AMENDMENT TO THE ENVIRONMENTAL AUTHORISATION FOR THE EXISTING 83MR MINING RIGHT: THETA HILL PROJECT NEAR PILGRIM'S REST, MPUMALANGA

SOCIO-ECONOMIC IMPACT ASSESSMENT

FINAL

(AS PART OF FINAL THIRD UPDATED EIA & EMPR)

Submitted by:

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AND

SED

Southern Economic Development

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EXECUTIVE SUMMARY

Project background:

After closing down operations in the Pilgrim's Rest area in 1971, Australian listed Theta Gold Mines or the former Transvaal Gold Mining Estates Limited (TGME) proposes to mine gold in the area again - mainly through open cast mining on the south-western hills behind the historic tourist town of Pilgrim's Rest in Mpumalanga. The project is located adjacent to the exciting metallurgical plant, 2.5km southwest of the town of Pilgrim's Rest, Mpumalanga Province. The expected LoM is 5 years.

Layout Progressions:

The site layouts changed throughout the course of this study from the Scoping Phase to the EIA Phase. As part of the draft Scoping Report, the Second Draft Scoping Report and the Final Scoping Report, the proposed infrastructure and two potential options for the Waste Rock Dumps (WRD) at Theta and Iota were assessed. The details of the Layout Option 1 included:

- Theta/Browns Waste Rock Dump Option 1: This option is situated between both Browns and Theta Pit;
- Theta/Browns Waste Rock Dump Option 2: Located to the north eastern side of Theta Pit, incorporates two smaller pockets separated by a tributary;
- Iota Waste Rock Dump Option 1: Located to the north western corner of the Iota Pit; and
- Iota Waste Rock Dump Option 2: Is located to the north eastern boundary of the Iota Pit.

The outcome of the biophysical and social studies undertaken during the Scoping Phase was used to inform Layout 2 (draft EIA phase mining layout). Layout 2 saw significant changes to the sizes of the various pits as well as changes to the locations of the Waste Rock dumps. The most significant changes made to Layout 2 included the following:

- Revised pit layouts, with the Theta Pit being affected most;
- Modification to WRD location to minimise potential environmental impact – here the concept and location of the Wishbone WRD is significant;
- Reduction in the number of PCDs to be constructed;
- Optimisation of the overall project footprint.

Layout 2 was assessed as part of the Draft SEIA submitted as part of the draft EIA/EMPr in November 2020, as well as the Updated EIA/EMPR documents that were made available from March 2020 until April 2020 and during the additional review (as a result of the impact of the Covid-19 regulations) period allowed from 26 June 2020 that closed on 6 July 2020.

In the first quarter of 2020, TGME continued to complete various detailed engineering designs as part of the approvals process for the Water Use License. During this design process, additional geotechnical work was completed to inform the final designs of the Waste Rock Dumps and Pollution Control Dams to ensure that the structures are designed and constructed in a stable and safe manner. During the same period, the applicant recognised the signs of significant changes in the global market due to the Covid-19 Pandemic, increase in gold prices and the downgrade of the South African economy to junk status and the potential impacts this would have on the project.

These detailed engineering designs for the Waste Rock Dumps, Pollution Control Dams and stormwater management, following additional geotechnical work have resulted in changes to the layout. The change to the mine schedule and the pit sequence to accommodate the significant changes in the global economic environment have resulted in further changes in Layout 3, including an increase in the pit dimensions.

Project Scope:

The scope of the Socio-Economic Impact Assessment (SEIA) is to describe the current local socio-economic baseline of the project and anticipated socio-economic impacts of the project on the local community of Pilgrim's Rest and its immediate townships (Brown's Hill, Darks Gully, Newtown/Schoonplaas), the larger municipal area as well as the larger national economy. This SEIA report is an update on the final SEIA submitted in February 2020 and has been amended based on the new layout as proposed by the applicant in 2020, taking into account the recent developments related to the global COVID-19 pandemic as well as incorporating updated financial information related to the project.

Baseline Description of the Receiving Environment:

The project is located in Ward 13 of the Thaba Chweu Local Municipality (TCLM) within the Ehlanzeni District Municipality (EDM) in Mpumalanga Province. The dominant land-use patterns in the area are forestry, old mining shafts, agriculture areas (mainly grazing areas), tourism related activities and residential areas. The main socio-economic sensitive receptors in the local area close to the project include Pilgrim's Rest Town, Brown's Hill, Darks Gully, Newtown/Schoonplaas, as well as a number of rural tourist establishments in and around Pilgrim's Rest town.

The population of the larger Pilgrim's Rest area is between 1700 to 2 500, the majority staying in the new township Newtown/Schoonplaas and Darks Gully, close to the old town while a minority (around 250 people) stay in the old historic part of the town. The population of the larger Pilgrim's Rest area represents less than 3% of the estimated 102 000 people living within the larger TCLM. The area is characterised by high historic (sporadic) in-migration to Newtown/Schoonplaas resulting from periodic-short term construction works in the area. Young people possibly leave Pilgrim's Rest for better job opportunities elsewhere while illegal miners move into Pilgrim's Rest from areas as far afield as Free State, Lesotho and Mozambique. In-migration of illegal miners has substantially increased in the last year. The illegal mining activities of these miners have significantly influenced the downstream biodiversity in and around the Blyde River, as well as the flow pattern of the Blyde River. Sedimentation from their activities is a further source of concern.

Due to limited opportunities provided in the tourism sector of Pilgrim's Rest, the unemployment and poverty rates were much higher than the provincial or municipal averages with an estimated 48% of households living below the lower bound poverty line. This emphasizes the priority within Pilgrim's Rest to create job opportunities for the working age group.

The Mpumalanga Department of Public Works, Roads and Transport (DPWRT) is currently custodian of the town on behalf of the government and is responsible for the maintenance and restoration of Pilgrim's Rest. The TCLM is responsible for basic service provision while the other provincial departments (e.g. health, education) are responsible for their respective mandates in Pilgrim's Rest.

In terms of public services the local area is characterised by large housing backlogs (only (60% had access to formal housing), the need for road upgrading and maintenance, distance from healthcare services and the lack of sufficient clinics and Emergency Medical Services (EMS) as part of the primary health care services. As is the case in the larger TCLM, Pilgrim's Rest also saw more protest action the past couple of years in protest to the high housing backlogs in Newtown/Schoonplaas. While absolute crime levels are low in Pilgrim's Rest, the crimes per capita is high. Illegal miners currently also pose a significant security threat in the Pilgrim's Rest Area.

While the larger mining sector dominates in the larger TCLM economy, the economy of Pilgrim's Rest town (historic and Newtown/Schoonplaas) is dominated by tourism related activities including accommodation, restaurants/taverns and arts and craft shops. The town currently employs around 250 people including unskilled staff at formal businesses, managers/entrepreneurs as well as hawkers and informal traders. The local economy experienced a sharp decline since its peak in the early 1990's due to the general decline in tourism to Mpumalanga Province, deteriorating safety and hygiene conditions in Pilgrim's Rest, factors related to illegal mining activities, increased vagrancies due to poverty and unemployment and lack of public facilities and municipal functions such as street cleaning. There was however some positive signs in the local economy in 2019 as a number of the vacant premises became occupied again. The impact of COVID-19 is however expected to hit the South African tourism sector very hard and it might take several years for the international tourism sector (the main group visiting Pilgrim's Rest) to recover.

Impact Assessment:

The TGME mining project holds very high potential in terms of short-term job and income creation for the local community; potential for up-skilling of the local workforce: public revenues in the form of taxes, royalties as well as local development funds over the five year Life of Mine (LoM).

On the other hand the socio-economic impact assessment also highlighted some high project related socio-economic risks as indicated in the summary table below. These risks mainly relates to the scale of the project over a relatively short time, high levels of informal and formal in-migration into the project area (although not solely related to the project), the potential negative impact on the downstream tourism industry due to possible surface water pollution as well as the negative impacts on the local community after mining activities come to an end.

In terms of the short time span of the project there is a high likelihood that this project will unlock future mining investment in the area which will extend the window of opportunity for the project to contribute positively to the local economy of Pilgrim's Rest. This could result in the development of alternative sustainable industries in the local area through the mine's social investment programme, skills programmes and contribution to tax revenues. The potential high informal influx of people anticipated into the area is a typical result of large mining projects in general, especially in societies or regions that experience high unemployment levels. The mine is expected to also benefit the larger regional economy through supply links with the mine and induced spending. It could also be said that if mine management maintains a well-publicised tight control of illegal mining activities in the area it might even deter some of the in-migration related to illegal mining activities into the project areas, as well as the subsequent environmental pollution as a result of the illegal mining activities.

Summary of Socio-Economic Impacts

Socio-economic Impact	Phase	Significance of Impact	
		Pre-mitigation	Post-mitigation
Employment and income generation	Construction	Medium (10) +	Medium (11) +
Project induced in-migration	Construction	Medium (11) -	Medium (10) -
Safety and Health Risks	Construction	Medium (8) -	Medium (7) -
Nuisance factors	Construction	Medium (7) -	Medium (7) -
Impact on other economic sectors in the local economy	Construction	Medium (9) -	Medium (8) -
Employment and income opportunities	Operations	High (12) +	High (12) +
Increase in Public revenues	Operations	High (13) +	High (13) +
Project Induced in-migration	Operations	High (12) -	High (12) -
Sense of place	Operations	Medium (11) -	Medium (10) -
Safety and health risks	Operations	Medium (9) -	Medium (8) -
Nuisance Factors	Operations	Medium (9) -	Medium (8) -
Impacts on Tourism Sector of Pilgrim's Rest	Operations	Medium (11) -	Medium (10) -
Impact on other economic sectors in the local and regional economy	Operations	High (12) -	Medium (11) -
Local Economic diversity and economic stability	Operations	Medium (11) -	Medium (11) -
Impact on resource use	Operations	Medium (11) -	Medium (10) -
Impact on Brown's Hill Settlement	Operations	Medium (11) -	Medium (11) +
Direct and flow-on job losses	Decommissioning and Closure	High (13) -	Medium (11) -
Decrease/Termination of community investment funds and support to local community	Decommissioning and Closure	High (13) -	Medium (10) -
Increase in illegal mining	Decommissioning and Closure	Medium (11) -	Medium (10) -
Sense of place	Decommissioning and Closure	High (13) -	Medium (10) -

In terms of the potential high negative downstream impact on other economic sectors, the risk relates to the potential surface water pollution that could have detrimental impacts on the downstream regional economy. The local tourism industry could also suffer negative consequences as a result of negative impacts on sense of place. The risk of downstream water pollution by the mine is rated low by the specialist studies that formed part of the larger EIA.

The increased illegal mining activities furthermore already have a significant existing impact on the water quality and quantity of the Blyde River. The flow of the river is being changed by their activities and the risks of sedimentation have increased. At this stage, the illegal mining activities cannot be controlled. Should the project not proceed, the illegal mining activities are anticipated to significantly increase, with significant consequences for the local and downstream environment. If the project is authorised, it is anticipated that TGME could assist in controlling and possibly eradicating the illegal mining activities through their safety and security measures to be put in place. Adherence to environmental regulations and guidelines can then be managed and audited through the formal processes.

In light of the possible impacts on the tourism industry, it should also be noted that there are examples elsewhere in South Africa where mining and tourism co-exist and where the heritage conservation value are considered.

The following recommendations are highlighted to address the potential negative impact of the project:

- Mitigation measures, responses to risks identified and the Social Management Plan must be adhered to.
- A Resettlement Action Plan needs to be developed for the Brown's Hill Community (approximately 10 permanent residents) and the proposed process and possible implications should be discussed with the residents of the Brown's Hill Community.
- A serious effort is required in the development of a sustainable post-mining economy through the social investment programme of the project, covering social investment in sustainable non-mining related activities as well as through a portable skills programme. These programmes need to be developed and implemented at an early phase of the project.
- The contribution that other potential sources of pollution (e.g. agriculture, waste water treatments, illegal mining activities and settlements) already have on the river's downstream water quality would be part of a Strategic Environmental Assessment (to be done under the auspices of the DWS) which falls outside the ambit of this project. Such an assessment remains a high priority to provide a scientific baseline to be used for future auditing and monitoring.
- A Biodiversity Offset Agreement (if finalised) must aim to create additional employment opportunities and must focus on capacity building among local community members.

In conclusion, it needs to be mentioned that the negative economic impacts of the COVID-19 pandemic are expected to be experienced for at least another two years. South Africa's economy is forecasted to decline by between 3 and 5% in 2020 and only partially making for the loss in 2020 (IMF, 2020). In this context, the proposed project will make a significant positive contribution in providing much needed jobs and tax income, not only for the local, but also for the larger regional and national economy. Based on the findings of the socio-economic impact assessment for the project it is therefore recommended that the proposed Theta Project be approved.

GLOSSARY OF ABBREVIATIONS

CSI:	Corporate Social Investment
CV's:	Curriculum Vitae
DMRE:	Department of Mineral Resources and Energy
DWS:	Department of Water and Sanitation
EAP:	Environmental Assessment Practitioner
EDM:	Ehlanzeni District Municipality
EIA:	Environmental Impact Assessment
EMPr:	Environmental Management Programme Report
FTE:	Full Time Equivalent (full time persons per year)
GVA:	Gross Value Added
HDI:	Historically Disadvantaged Individual
Ha:	Hectares
I&AP:	Interested and Affected Party
IDP:	Integrated Development Plan
IMF:	International Monetary Fund
Km:	Kilometres
Kt:	Kilotons
LED:	Local Economic Development
LoM:	Life of Mine
MWP:	Mining Works Programme
MCPA:	Maroabjang Communal Property Association
MDPWRT:	Department of Public Works, Roads and Transport (Mpumalanga)
MPRDA:	Minerals and Petroleum Resource Development Act, Act 28 of 2002
MWP:	Mining Work Programme
NEMA:	National Environmental Management Act, Act 107 of 1998
NEMWA:	National Environmental Management: Waste Act, Act 59 of 2008
NEMAQA:	National Environmental Management: Air Quality Act, Act 39 of 2004
NWA:	National Water Act, Act 36 of 1998
PPP:	Public Participation Process
RAP:	Resettlement Action Plan
ROM:	Run of Mine
SAFCOL:	South African Forestry Company Limited
SEIA:	Socio-Economic Impact Assessment
SDF:	Strategic Development Framework
SLP:	Social and Labour Plan
SMME:	Small, Medium Size Enterprises
SWM:	Stonewall Mining
SWR:	Stonewall Resources
TCLM:	Thaba Chweu Local Municipality
TFR:	Transnet Freight Rail
TGME:	Transvaal Gold Mining Estates Limited
TSF:	Tailings Storage Facility
WMA:	Water Management Area

WRD: Waste Rock Dump

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DOCUMENT STATUS

Document History	Purpose of Document	Date released	Report Authors
Draft Scoping	Document for public review period and stakeholder comment	April 2019	Ingrid Snyman: Batho Earth An Kritzinger: SED
Final Scoping	Document for submission to DMRE	May 2019	Same as above
Second Draft Scoping	Re-submission of document as part of relodging of application	12 July 2019	Same as above
Final Scoping	Re-submission of document as part of relodging of application	30 August 2019	Same as above
Draft SEIA	Document for public review period and stakeholder comment	7 November 2020 for review period of 13 November to 20 January 2020	Same as above
Final SEIA	Document for submission to DMRE	15 February 2020	Same as above
Final Updated SEIA	Final SEIA as part of the Second Final Updated EIA/EMPr	3 March 2020	Same as above
Updated Draft SEIA	Document for public review period and stakeholder comment as part of the Third Updated Draft EIA/EMPr	July 2020	Same as above
Updated Final SEIA	Final SEIA as part of the Final Third Updated EIA/EMPr: Document for submission to DMRE	August 2020	Same as above

1. INTRODUCTION

1.1. Project Background

Transvaal Gold Mining Estates Limited (TGME) has an existing and approved mining right with the Department of Mineral Resources and Energy (DMRE) reference MP 30/5/1/2/2/83MR. This right allows the mining of gold ore, silver ore, copper ore and stone aggregate. The total 83MR area encompasses the following farms and covers a total area of some 9,413.3366 ha:

- Frankfort 509KT: RE, Ptn 1, Ptn 2, Ptn 3, Ptn 4, Ptn 5;
- Krugers Hoop 527KT;
- Van der Merwes Reef 526KT: RE, Ptn 1;
- Morgenzon 525KT RE, Ptn 1, Ptn 2;
- Peach Tree 544KT and
- Ponieskrans 543KT: RE, Ptn 18, Ptn 42, Ptn 43, Ptn 44.

TGME, through an engineering scoping study and a feasibility study, has identified the opportunity to mine gold bearing reefs via modified terrace mining and this has triggered the need to amend the existing environmental authorisation of the MP 30/5/1/2/2/83MR right to include the new mining sections as terrace mining. The Life of Mine (LoM) is five years.

The project is located adjacent to the exciting metallurgical plant, 2.5km southwest of the town of Pilgrim's Rest, Mpumalanga Province. The proposed area of influence will be situated on Portion 42 of the farm Ponieskrans 543KT. TGME holds the mining rights. The surface rights for farms within the Mining Right area are owned by various organs of state, private companies and communal property associations.

The proposed project has proceeded into the detailed Environmental Impact Assessment Phase, which involves the detailed environmental and social specialist investigations. This Socio-Economic Impact Assessment (SEIA) forms part of the required documentation.

1.2. Project Lay-Out: Progression

The site layouts changed throughout the course of this study from the Scoping Phase to the EIA Phase. The Layout Alternative section is a portrayal of the progression from an initial to the most resent "updated" site layout related to the Theta Project. Included in this section is a portrayal of the progression from an initial layout (Layout 1) through to the Layout 3 which reflects a balanced layout of the project that takes into consideration the various drivers, including environmental and economic drivers amongst others.

The progression has been significantly influenced by environmental considerations in the first instance, and thereafter engineering, economic and social considerations and is described in detail in the subsequent sections.

1.2.1. Scoping Phase: Layout 1 - Engineering Feasibility Study

During the feasibility study phase of the project, the applicant identified resources that were amenable to modern open cut mining techniques and completed a full evaluation of the resources from identification through drilling and then finalisation of a feasibility study. The three broad mining areas identified and evaluated where:

- Theta Pit;
- Browns Pit; and
- Iota Pit.

In terms of the placement of the related infrastructure, a few design or layout alternatives were considered initially for the various Waste Rock Dumps (WRD). As part of the operational activities two potential options were proposed for the locations of the associated Waste Rock Dumps (WRD) at both Theta and Iota. These are detailed as follows:

- Theta/Browns Waste Rock Dump Option 1: This option is situated between both Browns and Theta Pit;
- Theta/Browns Waste Rock Dump Option 2: Located to the north eastern side of Theta Pit, incorporates two smaller pockets separated by a tributary;
- Iota Waste Rock Dump Option 1: Located to the north western corner of the Iota Pit; and
- Iota Waste Rock Dump Option 2: Is located to the north eastern boundary of the Iota Pit.

These layouts were included and assessed as part of the SEIA that formed part of the Draft Scoping Report (April 2019), the Second Draft Scoping Report (July 2019) and the Final Scoping Report (August 2019).

1.2.1. Environmental Impact Assessment Phase: Layout 2

The outcome of the biophysical and social studies undertaken during the Scoping Phase was used to inform Layout 2 (draft EIA phase mining layout). Layout 2 saw significant changes to the sizes of the various pits as well as changes to the locations of the Waste Rock dumps.

This strategy resulted in a reduction in the pit shell sizes, the relocation of the WRDs and re-consideration of the Pollution Control Dam (PCD) requirements. The objective was to avoid/minimise the impacts on the ground-truthed portions of highest biodiversity significance, to minimize the extent of areas requiring detailed rehabilitation and to limit the requirements for offsets of residual impacts. The most significant changes made to Layout 2 included the following:

- Revised pit layouts, with the Theta Pit being affected most;
- Modification to WRD location to minimise potential environmental impact – here the concept and location of the Wishbone WRD is significant;
- Reduction in the number of PCDs to be constructed;
- Optimisation of the overall project footprint.

Layout 2 was assessed as part of the Draft SEIA submitted as part of the draft EIA/EMPr in November 2020, as well as the Updated EIA/EMPR documents that were made available from March 2020 until April 2020 and during the additional review (as a result of the impact of the Covid-19 regulations) period allowed from 26 June 2020 that closed on 6 July 2020.

1.2.2. Environmental Impact Assessment Phase: Layout 3

Following the submission of Layout 2, further detailed design work was completed on the WRD's and PCD's as part of the existing water use licence application, to ensure that the structures would be stable and able to maximise successful concurrent rehabilitation outcomes. As part of this process, various stability and geotechnical activities were carried out which informed the designs. The design engineers were then asked to adapt their designs to avoid various high biodiversity areas within the WRD footprints.

The further studies included:

- Structural design engineering assessments: Mining area footprints had to change to ensure stable structures for the Waste Rock Dumps (WRDs) and Pollution Control Dams (PCDs).
- Ecological Assessment: Due to the change in the mining footprint, an additional site visit was required to assess the sensitive areas. This has led to the change in the mine layout plan to avoid areas of high value such as the protea stand located near the Wishbone WRD.
- Mining Engineering study: Additional engineering studies were required to improve mining resource utilization.

During the same period, TGME recognised that significant changes in the global market had resulted due to the Covid-19 Pandemic. These changes have the potential to impact on the Applicant's project due to, among others, an increase in the gold price and the downgrade of the South African economy to junk status.

To respond to the expected changes in the global economic environment, TGME completed a re-evaluation of the Theta Project (i.e. 83MR) with a view to improving the economic metrics of the project to further enhance the attractiveness to potential funders. This has resulted in a new mine schedule being developed which has changed the sequence of the pits being mined and has also resulted in the pits being made slightly larger to bring in more gold bearing material while still taking cognisance of the environmental conditions in the area.

This SEIA document (July 2020 and August 2020) that forms part of the Third Updated EIA/EMPr thus assesses the amended layout plan. This layout is referred to as Layout 3 as indicated in Figure 1 below.

The general mining site infrastructure will include offices, change houses and laundry facilities, control room, first aid station, stores and laydown yard, salvage yard and waste sorting area, transformer substation, fuel storage facility, refuelling bay, wash bay, workshops, brake test ramp and parking areas. Infrastructure associated with the terrace mining operations include topsoil stockpiles, run-of mine ore stockpiles, waste rock dumps and haul roads.

