have occurred, and that the system is recognised as being a "working river" (SAS, 2017).

Fatal Flaw?	**N**	**Photograph notes**	Representative photographs of the Groot Dwars River

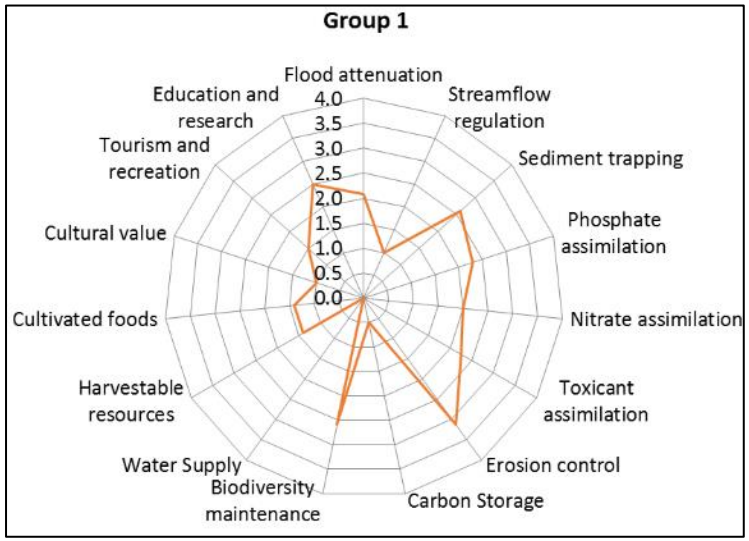
Watercourse characteristics:

a) Hydraulic regime

As mentioned in the PES discussion, the Der Brochen Dam is considered to be the most significant modifier of the hydraulic regime of the Dwars River, as the impoundment will result in reduction of flows and alteration of natural flood peaks and recharge of floodplains downstream of the dam. However, other instream infrastructure such as weirs are present (albeit not within the area assessed for the purposes of this study) and these will also have an impact on flow patterns.

Ecoservice provision	**Intermediate** The Groot Dwars River is considered to provide intermediate levels of ecological service provision, particularly in terms of benefits such as flood attenuation, streamflow regulation, and assimilation of nutrients and toxicants. Whilst the Der Brochen property, and other mining properties adjacent to Der Brochen are largely restricted access areas, when assessing socio-cultural benefits provided by the river, consideration was given to portions of the river which are accessible to local communities. Thus, benefits such as harvestable resources (e.g. fish) and tourism are considered possible, if not directly within the Der Brochen property.	**b) Water quality** According to SAS (2017), water quality within the Groot Dwars River generally complies with expected/natural water quality ranges, although slightly elevated Electrical Conductivity (EC) has been recorded downstream of the Mototolo Concentrator. However it should also be noted that this increased EC is compounded by upstream pollution sources and contributions from natural geomorphological processes. **c) Geomorphology and sediment balance** Whilst the Der Brochen dam is considered to be a notable modifier of the geomorphology of the Dwars River, this modification is static and limited to a relatively small portion of the river. Increased sediment inputs to the river are anticipated as a result of ongoing disturbances in the catchment, largely relating to mining activities. This may in time lead to smothering of biota, streambed alterations and bank incision, although at the time of the assessment, such modifications were not observed.
EIS discussion	**EIS Category: Very High** Although the river has been impacted by various activities such as agriculture and mining, it is nevertheless considered to be ecologically important from the perspective that it provides faunal migratory corridors, breeding and foraging habitat, and contributes to the functioning of downstream systems, as well as maintenance of key hydraulic processes within the assessment area (such as flood attenuation). Furthermore, as a "working system" it is considered important for the provision of water for economic use.	**d) Habitat and biota** Riparian habitat associated with the portion of the Groot Dwars River within the focus area remains largely intact, with removal of vegetation only occurring in areas where infrastructure (such as roads) has been constructed. As the major drainage system within the focus area, it provides ample breeding and foraging habitat for a variety of fauna, provides essential connectivity with other natural areas and is considered an important faunal migratory corridor.
REC Category	**Category C/D** Whilst the Government Gazette Number 39943 indicates that an Ecological Category D should be maintained for the Groot Dwars / Klein Dwars confluence, those sections of the Groot Dwars which remain in a higher ecological category should nevertheless be maintained as such. Thus, efforts must be made within the expansion area to minimise direct and indirect impacts on the portion of the river which is within close proximity to and downgradient of the focus area.	**Possible significant impacts, business case, conclusion and mitigation requirements:** Based on the layout provided by the proponent for the purposes of this study, the Groot Dwars River is unlikely to be directly affected by the activities associated with the proposed expansion. However, indirect and cumulative impacts may occur, as the proposed North Opencast Pit (previously authorised) and South Decline Shaft are located upgradient of the river. Additionally, numerous freshwater resources in the western portion of the focus area drain into the river, and these will be affected by the proposed activities (in particular the North Opencast Pit, southern-most WRD for the open pit, and auxiliary infrastructure associated with the South Decline Shaft). Indirect impacts which may occur include risk of spills and decant from the North Opencast Pit and the South Decline Shaft, changes to hydrology (if upgradient drainage lines are impacted, loss of recharge to the Groot Dwars River may occur) and increased sedimentation as soils upgradient of the river are disturbed during construction particularly. The barrier formed by a major access road which runs parallel to the river (between the river and the proposed expansion area) may reduce the possibility of such impacts occurring; nevertheless it is very important that mitigation measures be implemented throughout all phases of the proposed project to minimise the risk of indirect impacts on the Groot Dwars River.

Table 4: Summary of the assessment of the Group 1 drainage systems, located west of the Der Brochen dam, and far south of the Mototolo concentrator.

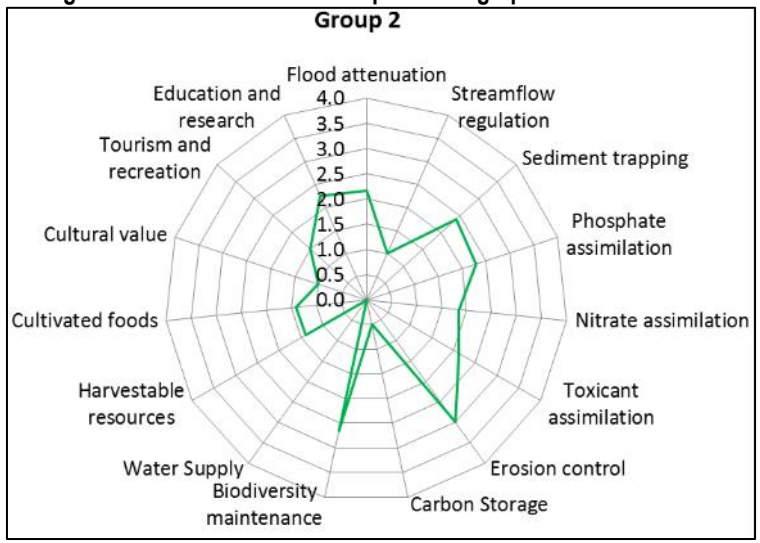
<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td colspan="4">   </td></tr>
<tr><td rowspan="2">PES discussion</td><td rowspan="2">PES Category: B/C
The most significant modifier of these systems is the access road, which runs north to south adjacent to the Der Brochen dam, as culverts have been installed under the road. Few other modifiers were observed in these areas, since active mining has not yet commenced, although some exploratory drilling has occurred in recent months. Various farm roads, which have subsequently been utilised by drill rigs, traverse the area and could potentially contribute to increased sedimentation of some of the drainage systems, however the impacts associated with such activities is minimal.</td><td>Fatal Flaw?</td><td>Possibly, if suitable diversions are not done</td><td>Photograph notes</td><td>Representative photographs of a well-defined ephemeral stream (left) and a smaller, less well-defined ephemeral drainage line with riparian vegetation (right) within the southern areas of the focus area.</td></tr>
<tr><td colspan="4">Watercourse characteristics:
a) Hydraulic regime
The primary modifier of the hydraulic regime of the majority of these systems is the access road which runs from north to south, parallel to the Groot Dwars River and the Der Brochen dam, as the installation of culverts under the road has altered flow patterns insofar as flow will become slightly concentrated through the culverts. However, no other flow-impeding structures or channel alterations could be discerned, either during the site assessment or during analysis of digital satellite imagery.</td></tr>
<tr><td>Ecoservice provision</td><td>Intermediate
These drainage systems were found to have intermediate levels of ecological service provisioning, particularly in terms of functions such as erosion control, nutrient and toxicant assimilation, sediment trapping and to a lesser extent, flood attenuation. These are largely attributed to the relatively intact vegetation profiles of these systems, particularly in the upper reaches which are largely inaccessible except on foot. They are considered important for biodiversity maintenance (floral diversity and faunal migratory</td><td colspan="4">b) Water quality
Only one large drainage system in this group (as shown in the photograph on the left, above) had sufficient surface water at the time of the assessment to allow for testing of basic water quality parameters, although it should be noted that the flow at the time was low, which may contribute to increased salts and turbidity. The pH of 8.41 can be considered within normal range. Electrical Conductivity (EC) was 30mS/m and turbidity was 150ppm. These values are in line with natural background values for the area, which has naturally elevated salts due to the geology of the region.