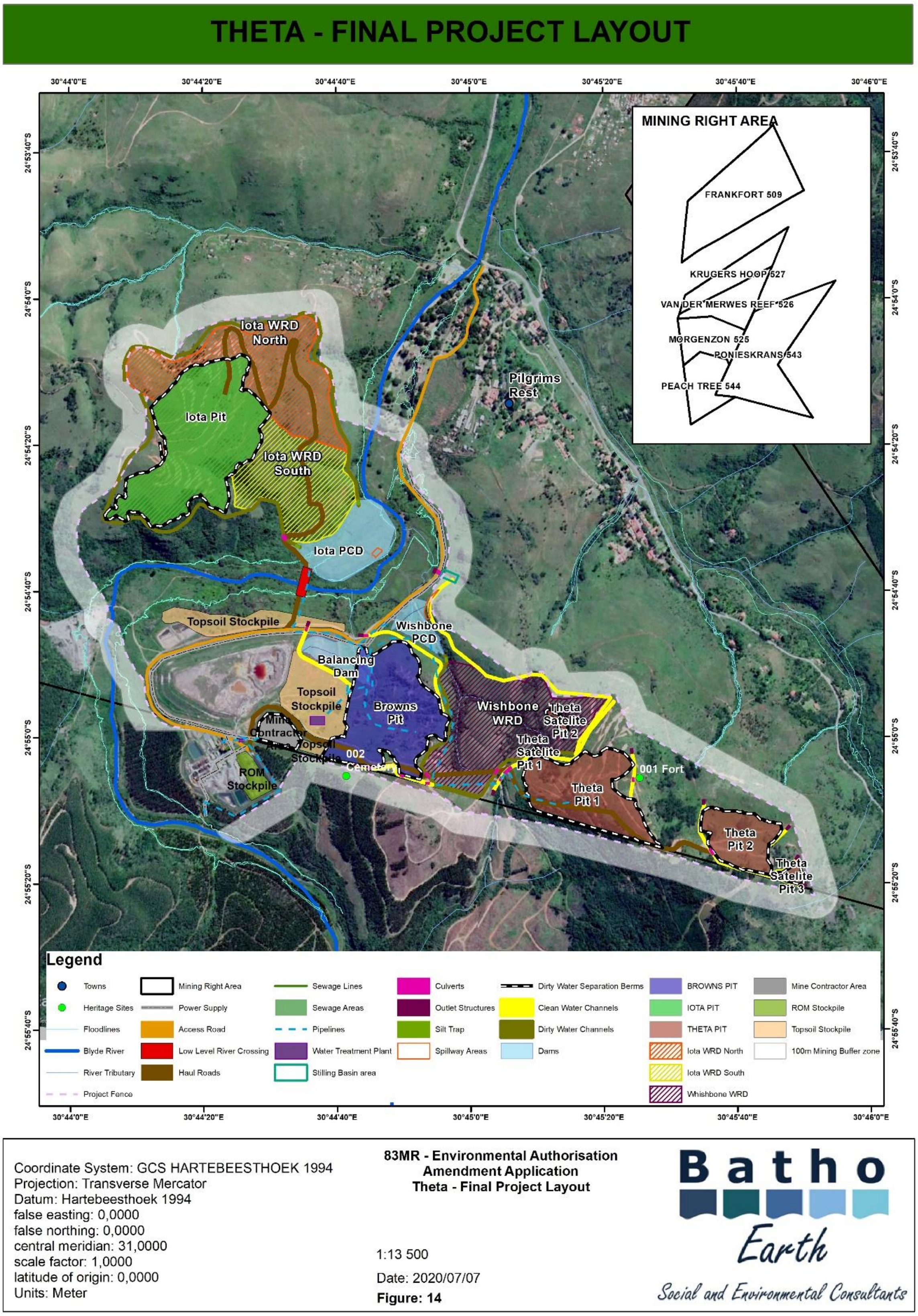

Figure 1: Layout 3

1.3. Purpose of the Report

The purpose of this SEIA report dated July 2020 is to provide the findings of the SEIA undertaken based on the new amended layout as proposed by the client in April 2020. The final SEIA submitted in February 2020 has thus been amended and updated through the following:

- Determining the current socio-economic status of the area and the social characteristics of the receiving environment;
- Indicating the anticipated core impact categories and impact areas (possible hot spots);
- Identifying anticipated positive socio-economic impacts of the proposed project, including positive impacts and provide management measures for these impacts;
- Identifying and highlighting negative social impacts (social hot spots) of the proposed project and indicate mitigation measures to deal with these impacts;
- Presenting the findings, recommendations and conclusions of the socio-economic study in terms of the environmental authorisation of the proposed project.

This report took the changes in the socio-economic environment into account as a result of South Africa’s current economic status (as in the first quarter of 2020), and as a result of the possible socio-economic impacts associated with the Covid-19 Pandemic.

2. LEGAL REQUIREMENTS AND GUIDELINES

2.1. General

In South Africa, the National Environmental Management Act, 1998 (NEMA), provides the legal framework for the correct use and management of the environment. In specific, Section 24 of NEMA provides for both the Minister and MEC to identify activities or areas in which certain activities may not be undertaken in absence of an environmental authorization.

Many developments undertaken by both public and private sector organisations require, by legislation, an Environmental Impact Assessment (EIA). An EIA is depended on the type, scale and size of the specific development. The National Environmental Management Act, Environmental Impact Assessment Regulations, GN R543 (“NEMA EIA Regulations”) were published on 18 June 2010 and came into operation on 2 August 2010. These Regulations has been superseded with the 2014 EIA Regulations, GNR 982 published on 4 December 2014 and came into operation on 8 December 2014.

The project is thus undertaken in terms of the following legal framework:

- Mineral and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA);
- National Environmental Management Act, Act 107 of 1998 (NEMA) and associated EIA regulations and listed activities;
- National Environmental Management: Waste Act, Act 59 of 2008 (NEMWA) and associated listed activities;
- National Environmental Management: Air Quality Act, Act 39 of 2004 (NEMAQA) and associated listed activities;

- National Water Act, Act 36 of 1998 (NWA).

Together with the NEMA EIA Regulations the assessment of the social environment came into place and thus the origin for undertaking a Socio-Economic Impact Assessment (SEIA). The guidelines from NEMA thus also apply to an SEIA.

Additional guidelines and regulations applicable and that were taken into account include:

- The Mineral and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA);
- The Social and Labour Plan required by MPRDA and MPRDA Regulations GN R527 (Part II Regulations 40 to 46); and
- Guidelines and Principles for Social Impact Assessment published by the International Association of Impact Assessment (2003).

2.2. Checklist Requirements for Specialist reports and contained in the 2014 EIA regulations

Table 1: Requirements for specialist reports, as contained in the 2014 EIA Regulations

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Required at Scoping/Desk-top Phase	Required at BA/EIA Phase	Cross-reference in this Report
a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	X	X	Section 12
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	X	X	Section 13
c) an indication of the scope of, and the purpose for which, the report was prepared	X	X	Sections 1.3 and 3
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	X	X	Section 3.1
e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	X	X	Section 3
f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	X	X	Section 4.3
g) an identification of any areas to be avoided, including buffers;	X	X	Sections 4.3

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Required at Scoping/Desk-top Phase	Required at BA/EIA Phase	Cross-reference in this Report
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	X	X	Section 1
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	X	X	Section **Error! Reference source not found.**.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	X	X	Sections 4, **Error! Reference source not found.**, 7 & 8
k) any mitigation measures for inclusion in the EMPr		X	Sections 5,6, 7, 8 and 9
l) any conditions for inclusion in the environmental authorisation;		X	Sections 9 and 10
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;		X	Sections 9 and 10
n) a reasoned opinion— as to whether the proposed activity or portions thereof should be authorised; and if the opinion is that the proposed activity 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;		X	Section 10
o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	X	X	Refer to PPP documentation
p) any other information requested by the competent authority	X	X	N/A

3. SCOPE OF WORK AND METHODOLOGY

3.1. Site Visit

A site visit was undertaken on 9 April 2019 with the aim of obtaining more information on the various sites and possibly affected areas, as well as to acquire an overview of the social characteristics of the study area and the social setting of the proposed mining project.

3.2. Scope of Work

This involved an investigation to identify the framework of the project through the identification and demarcation of the study area. Once the study area was determined, an evaluation framework was developed which assisted in identifying the main anticipated socio-economic impacts. Scoping further involved an outline of the social characteristics of the area which included the following:

- Background of the study area;
- Existing social characteristics of the affected communities;
- Culture, attitudes and socio-psychological conditions;
- Population characteristics and demographics;
- Community and institutional structures;
- Community resources; and
- A broad economic profile of the area.

3.3. Literature Review, Analysis and Desktop Studies

The literature review assisted the consultants to establish the social setting and characteristics of the study area, as well as the key economic activities. Secondary data, which was not originally generated for the specific purpose of the study, were gathered and analysed for the purposes of the study. Such data included maps, census data, internet searches, and the Integrated Development Plan (IDP) of the Local Municipality and so forth.

3.3.1. Consultation

Information was gathered and social issues were identified and verified through interviewing of selected stakeholders. A discussion guideline focused these sessions. The aim was to gather specific information related to the socio-economic environment and insight into community and stakeholder perceptions with regards to the proposed development. Section 11.3 below provides a list of stakeholders that were consulted.

3.3.2. Profiling

Profiling served to build on information generated during the scoping process. It involved a description of the social characteristics and history of the area being assessed, an analysis of demographic data, changes in the local population, and the land-use pattern in the study area, as well as any other significant developments in the area and thus social character over time. The profiling process is a combination of secondary and primary research, site visit and consultation. This included information on:

- The land-use in the area;
- The demographical profile and social characteristics of the host community;

- Institutional profile of the local community including municipal service levels;
- Safety and security profile of the local community;
- The local and regional economy including a description of:
    - Sector output and employment levels
    - Labour force composition;
    - Skills levels of the labour force;
    - Poverty levels;
    - Development priorities and initiatives in the local area; and
    - Institutional capacity for development planning.

3.4. Gaps, Limitations and Assumptions

With regards to the SEIA undertaken, the following should be noted:

- The SEIA included consultations with selected stakeholders and potentially affected parties as part of the impact assessment phase. This does not form part of the Public Participation Process (PPP) required for the overall EIA process, except where it was specifically specified as such during the consultation sessions.
- A SEIA aims to identify possible social and economic impacts that could occur in future. These impacts are based on existing baseline information. There is thus always an uncertainty with regards to the anticipated impact actually occurring, as well as the intensity thereof. Impact predictions have been made as accurately as possible based on the information available at the time of the study.
- Sources consulted are not exhaustive and additional information can still come to the fore to influence the contents, findings, ratings and conclusions made.
- Socio-economic baseline information was mainly based on official statistics from StatsSA, as well as municipal documentation. Sub-municipal data was only available for 2011. Recent trends as well as information on a sub-municipal level were also based on quantitative and qualitative information received from local representatives with local knowledge. The lack of more recent official socio-economic data is therefore seen as a limiting factor, although it is not anticipated to influence the outcome of the report.
- The profile of Pilgrim's Rest's economy was based on information supplied by the Pilgrim's Rest business community. No extensive audit was undertaken but rather information of an existing non-official audit of the economy was used as basis of the employment and output estimates of the local economy, cross-checked with other local data sources. Ratios of the national and provincial economy was used to establish the economic output of the economy and cross-check local employment data to be consistent with output figures.
- Additional information may become known or available during a later stage, which could not have been allowed for at the time of the study.
- Technical and other information provided by the client is assumed to be correct.
- Individuals view possible socio-economic impacts differently due to their association with the anticipated impact. Impacts could therefore be perceived and rated differently than those contained in the SEIA Report.
- The potential external costs associated with the project were based on information supplied by sub-specialists for the Environmental Impact Assessment of the project.

- The economic impact model was based on information supplied by Theta Gold Mines (Pty) Ltd (The Applicant). The employment and income impacts were based on financial information as contained in the Mining Works Programme (MWP) for the proposed project as well as the updated financial model (April 2020) for the project.
- Only the socio-economic impacts of mining operations and the processing plant were investigated in this environmental application. The TSF and processing plant falls outside the scope of this EIA. However since the processing plant forms an integral part of the total economic impact of mining activities it was included in the economic impact of the SEIA.
- Where client information of relevant socio-economic indicators for the mine was not available it was assumed that the operation will adhere to principles as set out by the Mining Charter.
- Economic multipliers, average salaries and wages and value added as a percentage of total income were based on provincial and national averages.
- An overall rating for the possible decommissioning and closure phase impacts was included although it is recommended that the socio-economic impacts be re-assessed at the time of decommissioning as the local dynamics could have changed.

3.5. Projecting Anticipated Impacts

For assessing the impacts associated with the proposed project, the above variables were adapted to allow the assessment of the full range of socio-economic impacts relevant to the specific project. These variables would relate to the start-up, construction and operational phases of the proposed project.

The anticipated impacts associated with the decommissioning and closure phase are discussed under Section 7. An overall rating for the possible impacts is included although it is recommended that the socio-economic impacts be re-assessed at the time of decommissioning as the local dynamics could have changed.

3.5.1. Significance Criteria

The evaluation of impacts is conducted in terms of the criteria detailed in Table 2 to Table 7. The various environmental impacts and benefits of this project are discussed in terms of impact status, extent, duration, probability, and intensity. Impact significance is regarded as the sum of the impact extent, duration, probability and intensity and a numerical rating system has been applied to evaluate impact significance. Therefore, an impact magnitude and significance rating is applied to rate each identified impact in terms of its overall magnitude and significance (Table 7).

In order to adequately assess and evaluate the impacts and benefits associated with the project, it was necessary to develop a methodology that would scientifically achieve this and to reduce the subjectivity involved in making such evaluations. To enable informed decision-making, it is necessary to assess all legal requirements and clearly defined criteria in order to accurately determine the significance of the predicted impact or benefit on the surrounding natural and social environment.

Impact Status

The nature or status of the impact is determined by the conditions of the environment prior to construction and operation. A discussion on the nature of the impact will include a description of what causes the effect, what will be affected and how it will be affected. The nature of the impact can be described as negative, positive or neutral.

Table 2: Status of Impact

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment	P
Neutral	No cost or benefit to the receiving environment	-
Negative	A cost to the receiving environment	N

Impact Extent

The extent of an impact is considered as to whether impacts are either limited in extent or if it affects a wide area or group of people. Impact extent can be site specific (within the boundaries of the development area), local, regional or national and/or international.

Table 3: Extent of Impact

Rating	Description	Quantitative Rating
Low	Site Specific; Occurs within the site boundary	1
Medium	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5 km from the Project Site boundary).	2
High	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5 km and more from the Project Site boundary).	3
Very High	National and/or international; Extends far beyond the site boundary; Widespread effect	4

Impact Duration

The duration of the impact refers to the time scale of the impact or benefit.

Table 4: Duration of Impact

Rating	Description	Quantitative Rating
Low	Short term; Quickly reversible; Less than the project lifespan; 0 – 5 years.	1
Medium	Medium term; Reversible over time; Approximate lifespan of the project; 5 – 17 years.	2
High	Long term; Permanent; Extends beyond the decommissioning phase; >17 years	3

Impact Probability

The probability of the impact describes the likelihood of the impact actually occurring.

Table 5: Probability of Impact

Rating	Description	Quantitative Rating
Improbable	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%	2
Highly Probable	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; Chance of occurrence >90%.	4
Definite and Cumulative	Impact will occur regardless of any prevention measures; Chance of occurrence >90% and is likely to result in in cumulative impacts	5

Impact Intensity

The intensity of the impact is determined to quantify the magnitude of the impacts and benefits associated with the proposed project.

Table 6: Intensity of Impact

Rating	Description	Quantitative Rating
Maximum Benefit	Where natural, cultural and / or social functions or processes are positively affected resulting in the maximum possible and permanent benefit.	+5
Significant Benefit	Where natural, cultural and / or social functions or processes are altered to the extent that it will result in temporary but significant benefit.	+4
Beneficial	Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified, beneficial way.	+3
Minor Benefit	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally benefited	+2
Negligible Benefit	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly benefited.	+1
Neutral	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are not affected.	0
Negligible	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly affected	-1
Minor	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally affected.	-2
Average	Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified way.	-3
Severe	Where natural, cultural and / or social functions or processes are altered to the extent that it will temporarily cease.	-4
Very Severe	Where natural, cultural and / or social functions or processes are altered to the extent that it will permanently cease.	-5

Impact Significance

The impact magnitude and significance rating is utilised to rate each identified impact in terms of its overall magnitude and significance.

Table 7: Impact Magnitude and Significance Rating

Impact	Rating	Description	Quantitative Rating
Positive	High	Of the highest positive order possible within the bounds of impacts that could occur.	+12-16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are	+6-11

Impact	Rating	Description	Quantitative Rating
		approximately equal in time, cost and effort	
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming	+ 1–5
No Impact	No Impact	Zero Impact	
Negative	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged.	-1-5
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form). Modification of the project design or alternative action may be required	-6-11
	High	Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt.	-12-16

4. DESCRIPTION OF THE BASELINE ENVIRONMENT

4.1. Defining the Local Area

The project is situated in the larger Ehlanzeni District Municipality (EDM), one of three districts in Mpumalanga Province located in the Northern Eastern part of Mpumalanga. EDM comprises four local municipalities namely Bushbuckridge, City of Mbombela, Nkomazi, and Thaba Chweu Local Municipalities. The Thaba Chweu Local Municipality (TCLM) is one of four local municipalities under the jurisdiction of the Ehlanzeni District. It is located in the north-western region of the Mpumalanga province as indicated in Figure 2 below. The main towns of TCLM are Pilgrim's Rest, Graskop, Sabie and Lydenburg. The escarpment divides the municipality into eastern and western sections. The western section (Lydenburg area) is dominated by agricultural and farming activities, while forestry is the main economic activity of the eastern section (Sabie/Graskop area).

Figure 2: Thaba Chweu Local Municipality

Source: www.localgovernment.co.za

The main economic sectors in the municipal area are mining, forestry, agriculture, business services, and tourism.[1] Within the study area, forestry dominates the land-use and is an important contributor to the economy.

The affected ward within the study area for the project is Ward 13 of Thaba Chweu Local Municipality. Ward 13 includes an area from north of Simile (near Sabie) to Pilgrim's Rest. The main town in the area is Pilgrim's Rest. Other areas falling in this ward include the Ohrighstad Dam area, Spekboom and Boomplaats[2].

Apart from the immediate communities in Ward 13 TCLM and the larger municipal areas, the larger regional and national economy is also relevant in terms of impacts such as employment and tax revenues.

4.2. Land-use Patterns

The study area is mainly located directly north and west of Pilgrim's Rest. The current land uses in the study area include:

[1] www.tclm.co.za

[2] Thaba Chweu Local Municipality. 2017. Integrated Development Plan 2017 – 2022 Term

- Forestry;
- Old Mining shafts;
- Residential Development (Pilgrim's Rest, Brown's Hill, Darks Gully and Newtown/Schoonplaas)
- Agricultural activities (although limited and focussed on cattle farming); and
- Tourism related activities, and accommodation facilities mainly centred in and around Pilgrim's Rest.

4.3. Socio-economic sensitive areas around the site

Sensitive receptors in the study area (less than 5 km zone) include the following:

- **Brown's Hill community** (300 metres north east of the existing TGME offices and plant area) consists of about four to five family units living in 10 mud and tin dwellings. The residents include ± four young working adults and five elderly individuals (mainly elderly women). One child that is of school-going age also permanently resides there (total population of approximately 10 permanent residents with an additional family that are mainly residing there over weekends). The families have vegetable gardens and goats that roam free. There is no water and sanitation facilities and the residents are reliant on water supplied by tankers. The borehole is not in working order at the moment;
- **Darks Gully** (± 500 m north-west of Pilgrim's Rest Downtown) is a residential area north of Pilgrim's Rest and west of the R533 road leading into Pilgrim's Rest that consists of scattered homesteads (formal and informal). Dwellings are sub-let. The area is experiencing an influx of outsiders and illegal miners.
- **Newtown/Schoonplaas** (about 700 m – 1 km north-east of Pilgrim's Rest town and east of R533 road leading to Pilgrim's Rest) consists of relatively densely populated homesteads (formal and informal). Dwellings are sub-let. Area is experiencing an influx of outsiders and illegal miners. The Pilgrim's Rest Primary School is located in Newtown/Schoonplaas.
- **Pilgrim's Rest Town** (is ± 2 to 2.5 km to the east / northeast of TGME's existing plant with Brown's Hill and Theta Hill in between. Businesses and the residential area of Pilgrim's Rest Town include inter alia the Royal Hotel, restaurants, guest houses, the Pilgrim's Rest Environmental Centre, a clinic and the Pilgrim's Rest Museum. The town consists of a Downtown area and an Uptown area with approximately 75 historical buildings. Iota Hill is approximately 1.5 km to the west of Pilgrim's Rest's Downtown area.
- **Former Pilgrim's Rest Caravan Park and Camping Site** (± 2.3 km from the existing TGME Metallurgical plant;.± 500 m south of Darks Gully and ± 300 m north of Pilgrim's Rest Downtown). The Caravan Park ceased operations in 2015 when the lessee terminated the contract. Buildings are in a deteriorated state and the area is not properly maintained. The Caravan Park falls under the management of the Mpumalanga Department of Public Works, Roads and Transport.
- **Pilgrim's Hut Guest House** (± 2.5 km to the east of the proposed development) is a self-catering accommodation facility situated in downtown Pilgrim's Rest. Hikers undertaking the Komatiland (SAFCOL) hiking tour can start or finish certain hiking trails at this facility.
- **Grootfontein Village (**± 2.7 km – south of the existing TGME Metallurgical plant) hosts about 150 workers of York Timber. It consists of formal dwellings and water and sanitation facilities are available. Cattle roam free within the area surrounding Grootfontein Village.

- **Mount Sheba Forever Lodge and Nature Reserve** (4 km - southwest of the existing TGME Metallurgical plant Facilities) include accommodation at the lodge, caravan and camping sites, self-catering timeshare cottages, general recreational facilities, conference facilities, wellness centre and wedding venue. Activities that can be undertaken include: General recreational activities (walking, swimming etc.), hiking trails and birdwatching.
- **Grazing areas** surrounding the proposed development, with informal cattle grazing taking place within the proposed development site. Community member's cattle are roaming free and grazing takes place throughout the area surrounding Pilgrim's Rest.

Receptors within a 5km – 10 km zone include the following:

- **Crystal Springs Mountain Lodge: (**± 6 km - northwest of the northern section (Iota Hill) of the proposed project). Facilities include Accommodation and Recreational Facilities (restaurant and wellness centre), and Conference Facilities
- **Forestry plantations** owned by commercial forestry companies (between 2.5 and 20km from the site) SAFCOL plantations to the north, York Timbers (Pty) Ltd. to the south and east; SAPPI to the south west.

Apart from forestry plantations extending beyond 10km from the site other main receptors further afield (more than 10 km) include the following:

- **Maorabajang Communal Property Association** owns several farms between 10km and 25 km to the east
- **Blyde River Canyon Nature Reserves (**15+ km east from the proposed development) extends along the Blyde River Canyon against the Greater Drakensberg escarpment and includes Bourke's Luck Potholes, the Three Rondavels, Pinnacle Rock and God's Window. Accommodation includes private lodges and guesthouses. Main activities include: Hiking, horse riding, white water rafting, kloofing, hot-air ballooning, fly-fishing, biking, tours and boat trips on the Blyde Dam.

4.4. Demographic Profile

4.4.1. Population Figures

The total population of the TCLM grew from 98 387 in 2011 to 101 895 in 2016, i.e. at an average annual rate of 3.4% per annum[3]. The population growth of the municipality as a whole exceeded national population growth rates thus indicating to some in-migration into TCLM mainly due to increased mining activities in the Lydenburg and the adjacent Limpopo areas of Burgersfort and Steelpoort since 2011.

Ward 13, which is a typical rural area without large settlements only represents less than 3% of the total TCLM population (2 584 in 2011). Within Ward 13, there were 1 721 individuals living in the town of Pilgrim's Rest in 2011 (66% of Ward 13's population) with 68 persons per km^2, 630

[3] Stats SA (2016) Community Survey

households and an average household size of 2.6.[4] (According to local sources the current (2019) population could the between 1 700 to 2 500 people – the majority population (between about 1500 – 2300 people) stay in the new township Newtown/Schoonplaas and Darks Gully, close to the old town while a minority (around 200- 300 people) stay in the old historic part of the town.

According to local sources, the population could have stayed relatively stable with limited in or out-migration after 2011. In the past, influx to Newtown/Schoonplaas happened sporadically and on an ad-hoc basis when labourers on short term construction works remained behind in the area. There is also a perception that young people leave Pilgrim's Rest for better job opportunities elsewhere while illegal miners move into Pilgrim's Rest from areas as far afield as Free State, Lesotho and Mozambique. From discussions with local representatives of TGME and residents of Pilgrim's Rest, the in-migration of illegal miners has substantially increased in the last year. Illegal miners operating in the area around Pilgrim's Rest are sub-letting from residents in Newtown/Schoonplaas and Darks Gully.

The illegal mining activities of these miners have significantly influenced the downstream biodiversity in and around the Blyde River, as well as the flow pattern of the Blyde River. Sedimentation from their activities is a further source of concern.

4.4.2. Age and Gender Structure

Table 8 below shows that the working age population group as well as percentage males are relatively higher in TCLM and Pilgrim's Rest than nationally. This corresponds with the relatively higher population growth rates and possible in-migration into the municipal and local area. In the case of Pilgrim's Rest it could be due to sporadic and historic in-migration as discussed above.

Table 8: The Age and Gender Structure of Selected Areas, 2011

AREA	Young population (0-14 years)	Working population (15-64 years)	Elderly (65+)	Total	% Males
Pilgrim's Rest	26.7%	70.2%	3.1%	100%	53.1%
TCLM	25.2%	69.9%	4.9%	100%	52.6%
South Africa	29.2%	65.5%	5.3%	100%	49.0%

Source: Stats SA (2011)

Within the TCLM the younger population group (under 15 years of age) has increased from 25.2% in 2011 to 27.7% in 2016. The youth ratio is however still below the national average, signifying to the higher priority within Pilgrim's Rest to create job opportunities for the working age group.

[4] Stats SA, (2011), Census

4.5. The Institutional Profile of the Local Community

4.5.1. Background

Pilgrim's Rest was sold to government as a living national museum village in 1971 when mining activities in the town closed down. The town was declared a National Monument and became a provincial heritage site in 1986. The Mpumalanga Department of Public Works, Roads and Transport (DPWRT) is currently custodian of the town on behalf of the government and is responsible for the maintenance and restoration of Pilgrim's Rest. The TCLM is responsible for basic service provision while the other provincial departments (e.g. health, education) are responsible for their respective mandates in Pilgrim's Rest[5].

4.5.2. Housing Provision and Basic Services [6]

Although 70% of the population within the TCLM lived in formal dwellings in 2016, the TCLM still has a huge housing backlog[7]. A challenge that worsens the problem, is the lack of available land as well as capacity constraints in terms of water, sanitation and energy provision. The situation and the dissatisfaction of residents with the lack of infrastructure and housing led to various community protest actions in TCLM in 2015 to 2019 in the Sabie, Graskop and Pilgrim's Rest areas.

Table 9 below shows that a relatively lower percentage of households in the Pilgrim's Rest area (60%) had access to formal housing in 2011 compared to the municipal and national averages. The informal dwellings are mainly situated in Newtown/Schoonplaas just outside the historic old town. According to local sources there is furthermore dolomite in the vicinity of the old town that could pose challenges in terms of the safety of structures in that area as well as further development of the area. There have been discussions with some local farmers and the Maroabjang CPA related to the availability of land to expand/relocate 'Newtown' in future.

Table 9: Access to housing and basic services, 2011 and 2016

AREA		Pilgrim's Rest	TCLM	South Africa
% of households in formal dwellings	2011	60%	65%	62%
	2016	n.a.	70%	77%
% of households with tap inside dwelling	2011	60%	39%	46%
	2016	n.a.	33%	42%
% of households with flush toilets	2011	61%	68%	60%
	2016	n.a.	66%	58%
% of households with access to electricity	2011	75%	84%	85%
	2016	n.a.	90%	93%
% of households with regular waste collection services	2011	68%	57%	58%
	2016	n.a.	58%	57%

[5] Thaba Chweu Local Municipality. 2017. Integrated Development Plan 2017 – 2022 Term

[6] Thaba Chweu Local Municipality. 2017. Integrated Development Plan 2017 – 2022 Term

[7] Ehlanzeni District Municipality. 2017. Final Integrated Development Plan and Budget: 2017 - 2022

Source: Stats SA (2011 and 2016)

The table also shows the pressure that the growing population has placed on the municipality to continue to provide basic services and infrastructure. As is the case nationally, water and sanitation services have specifically lagged behind household growth in TCLM. In 2011 Pilgrim's Rest still fared better than the municipality on average in terms of water provision and regular waste collection services as opposed to access to improved sanitation and electricity.

4.5.3. Water Provision and Sanitation Infrastructure[8]

Pilgrim's Rest rural area basically has two water supply schemes, the Mathibidi scheme and the Pilgrim's Rest scheme. Only two surface water resources are currently being utilized for primary water use in the Pilgrim's Rest area. One source is called the Moremela spring that feeds the Moremela stream. Water is withdrawn from the spring. Detailed investigations are required to augment supply to the Mathibidi scheme. The Blyde River, which passes south east of Moremela, is not currently utilized as a bulk water source[9]. Various options such as a bulk water pipeline, water treatment plant and reservoirs, as well as the refurbishment of the current reservoirs and reticulation lines are being investigated.

In Ward 13 of TCLM where Pilgrim's Rest is located, 75% of households received water from a water service provider while close to 25% of households had to rely on springs, rivers/streams, rain water tanks or water tankers or vendors to serve their daily needs in 2011.[10] Since the percentage coverage by a water service provider increased substantially in TCLM from 72% in 2011 to 85% in 2016 it could also be expected that the percentage households receiving water from a water service provider could also have increased substantially in Ward 13 of TCLM since 2011.

4.5.4. Electricity Infrastructure

As indicated in Table 9 above, there are large electricity backlogs in Thaba Chweu with more than 3 200 households still needing electricity connections. A new substation (Duma) is planned in the Mashishing area. There furthermore exists an electricity maintenance backlog in most areas across the municipal area including the maintenance of switchgears, transformers, streetlights, high mast lights and overhead lines[11].

The high contribution of the mining sector to the TCLM economy furthermore implies relative high energy use within the economy. Compared to other economic sectors, the mining sector is relatively energy inefficient, i.e. the production value of the sector is low relative to its energy use[12].

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[8] Thaba Chweu Local Municipality. 2017. Integrated Development Plan 2017 – 2022 Term

[9] Ehlanzeni District Municipality. 2017. Final Integrated Development Plan and Budget: 2017 - 2022

[10] Stats SA, 2016

[11] Thaba Chweu Local Municipality. 2016. Integrated Development Plan (IDP) 2016-2017

[12] Inglesi-Lotz R. and Blignaut J.N. 2011

4.5.5. Road Infrastructure

The TCLM does not have a road maintenance plan in place. However, various municipal roads within the towns of Sabie, Simile, Graskop and the Harmony Hill area have been identified to be in need of refurbishment, patching and/or reconstruction. Small sections of new municipal roads would also be required within these urban areas.

Within the study area, sections of the provincial and national routes must also be upgraded. These routes are frequently used by tourists and include the following[13]:

Table 10: Provincial and National Route Condition Analysis

Routes	Affected Towns / Areas	Ward(s) Affected
R540	Belfast, Dullstroom, Lydenburg	Wards 1, 2, 3, 4, 5, 12, and 14
R36	Lydenburg, Pilgrim's Rest	Wards 4 and 5
R533	Pilgrim's Rest, Graskop	Wards 13 and 10
R532	God's Window, Potholes, Blyde River Canyon	Wards 10, 8 and 9
R535	Kruger Park, Kruger National Park, Hazyview	Ward 10
R536	Sabie, Hazyview, Kruger Park, Kruger National Park	Ward 7

4.5.6. Health Services and Infrastructure

Most of the public health care facilities in the Ehlanzeni District are situated in the City of Mombela. Within the public health care system of TCLM there are three district hospitals, ten clinics (operating for eight hours per day) and three mobile units (Ehlanzeni District Municipality, District health Plan 2018/19- 2020/21). Pilgrim's Rest only has one clinic and the closest public hospital to the town is Sabie Hospital some 36km from Pilgrim's Rest. This public district hospital however was voted worst in Mpumalanga in 2015 according to a provincial hospital survey by the National Department of Health (DoH) based on aspects such as cleanliness, safety and security of patients and staff, waiting times, staff attitude, infection control and drug supply.[14] Graskop Hospital (a private sector hospital) is the closest hospital to Pilgrim's Rest (17 km). Specialist medical services are available in Nelspruit (96km from Pilgrim's Rest).

According to the Ehlanzeni District Municipality the district health facilities'r infrastructure need serious attention. It is estimated that some R4-R5million is needed to make the district's primary health care facilities and district hospitals compliant to ideal clinic and national core standards. In 2018 only 8% of Ehlanzeni's primary health care clinics were compliant with ideal clinic standards compared to the 44% national average. Ehlanzeni District fared fourth worst of all districts in South Africa[15].

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[13] Thaba Chweu Local Municipality. 2017. Integrated Development Plan 2017 – 2022 Term

[14] https://lowvelder.co.za/287640/sabie-hospital-worst-in-province

[15] Ehlanzeni District Municipality. 2019. District health Plan 2018/19- 2020/21

Another challenge that faces Pilgrim's Rest in terms of health care services is the lack of Emergency Medical Services (EMS) as part of the primary health care services. This situation could mainly be ascribed to the uncertain role played by Department of Public Works Roads and Transport (DPWRT-Mpumalanga) as the main administrator in Pilgrim's Rest. In 2005, the DPWRT purchased an ambulance for the town, but reports are that it has not managed or operated it due to a lack of mandate and budget to operate the service[16].

In terms of the incidence of illnesses in the district, TB and HIV/AIDS are the singular leading causes of natural and premature deaths in Ehlanzeni District. Ehlanzeni District recorded a HIV rate of close to 18% in 2017, on par with the average rate in Mpumalanga. The infection rate furthermore shows an increase of close to 2% between 2017 and 2018. This contributes to the high mortality and morbidity rates and the ever-increasing number of orphans and vulnerable children[17]. The EDM has acknowledged the above as a challenge and a major threat to sustainable development. As a result, coordination has taken place by establishing AIDS Councils and developing AIDS strategies in the district to guide activities and programmes in response to the issue. In 2017 EDM's male condom distribution rates (54%) were substantially higher than the national average (36%). The HIV testing averages for the District was also higher at 27% compared to the national average of 23%[18].

4.6. Safety and Security

4.6.1. Crime

While crime is considered relatively low in Pilgrim's Rest with only 135 cased reported in 2016, the per capita crime rate is relatively high i.e. close to 70 crimes per 1000 people in 2016 compared to the provincial average of 28 crimes per 1000 people and the national rate of 39 crimes per 1000 people. The presence of outsiders and illegal miners could have a negative impact on security in the municipal area. Between 2016 and 2018 reported crime rates could have increased with 19% from 135 in 2016 to 161 cases in 2018[19]. Table 11 below shows the majority of crimes in Pilgrim's Rest as drug-related crimes (37%) followed by community reported serious crimes (29%) and burglary and theft (12%).

Table 11: Type of crimes in Pilgrim's Rest, 2018

Crime category	Number of reported cases	% of cases
Drug related crimes	59	37%
Community-reported serious crimes	47	29%
Burglary and theft	20	12%
Violent (murder, assault, attempted murder)	14	9%

[16] https://mpumalanganews.co.za/7870/xxxxxx-21/

[17] Ehlanzeni District Municipality. 2017. Final Integrated Development Plan and Budget: 2017 - 2022

[18] Health Systems Trust.2019 District Health Barometer 2017/18

[19] www.crimestatssa.com

Common assault	8	5%
Illegal possession of firearms and ammunition	6	4%
Sexual offences	2	1%
Arson	2	1%
Malicious damage to property	2	1%
Carjacking	1	1%
Total crimes	**161**	**100%**

Source: Crime Stats SA (2018)

4.6.2. Community Protests

Service delivery protests in South Africa have remained on relative high levels since 2012. Violent protests increased from 75% of all service delivery protests in 2004 to 86% in 2016. Mpumalanga Province contributed 7% towards the total number of protests in 2016, slightly lower than the provincial contribution of 8% towards the total national population.[20]

The TCLM has experienced a number of service delivery protests since 2009. Protests are mainly directed at the local municipality and revolve around electricity supply, financial mismanagement, lack of proper consultation and weak leadership. More recently the municipality has been experiencing protest actions for each consecutive year since 2015. Issues revolve around alleged corruption, financial mismanagement and electricity supply. (Thaba Chweu Municipality was at one stage among the top twenty municipalities countrywide that owed Eskom R3.68 billion and was threatened by disconnection)[21].

The past two years (2018 and 2019) also saw community protest actions in Pilgrim's as protestors blocked the main access road to the historic town in protest to the high housing backlogs in 'Newtown'[22].

4.6.3. Illegal mining activities

Illegal activities are usually dominated by organised crime syndicates that operate on a global scale. Illegal miners are often heavily armed, have explosives, and set booby traps for employees, security and rival groups of illegal miners. Illegal miners are furthermore at a high risk to be injured owing to their unsafe practices, leaving it to the company to arrange for their rescue and/or the recovery of the bodies of deceased miners.[23]

The South African Police Service (SAPS) currently participates in forums such as the Mpumalanga Illegal Mining Stakeholder Forum and collaborates with mining companies and the Department of Mineral Resources and Energy (DME) to further curb illegal mining. Preventative measures include

[20] Municipal IQ Municipal Hotspots Monitor, 2016

[21] http://www.sabc.co.za/news/a/f24f7c804888dd658869ab5b3432783c/Mpumalanga-residents-up-in-arms-over-corrupt-municipality-20152805

[22]https://www.news24.com/SouthAfrica/News/protesters-block-roads-into-historical-town-of-pilgrims-rest-demanding-houses-20190424

[23] Moodley, 2013

demolishing illegal mining infrastructure; arrests, confiscating gold-bearing material; establishing whistle-blower channels etc.

Illegal miners currently pose a significant security threat in the Pilgrim's Rest Area. Most of the illegal miners stay in Newtown/Schoonplaas and Darks Gully. According to TGME management, a security team from TGME cleared Pilgrim's Rest area from illegal miners in 2013/14. These actions also had a positive impact on crime levels in the town. Since 2015 the situation has worsened again due to the TGME security team being withdrawn from the area. In 2017 for example an illegal miner fell to his death while fleeing from an armed rival group. According to local sources there is a specific rivalry between two illegal mining factions from Lesotho and Mozambique ".

It should further be noted that the illegal mining activities in the area have a severe negative impact on the environment in and around the Blyde River. Illegal miners are currently re-channelling the Blyde River and thereby changing the flow patterns of the river. General pollution of the water source and sedimentation due to their activities is a major source of concern. The activities further have a significant negative impact on the localised fauna and flora.

4.7. The Local Economy

4.7.1. The Structure of the Municipal Economy

In 2016 the total gross value added (GVA) of the Thaba Chweu municipal economy was estimated at R15bn (current prices) contributing close to 5% of the GVA produced in Mpumalanga province. The formal economy created between 25 000 and 30 000 jobs in 2016, representing around 12% of formal jobs in the district and 4% in the Province[24].

The mining sector is the single largest sector in the local economy contributing almost a quarter (24%) to total job opportunities created in the local area and about 45% towards output[25].

Thaba Chweu forms part of the Eastern Platinum Belt with more than 20 smelters and 30 platinum and other mineral resources mines operating in the Lydenburg and the adjacent Limpopo Steelpoort area, producing mainly platinum. The mines range from: Xstrata, Mototolo, Impala Platinum, Anglo Platinum, Aquarius, Dwarsrivier, Everest Platinum, junior miners and quarries[26].

While the primary sector (agriculture, forestry and mining) dominates the local economy there is limited downstream beneficiation of these products and most products are exported in a raw form and processed elsewhere[27]. This situation is reflected in the relatively low contribution of the manufacturing sector in the local economy.

[24] Estimates based on Stats SA, 2011 and 2016; Thaba Chweu, 2016 and Ledger, 2015

[25] Ledger, 2015

[26] Thaba Chweu Local Municipality. 2016. Integrated Development Plan (IDP) 2016-2017

[27] Thaba Chweu Local Municipality. 2016. Integrated Development Plan (IDP) 2016-2017

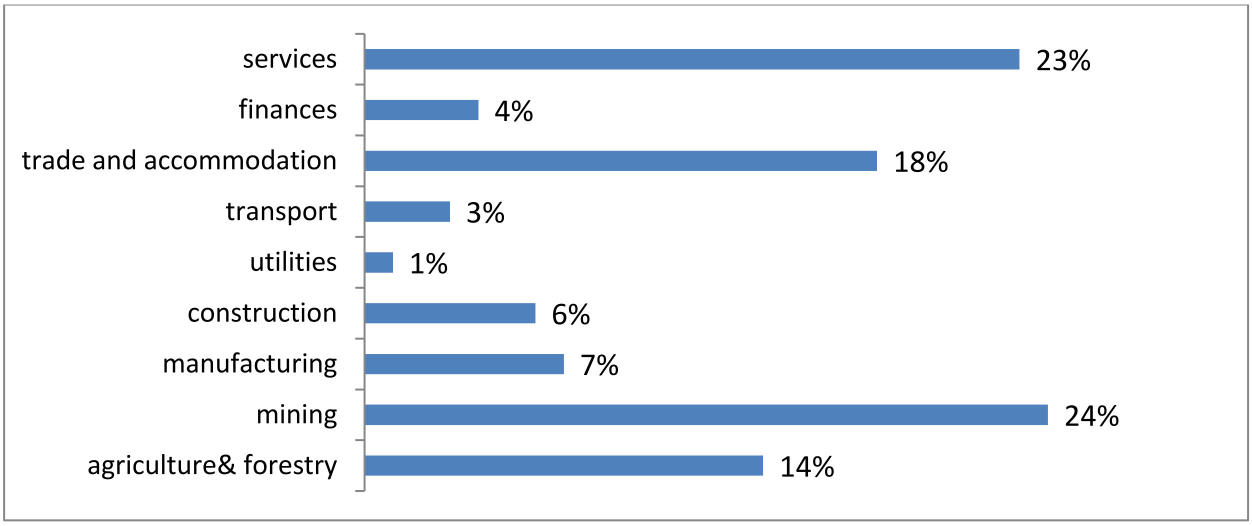

Figure 3: The Sector Distribution of Employment, Thaba Chweu, 2011
Source: Thaba Chweu (IDP 2016/17)

Between 1996 and 2013 the growth of the Mpumalanga economy was below the national economy at 2.3% per annum compared to the national growth of 3.1% (Stats SA, 2016). The TCLM economy grew at a higher rate of 3.9% for this period[28].

4.7.2. The Tourism Sector

The Ehlanzeni District Municipality (EDM) plays a dominant role in tourism in Mpumalanga hosting popular tourist destinations including the Kruger National Park (KNP) in Bushbuckridge Local Municipality as well as numerous prime tourism attractions located in Thaba Chweu Municipal area (e.g. Pilgrim's Rest, God's Window in Blyde Canyon, Three Rondavels, Bourke's Luck, Mac Mac Falls). Thaba Chweu furthermore hosts numerous events throughout the year that attracts both local residents and visitors to the area including the Long Tom Marathon, Subaru/Ashburton Sabie Classic Mountain Bike race and Sabie Forest Fair[29].

Tourism spending contributed 12% towards GVA in Ehlanzeni compared to the 7% provincial average in 2013, i.e. the highest contribution of all three districts of Mpumalanga. For the past decade the number of visitors to the district grew at a rate of more than 8% per annum and more than doubled from 700 000 visitors in 2001 to more than 1.8m visitors in 2013[30].

In 2013, tourism spending in Thaba Chweu LM made the second highest contribution (16%) towards GVA in the Ehlanzeni district (Mpumalanga Province, 2015). While there are indications of the growth of visitor numbers to Thaba Chweu municipality, not all tourist destinations share in tourism growth to the area. While visitor numbers to God's Window for example grew from 106 000 in 2013 to 133 000 in 2015, the historic town of Pilgrim's Rest face a deteriorating tourism industry due to deteriorating safety and hygiene conditions. These factors related to illegal mining

[28] Mpumalanga Province, 2015

[29] Thaba Chweu Local Municipality. 2016. Integrated Development Plan (IDP) 2016-2017

[30] Mpumalanga Province, 2015

activities, increased vagrancies due to poverty and unemployment and lack of public facilities and municipal functions such as street cleaning. The town currently falls under the national Department of Public Works[31].

The impact of COVID-19 is expected to especially hit the South African tourism sector very hard and it might take several years for the international tourism sector (the main group visiting Pilgrim's Rest) to recover.

4.7.3. The Pilgrim's Rest Economy

The economy of Pilgrim's Rest town (historic and Newtown/Schoonplaas) is dominated by tourism related activities including accommodation, restaurants/taverns and arts and craft shops. The Gross Value Added[32] of the local economy could be in the region of R20 million (current 2019 prices), employing in the region of an estimated 250 people (including employment of unskilled staff at formal businesses, managers/entrepreneurs as well as hawkers and informal traders). The Pilgrim's Rest economy is very small relative to the TCLM economy, contributing less than 1% towards municipal output and employment.

Main tourism attractions in and close to Pilgrim's Rest include the historic town itself, gold panning tours, Pilgrim's Rest Ghost Tours, Crystal Springs Mountain Lodge, Mount Sheba Resort, hiking tours and mountain bike trails throughout the area as well as bird watching tours and trails.

Businesses in the historic part of town lease premises from the Mpumalanga Department of Public Work, Roads and Transport (DPWRT) on the basis of a tender process.

As indicated in Table 12 below there are approximately 27 formal businesses and 72 informal crafts stalls operating in the historic old town of Pilgrim's rest including two rather distinct geographic areas, informally named an 'uptown' and 'downtown' area. Both areas serve the same market and there is little real distinction between the two areas. In addition to the businesses in the historic town, there are 4 businesses operational in Newtown (3 restaurants/taverns a 1 general dealer).

The reliance of the economy on the tourist industry is evident from the type of businesses present within the local economy namely accommodation (11 main establishments), formal arts and craft shops (9), informal craft staffs (72), restaurants/deli's (7), retail/wholesalers (2), one education centre and one recreation facility.