c) Geomorphology and sediment balance
Geomorphology has primarily been modified due to the aforementioned access road, as this has not only impacted on hydraulic connectivity, but has also resulted in the total loss of portions of certain drainage systems, even though hydraulic connectivity has been retained by means</td></tr>
</table>

	corridors) but have limited socio-cultural potential, due to their relatively small size, but also due to accessibility challenges.	of culverts under the road. Nevertheless, aside from the relatively small sections affected by the road, geomorphology remains largely intact, although some areas of erosion and bank incision were observed in some of the larger drainage lines.
EIS discussion	**EIS Category: High** These systems, being in a largely natural condition and in a generally inaccessible area due to the terrain, are considered to be ecologically important insofar as they contribute to sustaining populations of threatened species, such as *Resnova megaphylla, Catha sekhukhunensis* and *Vitex obovata*, the primary source of breeding habitat for the Critically Endangered *Pycna Sylvia* (a species of cicada endemic to South Africa). Additionally, they provide important faunal migratory corridors and contribute to the continued ecological functioning of the catchment. They are likely to be sensitive to increased flood peaks, insofar as increased availability of water may influence changes in vegetation and utilisation by fauna.	**d) Habitat and biota** Again, with the exception of the portions affected by the main access road, habitat and faunal migratory connectivity is considered to be in a largely natural state, and the impact of the road appears to be minimal in terms of migratory corridors. As noted in the EIS discussion, the drainage lines contain populations of threatened species such as *Resnova megaphylla, Catha sekhukhunensis* and *Vitex obovata* (thus potentially providing habitat for the threatened *Pycna sylvia* cicada). However, some alien invasive floral species were observed where the road traverses the drainage systems, which is expected under the circumstances. Nevertheless, the extent of proliferation was not considered to be severe at the time of the assessment. The majority of the drainage systems were ephemeral, exhibiting predominantly riparian characteristics although some systems had hydrophytic vegetation growing within the active channel, however in all instances, vegetation composition and community structure is deemed to be relatively intact, with no significant modifications such as trampling or overgrazing observed.
REC Category	**Category B/C** These systems are largely ecologically intact and are considered important contributors to the ongoing functioning of the ecology of the area, as well as contributing to the functioning of the downgradient system (Groot Dwars River) despite reduced connectivity to the downgradient areas. Therefore, these systems must be conserved and protected as much as possible, and it is essential that connectivity of the larger, non-perennial systems retained.	**Possible significant impacts, business case, conclusion and mitigation requirements:** Based on the proposed infrastructure layout provided by the EAP in July 2019, significant risks are potentially posed to numerous ephemeral drainage lines within Group 1, in particular, those in the region of the proposed North Opencast Pit and to a lesser extent those in the vicinity of the proposed South Decline Shaft and associated infrastructure, and those which will be traversed by linear infrastructure (i.e. roads and conveyors). It is thus strongly recommended that further planning of the positioning of infrastructure within these areas be undertaken, taking into consideration the delineations presented in this report, and that as far as possible, freshwater resources be excluded from development areas. This is particularly applicable to the layout of auxiliary infrastructure associated with the South Decline Shaft. Should total avoidance of freshwater resources not be feasible, potential impacts on drainage lines in these development areas include (but is not limited to) total loss of riparian habitat in turn affecting recharge of downstream systems (i.e. the Groot Dwars River), loss of catchment yield due to the increase in impermeable surfaces as well as the presence of clean and dirty water separation systems, increased risk of sedimentation due to disturbed soils and increased risk of proliferation of alien vegetation due to the disturbances associated with the construction and subsequent operation of infrastructure. Thus, strict mitigation measures such as possible stream diversions, separation of clean and dirty water, erosion controls, soils management and alien vegetation control will need to be implemented throughout the life of mine. In addition, potential risks associated with the underground workings associated with the South Decline Shaft includes possible decant, and the formation of a groundwater pollution plume. However, the possibility of occurrence and the impact significance of these risks must be ascertained by a suitably qualified specialist.

Table 5: Summary of the assessment of the Group 2 drainage systems, located north, immediately south, and east of the Mototolo concentrator.

Ecological & socio-cultural service provision graph:



PES discussion

PES Category: C

The drainage systems in the vicinity of the Mototolo concentrator (i.e. between 100m to 1km away) have been subjected to a higher degree of disturbance. These impacts include clearing of vegetation during various construction and routine maintenance activities, regular disturbances to vegetation leading to altered floral species composition, increased impermeable surfaces leading to increase water inputs, and increased sedimentation.

Fatal Flaw?	Potentially, if suitable diversions are not put in place	Photograph notes	A well-defined ephemeral drainage line with marginal riparian vegetation and instream obligate vegetation (left) and a well-defined non-perennial riverine system (right), located in the north-east of the focus area, in the vicinity of the Mototolo concentrator.

Watercourse characteristics:

a) Hydraulic regime

The hydraulic regime of these drainage systems is likely to have been impacted as a result of the construction and ongoing operations of the Mototolo concentrator, insofar as the increase in impermeable surfaces is likely to have resulted in increased water inputs to the systems. This may in turn have led to altered hydroperiods of some of the drainage lines, causing changes to floral community composition and structure. In addition, hydraulic connectivity between the upper and lower reaches of these systems has been modified as a result of the construction of the main access road (as described in Table 6 above) and the related installation of culverts. Nonetheless, no additional instream flow modifiers (such as weirs) were noted during the site assessment and thus, the hydraulic regime is deemed to be moderately modified.

Ecoservice provision

Intermediate

Despite the slightly lowered ecological integrity of these systems, ecoservice provision is nonetheless deemed to be intermediate. Of particular importance are functions such as sediment trapping, assimilation of nutrients and toxicants (especially given their proximity to active mining operations) and biodiversity maintenance. As with the Group 1 systems, potential for providing socio-cultural benefits is low due to accessibility.

b) Water quality

Sufficient surface water was present within one non-perennial riverine system, located on the northern boundary of the concentrator. Whilst the pH (8.23) was considered within normal parameters, EC and turbidity was higher than measured elsewhere on site, at 150mS/m and 750ppm respectively. This indicates that the water quality has been significantly impacted. Since the assessment took place downgradient of the Mototolo concentrator, it is possible that the contaminated is associated with the concentrator. Water quality may also be impacted by contaminated runoff from road surfaces which is likely to be sediment-laden and contain hydrocarbons.

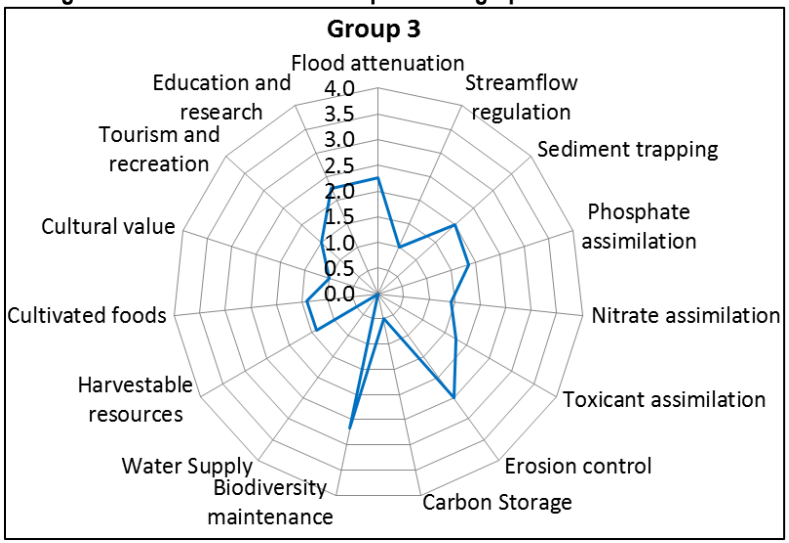
c) Geomorphology and sediment balance

Geomorphology of the various drainage systems in this vicinity have been moderately modified as a result of the construction of access roads which intersect various drainage lines, and which will also likely contribute to sedimentation of the systems.

EIS discussion	**EIS Category: High** As with the systems included in Group 1, these systems are considered to be of increased ecological importance, despite decreased ecological integrity, as they nevertheless provide important faunal migratory corridors. Occurrence of threatened species is more likely to be diminished and restricted to the upper reaches, due to ongoing anthropogenic activity in the lower reaches of the systems, however it is likely that these drainage systems are still utilised by a number of faunal species. As the majority of these systems are ephemeral, they are likely to be sensitive to increased flood peaks (which may occur with an increase in impermeable surfaces in the area.)	**d) Habitat and biota** Habitat has been moderately modified in terms of alterations to the vegetation community due to clearing or crushing during construction, and subsequently during routine maintenance activities. Smothering of vegetation has occurred in isolated areas downstream of the concentrator plant as a result of excess sediment entering the affected drainage systems. However, floral species composition and structure remains largely unimpacted and similar to less disturbed areas within the focus area and greater Der Brochen property, with minimal evidence of alien invasive vegetation at the time of the assessment.
REC Category	**Category C** As far as feasible, no further degradation of these systems should be permitted, and if necessary, the non-perennial system should be diverted if any future infrastructure is planned.	**Possible significant impacts, business case, conclusion and mitigation requirements:** As with the drainage lines included in Group 1, some of the drainage lines in Group 2 may potentially be directly impacted upon by the proposed project, specifically those traversed by linear developments. Based on the proposed project layout supplied by the EAP in July 2019, the project footprint has been optimised to prevent the direct encroachment on these drainage systems. Nevertheless, where linear infrastructure such as conveyors, mitigation measures to prevent impacts on the freshwater resources will be essential. Detailed mitigation measures are provided in the integrated risk assessment (SAS, 2018), but include measures such as ensuring that as much as feasible, support structures are not placed directly within the delineated watercourses, that sediment and erosion prevention measures are implemented prior to commencement of construction and measures to prevent spills from conveyors during operations.

Table 6: Summary of the assessment of the Group 3 drainage systems, located on the Mareesburg farm, west of the new TSF.

Ecological & socio-cultural service provision graph:



PES discussion

PES Category: C

Historical agricultural activities have contributed to the alteration of hydrology, geomorphology and vegetation, along with current activities such as game farming and the construction of the new TSF.

Ecoservice provision

Intermediate

These drainage systems, although of marginally decreased ecological integrity, are considered to be important in terms of providing ecological benefits such as nutrient and toxicant assimilation, sediment trapping, and erosion control. As with the Group 1 and Group 2 drainage systems, accessibility reduces the potential for socio-cultural service provision.

Fatal Flaw?	Potentially, if suitable diversions are not put in place	Photograph notes	Representative photographs of a non-perennial drainage system with riparian vegetation (left) and a lesser defined ephemeral drainage line (right) in the vicinity of the DMS complex on the Mareesburg farm. The non-perennial system depicted in the photograph on the left flows through the western portion of the DMS complex.