According to local sources international tourists (mainly from Europe) dominates the tourism industry of Pilgrim's Rest, accounting for 85% to 90% of tourists visiting the town. There are conflicting opinions concerning trends in domestic tourism to the local area. Some sources believe the domestic tourism market is stagnant while other business owners experience an increase in local tourists to the town, especially tourists from historically disadvantaged communities. Local tourism to the town only increases substantially during the holiday season in April and December.

[31] De Villiers, 2016

[32] Gross Value Added (GVA) is an economic measure of output that includes only income generated for labour, entrepreneurs, property and owners of other assets. It excludes intermediary inputs and is therefore not the same as turnover. Turnover would include costs related to primary as well as intermediary inputs.

As suggested above, the recent COVID-19 pandemic is expected to contribute to a steep decline in the tourism industry in Pilgrim's Rest, especially since the sector is highly reliant on visitors from overseas. It might take several years for the global tourism market to recover.

The Royal Hotel and its 10 annexes[33] dominate the local economy as single business entity. The Royal Hotel is currently managed as a private subsidiary company that falls under a Mpumalanga Provincial Government Section 21 Company named the Mpumalanga Regional Training Trust (MRTT). The Hotel does not receive any subsidies from provincial government. Up to 2020, the Royal Hotel received some 12 000 tourists per annum.

Table 12: Business Directory for Pilgrim's Rest, 2019

Historic town	**Business type**
The Royal Hotel and annexes	Accommodation
Mona Cottage	Accommodation
Berettas Guest House	Accommodation
DPW guest cottages (8)	Accommodation
Mrs Mac Shop	Arts and crafts
Olf Print Shop	Arts and crafts
Ponieskrantz arts and crafts	Arts and crafts
Iron Store	Arts and crafts
Zeederberg's (African Silk)	Arts and crafts
Spotted Dog	Arts and crafts
Kuzzulos Emporium	Arts and crafts
Bourke & Co	Arts and crafts
The Postal Agency	Arts and crafts
Hawker stalls (72)	Informal arts and crafts
Pilgrim's Pantry	Deli
The Daisy	Deli
The Vine Restaurant	Restaurant
Stables Restaurant	Restaurant
The Environmental Centre	Education centre
Pligrim's Golf Course	Recreation
Clewer General Dealer	Wholesale
New Town	
Paradise Tavern	Restaurant/tavern
Meadows Tavern	Restaurant/tavern

33 Including the Pilgrim's Hotel, Squareface, Welcome Inn, Montagues, Bank House, Victorian and Royal Cottages, Nutmeg, Halfway House and Leadleys

Historic town	Business type
Oupas Tavern	Restaurant/tavern
General dealer	Retail and wholesale

Source: Informal Business Audit, Pilgrim's Rest Business Community (updated 2019)

High level estimates suggest that local employment is dominated by informal craft and arts traders accommodated in some 72 stalls in the historic town of Pilgrim's Rest. Some 43% of total employment (an estimated 108 jobs) could be in informal trade, followed by the accommodation sector. The Royal Hotel is the single largest employer in formal economy of Pilgrim's Rest and dominates the accommodation sector, providing more than 60 jobs in 2019.

Local business sources agree that the economy of Pilgrim's Rest experienced a sharp decline since its peak in the early 1990's. The factors that are mentioned as the main reasons behind the decline in the local economy include the general decline in tourism to Mpumalanga Province due to the deteriorating road infrastructure and concerns around general safety especially related to the sharp decrease in civil protest actions. As was mentioned above, some authors ascribed the particular decline in the Pilgrim's rest tourism industry to deteriorating safety and hygiene conditions. These factors related to illegal mining activities, increased vagrancies due to poverty and unemployment and lack of public facilities and municipal functions such as street cleaning[34]. According to local business sources, in addition to the challenges above, the public tender process to fill the public-owned business premises in town created challenges in terms of unsustainable business enterprises and the non-payment of rentals. In 2014 the Public Protector released a report related to the negative impacts related to alleged irregular tender processes in Pilgrim's Rest[35].

In the past decade an estimated 17 business premises in Pilgrim's Rest became vacant resulting in a decline of close to 40 direct formal jobs. The local Caravan Park (300 stands), Bank and ATM are just a few of the business premises that became vacant in the past decade. The decline in activities has further negative spin-offs on the remaining business establishments in town.

There are some positive signs in the local economy in the past year as a number of the vacant premises became occupied again, e.g. the Clewer general dealer and the re-opening of the garage. After some mass community action in 2018, the provincial Department of Public Works also appear to have placed the town higher on its agenda[36]. There is however no consensus in the business community whether these trends imply the possible revival of the town. According to one respondent "for each step the town takes forward it moves a pace back". The low growth in the provincial and national tourism sector[37] is also an on-going concern for the town as once again will be the impacts of COVID-19.

[34] De Villiers, 2016

[35] The Public Protector, 2014

[36] https://lowvelder.co.za/443826/province-to-fast-track-rescue-measures-2/

[37] South African Tourism, 2018, Annual Tourism Report 2017/18

4.7.4. Composition of the labour force

Recent unemployment statistics for South Africa show that the national unemployment rate (official rate) has risen to close to 26% at the end of 2018. Mpumalanga Province had the third highest unemployment rate in South Africa in 2018 namely 34% (official /narrow unemployment) and 43% expanded definition – up from 30% (official rate) in 2011[38]. The official TCLM unemployment rate was much lower at 21% than the provincial or national rate in 2011[39].

Table 13: The Composition of the Pilgrim's Rest Labour Force, 2019

Pilgrim's Rest labour force (2019)	**2016**	**2019**
Population	1,900	2,016
Population in economic active years (15-64)	1,330	1,411
Labour force participation rate (narrow)	71%	71%
Total labour force (narrow)	944	1,002
Formal employment (including management)	141	130
Informal employment	114	124
Unemployment	689	748
Unemployment rate	**73%**	**75%**

Source: Based on Stats SA 2011 Pilgrim' Rest Population, age groups and national population growth rates, employment estimates for the town as well as Stats SA (2011) labour force participation ratios for Ward 13

Based on the population and employment figures in the sections above, the current (expanded) unemployment rate in Pilgrim's rest could be as high as 75% in 2019. Table 13 shows high level estimates of Pilgrim's Rest labour force in 2016 and 2019 based on current employment estimates, 2011 population figures, provincial population growth rates since 2011 as well as Ward 13 based labour force participation rates. The table also shows that formal jobs could have accounted for slightly more than 50% of total employment in 2019 compared to 55% in 2016.

4.7.5. Skills Levels of the Labour Force

Table 14 shows the relatively higher medium/semi skills levels of labour force in Pilgrim's Rest compared to municipal, provincial and national averages. A relatively large portion of the labour force completed matric (35%) compared to 33% on a national level. Skilled labour is as scarce as on a national level with only 7% of the labour force with tertiary qualifications.

[38] Stats SA (2019). Quarterly Labour Force Survey: Q4: 2018

[39] Stats SA (2011). Census 2011

Table 14: Highest Educational attainment of the Population age 20 years and older, 2011

Level of education	Pilgrim's Rest	TCLM	Mpumalanga	South Africa
No schooling aged 20+	7%	10%	14%	9%
Some schooling but less than matric	51%	51%	48%	51%
Matric aged 20+	35%	34%	33%	33%
Higher education aged 20+	7%	5%	5%	7%
Total aged 20+	**100%**	**100%**	**100%**	**100%**

Source: Stats SA (2011)

As is the case across South Africa, unskilled labour dominates in the local economy with 58% of the adult population having less than a matric qualification compared to 62% on a municipal and provincial level and 60% on a national level.

4.7.6. Income and Poverty Levels

The lower bound poverty level in 2011 was close to R 20 000 per households per year. The lower bound poverty level measures the income level needed for households to purchase enough food for minimum per-capita-per-day energy requirement (which is about 2 100 kilocalories) as well as a very basic non-food component (e.g. clothing, education).

Table 15 shows that more than 42% of households in Thaba Chweu fell below the lower bound poverty income line in 2011 - lower than the national average (45%) and the average for Mpumalanga Province (47%). In Pilgrim's Rest, the poverty rate was much higher than the municipal poverty rate and even higher than the provincial rate at 48% of households living below the lower bound poverty line. The percentage households that earned more than R 75 000 was also much less in Pilgrim's Rest (16%) than the municipal (21%) and national averages (24%).

Table 15: Distribution of households according to income level, 2011

Income category	Pilgrim's Rest	TCLM	Mpumalanga	South Africa
R0	15.%	12.1%	14.6%	15.5%
Under R4800	7.22%	3.2%	5.2%	4.5%
R5k - R10k	13.7%	5.7%	8.7%	7.4%
R10k - R20k	11.3%	21.2%	18.5%	17.1%
R20k - R40k	19.6%	22.8%	19.9%	19.0%
R40k - R75k	16.7%	14.6%	13.3%	13.0%
R75k - R150k	10.4%	9.4%	8.8%	9.2%
R150k - R300k	3.7%	6.0%	6.1%	7.1%
R300k - R600k	1.1%	3.6%	3.4%	4.6%
R600k - R1.2M	0.3%	1.0%	1.0%	1.8%
R1.2M - R2.5M	0%	0.3%	0.3%	0.5%
Over R2.5M	0%	0.2%	0.2%	0.3%

Income category	Pilgrim's Rest	TCLM	Mpumalanga	South Africa
Total	**100.0%**	**100%**	**100%**	**100%**
Lower than R20k	**48.1%**	**42.2%**	**47.0%**	**44.5%**

Source: Stats SA (2011)

4.7.7. Income Distribution

Although the Gini coefficient (1= perfectly unequal) of Mpumalanga is lower than the national average of 0.64 in 2013, the income distribution is still highly uneven in the province and likely also in Pilgrim's Rest. Unemployment is a major determinant of the high poverty levels in South Africa.

4.7.8. Economic diversity

While agriculture, forestry and tourism also play some role in the TCLM economy the local municipal economy is currently dominated by the mining sector in terms of output and employment. As was discussed under the economic structure above, the mining sector currently makes a major contribution (between 45% - 50%) towards local economic output. This situation potentially makes the local economy vulnerable to external factors such as fluctuations in commodity prices and changes in mining legislation with associated impact on investors. On the other hand, the more diversified the local economy in terms of economic activity, the more resilient the local economy will be.

On a more localised level, the Pilgrim's Rest Economy is mainly reliant on the foreign tourism industry, also leaving the economy vulnerable to external factors. For future resilience the local economy needs to diversify away from the mining and foreign tourism sectors, i.e. sectors that render it more vulnerable to external factors such as foreign tourism numbers and mining commodity prices.

4.7.9. Economic development priorities and initiatives

The Local Economic Development (LED) Strategy of TCLM has identified four priority areas including:

- Tourism Regeneration and Integration
- Development of Agriculture sector and Value Chain
- Business Development with a focus on SMMEs and BEE (e.g. through the Mashishing Industrial Park that focus on creating a mining supply hub)
- Creating an enabling Environment

The following economic opportunities have been identified in TCLM:

- Beneficiation of agriculture and forestry products (e.g. roof trusses, furniture)
- Tourism development around Kruger National Park and Blyde Canyon Reserve
- Using opportunities related to the N4 Maputo Corridor
- The development of a mining supplier park and downstream processing of mining products. So far, the only progress that has been made in this regard is with the launch of the Lydenburg Enterprise Development Hub as private sector (Glencore) initiative at the end of 2018 in

partnership with Regoapele Capital, aimed at incubating new entrepreneurs from all sectors, including the mining sector[40].

- Retail opportunities in Lydenburg, Sabie, Graskop, Ohrigstad and Mashishing

Specific development priorities listed for Pilgrim's rest in Ward 13 of TCLM include:

- Need for housing
- Need for land for human settlement and commercial township development
- Need for improved sanitation (flush toilets)
- Fencing and cleaning of the cemetery
- Need for municipal satellite offices for easy payment of social services
- Need for a library
- Need for crime prevention
- Need for internal streets/roads
- Water supply needs
- Need for permanent structures for the primary and secondary schools
- Need for re-opening of shops
- Need for jobs
- Need SMMEs and other businesses

4.7.10. Institutional Capacity for Development Planning

As was mentioned above, The Mpumalanga Department of Public Works, Roads and Transport (DPWRT) is currently the custodian of Pilgrim's Rest and is responsible for the maintenance and restoration of Pilgrim's Rest. The involvement of a provincial department in the administration of the town pose a challenge in terms of coordinating and demarcating the responsibilities of other levels of provincial government (e.g. health and education) and the TCLM in terms of public service delivery together with integrated human settlement and development[41]. It is specifically cross-cutting local government functions such as integrated development planning (including spatial planning and Local Development Planning) that appear to fall down the cracks. It is for example not clear whether the TCLM or the provincial department of economic development is responsible for economic development planning for the town.

Private local networks in Pilgrim's rest are also lacking and it would appear that it is down to individual businesses to take up some of the business's challenges in town (e.g. hawkers harassing tourists or charging exorbitant prices for certain services such as car washing). While there is a number of economic networks that represents general business and tourism interests in the municipal area, Pilgrim's Rest have limited representation in regional organisations. Pilgrim's Rest also currently have no active Business and Tourism Association (as opposed to associations that exist for Lydenburg/Mashishing, Sabie and Graskop). The Royal Hotel represents the interests of Pilgrim's Rest on the regional business chamber for Ehlanzeni District, the Kruger Lowveld Chamber of Business and Tourism (KLCBT).

[40] https://www.lydenburgbusiness.co.za/news/

[41] Thaba Chweu Local Municipality 2017, Integrated Development Plan 2017 – 2022 Term

In 2016 a multi-stakeholder committee for Pilgrim's Rest was established comprising of the Mpumalanga Department of Public Works, Roads and Transport (MPDWRT), the Mpumalanga Department of Economic Development and Tourism, the Mpumalanga Tourism and Parks Agency (MTPA), Mpumalanga Department of Human Settlement, Ehlanzeni District Municipality, Thaba Chweu Local Municipality and the private sector. While it may still be early days, local stakeholders however do not yet appear to embrace this platform as an effective planning platform for the town[42].

4.7.11. The Economy of the Downstream Blyde River Catchment Area

The economy downstream from the planned mining activities falls in the Blyde River upper catchment area that in turn forms part of the larger Olifants River Water Management Area (WMA).

Figure 4 below shows the Blyde River catchment area within the larger lower Olifants River. The figure shows that the population density in the Blyde catchment area is fairly low with larger population concentrations around Bourke's Luck (Moremela). The population in the total Blyde catchment area could have been around 62 000 people in 2011, i.e. about 18% of the population of the entire lower Olifants River catchment area (350 000 people in 2011)[43].

Due to the pristine condition of the river, Blyde River is popular with anglers. The upper region of the catchment area close to Pilgrim's Rest (downstream of the proposed mining activities) generates sustainable income for Pilgrim's Rest in terms of national angling competitions; provincial angling trials as well as ad hoc angling tourists. Based on conversations with local sources and provincial angling associations Pilgrim's Rest hosted two national angling competitions the past three years. This could have generated an income injection to the town of R200 000 for 3 days at least every second year. The national competitions generate demand for approximately 4 days overnight accommodation and work for 50 to 60 angling marshals employed from Newtown or the 3 days that the competitions last.

[42] https://klcbt.co.za/all-talk-and-no-action-for-pilgrims-rest-tourism-update/

[43] Department of Water Affairs, 2011

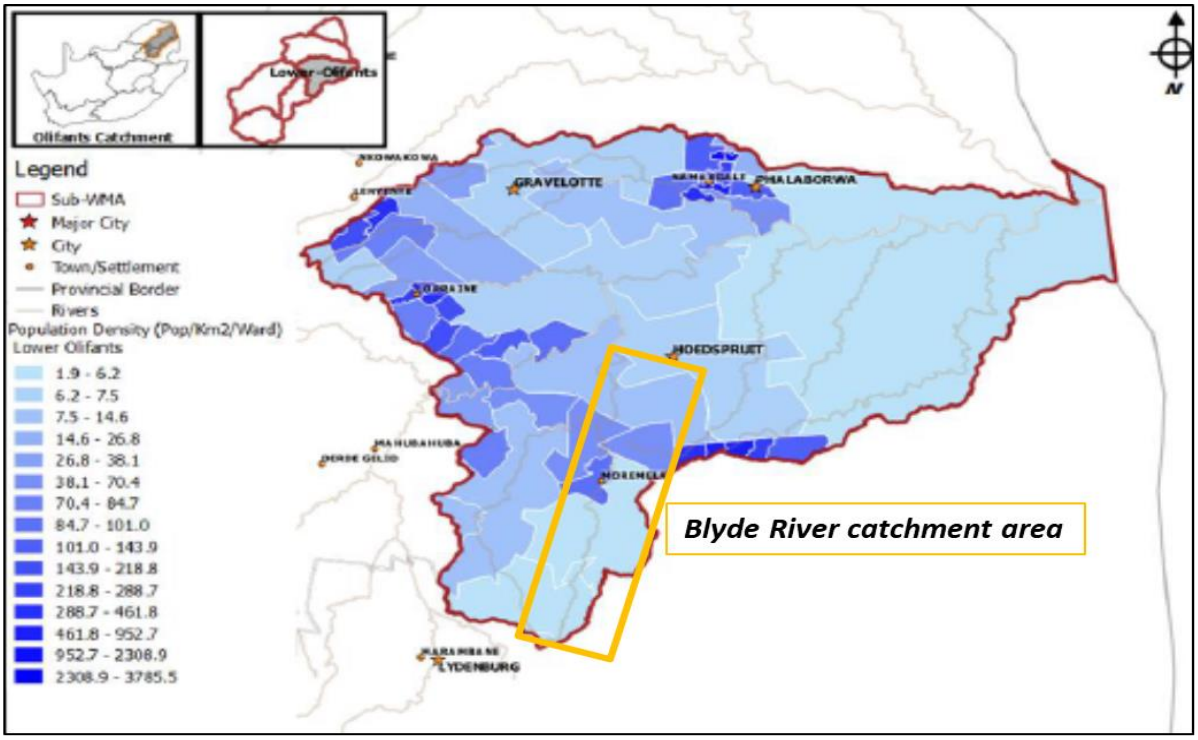

Figure 4: The Lower Olifants River Catchment Area

Source: Department of Water and Sanitation, 2018

Apart from national competitions, provinces across South Africa hold angling trials at Pilgrims, i.e. around 5 times a year. These trials involve around 18 people per trial spending 3 days in Pilgrim's Rest over the two-day trial. The provincial trials could generate an additional R 200 000 to the town every year and supply informal, ad hoc employment to close to 18 angling marshals from Newtown for 2 days every second month. Non-competitive leisure anglers could generate an additional R 135 000 to Pilgrim's Rest around the year. In summary angling activities in the Blyde River 20km downstream from Pilgrim's Rest could generate a total turnover of close to R 500 000 per annum. It is possible that close to 20% (R100 000) of this turnover could flow to low income families of which some R 75 000 could flow to informal angling marshal services per annum, generating some 450 Full time equivalent (FTE), person-days of work annually.

From a broader perspective, the entire Blyde River catchment area forms part of the lower Olifants River catchment area. The Blyde catchment area originates in Hartebeesvlakte (20km upstream from Pilgrim's Rest) and further downstream joins the Olifants River north of Hoedspruit before entering Kruger National Park. While the Blyde River is less than 200km in length, its total catchment area size is 2,842 km², i.e. consisting of 23% of the total lower Olifants River catchment area of 12, 154 km² that stretches from Steelpoort to Phalaborwa (including parts of the Kruger National Park)[44].

[44] International Water Management Institute, 2008

In Table 16 below, socio-economic information is provided for selected municipal wards within the Blyde River catchment. Note that only wards that could potentially be affected by the project (downstream of the project) are included in the table. The table shows that 35 000 people lives downstream of Pilgrim's Rest up to the Hoedspruit area; close to 6 500 formal and 3 000 informal jobs are created in the relevant downstream economy and the total economic output (GVA) of the economy could have been in the region of R460m in 2011 (i.e. R 740m in current 2019 prices).

Table 16: Selected Municipal Wards within downstream Blyde River Catchment Area [45]

Relevant wards	Population	Households	Formal Employment	Informal Employment	Total GVA (Estimate R Million)	Main Economic Activities
	2011	2011	2011	2011	2011	
TCLM ward 10 (including Ngwetsintshage and Kanana settlements north)	6,371	2,682	1,798	671	140	rural subsistence, agriculture
TCLM ward 9 (including settlement of Moremela)	7,528	2,136	647	191	47	rural subsistence, agriculture
TCLM ward 8 (including Blyde Poort Dam)	7,367	2,201	586	235	46	agriculture, eco-tourism
Maruleng LM ward 2 (downstream from Blydepoort Dam)	8,255	3,143	1,322	1,481	79	intensive agriculture (citrus) and eco-tourism
Maruleng LM ward 1 (including Hoedspruit)	5,622	2,113	2,126	455	146	intensive agriculture (citrus) and eco-tourism
Blyde catchment area (downstream from Pilgrim's Rest)	**35,143**	**12,275**	**6,479**	**3,033**	**459**	

Source: Stats SA (Census 2011), estimates for GVA based on Stats SA 2011 and 2017

The Department of Water and Sanitation estimated in a study in 2011 that the total value of eco system services derived from the lower Olifants River could have been in the region of R 411 million in 2010 (R 707million in 2019 prices). The table below shows the high contribution made by tourism (61%) followed by agriculture-related services (22%). The eco-system services in the entire Lower Olifants River catchment area could sustain in the region of 8 000 jobs (formal and informal)[46].

Table 17: Eco- system services in the Lower Olifants River, 2010

Eco System Service	R million
Domestic water use	55
Livestock watering and grazing	48
Harvesting products (plants, food, medicinal, hunting and fishing)	44
Water regulation and purification (e.g. Groundwater recharge, flood control)	6
Carbon sequestration[47]	2

45 Downstream from proposed the mining activities and excluding Ward 13 of TCLM and other wards further upstream

46 Based on Stats SA 2011 and Stats 2017 ratios

47 This involves a natural process by which carbon dioxide is removed from the atmosphere and held in liquid form.

Tourism	252
Aesthetic value (property values)	6
Education	0
Total	**411**

Source: Department of Water Affairs, 2011

If the rough assumption is made that economic activities are fairly evenly distributed across the lower Olifants River catchment area (and that the economic and geographic contribution of the Blyde River catchment area towards the larger catchment area is the same) the eco system services of the Blyde River catchment area could be in the region of (R95m or 23%) of the R 411million estimated for the lower Olifants River catchment area, (R 165 million in 2019 prices. In addition, some 2 000 jobs could be directly dependent on the healthy functioning of the Blyde River. That would imply that closer to 20% of the total economy in the wards within the downstream Blyde River catchment area (i.e. R95 million as portion of the total downstream economy of R459 million) could be directly dependent on the health of the Blyde River.