Watercourse characteristics:

e) Hydraulic regime

The hydrology of these drainage systems has been impacted by small impoundments, most likely relics of the agricultural era of the farm. A small furrow/canal was also observed parallel to one of the more well-defined drainage lines. The source of this canal was traced back to the southern headwaters of this drainage line. This diversion of water is likely to have an impact on the flow regime of the drainage line, as well as potentially on the vegetation and geomorphology.

f) Water quality

Testing of basic water quality parameters took place in the stream illustrated in the photograph (top left) on the Mareesburg farm. The pH of 7.90 is considered to be within normal background values, whilst EC and ppt were also low, at 50mS/m and 260ppm respectively. This is higher than expected for the area and elevated from baseline conditions, but is in line with recent data obtained from the biomonitoring programme.

g) Geomorphology and sediment balance

Geomorphology of some of the smaller drainage systems has been moderately modified as a result of road crossings, and in the lower-lying areas, by historical ploughing. Increased sediment inputs from the roads is anticipated, particularly at present since there is regular vehicular traffic in the eastern portions of the farm, due to the construction of the new TSF.

EIS discussion	**EIS Category: High** As with those systems in Group 2, despite the reduced ecological integrity, the drainage systems in Group 3 are nonetheless deemed to be ecologically important, largely due to their importance as breeding and foraging habitat, as well as providing faunal migratory corridors. Additionally, the ephemeral systems are likely to be sensitive to increased flood peaks.	**h) Habitat and biota** Alterations to the vegetation community have occurred more regularly and more extensively in this vicinity, firstly as a result of historical agricultural activities, and latterly due to game farming and mining activities. However, whilst a greater degree of alien invasive flora was observed in the assessed areas and systems, the riparian floral community remains largely natural.
REC Category	**Category C** Several drainage systems (excluded from this assessment) have already been impacted on the Mareesburg farm as a result of the construction of the new TSF. Thus, in order to minimise the cumulative impacts on downgradient systems, it is important that no further degradation of the systems included in this assessment be permitted, as far as possible.	**Possible significant impacts, business case, conclusion and mitigation requirements:** Due to the construction of a new Tailings Storage Facility (TSF) on the eastern portion of the Mareesburg farm portion, the integrity of drainage systems in the vicinity of the proposed DMS complex on the same farm portion are already under threat. The drainage systems delineated (and indicated in the figures contained in this report) ultimately drain into the Groot Dwars River, therefore any impacts occurring on these drainage systems pose an indirect threat to the Groot Dwars River. This may lead to cumulative impacts on the river such as decreased recharge, altered sediment budget, and impacts on water quality. Whilst it is acknowledged that the placement of the DMS complex may be dictated by restrictions such as surface area rights, mining rights held by other mining houses in the area and operational/engineering requirements, if at all feasible the layout and positioning of the stockpiles and PCDs within the DMS complex should be carefully considered and optimised to minimise the loss of natural watercourses and associated riparian habitat. Should this not be feasible, very strict adherence to cogent, well-conceived mitigation measures will need to take place in order to minimise potential impacts on the downstream systems, including (but not limited to): careful design of the stockpiles and PCDs to prevent failure thereof including lining with suitable HDPE liners to prevent seepage and contamination of groundwater and surface water, implementation and regular monitoring/maintenance of clean and water dirty separation systems throughout the life of mine, erosion control and soil management,. In addition, in accordance with the mitigation hierarchy, it is strongly recommended that a watercourse and biodiversity offset strategy be investigated and implemented in order to compensate for the residual impacts on the drainage systems impacted by the DMS complex.

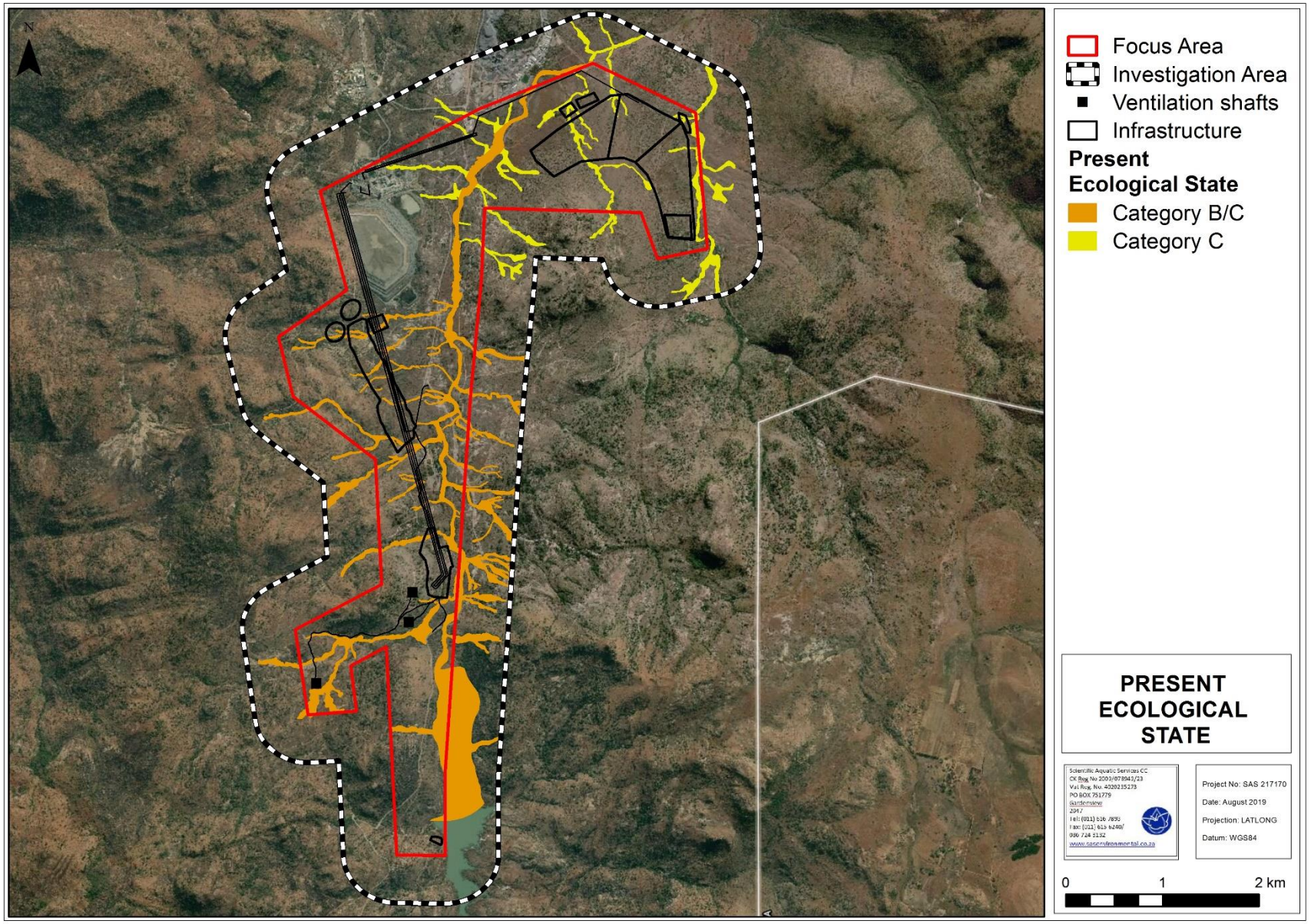


Figure 7: Conceptual presentation of the Present Ecological State (PES) categories applicable to the assessed freshwater resources.

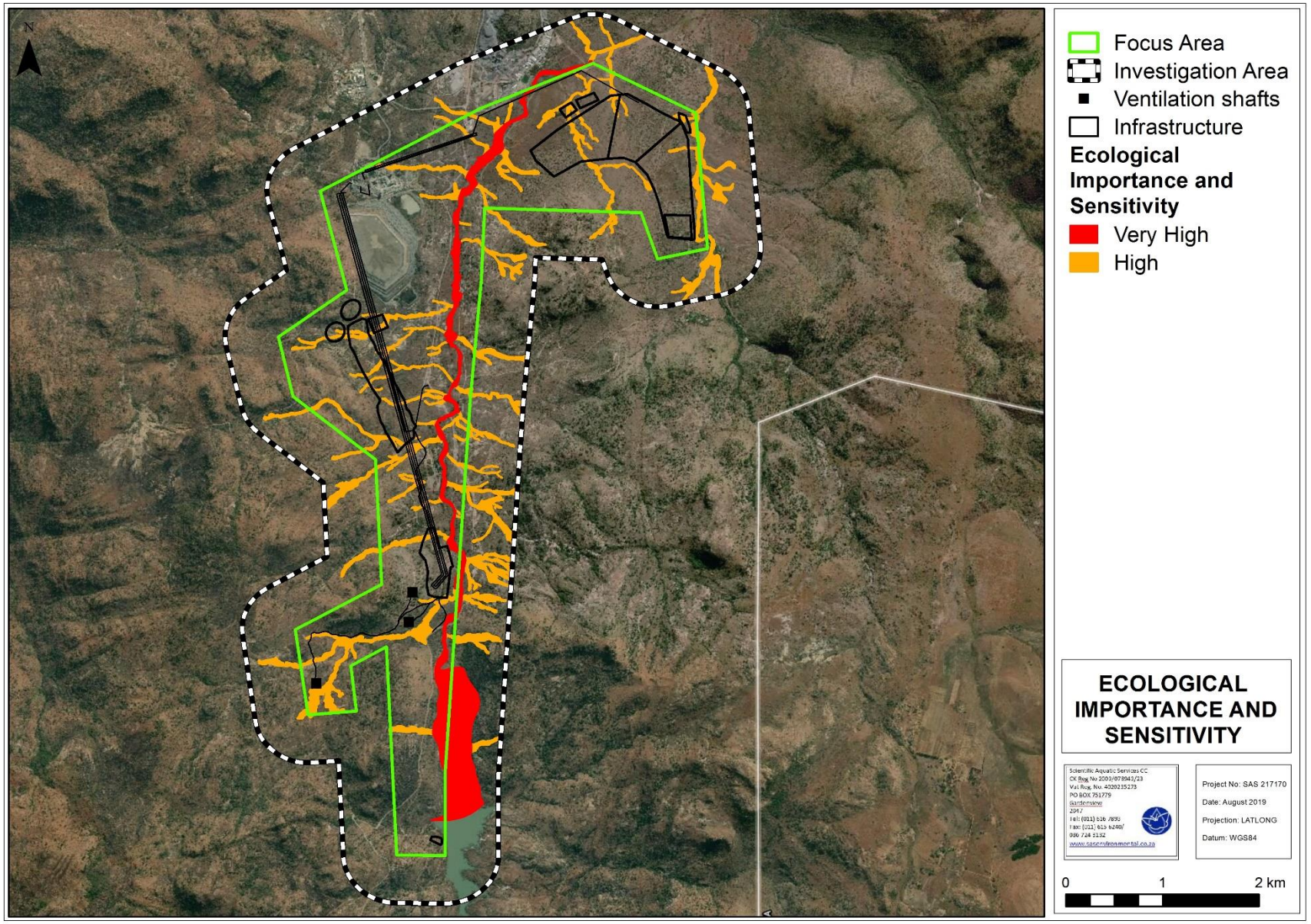


Figure 8: Conceptual presentation of the Ecological Importance and Sensitivity (EIS) of the assessed freshwater resources.