5. DESCRIPTION AND ASSESSMENT OF POTENTIAL IMPACTS DURING THE START-UP AND CONSTRUCTION PHASES

5.1. Introduction

Pre-construction activities would include fencing of the mining sections (sites), earth clearing activities (clearing of vegetation, soil stripping), road construction and the upgrading and/or extension of site offices, security checkpoints and surface infrastructure, as well as the establishment of contractor's laydown areas for the temporary storage of materials and equipment.

During the construction phase, the appointed contractors will be responsible for the erection of the change houses, temporary ablution facilities (chemical toilets) and so forth. This infrastructure will remain on site for the duration of the construction phase. Permanent infrastructure will then be established on site.

Infrastructure for the mining project will mainly include the establishment of a mining site with supporting infrastructure to be utilised by the mining contractor for the operation of the open pit mine.

Based on information supplied by the TGME Mining Work Programme (MWP) for the project, the construction period of the initial mining and shared infrastructure is planned for 6 months. The initial capital expenditure is estimated at R 121 million over a 6 months construction period. In year 2 an additional capital spending of R241 million would be required for the construction of the initial processing storage facility.

Over the 5 years life of mine (LoM) an additional R 17.7 million is estimated for on-going capital spending. This spending is expected to occur mainly in the last 3 years of the LoM.

The construction and maintenance of infrastructure will be the responsibility of the mine owner (probably through a construction contractor company) and not the mine contractor.

5.2. Employment and income opportunities during construction

Table 18 below shows that the project could directly create between 250 and 350 jobs over one and a half years alongside jobs created by the mining operation activities (discussed in Section 6.2). The potential unskilled and semi-skilled workers are very high (25% and 63% of total employment) compared to current employment estimate (250) for the town and could make a significant dent to the estimated 750 unemployed people currently residing in Pilgrim's Rest.

Construction activities related to the project could also significantly increase local income levels. The GVA of the town is currently estimated in the region of R20 million. Direct spending on construction activities alone could be four times the current size of the Pilgrim's Rest economy. The direct income from construction activities is also expected to have some distributive impact as low-income households are expected to earn a slightly higher portion (25%) of total income compared to their 11% contribution in provincial income and 16% in national income.

Flow on impacts due to spending on suppliers and induced spending due to higher income could add an additional 100 to 200 jobs, mainly in the larger municipal and regional economy.

Due to the limited spending opportunities of these increased wages and salaries in the local economy of Pilgrim's Rest, the adjacent towns of Sabie and Graskop is expected to receive the major induced spending benefits from increased income levels. Spending on construction suppliers/inputs will also mainly occur outside the local Pilgrim's Rest's economy. Within Pilgrim's Rest the income of the general dealer/hardware store could more than double, and activities could ensure a high turnover to a local petrol station. Some of the restaurants and accommodation facilities might also experience some increase in turnover during the short (18 month) construction boom.

Table 18: Forecasted employment and income impacts during construction (upper case)

DIRECT IMPACT	**(6 months)**	
Total Spending (R million) (2019 prices)	170	330
Direct gross value added (profits, salaries and wages) R million	40	80
Direct employment (FTE)	250	350
Skilled Employment (trades people, service workers, clerks, plant operators -completed matric)	35	35
Semi-Skilled Employment	75	88
Unskilled Employment (elementary occupations -less than matric certificate/diploma)	190	227
% of GVA to high income households	59%	59%
% of GVA to medium income households	16%	16%
% of GVA to low income households	25%	25%
FLOW-ON IMPACT (SUPPLY LINKED AND INDUCED)		

Direct gross value added (profits, salaries and wages) R million	40	80
Flow-on employment (FTE)	100	200
Skilled Employment (trades people, service workers, clerks, plant operators -completed matric)	20	40
Semi-Skilled Employment	35	70
Unskilled Employment (elementary occupations -less than matric certificate/diploma)	45	90
% of GVA to high income households	70%	70%
% of GVA to medium income households	19%	19%
% of GVA to low income households	11%	11%

Source: Estimates based on information supplied by TGME Mine Works Programme, Mpumalanga Social Accounting Matrix (2006) and Statistics South Africa Provincial Statistics (2017) and Labour Force Survey (2019)

Anticipated areas of impact:: Pilgrim's Rest (direct impact); broader region (Sabie, Graskop, Lydenburg and rest of Mpumalanga) (flow-on)

Table 19: Rating of Employment and Income Opportunities

THEME: DIRECT AND FLOW-ON EMPLOYMENT AND INCOME OPPORTUNITIES		
	Without mitigation	**With mitigation / enhancement**
Status	Positive - local and regional jobs and income (+)	Positive (+)
Extent	Local and regional (3)	Local and regional (3)
Duration	18 months with limited impacts beyond year 2 (1)	18 months with limited impacts beyond year 2 (1)
Probability	Highly probable (3)	Highly probable (3)
Intensity	Beneficial (3)	Significant (4)
Significance	Medium (10) +	Medium (11) +

Enhancement:

- Prioritise local labour in the recruitment process as part of the company's own recruitment policy or as part of contractor management plan
- Provide up-skilling opportunities for unskilled and semi-skilled local workers during the construction phase
- If use is made of a contractor, explore possibility of placement of up-skilled local workers in other projects
- Sequence the operations phase to commence after the construction phase if possible, to avoid negative cumulative impacts
- Explore possible placement of local construction workers in mining operations
- Prioritise the recruitment of unskilled local (Pilgrim's rest) labour if there is a risk of cumulative pressure in the demand of semi-skilled and skilled labour sources (see cumulative impacts below)
- Incorporate the mitigation measures worker related management plans and employment contracts as well as contractor management plans

Cumulative impacts:

- Due to the lack of other major projects within the immediate vicinity of the project limited cumulative impacts is foreseen within Pilgrim's Rest. If construction activities however run parallel to the mine's operations this could have cumulative impacts that could specifically place pressure on the availability of skilled and semi-skilled labour
- Other mining applications of TGME, other possible mining developments proposed by different applicants within the area, and other companies in TCLM have a cumulative impact on mining construction supplies.

Residual impacts: None

5.3. Negative impacts related to project induced in-migration

In-migration to an area as a result of large-scale projects is a common phenomenon in South Africa and is thus not just related to the proposed Theta Project. The proposed project can also be one of several contributing factors (albeit a dominant one) of in-migration to the area.

Project induced in-migration to the Pilgrim's Rest area could be structured and unstructured:

Formal/structured in-migration (workers associated with project moving into the local area): If outside workers would comprise the majority of the workforce during the construction phase it could result in an additional increase of about 300 people causing a dramatic increase in the small population of about 2 000 people living in Pilgrim's Rest, Newtown/Schoonplaas and Darks Gully. The potential size of the construction workforce relative to the size of the town underscores the high priority that should be given to source temporary labour as far as possible within the local population of Pilgrim's Rest. Even if the focus is to recruit unskilled labour exclusively from the local area it could still mean an influx of some 110 individuals into Pilgrim's Rest for the initial 18-month construction period. This strategy may be required due to limited availability of semi-skilled and skilled positions within Pilgrim's Rest -especially if the construction phase overlaps with the operations phase.

Informal/unstructured in-migration (job-seekers looking for economic opportunities into the area): The influx of individuals to an area in search of employment is difficult to quantify and to control, but the employment of locals as well as a clear communication strategy well in advance of the project could limit the negative social impacts in this regard. If mine management keeps a well-publicised tight control of illegal mining activities in the area it might deter some of the in-migration related to illegal mining activities into the project areas.

Both forms of in-migration could have some negative impacts on the local area. The following negative impacts could occur:

- <u>Pressure on local accommodation, increased potential of land invasion and informal settlement on nearby landowners:</u> At this stage it is unclear where the construction workforce would be accommodated. The requirement for accommodation would further depend on the number of locals that could be employed. There is limited housing available in town. An influx of jobseekers to the area could result in the further development of illegal and/or informal housing as well as sub-letting in Newtown/Schoonplaas and /or other settlements outside Newtown/Schoonplaas. The geological stability of Newtown/Schoonplaas and the potential expansion of the town are furthermore in question. The presence of a construction accommodation facility could result in social conflict (e.g. between residents and outsiders, misconduct of workers and so forth) and damaging environmental impacts. Such facilities are also generally perceived to serve as conduits of criminal activities. The likelihood of this impact negatively impacting on the local residents is thus high due to the mining activities being planned in close proximity to the populated areas of Pilgrim's Rest. Failure to effectively manage such a facility would thus increase the likelihood of the negative impacts actually materialising.
- <u>Pressure on other public services due to influx of newcomers to local area:</u> As mentioned in Section 4 above, Pilgrim's Rest specifically experience challenges in terms of housing backlogs, improved sanitation, electricity provision, lack of upgrading and maintenance of the provincial road (R533) that passes the town, quality primary health care services including emergency (ambulance) services and permanent structures at educational institutions. Due to the short duration and scale of the construction period, it would be necessary for the representatives of the TCLM and the Department of Public Works to liaise with TGME with regards to their planning processes and possible need for additional services and infrastructure. However, a possible influx of outsiders in search of employment who remains in the area as employed or unemployed members of society would place an unnecessary and additional long-term burden

on the provision of services and infrastructure which is mainly the responsibility of the TCLM and the Department of Public Works.

- Health and safety risks: As mentioned above, the per capita crime rates in Pilgrim's Rest is already high. Illegal miners also create significant safety risks. The informal influx of people could increase the risk of crime in the local area. An increased health risk, such as the spread of HIV/AIDS with long-term possible consequences, could also be created due to the influx of workers to the area and the social interaction between these outsiders and the local population. If the construction sites and accommodation facility (if required) are not properly managed it could result in negative impacts on the environment with related health impacts on the surrounding communities such as pollution of water sources due to improper sanitation facilities, solid waste management or wastewater management. Accidents during the construction phase furthermore always remain a source of concern.
- Social conflict between newcomers and the local community could arise due to the factors above e.g. possible increase in crime due to these jobseekers being unemployed, increased pressure on already strained infrastructure and additional pressure on health and community services and competition for local jobs.

Anticipated areas of impact: Pilgrim's Rest (with the focus on Newtown/Schoonplaas and Darks Gully)

Table 20: Rating of negative impacts associated to population influx

THEME: POPULATION CHANGE		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Medium/Local (2)	Medium /Local (2)
Duration	High /Informal in-migration remains in area after construction (3)	High /Informal in-migration remains in area after construction (3)
Probability	Highly Probable (3)	Probable (2)
Intensity	Average (3)	Average (3)
Significance	Medium (11) -	Medium (10) -

Mitigation:

- Employment of locals (within the low to semi-skilled positions) already residing in Pilgrim's Rest must receive priority
- The local labour procurement strategy as well as proof of residence required should be clearly communicated in the local community and broader regional media well in advance of the construction phase
- The creation of temporary accommodation facilities is not preferred or recommended from a social perspective although it could be implemented as part of this project. Should a temporary accommodation facility be required on site, this facility must be managed in an environmentally and socially acceptable manner to avoid any social conflict and environmental pollution. Such an accommodation facility should have security measures in place to avoid unauthorised and/or criminal activities
- The planned upgrading and development of the Caravan Park by TGME could serve as accommodation facility
- Contractors to ensure that workers outside the local area reside in suitable facilities and not establish informal houses
- The development of informal vending "stations" where food and small goods are sold should be properly managed, to avoid littering, safety risks and possible environmental pollution
- On-site construction workers should be supervised at all times
- First aid and/or emergency supplies should be available at various points at the construction site
- Continue and extend the current HIV/AIDS awareness and support programmes, with specific focus on those in and nearby the construction site
- The general health of construction workers should be monitored on an on-going basis

- A contractor management plan must be drawn up and implemented
- The Department of Public Works and community-based representatives in the area such as the councillor, business representatives, and so forth could be informed of the construction schedules and activities.
- Ensure that a proper emergency plan that fits with the Municipal Disaster Management Plan is in place. Such a plan could be developed by the TCLM, Department of Public Works and adjacent property owners e.g. SAFCOL and York Timbers in consultation with TGME
- TGME to discuss other infrastructure requirements of the construction phase with the Department of Public Works, and TCLM to pro-actively deal with the possible negative impacts
- Support the local governments by sharing data and information to ensure that all the impacts and risks are taken into consideration and addressed
- Support the local government in conducting impact assessments and policy planning around these issues, and jointly agree on shared responsibilities for managing the flux and its impacts on children
- Support the local government in conducting impact assessments and policy planning with regards to the existing housing issues and dolomitic area and the subsequent expansion/development of Newtown/Schoonplaas that is currently hampered due to i.e. geological issues.
- Sequence the operations phase to commence after the construction phase if possible, to avoid negative cumulative impacts
- Exercise tight control over illegal mining activities in the area and make it public in the regional and national media
- Incorporate the mitigation measures worker related management plans and employment contracts as well as contractor management plans

Cumulative impacts:

- Cumulative pressure on infrastructure and services due to general population growth and if mining operations run parallel to the construction phase

Residual impacts:

- The presence of new groups of jobseekers within the local communities remaining unemployed with subsequent negative socio-economic consequences
- Possible long-term impacts on services and infrastructure if construction workers remain in the area after the construction has been completed
- Possible increase in HIV/Aids and related diseases
- Possible lack of maintenance of infrastructure and adequate infrastructure and services

5.4. Safety and Health Risks

Apart from safety issues related to project induced in-migration (as discussed under Section 5.3), construction activities could in itself pose safety issues for the local community:

- Safety at and around the different construction sites should impose fire risks
- The construction site could pose risks of injury for community members and workers
- Increased traffic on the local roads and access road could have possible negative impacts on road safety

The Brown's Hill community is approximately 300 metres south of the existing TGME Metallurgical plant. The residents residing at Brown's Hill frequently use the existing gravel road to be used as access road to the proposed development. Mining related vehicles on this road would pose additional safety risks for these pedestrians.

Darks Gully, Pilgrim's Rest and Newtown/Schoonplaas are between ± 250 m from the nearest development sections to approximately 2.5 km from the furthest development sections from the proposed development. The project activities could thus pose new risks e.g. safety and security risk due to movement of vehicles and mining activity, health risk, fire risks, and so forth to these receptors.

It is not anticipated that communities and/or settlements further afield would be directly negatively affected in terms of safety risks during the construction phase.

The main concern in terms of public health is HIV/Aids as it is known that the disease spreads with the influx of outside workers to an area. Young male construction workers could be classified as those in the "high risk" categories, and if exposed to extreme conditions, they can easily fall victim to Aids related diseases, thus increasing the HIV/Aids prevalence. If a significant proportion of the construction workforce are affected by HIV/Aids, it can lead to lower productivity, increased health related expenses and negative implications to replace workers. A large proportion of the population in the TCLM area is classified as "young adults", thus part of the 'high risk' age category.

Anticipated areas of impact:

- Pilgrim's Rest
- Local communities (e.g. Brown's Hill and Darks Gully) close to the project
- Indirect health risks to nearby communities

Table 21: Negative impacts on safety and health

THEME: SAFETY AND SECURITY

	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Medium/Local (2)	Medium /Local (2)
Duration	Short term (1)	Short term (1)
Probability	Probable (2)	Probable (2)
Intensity	Average (3)	Minor (2)
Significance	Medium (8) -	Medium (7) -

Mitigation:

- The construction area should be fenced or access to the area should be controlled to avoid unauthorised entry
- The construction sites should be clearly marked, and "danger" and "no entry" signs should be erected.
- Ensure that sufficient safety and security measures are in place in the areas surrounding the mining sites
- Employ permanent security personnel for the duration of the construction period. The TGME security team can thus be re-deployed and expanded which would result in security improvements in the area.
- On-site, construction workers would furthermore be exposed to operational safety risks. These risks should be addressed as part of the Mines Health and Safety Act (Act 29 of 1996).
- A Fire/Emergency Management Plan should be developed and implemented. It is important that this management plan and associated communication channels are developed at the outset of the construction phase. It would be important to regularly review the functionality and efficiency of such a plan in conjunction with the local emergency teams, mine management and affected communities as well as neighbouring landowners (timber companies)
- Appropriate fire-fighting equipment should be on site and designated construction workers should be appropriately trained for fire fighting
- Open fires for cooking and related purposes should not be allowed on site
- All construction vehicles should be in a good condition and adhere to the road worthy standards
- The construction of additional access roads should be limited
- Should local road users be affected by the movement of the construction vehicles or by the construction activities of access roads taking place near main roads, sufficient warning signs should be erected
- All construction vehicles should be in a good condition and adhere to the road worthy standards and speed limits. Speeding of construction vehicles must be strictly monitored
- Incorporate the mitigation measures worker related management plans and employment contracts as well as contractor management plans

Cumulative impacts: The significance of the impacts can increase if the operations phase coincides with the construction phase.

Residual impacts: None foreseen

5.5. Nuisance factors (Noise and dust)

General intrusion impacts during the construction phase would include dust and noise due to the inflow of workers, general construction activities and heavy vehicle movement. These types of noises would have different nuisance impacts during the day and night on those within the construction site and possibly on nearby settlements or dwellings. It should, however, be noted that the construction activities and associated noise would be intermittent and of a short duration at each section of the project area. A detailed Noise Impact Assessment and Air Quality Impact Assessment have been undertaken as part of the EIA process and this section only aims to highlight the possible social consequences associated with the anticipated noise and air quality impacts.

Anticipated areas of impact:

- Areas along the access roads and on sections of the local roads that would be used for movement of construction vehicles.
- Pilgrim's Rest, Newtown/Schoonplaas, Brown's Hill, Darks Gully

Table 22: Nuisance factors

THEME: NOISE AND DUST IMPACTS		
	Without mitigation	**With mitigation**
Status	Negative (-)	Negative (-)
Extent	Medium/Local (2)	Medium /Local (2)
Duration	Short term (1)	Short term (1)
Probability	Probable (2)	Probable (2)
Intensity	Minor (2)	Minor (2)
Significance	Medium (7) -	Medium (7) -

Mitigation:

- The mitigation measures of the Noise and Air Quality Impact Assessments are relevant
- Construction vehicles should be in a good working order
- Dust suppression measures should be applied if and when necessary
- Sequence the operations phase to commence after the construction phase if possible, to avoid negative cumulative impacts
- Incorporate the mitigation measures worker related management plans and employment contracts as well as contractor management plans

Cumulative impacts: The significance of the impacts can increase if the operations phase coincides with the construction phase.

Residual impacts: None anticipated

5.6. Negative impact on other economic sectors in the local economy

Construction activities could have negative impacts on other economic sectors in and around Pilgrim's Rest in the following ways:

- Construction vehicles could pose a threat to livestock that has been noted to graze in the vicinity of the road from the R533 to the TGME processing plant and within the proposed mining area. This could impact on the cattle owners' unauthorised/opportunistic use of the land for grazing.
- During the construction phase the main impacts associated with the mining activities would relate to construction workers trespassing on private properties, as well as nearby and adjacent forestry and conservation areas and increasing the risk of fires.

- Construction activities could impact negatively on tourists' numbers due to perceptions and communications of nuisance factors such as noise and dust, visual intrusions on sense of place and increase in criminal activities due to in-migration.
- Recruiting informally skilled agricultural, forestry or tourism workers could increase the training and recruiting costs for the local agricultural and forestry sector.

Anticipated areas of impact:

- Pilgrim's Rest
- En-route tourism ventures and establishments
- Adjacent farms and forestry activities

Table 23: Rating of negative impacts on other economic sectors in the local economy

THEME: IMPACT ON OTHER LOCAL ECONOMIC SECTORS		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	High (3)	High (3)
Duration	Short term (1)	Short term (1)
Probability	Probable (2)	Probable (2)
Intensity	Average (3)	Minor (2)
Significance	Medium (9) -	Medium (8) -

Mitigation / Enhancement:

- The construction area should be fenced to avoid unauthorised entry by animals onto the mining area
- The contractor could communicate the construction schedule and vehicle movements to the livestock owners and/or representative organisations e.g. the Maorabjang Communal Property Association, as well as to the neighbouring property owners (e.g. SAFCOL and York Timbers)
- Construction workers should focus their activities within the mining areas. As far as possible, the movement of construction workers should be confined to the work site to avoid any trespassing on forestry and privately-owned areas.
- No fires should be allowed on site.
- Facilitate the establishment of a business forum and/or communication forum for local businesses and community representatives of Pilgrim's Rest and set up a grievance mechanism by introducing a complaints register at the mine where concerns/complaints with regards to e.g. noise related to construction activities can be voiced.
- The construction site should be kept litter free
- Site rehabilitation should occur as soon as the construction process allows
- The recommendations made by the Visual Impact Assessment should be adhered to in order to limit any possible negative impacts on the tourism industry.
- Dust suppression methods should be strictly implemented if and where required
- Should local road users such as tourists be affected by the movement of the construction vehicles or by the construction activities of access roads taking place near main roads, sufficient warning signs should be erected
- Involve the SAPS and other relevant stakeholders (e.g. other business entities operating in the area, as well as Police Forums and Sector Forums) in the preventative security measures to be undertaken
- Prioritise recruiting unskilled workers among the unemployed.
- Align unskilled wages to other sectors (tourism, agriculture, forestry) in the local economy
- Incorporate the mitigation measures worker related management plans and employment contracts as well as contractor management plans.

Cumulative impacts: None anticipated

Residual impacts: None anticipated

6. DESCRIPTION AND ASSESSMENT OF IMPACTS DURING THE OPERATIONAL PHASE

6.1. Introduction

During the operational phase, the mine is to exploit the ore body with open pit mining conducted by the modified terrace mining method. The LoM is estimated to be five years. Due to the mountainous topography there is limited space available for waste rock dumps on the project area. The planned mining strategy is to utilise space in the mined-out areas for backfilling of waste to reduce waste rock dump footprints.

Mining production will be ahead of plant production and will be stockpiled appropriately. Different gold bearing reefs will be mined at three areas which are referred to as Brown's Hill, Theta Hill and Iota Hill Pits. Run of Mine (RoM) ore will be stockpiled from the mining operations and introduced into the processing plant by means of a Front-end Loader into a closed-circuit crushing plant.

The processing plant will produce gold doré, a semi-pure gold alloy that will be air-lifted to Rand refinery in Germiston for further purification. Rand refinery has liaison arrangements with members of the London Bullion Market association for the sale and distribution of their products. The finished product customers include bullion banks, jewellery manufacturers and distributers and mints.

Tailings material will be deposited into an existing tailings storage facility (the TSF) which includes a gravity decant system that recovers water back to the plant. Only the socio-economic impacts of mining operations and the processing plant will be investigated in this environmental application. The existing TSF does not form part of the scope of this application.

A contractor miner will be used during the operational phase.

It should be noted that, if this project's is to proceed, profits from the project would unlock further mining opportunities for the project developer in the area in future. This implies that similar positive as well as the negative impacts related to mining operations as described in this section could potentially be sustained in the local area for another 20 years or more if this project is to proceed.

6.2. Employment and income opportunities during the operational phase

Direct employment and income: The operational phase related to the mining application is expected to last approximately five years. As indicated in Table 24 below, between 400-450 direct jobs could be created during the operational phase, representing more than 1% of total employment across the whole TCLM - a very high percentage for any single project. The jobs are directly related to the proposed mining activities and will be created as in-house jobs by the mining license holder itself, the mine contractor as well as service providers (e.g. security, tailings facility management, administration and gold handling). Of the direct jobs, 18% will be skilled; 44% semi-skilled and 38% could be unskilled/elementary jobs. Most of the jobs (80%) will be contracted through service providers and the mine contract manager on behalf of TGME.