4.3 Delineation and Sensitivity Mapping

4.3.1 Delineation

As noted in Section 1.3, the freshwater resource delineation was limited to the focus area, although due to the nature of the terrain and access restrictions on the Mareesburg farm, field-verified delineations were refined and augmented with the use of aerial photographs, digital satellite imagery and topographical maps. The delineations as presented in this report are thus regarded as a best estimate of the riparian and temporary zone boundaries based on the site conditions present at the time of the assessment.

During the field assessment, the following indicators were used to delineate the boundaries of the drainage lines with riparian vegetation:

- Terrain units were used as the primary indicator, as the terrain of the focus area, particularly the eastern portions has well-defined low-lying areas where water is likely to collect and/or move through the landscape;
- Vegetation was utilised as a secondary indicator. Whilst floral species typically associated with saturated soils (such as sedges) were present in some of the larger, non-perennial systems, floral species composition in the riparian zones did not necessarily differ significantly from that of the surrounding terrestrial areas, although some species, such as *Resnova megaphylla, Catha sekhukhuniensis* and *Vitex obovata* were more prevalent in moist areas. However, increased floral density along drainage lines was usually a key indicator of increased soil moisture and this was therefore used to delineate riparian zones;
- Soil morphological characteristics typically associated with wetland conditions, such as gleying or mottling, are generally not present within the focus area, and therefore the soil indicator was not used extensively. However, feint mottling was observed in some of the poorly-defined drainage systems. These were therefore delineated as best as possible using a combination of the aforementioned indicators and included in the delineations presented in this report.

4.3.2 Legislative Requirements, national and provincial guidelines pertaining to the application of buffer zones

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be “a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from

another". Buffer zones are considered important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on water resources arising from upstream activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted however that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

The definition and motivation for a regulated zone of activity for the protection of the freshwater resources can be summarised as follows:

Table 7: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998)	In accordance with GN509 of 2016 as it relates to the NWA, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation, as well as General Notice no. 509 of 2016 as it relates to the NWA.
	GN 704 – Regulations on use of water for mining and related activities aimed at the protection of water resources, 1999 These Regulations, forming part of the NWA, were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the proposed project complies with Regulation GN 704 of the NWA, 1998 (Act no. 36 of 1998) which contains regulations on use of water for mining and related activities aimed at the protection of water resources. GN 704 states that: *No person in control of a mine or activity may:* *(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest.

Regulatory authorisation required	Zone of applicability
Listed activities in terms of the NEMA (1998) EIA Regulations as amended in April 2017 must be taken into consideration if any activities (for example, stockpiling of soils) are to take place within the applicable zone of regulation. This must be determined by the EAP in consultation with the relevant authorities.	32m from the edge of a watercourse

Taking the above into consideration, a 100m zone of regulation in line with GN704 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) is applicable to any drainage systems which may be affected by specific mining infrastructure, such as the DMS complex, shaft complex and conveyors. However, a 32m zone of regulation in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) may also be applicable, during the construction of non-mining infrastructure such as access roads, administration buildings, workshops, staff change rooms etc. It is however acknowledged that linear developments (such as the conveyor, and any additional access roads) may need to traverse drainage systems and therefore cannot be entirely excluded from the applicable zones of regulation. Thus, it is essential that strict implementation of well-developed, cogent mitigation measures takes place, to prevent unnecessary impacts on the affected drainage systems particularly during construction. Additionally, the mitigation hierarchy must be followed, and impacts which cannot be practicably avoided, minimised or rehabilitated must be offset. This applies especially to the residual impacts associated with the loss of riparian habitat and drainage systems which will occur as a result of the construction of the DMS complex.

The respective zones of regulation in terms of Regulations GN509 and GN704 of the NWA, and the NEMA, are depicted in the figures below.

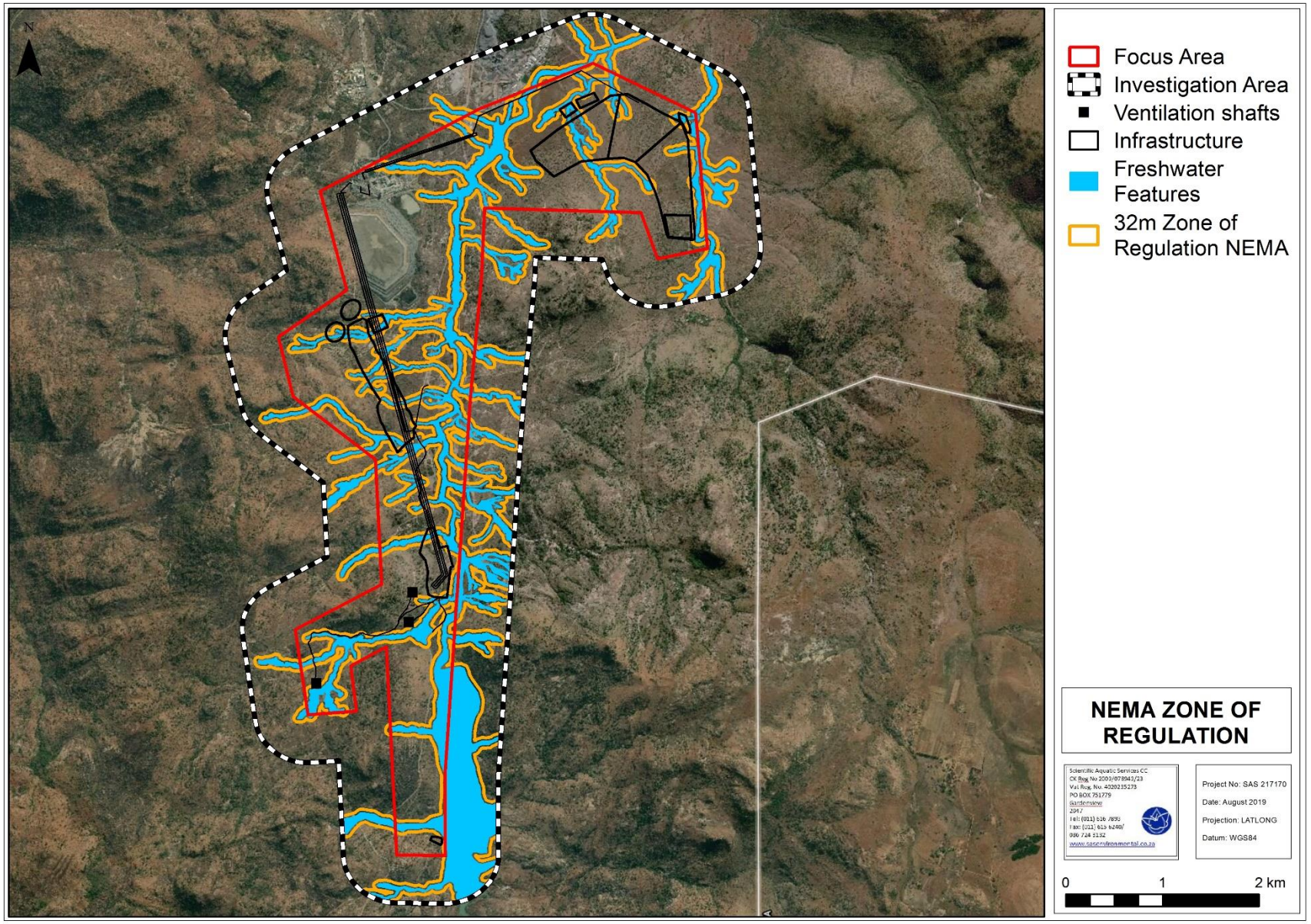


Figure 9: Conceptual presentation of the zones of regulation in terms of NEMA in relation to the freshwater resources within the focus area.