The operations will invest 1.2% of its annual payroll in skills development activities as provided for in a Social and Labour Plan (SLP) budget. The SLP should also make provision for a skills development, career progression, mentorship, bursary and internship and employment equity plans.

As indicated in Table 24 below, the direct contribution of the mining operations to the Gross Value added[48] (GVA) of TCLM could be in the region of R 600m on average per annum, representing close to 4% of the current economic output of TCLM. A relatively small portion of the GVA however consists of salaries and wages, and of the total labour bill. In addition a relatively small portion is expected to be earned by semi-skilled and unskilled workers potentially originating from Pilgrim's Rest. Assuming all unskilled labour and 25% of semi-skilled labour is recruited from Pilgrim's Rest (i.e. close to 200 local jobs), local income levels in Pilgrim's rest could still increase on average by some R13m per annum for the 4 year duration of the project – almost half the estimated current GVA of R20 million of the town. The potential number of local jobs on the mine could well double local employment figures in Pilgrim's Rest. Most of these direct job opportunities for Pilgrim's rest will be created for low income households.

Flow-on employment and income: In addition to the direct employment and income generation of the mine, its supply spending and further induced spending due to higher income levels could add some flow-on income of R 250m on average per annum and flow on employment in the region of 350 jobs for the larger regional economy during mining operations. Most of the additional income and employment will be generated in the larger regional economy due to the limited economic activity in Pilgrim's Rest. The Mining Charter of 2018 targets 70% of mining goods and 80% of services to be procured from South African companies - 21% of companies supplying mining goods and 50% of service providers should be HDI controlled (more than 50% share).

There are a few local/ Pilgrim's Rest procurement opportunities for the mine in terms of its spending on alien vegetation removal, procuring basic hardware supplies, catering and accommodation services. While this spending could only contribute 2% or less of the total discretionary spending (excluding overheads and utility costs) of the project, it could still add significantly to income levels within Pilgrim's Rest.

Furthermore, while a large portion of skilled and semi-skilled mine workers might not stay in Pilgrim's Rest, they will still spend their working days close to the town and even if they should spend only a small portion of their income in town on fuel, restaurants and basic food stuffs (bread, milk etc.). This could also have a relatively high impact on income levels in the town. It is estimated that this joint supply and induced spending impact could potentially increase total sales in Pilgrim's Rest on average between R10m and R 15 million per annum over the 5 full year period (GVA between R5 million and R8 million) with the potential to create an additional 30 to 50 jobs in town of which 60% could be unskilled jobs.

Anticipated areas of impact:

- Pilgrim's rest, Sabie, Graskop and rest of regional economy

[48] Economic production is measured by Gross Value Added (GVA) and is a sum of all the income to production factors (labour, capita, entrepreneurship, land) used in the production process.

Table 24: Forecasted employment and income impacts during operations (average per year)

DIRECT IMPACT	Average per year over 4 years
Direct gross value added R million	600
Direct employment (number)	410
skilled employment (managers, professionals) (%)	18%
semi-skilled employment (artisans, foreman) (%)	44%
unskilled employment (elementary occupations -less than matric certificate/diploma) (%)	38%
FLOW-ON IMPACT (SUPPLY LINKED AND INDUCED)	
Direct gross value added (profits, salaries and wages) R million	250
Flow-on employment (number)	350
skilled employment (managers, professionals) (%)	18%
semi-skilled employment (artisans, foreman) (%)	37%
unskilled employment (elementary occupations -less than matric certificate/diploma) (%)	45%
% of GVA to high income households	70%
% of GVA to medium income households	19%
% of GVA to low income households	11%

Source: Estimates based on information supplied by TGME Mine Works Programme, Mpumalanga Social Accounting Matrix (2006) and Statistics South Africa Provincial Statistics (2017) and Labour Force Survey (2019)

Anticipated areas of impact:

- Pilgrim's Rest (direct impact); broader region (Sabie, Graskop, Lydenburg and rest of Mpumalanga) (flow-on)

Table 25: Rating of Employment and Income Opportunities during Operations

THEME: DIRECT AND FLOW-ON EMPLOYMENT AND INCOME OPPORTUNITIES		
	Without mitigation	**With mitigation / enhancement**
Status	Positive (+)	Positive (+)
Extent	Local and regional (3)	Local and regional (3)
Duration	Medium (2)	Medium (2)
Probability	Highly probable (3)	Highly probable (3)
Intensity	Significant (4)	Significant (4)
Significance	High (12) +	High (12) +

Enhancement:

- 100% recruitment of unskilled labour from local communities, with focus on Pilgrim's Rest, Newtown/Schoonplaas and Darks Gully; up-skilling of local labour force as per SLP
- Develop a database of goods and services that could potentially be outsourced to the local community
- Establish a supplier development programme as part of the Local Economic Development component of the SLP. The programme should focus on small businesses in Pilgrim's Rest that could supply non-core mining goods and services to the mine (e.g. catering and cleaning) as well as larger businesses within the region. It should be noted that the project could offset 30% of the Mining Charter (2018) procurement target for mining goods with an enterprise development fund and programme and 10% of services. The focus of the fund should be on the development of HDI owned and controlled businesses with less than a R 50 million turnover
- Focus in the local supplier development programme on creating sustainable local businesses that could continue to operate after mine closure, e.g. by assisting local businesses in market diversification strategies
- Participate in the development of a regional mine supplier hub to promote the development of a local supply base (e.g. the current enterprise hub in Lydenburg that was launched by Glencore)

- Put a contractor management plan (including direct service providers) in place to ensure that the local employment and procurement targets of the operations are met. The targets should also be aligned to the Mining Charter of 2018
- Plan the operational phase to commence after the construction phase to prevent cumulative impacts in terms of local labour demand, in-migration and related challenges and compounded impacts on noise and dust

Cumulative impacts:

- Due to the lack of other major projects within the immediate vicinity of the project, limited cumulative impacts is foreseen within Pilgrim's Rest. If construction activities however run parallel to the mine's operations this could have cumulative impacts that could specifically place pressure on the availability of skilled and semi-skilled labour
- Other mining applications of TGME and other companies in TCLM have a cumulative impact on mining construction supplies.

Residual impacts:

- None

6.3. Increase in Public Revenues

Table 26 below shows the different contributions of the mining project to public revenues of the 5-year operational period of the mine. The table shows that the project could possibly create between R 600m to R 730 million in public revenues over the 4-full year period. The contribution of the project to central government tax and royalty revenues is particularly high and contributes around 35% towards the total GVA (direct and flow-on) of the project compared to the 26% contribution that taxes in general contribute to national GVA. The 26% contribution is furthermore already considered high in terms of international standards. This high tax ratio signifies to a strong emphasis of rectifying the generally low contribution of low income households in total income generated during mining operations as well as compensating local communities for potential negative social and environmental impacts associated with hosting mining projects in general.

Table 26: Estimated public revenues generated by the project

Public funds (R1000)	**Total**
Royalties	155
National skills fund (1% of labour costs)	0.6
Taxes (personal, company and indirect taxes) from mining activity (direct)	400
Taxes (personal, company and indirect taxes) from suppliers and induced impacts (flow-on)	68
Local economic development funds	13
Total public revenues	**193,213**

Source: Estimates based on information supplied by TGME Mine Works Programme, Mpumalanga Social Accounting Matrix (2006) and Statistics South Africa Provincial Statistics (2017) and Labour Force Survey (2019)

In terms of local contributions, mining legislation specifies that mining operations should contribute to the economic development of the affected local community as per a Social and Labour Plan (SLP). The Local Economic Development plan should be aligned to the local, provincial and national development priorities. The local communities should furthermore be consulted. Both income generating activities and social infrastructure should be implemented as part of the plan. While the old (2010) mining guidelines did not specify a specific portion of turnover or profit to be allocated to such a fund, a generally good practice among mining companies was to set aside 1% of net profits after tax. The 2018 Mining Charter targets an equity equivalent benefit to the minimum of 5% to be allocated to the socio-economic development of local communities. Mining legislation furthermore specifies that 0.5% of income that multinational suppliers receive from the mining operations must be contributed to a social development fund. The MWP for this project make provision for some R 13 million to the local community for local economic development over the lifetime of the project. Depending on the actual size of the project this contribution could be between R10m – R20 million over the full 4 year period, i.e.an average R2.5m – R 5m per year.

The local governing agency will receive no additional rates and taxes due to the project since TGME/Theta Gold Mines is not the land or surface right owners.

Anticipated areas of impact:

- The benefits of additional taxes, royalties as well as an increase in the National Levy is a benefit for the larger national economy
- Pilgrim's Rest and surrounds, as affected mining community close to the project, will be the focus of the Local Economic Development Fund that forms part of the SLP

Table 27: Rating of Increase in Public Revenues

THEME: INCREASE IN PUBLIC REVENUES		
	Without mitigation	**With mitigation / enhancement**
Status	Positive (+)	Positive (+)
Extent	Local and national (4)	Local and national (4)
Duration	Medium (2)	Medium (2)
Probability	Highly probable (3)	Highly probable (3)
Intensity	Significant (4)	Significant (4)
Significance	High (13) +	High (13) +

Mitigation:

- Develop an updated Local Economic Plan as part of an updated SLP for the project in consultation with the local community
- Ensure that the current allocation as per TGME's Mine Works Programme for the updated SLP is in line with the targets of the Mining Charter of 2018
- Monitor and manage the social contribution of multinational suppliers (in-house as well as suppliers to contractor and direct service providers)

Cumulative impacts:

- None

Residual impacts:

- None

6.4. Negative Impacts from Project Induced In-Migration

In-migration to an area as a result of large-scale projects is a common phenomenon in South Africa and is thus not only related to the proposed Theta Project. As indicated in the baseline, the TCLM experienced municipal wide in-migration since 2011 mainly due to other mining activities in the larger area. As is the case during the construction phase, project induced in-migration could be structured and unstructured:

Formal/structured in-migration (workers associated with project moving into the local area): If outside workers would comprise the majority of the workforce during the operational phase it could result in an additional maximum increase of some 410 individuals causing another dramatic increase in the small population of about 2 000 people living in Pilgrim's Rest. Both semi-skilled and skilled workers from Pilgrim's Rest should be focused on in a local procurement strategy to minimize formal influx into a town that already experiences high pressure in terms of accommodation facilities and the availability of appropriate land for further residential development. It is our understanding that mine management is planning accommodation units for mine workers on part of the land used by the old (closed-down) Caravan Park in Pilgrim's Rest, whilst also upgrading the tourist related accommodation in the Caravan Park.

Anticipated negative social impacts, however, should be noted with regards to such an accommodation unit, such as misconduct of workers (especially after hours), mismanagement of the accommodation facilities resulting in possible environmental pollution and conflict between locals and the outside workforce.

Informal/unstructured in-migration (job-seekers looking for economic opportunities into the area): The negative secondary impacts related to project-induced in-migration is the same as during the construction phase and include pressure on scares local accommodation and land, public services (municipal services, roads, health and education), health and safety risks as well as potential negative impacts on community cohesion resulting in conflicts. It is highly likely that jobseekers would come to the area in search of employment opportunities due to the high levels on unemployment in Mpumalanga and the number of youths in the working age category.

The influx of individuals to an area in search of employment is difficult to quantify and to control, but the employment of locals as well as a clear communication strategy well in advance of the project could limit the negative social impacts in this regard.

Anticipated areas of impact:

- Pilgrim's Rest (with the focus on Newtown/Schoonplaas and Darks Gully)

Table 28: Rating of negative impacts associated to population influx

THEME: POPULATION CHANGE		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Medium/Local (2)	Medium /Local (2)
Duration	High /Informal in-migration remains in area after construction (3)	High /Informal in-migration remains in area after construction (3)
Probability	Highly Probable (3)	Highly Probable (3)
Intensity	Severe (4)	Severe (4)
Significance	High (12) -	High (12) -

Mitigation:

- Employment of locals (within the low to semi-skilled positions) already residing in Pilgrim's rest must receive priority as this would limit the negative impacts (e.g. Infrastructure requirements) associated with a sudden population increase and to avoid possible conflict arising between locals and the outside workforce
- The local labour procurement strategy as well as proof of residence required should be clearly communicated in the local community and broader regional media well in advance of the operational phase.
- Mine management, contractors and service providers should ensure that workers outside the local area should reside in suitable facilities and not establish informal houses
- Continue with plans to provide accommodation facilities for mine workers on land belonging to the old Caravan Park. The involvement of the Department of Public Works is critical in this regard.
- Should a temporary accommodation unit be established at the Caravan Park, this facility must be managed in an environmentally and socially acceptable manner to avoid any social conflict and environmental pollution
- Security measures to avoid unauthorised access at the Caravan Park should be established
- The development of informal vending "stations" where food and small goods are sold should be properly managed, to avoid littering, safety risks and possible environmental pollution
- Continue and extend the current HIV/AIDS awareness and support programmes, with specific focus on those in and nearby the construction site
- Support the local governments by sharing data and information to ensure that all the impacts and risks are taken into consideration and addressed
- Support the local government in conducting impact assessments and policy planning around these issues, and jointly agree on shared responsibilities for managing the flux and its impacts on children
- Support the local government in conducting impact assessments and policy planning with regards to the existing housing issues and dolomitic area and the subsequent expansion/development of Newtown/Schoonplaas that is currently hampered due to i.e. geological issues

- The general health of workers should be monitored on an on-going basis
- All the requirements above should form part of a contractor management plan
- Maintenance of the roads frequently used by workers travelling from outside places (e.g. Sabie, Graskop) should be discussed and negotiated with the Mpumalanga Department of Public Works, Road and Transport
- Assist the TCLM and provincial department with the planning and implementation processes of IDP priority projects in Pilgrim's rest. Align these priorities with the SLP and the needs of the local community members.
- Establish a forum, with representatives of TGME and local stakeholders for discussing potential issues of community conflict
- Sequence the operations phase to commence after the construction phase if possible, to avoid negative cumulative impacts

Cumulative impacts:

- Cumulative pressure on infrastructure and services due to general population growth and if mining operations run parallel to the construction phase
- Cumulative impacts of future mining applications in the area

Residual impacts:

- The presence of new groups of jobseekers within the local communities remaining unemployed with subsequent negative social impacts
- Possible long-term impacts on services and infrastructure if construction workers remain in the area after the construction has been completed
- Increase in HIV/Aids and related diseases
- Possible lack of maintenance of infrastructure and adequate infrastructure and services

6.5. Sense of Place – Visual and Noise impacts

The social impact associated with the impact on the sense of place relates to the change in the landscape character and visual impact as well as increase in noise levels during mining operations.

The Pilgrim's Rest community is a small, relatively close knitted community that shares a dependence on tourists (mainly foreign) attracted to the mining history of the town. Although previous mining activities have been undertaken in the area of Pilgrim's Rest, limited infrastructure associated with these mining activities can still be seen. There are conflicting views within the community whether new mining activities contradict or complete the history of the town. Many inhabitants of the old town have strong feelings to protecting the natural environmental habitat surrounding the town while Newtown/Schoonplaas inhabitants raise the need for job opportunities as priority, while taking cognizance of the historic importance of the area and the establishment of the town as a result of mining.

The increase in noise and activity levels in and around the town could also have an impact on the sense of place. The sheer scale of the project (e.g. height of WRDs) and its proximity to Pilgrim's Rest is bound to have a significant impact on the social character of the town. The mine will be operational 6 days per week (excluding Sundays) and work will be done based on a two-shift system of 10 hours per shift, Monday to Saturday - 26 days a month.

The main visual receptors associated with mining operations are discussed in a detailed Visual Impact Assessment that was undertaken as part of the EIA study. As discussed in more detail in the Visual Impact Assessment, a number of areas in 'Downtown' Pilgrim's Rest could be negatively impacted while some places in 'Uptown' Pilgrims Rest (upper edges) might also be able to see the mining activities. However, the mine would be visible to all travellers at certain points along the R 533 to Lydenburg or Graskop/Sabie.

The Brown's Hill settlement, due to the location where it is situated within the mining area, would be a critical sensitive receptor in terms of the visual and noise impacts (due to the mining activities surrounding the settlement).

Anticipated areas of impact:

- Certain areas in Pilgrims' Rest points in Downtown, limited areas (non-tourism in Uptown)
- Sensitive points along the R533 and R532
- Brown's Hill settlement
- Darks Gully
- Newtown/Schoonplaas
- Look-out points on Mount Sheba walking trails

Table 29: Rating of visual impacts and sense of place

THEME: VISUAL IMPACT AND SENSE OF PLACE		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Medium/ Local (2)	Medium/Local (2)
Duration	Long term (3)	Long term (3)
Probability	Highly Probable (3)	Probable (2)
Intensity	Average (3)	Average (3)
Significance	Medium (11) -	Medium (10) -

Mitigation:

- Mining areas should be rehabilitated as soon as the Mining Works Programme allows
- The recommendations made by the Visual Impact Assessment should be adhered to
- Operational mining activities with potential noise impacts should be mitigated and should not be undertaken during night time. Noise generating activities should thus be kept to normal working hours (e.g. 7 am until 5 pm) where possible
- The recommendations made by the Noise Impact Assessment should be adhered to
- The measures above should form part of the contractor management plan

Cumulative impacts:

- None anticipated

Residual impacts:

- Possible long term or permanent visual impacts could occur should rehabilitation not be successfully implemented

6.6. Safety and Health Risks

Apart from safety issues related to project induced in-migration, mining activities could in itself pose safety issues for the local community:

- The mining site itself could pose risks of injury and fire for community members and workers. Not only the mining activities, but also the storage of hazardous substances (diesel and explosives) on site creates safety risks. Even though all precautionary safety measures will be implemented with regards to the storage, transportation and handling of these substances, this remains a concern. Occupational safety risks (e.g. mining related accidents, underground fires and so forth) would have to be dealt with under the Mines Health and Safety Act (1996).
- Increased traffic on the roads could have higher safety risks to general road users, tourists, cyclists and pedestrians. Of direct concern is the safety of the residents from Brown's Hill making use of the access road on a regular basis to walk to and from Pilgrim's Rest and Newtown/Schoonplaas. If a large number of employees would be sourced from outside Pilgrim's Rest, these employees would travel to and from work on a daily basis in private

vehicles and possibly by public transport (taxi's and busses). The main tarred road in the study area that is expected to be used is the R533 between Lydenburg, Pilgrim's Rest, Sabie and Graskop. No additional mining vehicles are expected on the provincial road since gold output will be airlifted to Germiston.

- Illegal miners already present in the local area form factions with regular violent infighting. These illegal miners could come in conflict with mine workers. Loss of potential gold products through smuggling could further result in severe negative impacts on the formalised gold mining companies with subsequent negative local economic impacts filtering through to grassroots level.
- It should further be noted that experience has shown that when formal mining starts, illegal mining tends to spill over to the forestry (timber) and conservation areas, with severe negative environmental impacts on the conservation areas (e.g. impact on bio-diversity as a result of poaching) and safety risks for employees of the timber production companies
- The Brown's Hill settlement is in very close proximity (approximately 300 m) to the existing plant and TSF. This settlement would be exposed to safety and health risks mainly due to movement of mining vehicles, possible noise and dust pollution (wind erosion), as well as the increase in traffic on the access road. The Brown's Hill Pit's western boundary is approximately 200 m from the Brown's Settlement and a Waste Rock Dump (WRD) and Pollution Control Dam (PCD) (Wishbone) are proposed to be approximately 500 m to 600 m from the Brown's Hill Settlement. Safety and health risks are of major concern in this regard.
- The Darks Gully settlement is in very close proximity to the north eastern section of the Iota Pit, WRD North and related infrastructure. The mining activities in this area are expected to pose safety and health risks (e.g. wind erosion) to the inhabitants.
- The former Caravan Park is also in very close proximity to the Iota Pit and the Iota WRD South which is expected to pose some safety and health risks to the inhabitants, should the Caravan Park be developed as accommodation unit for mine employees.
- Possible dust pollution as a result of the mining activities, and vehicle movement could impact on the timber companies operating in the area (SAFCOL and York Timber). This could again impact on their compliance to the Forest Stewardship Certification (FSC) which is critical for their economic sustainability and maintaining their current markets.

In terms of safety aspects, it should be noted that TGME has an existing security team on site which will probably be extended in terms of employees and vehicles once operational. It is anticipated that the overall crime in the area would decrease with the visible security presence of the mine's security personnel.

Anticipated areas of impact:

- Pilgrim's Rest
- Local communities (e.g. Brown's Hill, Darks Gully and Newtown/Schoonplaas) close to the project
- Forestry areas

Table 30: Rating of Negative Impacts on Safety and Health

THEME: SAFETY AND SECURITY		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Medium/Local (2)	Medium /Local (2)

Duration	Medium (2)	Medium (2)
Probability	Probable (2)	Probable (2)
Intensity	Average (3)	Minor (2)
Significance	Medium (9) -	Medium (8) -

Mitigation:

- Mining areas should be fenced, and permanent security should be in place
- Access roads should be fitted with security cameras and equipped with a controlled barrier (or equivalent).
- Workers must not be allowed to leave the designated mining areas during working hours.
- A Health and Safety Plan should be implemented, and it must be ensured that designated managers are qualified in First Aid and other relevant safety courses
- Implement safety measures to limit fire hazards and implement fire breaks if possible.
- A Fire/Emergency Management Plan should be developed and implemented. It is important that this management plan and associated communication channels are developed at the outset of the operational phase. It would be important to regularly review the functionality and efficiency of such a plan in conjunction with the local emergency teams, mine management and affected communities as well as neighbouring landowners (timber/forestry companies)
- Appropriate fire-fighting equipment should be on site and designated workers should be appropriately trained for fire fighting
- Open fires for cooking and related purposes should not be allowed on site
- Access from gravel roads to local main roads should be in line with the road standard and requirements to accommodate the traffic load and traffic patterns.
- Set up a platform whereby community members and miners can report any illegal mining activities
- Involve the SAPS and other relevant stakeholders (e.g. other business entities operating in the area, as well as Police Forums and Sector Forums) in the preventative security measures to be undertaken in terms of illegal mining
- A private security company (or existing security) to be contracted by TGME to prevent illegal miners to access mined areas.
- The mine could assist in implementing a community and employee health awareness plan
- The general health of employees should be monitored on an on-going basis through local health care services
- The mine could, through LED programmes and infrastructure developments assist in improving the overall health services within the communities. TGME/Theta Mines should closely liaise with the representatives of the Department of Public Works and the Provincial Department of Health to jointly develop solutions to some of the community health issues and to determine which role TGME could play in this regard e.g.
  - TGME should consider assisting with the improvement of the ambulance services and community health infrastructure. Their involvement in this regard should be discussed with the Provincial Department of Health, representatives of the nearby hospitals, community health care workers in the study area, community representatives and councillors
  - The mine could investigate sponsorship to the local Pilgrim's Rest Clinic (e.g. sponsoring an extra full-time nurse)

Cumulative impacts:

- The significance of the impacts can increase if the operations phase coincides with the construction phase

Residual impacts:

- None foreseen

6.7. Nuisance Factors (Noise and Dust)

General intrusion impacts during the operational phase will mainly be due to noise. Vehicle movements and on-site working activities were identified as one of main sources of noise related to the project. A detailed Noise Impact Assessment was undertaken as part of the EIA study.