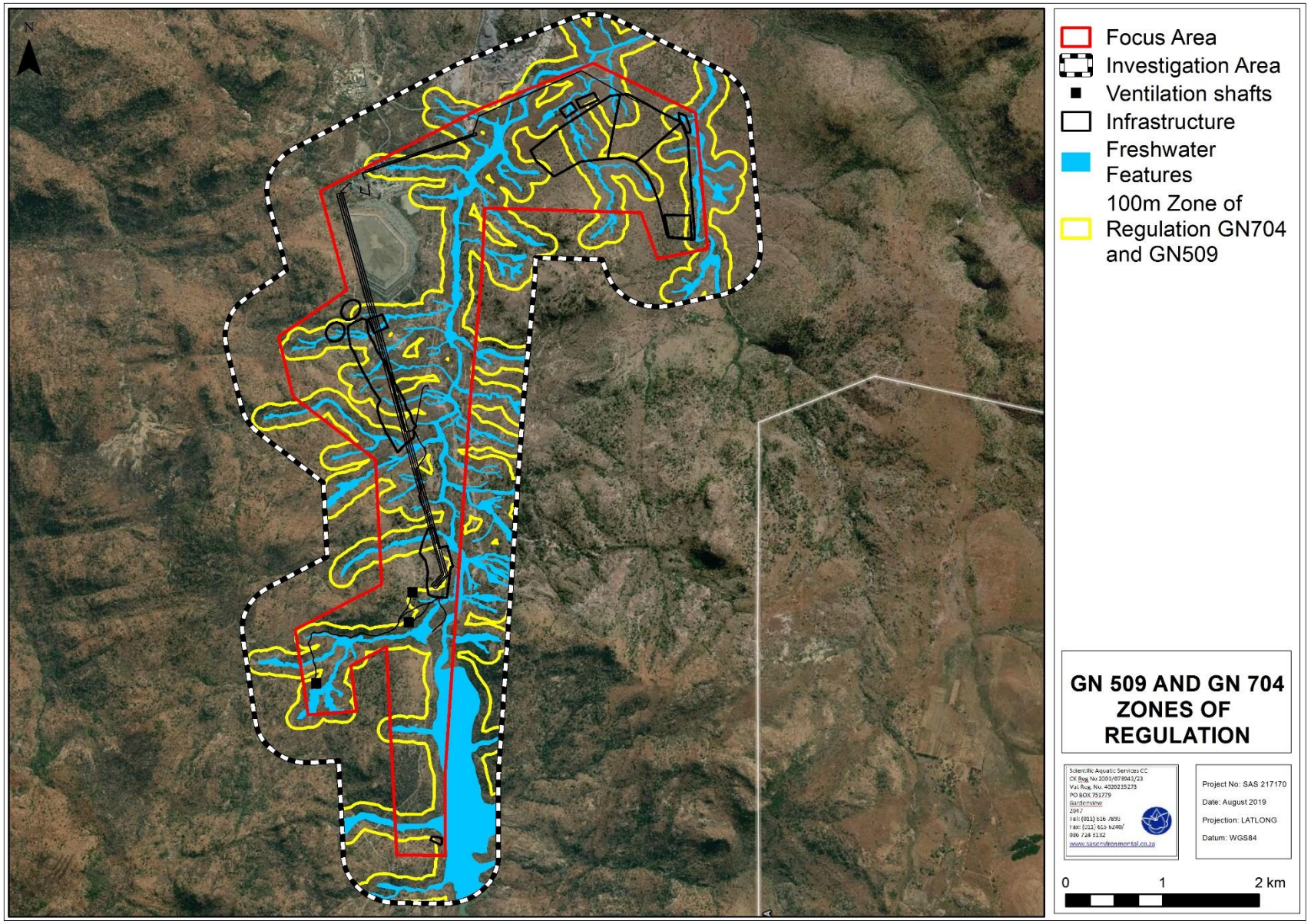


Figure 10: Conceptual presentation of the zones of regulation in terms of GN704 and GN509 as they relate to the NWA in relation to the freshwater resources within the focus area.

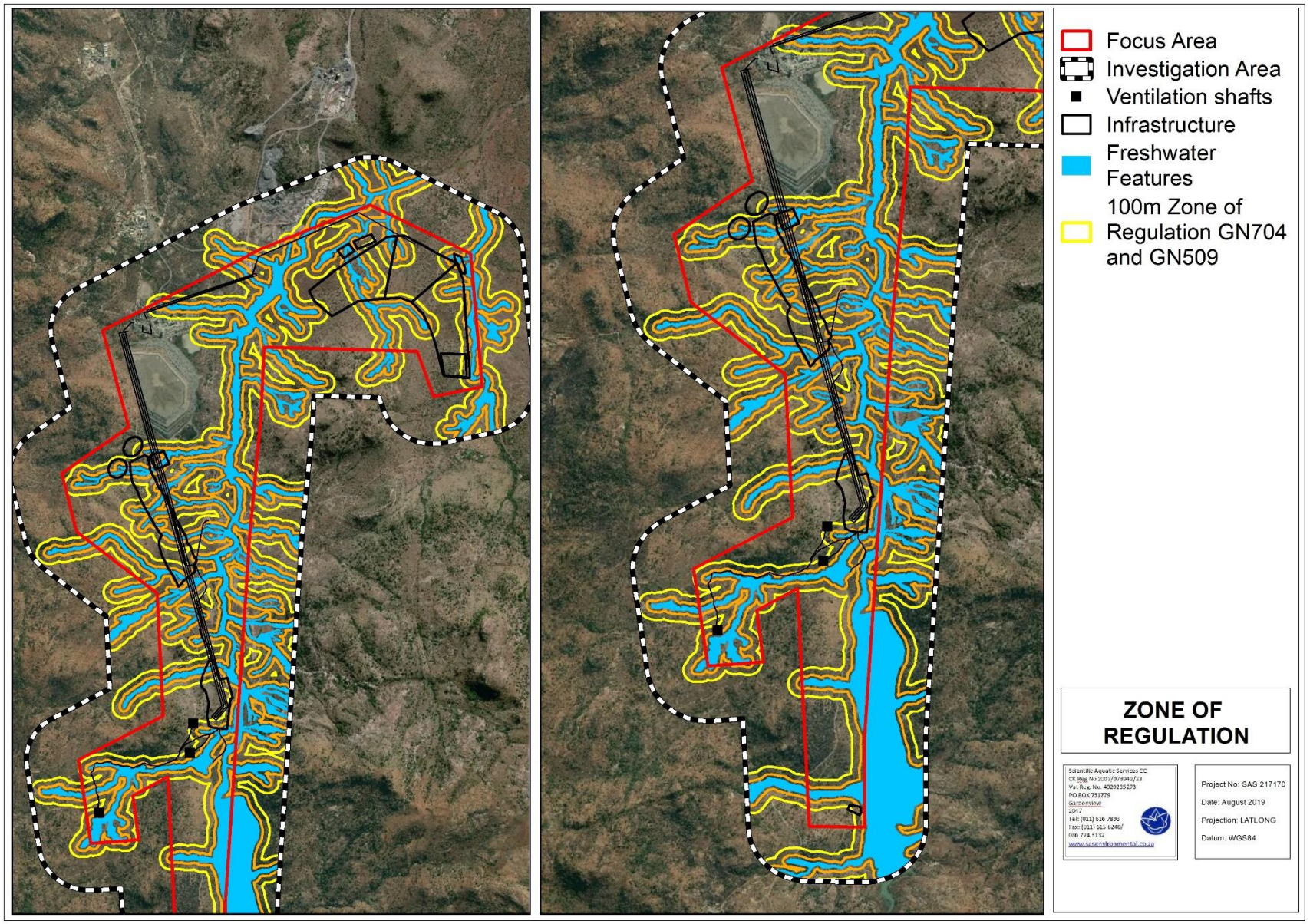


Figure 11: Conceptual presentation of the zones of regulation in terms of NEMA, GN704 and GN509 as they relate to the NWA, in relation to the freshwater resources within the focus area.

5 IMPACT ASSESSMENT

Please refer to Section C for the results of the integrated impact assessment undertaken for both the aquatic and freshwater (riparian) resources associated with the proposed Der Brochen Amendment project. Section C also indicates the required mitigatory measures needed to minimise the perceived impacts of the proposed development on these resources and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented.

6 CONCLUSION

Numerous freshwater resources were identified within the focus area, including the Groot Dwars River, a major tributary of the Steelpoort River. With the exception of the Groot Dwars River, these resources were classified as ephemeral drainage lines with associated riparian vegetation. The Groot Dwars River is a perennial system. Due to the numerous ephemeral drainage lines within the focus area and surrounds, and due to the relatively homogenous characteristics of these, for the purposes of discussion, the drainage lines were grouped according to their location. Thus, three groups of drainage lines and the Groot Dwars River were assessed in order to determine the PES and EIS. The drainage systems located within the western portion of the focus area were found to be in a largely natural to moderately modified ecological condition, and of high to very high EIS. Those within the eastern portion of the focus area were found to be moderately modified, but of a high EIS. The results of the assessments are summarised in the table below.

Table 8: Summary of results of the field assessment as discussed in Section 4.

Freshwater Resources	PES	Ecoservices	EIS	REC
Groot Dwars River	B/C	Intermediate	Very High	C/D
Group 1 (south of Mototolo concentrator and west of Der Brochen Dam)	B/C	Intermediate	High	B/C
Group 2 (immediately south, north and east of Mototolo Concentrator)	C	Intermediate	High	C
Group 3 (eastern portion of Mareesburg farm in the vicinity of the new TSF)	C	Intermediate	High	C

The drainage lines included in Group 1 have been largely unimpacted by anthropogenic activities, largely because the topography limits landuses (e.g. it is unsuitable for traditional agricultural practices) and therefore it has remained undeveloped with the exception of a few informal roads. However, disturbances around the Mototolo concentrator (situated in the north-west of the focus area) and in the east (Mareesburg) are greater in extent and

significance and have resulted in alterations to the ecology of most, if not all, of the drainage systems in the immediate vicinity of the activities. Modifications include alterations to hydraulic patterns, changes to sediment budgets and increased occurrence of alien vegetation due to soil disturbances. Whilst all the drainage lines are ephemeral and are therefore considered to be of moderately low ecological value in terms of capacity to perform functions such as flood attenuation and streamflow regulation, they are nevertheless considered of high ecological importance in terms of biodiversity maintenance (such as provision of breeding and foraging habitat). In addition, these systems are considered to be sensitive to increased flood peaks.

Following the assessment of the freshwater resources, an impact assessment was undertaken in order to ascertain the significance of perceived impacts associated with the proposed activities on the receiving environment. The results of this assessment are contained in Section C (*Freshwater Resource and Aquatic Ecological Assessment for the Proposed Anglo Platinum Der Brochen Project, Limpopo Province. Section C: Integrated Impact Assessment and Mitigation.SAS, 2018)*. In summary however, the results of the assessment indicate that without mitigation, impact significance is likely to be moderate to high. This significance can be reduced firstly by ensuring that infrastructure does not encroach on drainage systems. However, should it not be feasible to avoid the drainage systems altogether, then some impacts (such as those associated with the construction of the DMS complex) will remain high. Nevertheless, the strict implementation of well-developed, cogent mitigation measures (as contained in Section C [SAS, 2018]) will need to take place in order to reduce the impact significance.

Based on the findings of the ecological assessment and results of the impact assessment, it is the opinion of the ecologist that the proposed Der Brochen Amendment project carries the potential to pose a significant risk to several ephemeral drainage lines, which may in turn have an indirect impact on the functioning of downstream systems, most notably the Groot Dwars River. However, should careful planning of the positioning and layout of the proposed infrastructure take into account the locations of the drainage lines, taking care to avoid these systems as much as possible, impact significance can be greatly reduced. Furthermore, the adherence to cogent, well-conceived mitigation measures as well as general good construction practice will aid in reducing the impact significance to acceptable levels. However, it should be noted that the significance of some risks, such as possible decant from the South Decline Shaft and loss of catchment yield could not be accurately assessed since the relevant specialist studies had not been completed at the time of this assessment. Taking the above into account, it is therefore the opinion of the specialist that from a freshwater ecological

perspective, the proposed expansion project be carefully considered, and that preferably, further development of the site layout plans takes place before the project be authorised.

7 REFERENCES

Department of Water Affairs and Forestry (DWAF). 2008. *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas,* prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare. Report no. X. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water Affairs and Forestry (DWAF). 2005. *Final draft: A practical field procedure for identification and delineation of wetlands and Riparian areas.*

Department of Water Affairs and Forestry. 2007. *Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types by M. Rountree (ed); C.P. Todd, C. J. Kleynhans, A. L. Batchelor, M. D. Louw, D. Kotze, D. Walters, S. Schroeder, P. Illgner, M. Uys. and G.C. Marneweck. Report no. N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.*

Department of Water and Sanitation (DWS). 2014. *A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: C2* Compiled by RQIS-RDM: Online available: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx as retrieved in July 2016

Kleynhans C.J. 1999. *A procedure for the determination of the ecological reserve for the purposes of the national water balance model for South African River*. Institute of Water Quality Studies, Department of Water Affairs & Forestry, Pretoria.

Kleynhans C.J., Thirion C. and Moolman J. 2005. *A Level 1 Ecoregion Classification System for South Africa, Lesotho and Swaziland.* Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria

Kleynhans C.J., Thirion C., Moolman J, Gaulana L. 2007. *A Level II River Ecoregion Classification System for South Africa, Lesotho and Swaziland.* Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria

Kleynhans CJ, Louw MD, Graham M. 2008. Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity (Section 1, Technical manual) Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 377-08

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B. 2009. *WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands.* WRC Report No. TT 339/09. Water Research Commission, Pretoria.

Macfarlane D.M., Kotze D.C., Ellery W.N., Walters D., Koopman V., Goodman P. and Goge C. 2008. *WET-Health: A technique for rapidly assessing wetland health.* WRC Report No. TT 340/08. Water Research Commission, Pretoria.

National Environmental Management Act (NEMA) 107 of 1998

National Water Act (NWA) 36 of 1998.

Nel, JL, Driver, A., Strydom W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J, Nienaber, S., Van Deventer, H., Swartz, E. & Smith-Adao, L.B. 2011. *Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources.* Water Research Commission Report No. TT 500/11, Water Research Commission, Pretoria.

NFEPA: Driver, A., Nel, J.L., Snaddon, K., Murruy, K., Roux, D.J., Hill, L., Swartz, E.R., Manuel, J. and Funke, N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. Water Research Commission. Report No. 1801/1/11. Online available: http://bgis.sanbi.org/nfepa/project.asp

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems.* SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.

Rountree, M.W. and Kotze, D.C. 2013. Appendix A3: Ecological Importance and Sensitivity Assessment. In: Rountree, M. W., Malan, H.L., and Weston, B.C. Eds. *Manual for the Rapid*

Ecological Reserve Determination of Inland Wetlands (Version 2.0). WRC Report No. 1788/1/12. Pretoria.

Van Oudtshoorn, F. 2004. Second Edition, Third Print. *Guide to Grasses of South Africa.* Briza Publications, Pretoria, RSA

APPENDIX A – Terms of Use and Indemnity

INDEMNITY AND TERMS OF USE OF THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and SAS CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.
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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

Mineral and Petroleum Resources Development Act (MPRDA) (Act 28 of 2002)	The obtaining of a New Order Mining Right (NOMR) is governed by the MPRDA. The MPRDA requires the applicant to apply to the DMR for a NOMR which triggers a process of compliance with the various applicable sections of the MPRDA. The NOMR process requires environmental authorisation in terms of the MPRDA Regulations and specifically requires the preparation of a Scoping Report, an Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP), and a Public Participation Process (PPP).
National Environmental Management Act (NEMA) (Act No. 107 of 1998)	The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 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 Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Water Act (NWA) (Act No. 36 of 1998)	The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in 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 Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998)	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water

	use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.
GN 704 – Regulations on use of water for mining and related activities aimed at the protection of water resources, 1999	These regulations, forming part of the National Water Act, were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the project complies with Regulation GN 704 of the NWA, 1998 (Act no. 36 of 1998) which contains regulations on use of water for mining and related activities aimed at the protection of water resources. GN 704 states that: *No person in control of a mine or activity may:* *(b) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres (m) from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the drainage feature or 100m from the edge of the feature, whichever distance is the greatest, unless authorised by DWS.

APPENDIX C – Method of Assessment

FRESHWATER RESOURCE METHOD OF ASSESSMENT

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the freshwater resources present or in close proximity of the proposed focus area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA, 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), DWA, South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable, natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland features present in the vicinity of or within the proposed focus area.

1.2 *Department of Water and Sanitation (DWS) Resource Quality Information Services Present Ecological State / Ecological Importance and Sensitivity (PES/EIS) Database (2012)*

The PES/EIS database as developed by the DWS RQIS department was utilised to obtain background information on the project area. The PES/EIS database has been made available to consultants since mid-August 2014. The information from this database is based on information at a sub-quaternary catchment reach (subquat reach) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as SA RHP sites, EWR sites and Hydro WMS sites. The results obtained serve to summarise this information as a background to the conditions of the watercourse traversed by the proposed linear development.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa

The freshwater features encountered within the proposed focus area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al*., 2013), hereafter referred to as the "Classification System". A summary of Levels 1 to 4 of the classification system are presented in Table C1 and C2, below.

Table C1: Proposed classification structure for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Unit for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the Classification System, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[4] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included at Level 2 of the classification system is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) group's vegetation types across the country according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the National Freshwater Ecosystem Priority Areas (NFEPA) project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

At Level 3 of the Classification System, for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et al.,* 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the Classification System (Table C2), on the basis of hydrology and geomorphology (Ollis *et al*., 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;

[4] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et al*., 2009).

3. WET-Health

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management.

Level of Evaluation
Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Framework for the Assessment
A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

Units of Assessment
Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems above.

Quantification of Present State of a wetland
The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial *extent* of the impact of individual activities and then separately assessing the *intensity* of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall *magnitude* of impact. The impact scores, and Present State categories are provided in the table below.

Table C3: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

Impact category	Description	Impact score range	Present State category
None	Unmodified, natural	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

Assessing the Anticipated Trajectory of Change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (table below).

Table C4: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Overall health of the wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

4. Riparian Vegetation Response Index (VEGRAI)

Riparian vegetation is described in the NWA (Act No 36 of 1998) as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

The Riparian Vegetation Response Assessment Index (VEGRAI) is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results[5]. Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

Table C5: Descriptions of the A-F ecological categories.

Ecological category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitat and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat have occurred, but the basic ecosystem functions are still predominately unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. 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	0-19

5. Index of Habitat Integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans *et al.* 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in Table C6 below.

[5] Kleynhans et al, 2007

Table C6: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans *et al.* 2008]

Class	Description	Score (% of total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 - 89
C	Moderately modified. 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	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the 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 - 19

6. Wetland Function Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[6] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;
- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the freshwater features. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the freshwater features.

Table C7: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

[6] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999

7. Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purposed of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C8) of the wetland system being assessed.

Table C8: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

8. Recommended Ecological Category (REC)

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability, but carries a higher risk of ecosystem failure." [7]

The REC (Table C9) was determined based on the results obtained from the PES, reference conditions and EIS of the resource (sections above). Followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired REC.

[7] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources 1999

A freshwater feature may receive the same class for the PES as the REC if the freshwater feature is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the freshwater feature.

Table C9: Description of REC classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

9. Wetland Delineation

The freshwater resource delineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" published by DWAF in 2008. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

According to the DWA (2005) like wetlands, riparian areas have their own unique set of indicators. It is possible to delineate riparian areas by checking for the presence of these indicators. Some areas may display both wetland and riparian indicators, and can accordingly be classified as both. If you are adjacent to a watercourse, it is important to check for the presence of the riparian indicators described below, in addition to checking for wetland indicators, to detect riparian areas that do not qualify as wetlands. The delineation process requires that the following be taken into account:

- topography associated with the watercourse;
- vegetation; and
- alluvial soils and deposited material.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWA, 2005).

APPENDIX D – Results of Field Investigation

PRESENT ECOLOGICAL STATE (PES), ECOSERVICES AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

Table E1: Presentation of the results of the ecosystem services provided by the various drainage systems within the focus area.

Ecosystem service	Group 1	Group 2	Group 3	Groot Dwars
Flood attenuation	2.1	2.2	2.3	2.3
Streamflow regulation	1.0	1.0	1.0	1.8
Sediment trapping	2.6	2.4	2.0	1.8
Phosphate assimilation	2.3	2.3	1.9	2.0
Nitrate assimilation	2.0	1.9	1.4	2.1
Toxicant assimilation	2.3	2.1	1.8	2.3
Erosion control	3.1	3.0	2.5	2.5
Carbon Storage	0.5	0.5	0.5	1.5
Biodiversity maintenance	2.6	2.7	2.7	2.1
Water Supply	0.0	0.0	0.0	1.3
Harvestable resources	1.4	1.4	1.4	1.6
Cultivated foods	1.4	1.4	1.4	2.2
Cultural value	1.0	1.0	1.0	1.0
Tourism and recreation	1.5	1.5	1.5	1.8
Education and research	2.5	2.3	2.3	2.3
SUM	**26.2**	**25.6**	**23.5**	**28.5**
Average score	**1.7**	**1.7**	**1.6**	**1.9**
Class	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**

Table E2: Presentation of the results of the PES (IHI) assessment of the Groot Dwars River

INSTREAM IHI	
Base Flows	-1.0
Zero Flows	0.0
Floods	1.0
HYDROLOGY RATING	**0.5**
pH	0.0
Salts	0.0
Nutrients	-2.0
Water Temperature	0.0
Water clarity	1.0
Oxygen	0.0
Toxics	0.0
PC RATING	**0.5**
Sediment	0.0
Benthic Growth	-2.0
BED RATING	**0.8**
Marginal	-2.0
Non-marginal	-1.0
BANK RATING	**1.5**
Longitudinal Connectivity	-1.0
Lateral Connectivity	1.0
CONNECTIVITY RATING	**1.0**
INSTREAM IHI %	**84.6**
INSTREAM IHI EC	**B**
INSTREAM CONFIDENCE	**3.0**

RIPARIAN IHI	
Base Flows	-1.0
Zero Flows	0.0
Moderate Floods	1.5
Large Floods	1.5
HYDROLOGY RATING	**0.9**
Substrate Exposure (marginal)	1.0
Substrate Exposure (non-marginal)	1.0
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	0.5
Erosion (marginal)	2.5
Erosion (non-marginal)	2.5
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	1.0
Marginal	2.5
Non-marginal	2.5
BANK STRUCTURE RATING	**2.5**
Longitudinal Connectivity	1.5
Lateral Connectivity	0.5
CONNECTIVITY RATING	**1.4**
RIPARIAN IHI %	**65.8**
RIPARIAN IHI EC	**C**
RIPARIAN CONFIDENCE	**3.0**

Table E3: Presentation of the results of the PES (WET-IHI) assessment of the Group 1 drainage systems.