Isolated communities close to the site such as the Brown's Hill settlement and Darks Gully might experience some increase in dust fallout due to on-site movement of vehicles making use of unpaved roads.

Anticipated areas of impact:

- Pilgrim's Rest
- Communities close to the site (Brown's Hill and Darks Gully)

Table 31: Rating of Impacts related to Nuisance factors

THEME: NOISE AND DUST IMPACTS		
	Without mitigation	**With mitigation**
Status	Negative (-)	Negative (-)
Extent	Medium/Local (2)	Medium /Local (2)
Duration	Short term (1)	Short term (1)
Probability	Highly Probable (3)	Probable (2)
Intensity	Average (3)	Average (3)
Significance	Medium (9) -	Medium (8) -

Mitigation:

- The mitigation measures of the Noise and Air Quality Impact Assessments should be adhered to
- Operational mining activities with potential noise impacts should be mitigated and should not be undertaken during night time. Noise generating activities should thus be kept to normal working hours (e.g. 7 am until 5 pm) where possible
- Heavy machinery and heavy vehicles should be kept in a good working order. Also, ensure that all vehicles and equipment comply with generally accepted noise levels and noise abatement regulations
- Personnel should be equipped with the necessary noise protection equipment
- Dust suppression measures should be applied if and when necessary
- Sequence the operations phase to commence after the construction phase if possible, to avoid negative cumulative impacts

Cumulative impacts: Additional impacts if the operations phase coincides with the construction phase.

Residual impacts: None anticipated

6.8. Impacts on the Tourism Sector of Pilgrim's Rest

As was discussed in the baseline section above, the tourism sector plays a dominant role in the Pilgrim's Rest economy. Although the town's attraction is its mining history, there is a perception that new mining activities will not blend well with the historic character of Pilgrim's Rest town and that the project will crowd-out the foreign-based tourist sector in favour of a short-term mining project.

The different concerns related to the tourism industry are discussed in more detail below:

Negative impacts due to the change in the town's character: The detailed Visual Assessment Study as part of this EIA identified a couple of tourist points that might be visually affected by the mining project. As discussed under visual impacts above, a number of areas in 'Downtown' Pilgrim's Rest could be negatively impacted while a number of places in 'Uptown' Pilgrims Rest (upper edges) might also be able to see the mining activities. However, the mine would be visible to all travellers as they travel on the R 533 to Lydenburg or Sabie/Graskop.

Visual impacts on Mount Sheba's walking trails could impact negatively on visitors to Mount Sheba Forever Resorts and Mount Sheba ShareBlock Company (timeshare units, which in turn could reduce the number of visitors to Pilgrim's Rest). Based on figures supplied by Mount Sheba Forever Resorts and the Shareblock Company, approximately 8 000 visitors to these entities conduct the walking trails each year.

From Pilgrim's Rest one can also undertake the Prospector's Hiking Trail (Komatiland Forest (Pty) Ltd.) stretching over the farms Ponieskrantz and Blackhill with a look-out point overlooking the Crystal Springs area. Hikers would start just outside Pilgrim's Rest at either Morgenzon plantation or Pilgrim's Rest Hut, depending on the specific hike that is undertaken. These trails include a ± 60 km circular route to the west of the town of Pilgrim's Rest where hikers experience various types of habitat and see the sights of historical gold mining areas, such as the town of Pilgrim's Rest. It seems that these trails have been closed at the time of the study but that it would not necessarily remain closed. At this stage it is not anticipated that these trails would be impacted by visual disturbances from the proposed development.

It must be noted that the negative visual impact of the proposed project would depend on the perception of the individual tourist. As the scenic beauty of the area and the vast viewpoints are one of the key features of the tourist establishments, it is safe to conclude that the visitors would be sensitive to negative visual impacts. The intensity of the visual impact associated with the mining infrastructure would further depend on the angle of observation, the number of viewers, the duration of the view, and lighting at night. The overall recreational experience of the tourist also plays an important role in this regard. It is therefore difficult to predict the behaviour of tourists as a result of such visual impacts on the walking trails of Mount Sheba.

As worst case scenario, assuming that visitors walking the trails (and hence to these entities) would be halved due to the visual impacts of the mine, it could potentially result in an estimated loss of annual income to the these entities of close to R 15 million per annum (worst case) as well as an annual loss of spending of these visitors in Pilgrim's rest Town, i.e. an estimated R2 million per year (again worst case scenario)[49]. In addition, current estimated R 3 million asset value of the time shares units[50] could be reduced substantially if the time share prices are dropped as owners try to sell off their shares.

The opposite view is also held by some tourism businesses in Pilgrim's Rest that mining activities would be beneficial to their visitor numbers. The Environmental Centre, for instance, anticipates a substantial increase in the number of educational tourists to the Centre in Pilgrims Rest due to the potential to observe old and new mining practices side by side. This view is partially substantiated by the successful co-existence of mining and tourism activities in other parts of the country, e.g. Cullinan close to Pretoria and Kimberley in the Northern Cape. Cullinan town accommodates 3 mine tour companies that among them receive close to 40 000 visitors a year. Close to 80% of the Cullinan visitors come from Europe with some 20% being visiting schools from across the country.

Nuisance and safety issues related to increased traffic on the R533: From a transport point of view, mining activities during the operational phase will contribute marginally to increased traffic flow in the area since gold will be airlifted to Germiston. Workers staying in Graskop, Sabie or Lydenburg will contribute marginally to current traffic flows on these roads. It is therefore anticipated that the project will have a low impact on road users such as tourists or cyclists.

Nuisance factors associated with noise and dust: Negative impacts on tourism due to nuisance factors will mainly emanate from increased noise due to mining activities. The mining operating

[49] These figures were based on the assumptions that visitors to both these entities spend about R 800 per night and stays on average between 2 and 5 nights. It was also assumed that the 20 time share units receive on average 4 visitors per week and is occupied almost every week of the year.

[50] There is 20 units being sold on weekly base selling for R 5 000 – R 25 000 time share unit

times will consist of two shifts a day (excluding Sundays) from 6am to 4pm and from 4pm to 2am The process plant will run on a 24 hour per day, 7 days a week basis. The negative impacts on the accommodation facilities in Pilgrim's Rest town and overnight tourists are of concern.

Health and safety concerns: As noted in the baseline section, while the number of crimes is relatively low in Pilgrim's Rest, the per capita crime rate is relatively high and increasing. The Pilgrim's Rest tourism sector faces a constant challenge with high unemployment rates and rising crime rates in the area. It could be argued that unemployment levels should decline substantially once mining starts and hence could have a positive impact on lowering crime rates in the local area. It could also be argued that TGME's resuming the active control of illegal mining activities in the neighbourhood could also reduce crime rates in Pilgrim's Rest. However, high levels of project-induced in-migration (as mentioned above) could somewhat defeat this objective. In some mining areas in South Africa, unemployment and crime rates has risen despite high rates of local employment growth.

Short term impact of mining: There is a real risk that the mining project could crowd-out long-term tourism jobs while offering only short term benefits to the town. It is however highly probable that this project, once successful, will lead to further investment in mining projects in the area by TGME that could last for another 20 years. While these projects could last up to two decades it should however still be noted that there is a limited lifespan to any mining project and it is therefore crucial that any mining company operational in this area should prioritise the long term sustainability and conservation of the tourism industry in Pilgrim's Rest.

In conclusion, nature-based tourist activities in Pilgrim's Rest, like Mount Sheba however are at risk to experience negative economic impacts from the mining project while other businesses (including general dealers and mining–related tourist businesses in the historic town) could experience positive impacts. Possible industrial tourism ventures (where historical features and existing mining features could be combined) could further assist in a boost to the local tourism industry.

Only the negative impacts with regards to the local tourist sector are rated below. The anticipated positive impacts on the local tourist sector have been considered as part of the downstream positive supply link impacts.

As was mentioned above, COVID-19 is expected to have a high negative impact on the Pilgrim's Rest tourism sector and hence local economy. Due to the sector's dependence on overseas visitors, it could take years for the sector to recover.

Anticipated areas of impact:

- Pilgrim's Rest tourists' establishments as well as people from nearby settlements such as Newtown/Schoonplaas employed by the tourism industry
- En-route tourism ventures and establishments (R533)
- Mount Sheba Resort walking trails look-out points

Table 32: Rating of negative impacts on the local tourist sector

THEME: IMPACT ON THE LOCAL TOURIST SECTOR		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Local (2)	Local (2)
Duration	High (3)	High (3)

Probability	Highly Probable (3)	Probable (2)
Intensity	Average (3)	Average (3)
Significance	Medium (11) -	Medium (10) -

Mitigation / Enhancement:

- Site rehabilitation should occur as soon as the construction process allows
- The construction site and operating area should be kept litter free
- The recommendations made by the Visual Impact Assessment should be adhered to.
- The mitigation measures of the Noise and Air Quality Impact Assessments should be adhered to
- Operational mining activities with potential noise impacts should be mitigated and should not be undertaken during night time. Noise generating activities should thus be kept to normal working hours (e.g. 7 am until 5 pm) where possible
- Heavy machinery and heavy vehicles should be kept in a good working order. Also, ensure that all vehicles and equipment comply with generally accepted noise levels and noise abatement regulations
- Dust suppression measures should be applied if and when necessary
- Sequence the operations phase to commence after the construction phase if possible, to avoid negative cumulative impacts
- TGME should proceed in developing and implementing a detailed tourist strategy for Pilgrims Rest as part of its LED programme in close consultation with the local community and local tourism sector. Some ideas that could be explored further include:
    - Commitment from business visitors to the mine to use the overnight facilities in Pilgrim's Rest or the immediate surroundings
    - Develop old adits in tourist spots with view points to contrast with modern mining
    - Caravan park space development (one-part offices, the other ablution blocks and ground clearance and maintenance for caravan standing areas) – TGME already assisting with the management of the golf course
    - Development of old TGME stall/space that sells memorabilia
    - Assist with maintenance of e.g. the road between Graskop and Pilgrim's (bush clearance and some repairs)
    - Museum support (gold panning)
    - Assist and liaise with SAFCOL in promoting and re-establishing their hiking trails
    - Facilitate the establishment of an ATM in town
    - Provide support by sponsoring transaction advisors to develop local SMMES in vacant business areas
    - Liaise directly with Mount Sheba resort and other business that might be negatively affected by the mining operations
    - Expanding their existing involvement in the Pilgrim's Rest Golf Club by assisting with the management and maintenance of the club, and by providing the impetus for capacity building and skills transfers
- Liaise and assist with the promotion of Road safety on the R533
- Dust suppression methods should be strictly implemented if and where required
- Involve the SAPS and other relevant stakeholders (e.g. other business entities operating in the area, as well as Police Forums and Sector Forums) in the preventative security measures to be undertaken
- Facilitate the establishment of a local Business and Tourism Chamber for Pilgrim's Rest. Regional tourism chambers could assist in this regard.
- Engage on a regular basis with the tourism sector through the local business chambers (Sabie, Graskop and Pilgrim's Rest) to address issues that could negatively impact on local businesses, specifically tourist businesses.
- Once established, assist the local business chamber and/or tourism forum to become a member of the regional organisations/forums
- TGME can assist in changing the negative perception among South Africans, and possibly among international tourists of Pilgrim's Rest not being a popular tourist destination to a highly ranked tourism destination
- Any other recommendations above that relate to mitigating the negative impacts of in-migration also applies to this impact
- Other mitigation measures discussed under the other economic impacts below also applies to this impact

Cumulative impacts: Negative impacts on tourism by other TGME mining applications in the broader region

Residual impacts: None anticipated

6.9. Other economic impacts on the local and regional economy

Operational activities could also have negative impacts on other economic sectors in and around Pilgrim's Rest as well as the larger downstream region in the following ways:

- Recruiting informally skilled agricultural or forestry workers could increase the training and recruiting costs for these sectors.
- There could be an intrusion on forestry and conservation areas, with safety (illegal harvesting of trees or illegal mining within forestry areas), as well as fire risks as a result of the presence and movement of workers in close proximity to these areas.
- The livelihood of the farmers, community members, as well as the timber industry in the area and the residents in the towns depends on their water quality and quantity. Water remains a scarce commodity and any decrease in the water tables would result in severe negative impacts with subsequent economic losses. The possible impact of the project on water quality and quantity is a definite concern for the local community and economy. This issue is specifically relevant since the existing Tailings Storage Facility (TSF) is located in a dolomitic area and a barrier does not form part of its design[51]. Although the existing TSF technically falls outside the scope of this EIA, the mining project will use the existing tailings facility. As was discussed in the baseline section above, pollution of the Blyde River could have significant consequences for the economy of the Blyde River catchment area that relies heavily on the health of the river for agricultural and tourism activities. In this regard, it should however be noted that the surface water hydrological study indicated that the risks would be low if mitigation measures are adhered to. The geohydrology assessment's groundwater model concluded that the "contaminant risk to the aquifer system and the Blyde River is minimal". Even though the risk was found to be minimal, from a socio-economic perspective it must still be noted that any possible negative impacts on ground and surface water could damage the economy that supports the economic livelihood of an estimated 2 000 people.

Anticipated areas of impact:

- Pilgrim's Rest
- Adjacent farms and forestry areas
- Downstream Blyde River catchment area

Table 33: Rating of negative impacts on other economic sectors in the local economy

THEME: IMPACT ON OTHER LOCAL ECONOMIC SECTORS		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Regional (3)	Regional (3)
Duration	High (3)	High (3)
Probability	Probable (2)	Probable (2)
Intensity	Severe (4)	Average (3)
Significance	High (12) -	Medium (11) -
Mitigation / Enhancement:		

[51] A 21(g) authorisation is in place for the TSF. The TSF thus has an existing licence. There is also a permit in place for abstraction of water. In 2013, the National Waste Act was amended, however the TSF was constructed and operational prior to 2013. Therefore, no barrier or liner systems were required to be put in place at the time of the construction of the existing TSF.

- Effective management of the mining activities to avoid any environmental pollution focusing on water, and dust pollution, and limiting any increase in noise levels as per the respective environmental management plans (high priority)
- The contribution that other potential sources of pollution (e.g. agriculture, waste water treatments and settlements already have on the river's downstream water quality would be part of a Strategic Environmental Assessment which falls outside the ambit of this project. Such an assessment remains a high priority to provide a scientific baseline to be used for future auditing and monitoring. TGME could become part of a regional planning forum, to address such a strategic assessment. Such an initiative would have to be driven by the DWS, as the custodian of the water sources in South Africa.
- Treated discharge water could possibly be used for irrigation purposes e.g. at the golf course and caravan park if such a proposal adheres to environmental regulations
- Workers should not be allowed to leave the operations site while on duty
- A fire hazard management plan on and off site is required
- Align unskilled wages to other sectors (tourism, agriculture, forestry) in the local economy
- The active mining area should be fenced to avoid unauthorised entry by animals onto the mining area
- Specify the conduct of contract workers in worker related management plans and employment contracts.

Cumulative impacts:

- Cumulative impacts of other downstream water polluting sources (e.g. agriculture, illegal mining, settlements, waste water treatment plants) should be taken into consideration

Residual impacts:

- Continued negative economic impacts due to environmental pollution

6.10. Impact on local economic diversity and economic stability

The local economy of Pilgrim's Rest is already over-exposed to one (tourism) sector. However, whether mining or the (foreign) tourism sector dominates, Pilgrim's Rest's economy will remain highly dependent on economic sectors that, in turn, are highly dependent on external factors (i.e. international commodity prices in the case of the mining sector and the number of foreign tourists visiting the country in the case of the local tourism sector). For long term stability, Pilgrim's Rest's economy will need to develop a more diversified economic base in terms of the development of other sectors as well as other markets. The situation in the broader TCLM is no better since mining dominated the municipal area with platinum mining and smelter activities concentrated in the Lydenburg, Steelpoort and Burgersfort areas.

It should be noted that the mine's involvement in the local economy through their social funds and SLP and local procurement programmes could result in certain positive opportunities for economic diversification.

Anticipated areas of impact: Pilgrim's Rest as well as the broader TCLM economy.

Table 34: Negative impact on local economic diversity and economic stability

THEME: LOCAL ECONOMIC DIVERSITY AND ECONOMIC STABILITY		
	Without mitigation	**With mitigation**
Status	Negative (-)	Negative (-)
Extent	High (regional) (3)	High (regional) (3)
Duration	High/long term (3)	High/long term (3
Probability	Probable (2)	Probable (2)
Intensity	Average (3)	Average (3)
Significance	Medium (11) -	Medium (11) -
	Without mitigation	**With mitigation**
Mitigation:		

- Focus on the support of non-mining related activities in community development programmes
- Focus on the develop of the local tourist market in community development programmes
- Focus the local procurement programme on non-core mining inputs in Pilgrim's Rest with a broader regional market (e.g. catering, accommodation)
- If a supplier development programme is established, focus the programme on non-core mining inputs in Pilgrim's Rest with a broader regional market

Cumulative impacts: New mining applications in and around Pilgrims Rest and TCLM including other mining applications by TGME

Residual impacts: Local concentration of economy in the mining sector

6.11. Impact on resource use (water, energy)

The mining sector is highly energy intensive relative to its economic output. In this case, however, the Hydrology Impact Assessment indicated that the proposed project will result in a positive water balance. No negative impacts are thus anticipated on the water quantity[52].

The timber industries rely on adequate ground water of suitable quality for the growing of its trees. Should there be any negative impact on the water quality it would result in long term and irreversible impacts. In this case, however, the Geohydrology Impact Assessment indicated that the risks with regards to groundwater quality deterioration are unlikely as mining will take place at a minimum of 50m above the groundwater table. The risks of impacts on the regional groundwater quality, as a result of seepage of contaminants from the mining site and seepage of contaminants from waste bodies, remain.

The Surface Water Hydrological Study highlighted the possible risk of sedimentation and indicated that erosion and sediment control, as well as dirty water containment and management, should be implemented during the construction and operational phases of the project[53]. This would also be critical from a socio-economic point of view to ensure that the water quality is not influenced to limit any negative impacts on the downstream water uses (agricultural and tourism related activities).

Negative socio-economic impacts in this regard are thus rated medium as a result of the impact risk with regards to the water quality.

Anticipated areas of impact:

- Pilgrim's Rest
- Possibly the Blyde River and possibly the larger Olifant's River catchment area
- Forestry sections

Table 35: Resource intensity of mining sector relative to economic production

THEME: WATER AND ENERGY INTENSITY OF MINING ACTIVITIES		
	Without mitigation	**With mitigation**
Status	Negative (-)	Negative (-)
Extent	High (regional) (3)	High (regional) (3)
Duration	Medium (2)	Medium (2)

[52] MvB Consulting, 2019 Geohydrological Study for the Theta Hill Project, Pilgrims Rest Region

[53] Hydrospatial (Pty) Ltd. (2019) Surface Water Hydrological Study for the Proposed Theta Mine Project

Probability	-Highly Probable (3)	Probable (2)
Intensity	Average (3)	Average (3)
Significance	Medium (11) -	Medium (10) -
	Without mitigation	**With mitigation**

Mitigation:

- Develop a resource use plan with the specific objective to minimize the mining operations' energy and water use as far practical
- Ensure that water quality and quantity issues are managed appropriately through engineering controls and through regular and required quality and quantity groundwater monitoring
- Mitigation measures of the Geohydrology and Surface Water Hydrology Impact Assessments must be strictly implemented.
- Treated discharge water could possibly be used for irrigation purposes e.g. at the golf course and caravan park if such a proposal adhere to environmental regulations

Cumulative impacts: Other mining applications in the Blyde River Catchment, as well as agricultural and human settlement expansions in the Olifant's River catchment area.

Residual impacts: None

6.12. Impact on Brown's Hill Settlement

The Brown's Hill Settlement is located approximately 300 m from the existing plant and TSF. The Brown's Hill Pit are planned in this area and the latter's western boundary could be as close as 200 metres from the Brown's Settlement and a Waste Rock Dump (WRD) and Pollution Control Dam (PCD) (Wishbone) are proposed to be approximately 500 m to 600 m from the Brown's Hill Settlement.

This settlement consists of approximately four to five family units that consist of approximately 10 mud and tin dwellings. The residents include ± four young working adults and five elderly individuals (mainly elderly women). One child that is of school-going age also permanently resides there (total population of approximately 10 permanent residents with an additional family that are mainly residing there over weekends).

The families have vegetable gardens and goats that roam free. There is no water and sanitation facilities and the residents are reliant on water supplied by tankers. The borehole is not in working order at the moment.

Due to the location of the settlement, as well as the impacts with regards to the visual impact, noise, dust and safety risks, it is recommended that the inhabitants of Brown's Hill be resettled.

Resettlement of these residents would negatively impact on their sense of place, their social networks and quality of life. It could include the following:

- Disruption in their small social network, and social relationships with possible negative psychological consequences;
- Loss of community cohesion and loss of "sense of place" by residents;
- Periods of uncertainty due to negotiations and finalisation of resettlement process; and
- Conflict between parties involved in the process and conflicting viewpoints/attitudes regarding resettlement within the community.

It should however be noted that positive economic implications could result for those residents that would be resettled such as:

- Proximity to work or employment opportunities;
- Proximity to amenities such as health and educational facilities;
- Once resettled, infrastructural improvements such as proper housing facilities, as well as access to water and sanitation facilities could positively impact on their quality of life.

Resettlement and the process to be followed such as the compilation of a Resettlement Action Plan (RAP) and the actual resettlement of residents do not form part of the EIA process. A RAP usually assesses the full impact of the resettlement process as well as the potential impact on the relocation site. With regards to resettlement, the following possible impacts and cumulative issues should be noted:

- Resettlement is a lengthy process associated with various levels of conflict arising between residents due to the perceived benefits that could accrue to those being resettled. Most groups or individuals in a settlement usually tussle to obtain as many benefits from the process as possible.
- The socio-economic status of the different residents could worsen the intricacy of the process. Resettlement of poor households could affect their close-knit social cohesion and increase the insecurity experienced by these households.
- Political influences and land ownership could exacerbate the complexity of the process.
- Settling of individuals and / or jobseekers from outside of the study area could occur as these individuals could aim to take advantage of the resettlement process by claiming to be long term residents who should be resettled.
- Suitable land for the resettlement of individuals is usually not readily available. It is thus fair to state that acquiring suitable land could furthermore delay the implementation of the resettlement process.
- Negotiations with the owners where no title deeds have been registered could be problematic.