OVERALL PRESENT ECOLOGICAL STATE (PES) SCORE					
	Ranking	**Weighting**	**Score**	***Confidence Rating***	**PES Category**
DRIVING PROCESSES:		**100**	**1.5**		
Hydrology	1	100	1.6	*3.0*	**C**
Geomorphology	2	80	1.7	*3.6*	**C**
Water Quality	3	30	0.6	*2.0*	**A/B**
WETLAND LANDUSE ACTIVITIES:		**80**	**0.5**	***3.7***	
Vegetation Alteration Score	1	100	0.5	*3.7*	**A/B**
OVERALL SCORE:			**1.0**		
	PES %		**79.3**	***Confidence Rating***	
	PES Category:		**B/C**	***1.6***	

Table E4: Presentation of the results of the PES (WET-IHI) assessment of the Group 2 drainage systems.

OVERALL PRESENT ECOLOGICAL STATE (PES) SCORE					
	Ranking	Weighting	Score	*Confidence Rating*	PES Category
DRIVING PROCESSES:		**100**	**1.5**		
Hydrology	1	100	1.6	*3.0*	**C**
Geomorphology	2	80	1.7	*3.6*	**C**
Water Quality	3	30	0.6	*2.0*	**A/B**
WETLAND LANDUSE ACTIVITIES:		**80**	**0.9**	***3.7***	
Vegetation Alteration Score	1	100	0.9	*3.7*	**B/C**
OVERALL SCORE:			**1.2**		
	PES %		**75.2**	***Confidence Rating***	
	PES Category:		**C**	***1.6***	

Table E5: Presentation of the results of the PES (WET-IHI) assessment of the Group 3 drainage systems.

OVERALL PRESENT ECOLOGICAL STATE (PES) SCORE					
	Ranking	Weighting	Score	*Confidence Rating*	PES Category
DRIVING PROCESSES:		**100**	**1.4**		
Hydrology	1	100	1.5	*3.1*	**C**
Geomorphology	2	80	1.5	*3.8*	**C**
Water Quality	3	30	0.6	*2.0*	**A/B**
WETLAND LANDUSE ACTIVITIES:		**80**	**0.9**	***3.7***	
Vegetation Alteration Score	1	100	0.9	*3.7*	**B**
OVERALL SCORE:			**1.2**		
	PES %		**76.8**	***Confidence Rating***	
	PES Category:		**C**	***1.6***	

Table E6: Presentation of the results of the EIS assessment of the Group 1 drainage systems.

Ecological Importance and Sensitivity	Score (0-4)	*Confidence (1-5)*
Biodiversity support	A (average)	(average)
	3.00	4.00
Presence of Red Data species	3	4
Populations of unique species	3	4
Migration/breeding/feeding sites	3	4
Landscape scale	B (average)	(average)
	2.40	4.00
Protection status of the wetland	3	4
Protection status of the vegetation type	4	4
Regional context of the ecological integrity	2	4
Size and rarity of the wetland type/s present	2	4
Diversity of habitat types	1	4
Sensitivity of the wetland	C (average)	(average)
	1.33	4.00
Sensitivity to changes in floods	2	4
Sensitivity to changes in low flows/dry season	1	4
Sensitivity to changes in water quality	1	4
ECOLOGICAL IMPORTANCE & SENSITIVITY	**(max of A,B or C)**	*(average of A, B or C)*
Fill in highest score:	**A**	**3.00**
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.		

Hydro-Functional Importance			Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits	**Flood attenuation**		2	4
	Streamflow regulation		1	4
	Water Quality Enhancement	***Sediment trapping***	3	4
		Phosphate assimilation	2	4
		Nitrate assimilation	2	4
		Toxicant assimilation	2	4
		Erosion control	3	4
	Carbon storage		1	4
HYDRO-FUNCTIONAL IMPORTANCE			2	4
Direct Human Benefits			Score (0-4)	Confidence (1-5)
Subsistence benefits	***Water for human use***		0	4
	Harvestable resources		1	4
	Cultivated foods		1	4
Cultural benefits	***Cultural heritage***		1	4
	Tourism and recreation		1	4
	Education and research		2	4
DIRECT HUMAN BENEFITS			1.00	4

Table E7: Presentation of the results of the EIS assessment of the Group 2 drainage systems.

Ecological Importance and Sensitivity	Score (0-4)	*Confidence (1-5)*
Biodiversity support	A (average)	(average)
	1.67	3.00
Presence of Red Data species	2	3
Populations of unique species	1	3
Migration/breeding/feeding sites	2	3
Landscape scale	B (average)	(average)
	2.60	4.00
Protection status of the wetland	3	4
Protection status of the vegetation type	4	4
Regional context of the ecological integrity	2	4
Size and rarity of the wetland type/s present	2	4
Diversity of habitat types	2	4
Sensitivity of the wetland	C (average)	(average)
	1.33	4.00
Sensitivity to changes in floods	2	4
Sensitivity to changes in low flows/dry season	1	4
Sensitivity to changes in water quality	1	4
ECOLOGICAL IMPORTANCE & SENSITIVITY	**(max of A,B or C)**	*(average of A, B or C)*
Fill in highest score:	**B**	**1.67**

High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.

Hydro-Functional Importance			Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits	**Flood attenuation**		2	4
	Streamflow regulation		1	4
	Water Quality Enhancement	***Sediment trapping***	3	4
		Phosphate assimilation	2	4
		Nitrate assimilation	2	4
		Toxicant assimilation	2	4
		Erosion control	3	4
	Carbon storage		1	4
HYDRO-FUNCTIONAL IMPORTANCE			2	4
Direct Human Benefits			Score (0-4)	Confidence (1-5)
Subsistence benefits	***Water for human use***		0	4
	Harvestable resources		1	4
	Cultivated foods		1	4
Cultural benefits	***Cultural heritage***		1	4
	Tourism and recreation		1	4
	Education and research		2	4
DIRECT HUMAN BENEFITS			1.00	4

Table E8: Presentation of the results of the EIS assessment of the Group 3 drainage systems.

Ecological Importance and Sensitivity	Score (0-4)	*Confidence (1-5)*
Biodiversity support	A (average)	(average)
	2.00	3.00
Presence of Red Data species	2	3
Populations of unique species	1	3
Migration/breeding/feeding sites	3	3
Landscape scale	B (average)	(average)
	2.40	4.00
Protection status of the wetland	3	4
Protection status of the vegetation type	4	4
Regional context of the ecological integrity	1	4
Size and rarity of the wetland type/s present	2	4
Diversity of habitat types	2	4
Sensitivity of the wetland	C (average)	(average)
	1.33	4.00
Sensitivity to changes in floods	2	4
Sensitivity to changes in low flows/dry season	1	4
Sensitivity to changes in water quality	1	4
ECOLOGICAL IMPORTANCE & SENSITIVITY	**(max of A,B or C)**	*(average of A, B or C)*
Fill in highest score:	**B**	**2.40**

High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.

Hydro-Functional Importance			Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits	**Flood attenuation**		2	4
	Streamflow regulation		1	4
	Water Quality Enhancement	***Sediment trapping***	2	4
		Phosphate assimilation	2	4
		Nitrate assimilation	2	4
		Toxicant assimilation	2	4
		Erosion control	2	4
	Carbon storage		1	4
HYDRO-FUNCTIONAL IMPORTANCE			2	4
Direct Human Benefits			Score (0-4)	Confidence (1-5)
Subsistence benefits	***Water for human use***		0	4
	Harvestable resources		1	4
	Cultivated foods		1	4
Cultural benefits	***Cultural heritage***		1	4
	Tourism and recreation		1	4
	Education and research		2	4
DIRECT HUMAN BENEFITS			1.00	4

Table E9: Presentation of the results of the EIS assessment of the Groot Dwars River.

Ecological Importance and Sensitivity	Score (0-4)	*Confidence (1-5)*
Biodiversity support	A (average)	(average)
	3.67	3.33
Presence of Red Data species	3	3
Populations of unique species	4	3
Migration/breeding/feeding sites	4	4
Landscape scale	B (average)	(average)
	3.20	3.80
Protection status of the wetland	3	3
Protection status of the vegetation type	4	4
Regional context of the ecological integrity	3	4
Size and rarity of the wetland type/s present	3	4
Diversity of habitat types	3	4
Sensitivity of the wetland	C (average)	(average)
	2.33	4.00
Sensitivity to changes in floods	3	4
Sensitivity to changes in low flows/dry season	2	4
Sensitivity to changes in water quality	2	4
ECOLOGICAL IMPORTANCE & SENSITIVITY	**(max of A,B or C)**	*(average of A, B or C)*
Fill in highest score:	**A**	**3.67**

Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.

Hydro-Functional Importance			Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits	**Flood attenuation**		2	4
	Streamflow regulation		2	4
	Water Quality Enhancement	***Sediment trapping***	2	4
		Phosphate assimilation	2	4
		Nitrate assimilation	2	4
		Toxicant assimilation	2	4
		Erosion control	2	4
	Carbon storage		2	4
HYDRO-FUNCTIONAL IMPORTANCE			2	4
Direct Human Benefits			Score (0-4)	Confidence (1-5)
Subsistence benefits	***Water for human use***		1	4
	Harvestable resources		1	4
	Cultivated foods		2	4
Cultural benefits	***Cultural heritage***		1	4
	Tourism and recreation		2	4
	Education and research		2	4
DIRECT HUMAN BENEFITS			1.50	4

APPENDIX E – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

Amanda Mileson NDip Nature Conservation (UNISA)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Natural Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health Practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)

Accredited River Health practitioner by the South African River Health Program (RHP)

Member of the South African Soil Surveyors Association (SASSO)

Member of the Gauteng Wetland Forum

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2002
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2000
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	1999

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces

Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe

Eastern Africa – Tanzania

West Africa – Ghana, Liberia, Angola, Guinea Bissau

Central Africa – Democratic Republic of the Congo

SELECTED PROJECT EXAMPLES

Development compliance studies

- Project co-leader for the development of the EMP for the use of the Wanderers stadium for the Ubuntu village for the World Summit on Sustainable Development (WSSD).
- Environmental Control Officer for Eskom for the construction of an 86Km 400KV power line in the Rustenburg Region.
- Numerous Environmental Impact Assessment (EIA) and EIA exemption applications for township developments and as part of the Development Facilitation Act requirements.
- EIA for the extension of mining rights for a Platinum mine in the Rustenburg area by Lonmin Platinum.
- EIA Exemption application for a proposed biodiesel refinery in Chamdor.
- Compilation of an EIA as part of the Bankable Feasibility Study process for proposed mining of a gold deposit in the Lofa province, Liberia.
- EIA for the development of a Chrome Recovery Plant at the Two Rivers Platinum Mine in the Limpopo province, South Africa.
- Compilation of an EIA as part of the Bankable Feasibility Study process for the Mooihoek Chrome Mine in the Limpopo province, South Africa.
- Mine Closure Plan for the Vlakfontein Nickel Mine in the North West Province.

Specialist studies and project management

- Development of a zero discharge strategy and associated risk, gap and cost benefit analyses for the Lonmin Platinum group.
- Development of a computerised water balance monitoring and management tool for the management of Lonmin Platinum process and purchased water.
- The compilation of the annual water monitoring and management program for the Lonmin Platinum group of mines.
- Analyses of ground water for potable use on a small diamond mine in the North West Province.
- Project management and overview of various soil and land capability studies for residential, industrial and mining developments.
- The design of a stream diversion of a tributary of the Olifants River for a proposed opencast coal mine.
- Waste rock dump design for a gold mine in the North West province.
- Numerous wetland delineation and function studies in the North West, Gauteng and Mpumalanga Kwa-Zulu Natal provinces, South Africa.
- Hartebeespoort Dam Littoral and Shoreline PES and rehabilitation plan.
- Development of rehabilitation principles and guidelines for the Crocodile West Marico Catchment, DWAF North West.

Aquatic and water quality monitoring and compliance reporting

- Development of the Resource quality Objective framework for Water Use licensing in the Crocodile West Marico Water management Area.
- Development of the Resource Quality Objectives for the Local Authorities in the Upper Crocodile West Marico Water management Area.
- Development of the 2010 State of the Rivers Report for the City of Johannesburg.
- Development of an annual report detailing the results of the Lonmin Platinum groups water monitoring program.
- Development of an annual report detailing the results of the Everest Platinum Mine water monitoring program.
- Initiation and management of a physical, chemical and biological monitoring program, President Steyn Gold Mine Welkom.
- Aquatic biomonitoring programs for several Xstrata Alloys Mines and Smelters.
- Aquatic biomonitoring programs for several Anglo Platinum Mines.
- Aquatic biomonitoring programs for African Rainbow Minerals Mines.
- Aquatic biomonitoring programs for several Assmang Chrome Operations.
- Aquatic biomonitoring programs for Petra Diamonds.
- Aquatic biomonitoring programs for several coal mining operations.
- Aquatic biomonitoring programs for several Gold mining operations.
- Aquatic biomonitoring programs for several mining operations for various minerals including iron ore, and small platinum and chrome mining operations.
- Aquatic biomonitoring program for the Valpre bottled water plant (Coca Cola South Africa).
- Aquatic biomonitoring program for industrial clients in the paper production and energy generation industries.
- Aquatic biomonitoring programs for the City of Tshwane for all their Waste Water Treatment Works.
- Baseline aquatic ecological assessments for numerous mining developments.

- Baseline aquatic ecological assessments for numerous residential commercial and industrial developments.
- Baseline aquatic ecological assessments in southern, central and west Africa.
- Lalini Dam assessment with focus on aquatic fish community analysis.
- Musami Dam assessment with focus on the FRAI and MIRAI aquatic community assessment indices.

Wetland delineation and wetland function assessment

- Wetland biodiversity studies for three copper mines on the copper belt in the Democratic Republic of the Congo.
- Wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.
- Terrestrial and wetland biodiversity studies for developments in the mining industry.
- Terrestrial and wetland biodiversity studies for developments in the residential commercial and industrial sectors.
- Development of wetland riparian resource protection measures for the Hartbeespoort Dam as part of the Harties Metsi A Me integrated biological remediation program.
- Priority wetland mammal species studies for numerous residential, commercial, industrial and mining developments throughout South Africa.

Terrestrial ecological studies and biodiversity studies

- Development of a biodiversity offset plan for Xstrata Alloys Rustenburg Operations.
- Biodiversity Action plans for numerous mining operations of Anglo Platinum throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plans for numerous mining operations of Assmang Chrome throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plans for numerous mining operations of Xstrata Alloys and Mining throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plan for the Nkomati Nickel and Chrome Mine Joint Venture.
- Terrestrial and wetland biodiversity studies for three copper mines on the copperbelt in the Democratic Republic of the Congo.
- Terrestrial and wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.
- Numerous terrestrial ecological assessments for proposed platinum and coal mining projects.
- Numerous terrestrial ecological assessments for proposed residential and commercial property developments throughout most of South Africa.
- Specialist Giant bullfrog (*Pyxicephalus adspersus*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist Marsh sylph (*Metisella meninx*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Project management of several Red Data Listed (RDL) bird studies with special mention of African grass owl (*Tyto capensis*).
- Project management of several studies for RDL Scorpions, spiders and beetles for proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist assessments of terrestrial ecosystems for the potential occurrence of RDL spiders and owls.
- Project management and site specific assessment on numerous terrestrial ecological surveys including numerous studies in the Johannesburg-Pretoria area, Witbank area, and the Vredefort dome complex.
- Biodiversity assessments of estuarine areas in the Kwa-Zulu Natal and Eastern Cape provinces.
- Impact assessment of a spill event on a commercial maize farm including soil impact assessments.

Fisheries management studies

- Tamryn Manor (Pty.) Ltd. still water fishery initiation, enhancement and management.
- Verlorenkloof Estate fishery management strategising, fishery enhancement, financial planning and stocking strategy.
- Mooifontein fishery management strategising, fishery enhancement and stocking programs.
- Wickams retreat management strategising.
- Gregg Brackenridge management strategising and stream recalibration design and stocking strategy.
- Eljira Farm baseline fishery study compared against DWAF 1996 aquaculture and aquatic ecosystem guidelines.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

Position in Company	Ecologist
Date of Birth	15 February 1978
Nationality	Zimbabwean
Languages	English
Joined SAS	2013

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member South African Wetland Society

Member Gauteng Wetland Forum

EDUCATION

Qualifications

N.Dip Nature Conservation (UNISA)	2017
Tools for Wetland Assessment (Rhodes University)	2016
Wetland Rehabilitation short learning programme (UFS)	2015

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, Northern Cape, Eastern Cape

Zimbabwe

SELECTED PROJECT EXAMPLES

Wetland Assessments

- Wetland assessment as part of the environmental authorisation process for the Anglo Platinum Der Brochen Project, Limpopo Province
- Wetland assessment as part of the environmental authorisation process for the proposed Tharisa North eastern waste rock dump, North West Province
- Wetland assessment as part of the environmental authorisation process for the proposed Yzermyn Coal Mining Project near Dirkiesdorp, Mpumalanga
- Wetland assessment as part of the environmental authorisation process for the Mzimvubu Water Project, Eastern Cape
- Wetland assessment as part of the environmental authorisation process for the proposed expansion of mining operations at the Langkloof Colliery, Mpumalanga
- Wetland assessment as part of the proposed water management process at the Assmang Chrome Machadodorp Works, Mpumalanga
- Wetland assessment as part of the water use licencing process for the proposed development in Rooihuiskraal Ext 24, Centurion, Gauteng
- Wetland assessment as part of the environmental authorisation process for the proposed road crossings on The Hills EcoEstate, Midrand, Gauteng
- Wetland ecological assessment as part of the Section 24G application process for the Temba Water Purification Plant

- Wetland assessment and offset studies for the Optimum Colliery Kwagga North Project, Mpumalanga
- Wetland assessment and delineation as part of the environmental authorisation process for the proposed development of a mall adjacent to the M10 Road in Mahube Valley, Mamelodi, Gauteng
- Wetland assessment as part of the environmental authorisation process for the proposed construction of a sewer system in Ekangala Township, Gauteng

Terrestrial Assessments

- Investigation of specialist biodiversity aspects required by GDARD in the vicinity of the Apies River, downstream of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for three proposed bridge upgrades near Edenvale, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for the proposed Dalpark Ext 3 filling station development, Gauteng

Rehabilitation Projects

- Wetland rehabilitation and management plan for The Hills EcoEstate, Midrand, Gauteng
- Riparian rehabilitation and management plan for The Diepsloot River, Riversands, Gauteng
- Riparian rehabilitation and management plan for the Apies River in the vicinity of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng

Environmental Control Officer

- Monthly specialist Environmental Control Officer (ECO) function for the monitoring of riparian crossings at Riversands Country Estate Development, Gauteng

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, 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 relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, 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

Signature of the Specialist