Table 36: Brown's Hill Settlement

THEME: IMPACTS ON BROWN'S HILL SETTLEMENT		
	Without mitigation	**With mitigation**
Status	Negative (-)	Positive (+)
Extent	Medium (Local) (2)	Medium (Local) (2)
Duration	Low (Short term) (1)	High (Long term) (3)
Probability	Definite (4)	Highly Probable (3)
Intensity	Severe (4)	Beneficial (3)
Significance	Medium (11) -	Medium (11) +
	Without mitigation	**With mitigation**

Mitigation:

- A comprehensive Resettlement Action Plan (RAP) must be developed in consultation with the affected inhabitants. This plan would include the number of dwellings and individuals to be affected, timeframes and the availability of a site where resettlement could occur.
- Representatives of the DPW and TGME must liaise with the inhabitants and local councillor with regards to the resettlement process and timeframes. This communication must further ensure that the correct information regarding this issue is portrayed to the community members.
- It would be desirable to address issues relating to resettlement as a matter of urgency and also to provide definitive timeframes linked to any possible resettlement.

Cumulative impacts: None.

Residual impacts: None

7. DESCRIPTION AND ASSESSMENT OF IMPACTS DURING THE DECOMMISSIONG AND POST-CLOSURE PHASES

7.1. Introduction

Rehabilitation is expected to follow immediately after the mining process as per the recommendations of the detailed Visual Assessment Study.

As the timing with regards to decommissioning or the replacement of the infrastructure cannot be determined at this stage, it is recommended that further studies be undertaken at the time of decommissioning to determine the actual impacts on the changing social environment at that stage.

A range of possible socio-economic impacts could be experienced during decommissioning (closure of the mine) including:

- Job losses due to mine closure;
- Decline in the sustainability of the local economy as a result of the loss of employment, household income and capital investments;
- Reduced economic activities within the area with subsequent negative impacts on smaller businesses;
- Population changes and out-migration of people from the area;
- Decrease in the quality of life of the surrounding communities due to the discontinuation of social development support and local economic development programmes;
- Possible relocation of families;
- Skilled workers moving out of the area in search of employment elsewhere;
- Negative impact on infrastructure development and maintenance;
- A change in community infrastructure;
- Disruptions and nuisance factors associated with the actual decommissioning such as noise, visual and traffic related impacts;
- Increased safety risks associated with the decommissioning of the infrastructure;
- Possible negative impact on the crime levels due to a possible increased localised unemployment rate;
- Remnants of possible environmental impacts; and
- Remaining visual impact as a result of mining.

Some of the most prominent anticipated impacts are discussed in more detail below.

7.2. Loss of direct and flow-on jobs due to closure

When the Theta Hill project closes about 410 job opportunities will be gone (18% skilled, 44% semi-skilled and 38% unskilled). It is however, also noted that this project could unlock further mining opportunities in the area in future, but this is not yet a certainty.

Anticipated areas of impact:

- Pilgrim’s Rest, Darks Gully and Newtown/Schoonplaas area
- Regional economy

Table 37: Job losses due to scaling down of mining activities and mine closure

THEME: LOSS OF DIRECT JOBS DUE TO MINE CLOSURE		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	High (regional) (3)	High (regional) (3)
Duration	Permanent /High (3)	Permanent /High (3)
Probability	Definite (4)	Probable (2)
Intensity	Average (3)	Average (3)
Significance	High (13) -	Medium (11) -

Mitigation:

- Ensure that the mine investigates additional resources and increase its LoM in order to maintain and promote job security
- As per the requirements of the SLP develop mechanisms to assist employees, prior to the retrenchment date in the transition phase and after closure of the operations. This would include providing portable skilled development programmes during the operational phase of the mine, providing assistance in accessing available and suitable jobs with other local mines or companies etc.
- Focus on supporting non-core local supply links in procurement strategies as well as potential local enterprise development programmes during the operational phases of the mine to facilitate easier transitioning of local suppliers to other customers

Cumulative impacts: None foreseen

Residual impacts: Workforce without alternative employment

7.3. Decrease/termination of community investment funds and support to local communities

The commitment with regards to social and economic development of between R 2.5m and R 5m per annum is expected to cease over the course of the decommissioning and closure of mining operations. In addition any other non-tacit support to government structures in the running of Pilgrim's Rest will come to an end. The risk exists that projects and local government structures become dependent on the funding that they receive from the proponent and that projects will fail and that local governance could be negatively affected due to the decrease in funding.

Anticipated areas of impact: Pilgrim's Rest and environs

Table 38: Decrease /termination of community investment funds to local communities

THEME: DECREASE/TERMINATION OF COMMUNITY INVESTMENT FUNDS		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Local (2)	Local (2)
Duration	Permanent /High (3)	Permanent /High (3)
Probability	Definite (4)	Probable (2)
Intensity	Severe (4)	Average (3)
Significance	High (13) -	Medium (10) -

Mitigation:

- Ensure that the mine investigates additional resources and increase its LoM in order to maintain and promote job security
- Focus on community support programmes and with that build local capacity and sustainability in the local community
- Plan projects with an exit strategy of which beneficiaries are aware of

Cumulative impacts: None

Residual impacts: None

7.4. Increase in illegal mining activities after closure

There is a risk that the withdrawal of TGME and their security team from the local area will, once again, result in the proliferation of illegal mining activities in the local area with resultant impacts on the biodiversity, the Blyde River and the safety and security risks in the area. The risk is increased if jobless migrants attracted by the mining activities in the first place remains in the local area after mine closure.

The negative impacts of illegal mining spill over into the forestry and conservation areas should also be noted.

Anticipated areas of impact: Pilgrim's Rest

Table 39: Increase in Illegal Mining Activities

THEME: Increase in Illegal Mining Activities		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Local (2)	Local (2)
Duration	Permanent /High (3)	Permanent /High (3)
Probability	Highly Probable (3)	Probable (2)
Intensity	Average (3)	Average (3)
Significance	Medium (11) -	Medium (10) -

Mitigation:

- Adhere to modern mining designs that makes it more difficult for illegal miners to enter mining areas after closure
- Close any openings to underground mining sites in the vicinity
- Allocate funds to implement security measures to remove illegal miners from the local areas for another 5 years after closure

Cumulative impacts: None

Residual impacts: None

7.5. Sense of Place Impact after closure

The possible visual impact of the mining activities and infrastructure that will remain post closure would depend on the rehabilitation process. Such rehabilitation would have to include in-filling of the pits (where technically possible and feasible), re-sloping and re-vegetation of the area and the removal of mining related infrastructure.

Rehabilitation envisages that the land will be rehabilitated back to original grassland. At this stage TGME is also considering the implementation of a composting facility (thereby reducing alien invasive plants) and to use this material as part of the rehabilitation process on disturbed areas. A landscape architect will be involved to minimise the negative visual impacts. Consultation with landowners as part of the finalisation of the rehabilitation plan and end-land use is thus important to determine what is required from an environmental perspective but to also address localised community needs.

If the rehabilitation is not successful, negative permanent visual impacts would remain.

Anticipated areas of impact: Pilgrim's Rest and sensitive receptors affected as discussed as part of Section 6.5

Table 40: Sense of Place Impact after closure

THEME: Impact on Sense of Place		
	Without mitigation	**With mitigation / enhancement**
Status	Negative (-)	Negative (-)
Extent	Medium/ Local (2)	Medium/Local (2)
Duration	Permanent /High (3)	Long term (3)
Probability	Definite (4)	Probable (2)
Intensity	Severe (4)	Average (3)
Significance	High (13) -	Medium (10) -

Mitigation:

- Mining areas should be rehabilitated as soon as the Mining Works Programme allows
- The recommendations made by the Visual Impact Assessment should be adhered to
- Mining infrastructure must be removed or where applicable should be maintained and incorporated into a mining tourism strategy
- Re-vegetation and landscaping options should be considered but should aim to re-establish the area to its pre-mining state as far as possible.
- The end land-use should be determined in consultation with the local community and relevant government departments to determine what is required from an environmental perspective but to also address localised community needs

Cumulative impacts:

- None

Residual impacts:

- Negative visual impacts should rehabilitation be unsuccessful.

8. DESCRIPTION AND ASSESSMENT OF POTENTIAL IMPACTS ASSOCIATED WITH THE NO-GO ALTERNATIVE

The socio-economic issues listed above would not materialise should the proposed project not proceed and the status quo in the area would therefore remain. The most significant negative socio-economic impact with regards to the no-go alternative relates to the following:

- New employment and income opportunities associated with mine during construction, operations and rehabilitation (albeit for a relative short period) will not be created and the local economy of Pilgrim's Rest and the unemployed would remain dependent on other sectors such as the existing tourism sector to create future opportunities. Young people could continue leaving Pilgrim's Rest for better job opportunities elsewhere.
- The Pilgrim's Rest community and businesses would have to initiate ventures to sustain the local socio-economic environment. Some sources even indicated that, should the mining not proceed, it could lead to "positive investment sentiment within the eco-tourism, forestry, agriculture, nature reserve management and conservation sectors".
- Pilgrim's Rest's local economy would not diversify slightly to become less dependent on one sector (tourism) only.

- The Pilgrim's Rest economy will take a long time to recover from the negative impacts of the COVID-19 pandemic due to its current reliance on tourists from overseas, without any positive downstream inputs from the proposed project.
- Illegal mining could increase which could impact on the local safety and security status quo. The risk of spill over of illegal mining into forestry and conservation areas could further increase.
- The increase in illegal mining activities in the area have a severe negative impact on the river flow of the Blyde River, the biodiversity around the river and result in increased sedimentation. Illegal mining activities cannot be controlled and the damage to the environment will significantly increase.
- It is highly likely that the local community members will continue to sub-let accommodation facilities to illegal miners due to the lack of other available sources of income for the locals and due to the lack of housing infrastructure. This could result in spin-off social problems.
- The quality of life of the residents of the Brown's Hill settlement would remain as is. They would not have an opportunity to socio-economic upliftment as part of the proposed development. If resettlement is successful, they would have access to improved housing conditions, as well as to adequate infrastructure and services.
- The town of Pilgrim's Rest and the tourism industry would continue to be managed by the Department of Public Works as managers of the town and the TCLM would remain responsible for the upkeep and socio-economic development of the town, without the potential assistance from an outside company.
- No indirect spin-offs for entrepreneurs and opportunities for local businesses would materialise as a result of mining activities.
- Employees would not have the opportunity to undergo skills training and capacity building with no human resource development whereby transferable skills could be created.
- As the mine is planning to be involved in various corporate social investment programmes these would not be further implemented and no impacts on poverty alleviation would occur as a result of such programmes
- The larger economy will not receive a net increase in tax and royalty income from the project.

Further socio-economic impacts that would occur and that would sustain the status quo relate to the following:

- The sense of place and historic character of Pilgrim's Rest would remain unchanged.
- Negative visual impacts with subsequent possible negative impacts on specific sectors of the local tourism industry and residents would be eliminated.
- The viability of the local tourism industry would not be placed at risk as a result of the possible noise and visual impacts.
- There would be no additional risks to the water quality and quantity of the Blyde River and thus no risks to the subsequent downstream users and those dependent on the eco system services along the Blyde River Catchment.

- No additional traffic would limit the risk of traffic accidents, as well as noise and air pollution.
- Negative intrusions on the residents of the larger Pilgrim's Rest area will not occur.
- The population growth in Pilgrim's Rest will most likely remain steadier with less pressure on service delivery and other challenges related to sudden and high rates of in-migration into a small town.
- The town would have more potential for a steady economic growth path built on more sustainable sectors instead of repeating its old pattern of 'feast and famine' (worst case) associated with the extractive industry.

9. THE SOCIAL MANAGEMENT AND MONITORING PLAN

From a social perspective the following objectives and measures should be included as part of the Social Management Plan (SMP) as part of the Environmental Management Plan (EMP).

It should be noted that the responsibility of the mitigation lies with the owner, operator, and/or with the local municipality. The mitigation measures would have to form part of the respective stakeholder's expenditure predictions or operations and management within the area, therefore the monitoring activities cannot be expressed in financial terms.

9.1. Maximise Employment Opportunities, Skills and Enterprise Development

Objective	**Maximise local employment opportunities and limit skills inequities associated with the construction and operation**	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Prioritise local labour in the recruitment process as part of the company's own recruitment policy or as part of contractor management plan during construction and operations	Human resources /SLP officer	Before construction activities commences
Meet the targets of mining legislation and the relevant mining charter for employment of HDI in management positions and core skills	Human resources /SLP officer	Before construction activities commences
Put a procurement strategy as well as a contractor management plan (if relevant) in place to ensure that 100% local employment target in terms of unskilled labour is met	Human resources /SLP officer	Before construction activities commences
Up-skill the local labour force as per SLP	Human resources /SLP officer	Before construction activities commences
Explore possible placement of local construction workers in mining operations	Human resources /SLP officer	Before construction activities commences
Develop a database of goods and services that could potentially be outsourced to the local community	Supply chain management	Before construction activities commences
Establish a supplier development programme as part of the Local Economic Development component of the SLP. Focus in the local supplier development programme on creating sustainable local businesses that could continue to operate after mine closure, e.g. by assisting local businesses in market diversification strategies	Supply chain management	Before construction activities commences
Participate in the development of a regional mine supplier hub to promote the development of a local supply base	Supply chain management	Before construction activities commences

Objective	Maximise local employment opportunities and limit skills inequities associated with the construction and operation	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Where local contractors are used, put a contractor management plan in place to ensure that the local employment and procurement targets of the operations are met	Supply chain management	Before construction activities commences
Performance Indicator	» % local labour employed in different skill categories » % HDSA in management positions » Training programmes completed by local labour force » % of goods and services procured from local community by type of product	
Monitoring	» Annually as per SLP and procurement strategies	

9.2. Minimise Impacts of Population Change, Inflow of Temporary Workers and Jobseekers

Objective	Minimise any potential negative impacts associated with the inflow of workers and jobseekers	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Employment of locals (within the low to semi-skilled positions) already residing in the larger Pilgrim's Rest area must receive priority as this would limit the negative impacts (e.g. Infrastructure requirements) associated with a sudden or additional population increase.	TGME and Contractor	All Phases
The local labour procurement strategy as well as proof of residence required should be clearly communicated in the local community and broader regional media well in advance of the construction phase. The communication strategy should ensure that unrealistic employment expectations are not created.	TGME and Contractor	All Phases
TGME to discuss the infrastructure requirements of the pre-construction and construction phase with the TCLM and DPWRT to pro-actively deal with the possible negative impacts	TGME, DPWRT, TCLM	All Phases
Maintenance of the roads frequently used by construction traffic should be discussed and negotiated with the Mpumalanga Department of Public Works, Road and Transport	TGME, DPWRT, TCLM	All Phases
Accommodation requirements of the construction team should be addressed prior to the construction phase commencing	TGME, DPWRT, TCLM	Pre-Construction
The Department of Public Works and community based representatives in the area such as the councillor, business representatives, and so forth should be informed of the construction schedules and activities	TGME, DPWRT, Tribal authorities	Pre-Construction and Construction Phase
Introduce contractual obligations for contractors to use local labour as far as possible.	TGME and Contractor	Pre-Construction and Construction Phase
Contractors to ensure that foreign workers reside in suitable facilities and not establish informal houses.	TGME and Contractor	All phases

Objective	Minimise any potential negative impacts associated with the inflow of workers and jobseekers	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Security measures to avoid unauthorised access at the Caravan Park should be established, in the event that workers will be accommodated at the Caravan Park (upgraded)	TGME and Contractor	All phases
Workers should be supervised at all times.	TGME and Contractor	All phases
Information distributed as part of the existing HIV/Aids awareness campaigns undertaken in the area should again be focused on and communicated to the local workforce.	TGME and Contractor	All phases
The development of informal vending “stations” where food and small goods are sold should be properly managed, to avoid littering, safety risks and possible environmental pollution	TGME and Contractor	All phases
First aid and/or emergency supplies should be available at various points at the construction and operations sites	TGME and Contractor	All phases
The general health of workers should be monitored on an on-going basis	TGME and Contractor	All phases
Ensure that a proper emergency plan that fits with the Municipal Disaster Management Plan is in place. Such a plan could be developed by DPWRT/TCLM in consultation with the TGME	TGME, DPWRT, TCLM	All phases
The creation of temporary accommodation facilities is not preferred or recommended from a social perspective although it could be implemented as part of this project. Should a temporary accommodation facility be required, this facility must be managed in an environmentally and socially acceptable manner to avoid any social conflict and environmental pollution.	TGME and Contractor	Construction Phase
Should a temporary accommodation unit be established at the Caravan Park, this facility must be managed in an environmentally and socially acceptable manner to avoid any social conflict and environmental pollution	TGME and Contractor	Operations
Support the local governments by sharing data and information to ensure that all the impacts and risks are taken into consideration and addressed	TGME, DPWRT, TCLM	All phases
Support the local government in conducting impact assessments and policy planning around these issues, and jointly agree on shared responsibilities for managing the flux and its impacts on children	TGME, DPWRT, TCLM	All phases
Support the local government in conducting impact assessments and policy planning with regards to the existing housing issues and dolomitic area and the subsequent expansion/development of Newtown/Schoonplaas that is currently hampered due to i.e. geological issues	TGME, DPWRT, TCLM	All phases
Assist the TCLM and provincial department with the planning and implementation processes of IDP priority projects in Pilgrim’s Rest. Align these priorities with the SLP and the community needs.	TGME, DPWRT, TCLM	All phases
Establish a forum, with representatives of TGME and local stakeholders for discussing potential issues of community conflict	TGME, DPWRT, TCLM	All phases
Exercise tight control over illegal mining activities in the area and make it public in the regional and national media	TGME	All phases

Objective	Minimise any potential negative impacts associated with the inflow of workers and jobseekers	
Mitigation: Action/control	**Responsibility**	**Timeframe**
The relevant actions related to this objective should form of the a contractor management plan	TGME and Contractor	All phases
Performance Indicator	» Locals are employed. » No conflict between outsiders, jobseekers and local community members » Limited or no increase in informal settlements in the area surrounding the mining activities » There should not be a housing shortage » Infrastructure and service needs are met » Maintenance of the local roads is undertaken » No negative impacts on the health services and infrastructure, water and electricity services and road infrastructure	
Monitoring	» TGME, Mpumalanga Province, TCLM and local leaders must monitor indicators listed above to ensure that these have been met	

9.3. Minimise Impact on Sense of Place

Objective	Limit negative impacts on sense of place through reduced visual and noise impacts	
Mitigation: Action/control	**Responsibility**	**Timeframe**
The construction site should be kept litter free	TGME and Contractor	Construction
Site rehabilitation should occur as soon as the construction process allows	TGME and Contractor	Construction
The recommendations made by the Visual Impact Assessment should be adhered to	TGME and Contractor	All Phases
Mining areas should be rehabilitated as soon as the Mining Works Programme allows	TGME and Contractor	All Phases
Where heritage sites could potentially be affected the legal requirements related to heritage sites should be adhered to and a clear communication strategy should be followed with local stakeholders	TGME, Contractor and representatives of Pilgrim's Rest Museum and the Department of Culture and Recreation	All Phases
Operational mining activities with potential noise impacts should be mitigated and should not be undertaken during night time. Noise generating activities should thus be kept to normal working hours (e.g. 7 am until 5 pm) where possible	TGME and Contractor	Operations
The recommendations made by the Noise Impact Assessment should be adhered to	TGME and Contractor	All Phases
The measures above should form part of the contractor management plan	TGME and Contractor	All Phases
Performance Indicator	» Limited visual impact on landscape character and sense of place » Number of complaints received from the local community in terms of visual impacts	

Monitoring	» TGME, Mpumalanga Province, TCLM and local leaders must monitor indicators listed above to ensure that these have been met

9.4. Minimise Safety and Health Risks

Objective	**Limit any safety and health risks during the pre-construction, construction and operational phases**	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Discuss the safety and security issues, as well as construction schedule with the local community policing forum and local SAPS.	TGME, DPWRT, TCLM, SAPS, Community Policing Forums	All Phases
Ensure that sufficient safety and security measures are in place in the areas surrounding the mining sites	TGME and contractor	All Phases
Set up a platform whereby community members and miners can report any illegal mining activities	TGME and contractor	All Phases
Permanent security personnel should be on site.	TGME and contractor	All Phases
Private security company to be contracted by TGME to prevent illegal miners to access mined areas.	TGME and contractor	All Phases
The construction areas should be fenced or access to the area should be controlled to avoid animals or people entering the area without authorisation.	TGME and contractor	Construction
The construction and mining sites should be clearly marked and “danger” and “no entry” signs should be erected. The mining area must be fenced with electrical fencing	TGME and contractor	Construction
Speed limits on the local roads surrounding the mining sites should be enforced	TGME and contractor	All Phases
Workers must not be allowed to leave the designated mining areas during working hours.	TGME and contractor	All Phases
Access roads should be fitted with security cameras and equipped with a controlled barrier (or equivalent).	TGME and contractor	All Phases
The mining area should be equipped with surveillance around its perimeter.	TGME and contractor	All Phases
A Health and Safety Plan should be implemented and it must be ensured that designated managers are qualified in First Aid and other relevant safety courses	TGME and contractor	All Phases
Implement safety measures to limit fire hazards and implement fire breaks if possible.	TGME and contractor	All Phases
Ensure that a proper emergency plan that fits with the Municipal Disaster Management Plan is in place. Such a plan could be developed by the TCLM, Department of Public Works and adjacent property owners e.g. SAFCOL and York Timbers in consultation with the TGME	TGME and contractor	All Phases
Should local road users be affected by the movement of the mining vehicles or by the construction activities of access roads taking place near main roads, sufficient warning signs should be erected	TGME and contractor	All Phases
The construction of additional access roads should be limited	TGME and contractor	Construction

Continue and extend the current HIV/AIDS awareness and support programmes, with specific focus on those in and nearby the mining areas, as well as on the mine employees	TGME and contractor	All Phases
TGME could assist in implementing a community health awareness plan	TGME and contractor	All Phases
The general health of mine workers should be monitored on an on-going basis	TGME and contractor	All Phases
The mining sites should be effectively managed to avoid any environmental pollution focusing on water, waste and sanitation infrastructure and services	TGME and contractor	All Phases
Environmental pollution must be limited and the mine should be managed and operated according to International Best Practice	TGME and contractor	All Phases
The mine could financially support community-based health research and monitoring programmes through their corporate social investment initiatives	TGME and contractor	All Phases
The mine could, through LED programmes and infrastructure development assist in improving the overall health services within the communities	TGME and contractor	All Phases
Fire-fighting equipment should be on site and should be in a good working condition. Designated workers should be trained in fire fighting.	TGME and contractor	All Phases
Open fires for cooking and related purposes should not be allowed on site	TGME and contractor	All Phases
All construction and mining vehicles should be in a good condition and adhere to the road worthy standards	TGME and contractor	All Phases
Access from gravel roads to local main roads should be in line with the road standard and requirements to accommodate the traffic load and traffic patterns.	TGME and contractor	All Phases
The construction sites should be clearly marked and “danger” and “no entry” signs should be erected.	TGME and contractor	All Phases
The measures above should form part of the contractor management plan	TGME and Contractor	All Phases
Performance Indicator	» No increase in criminal activities » No increase in illegal mining activities in the area » No speeding of construction and mining related vehicles on local roads » No increase in road accidents » No veld fires » Emergency, Health and Safety, as well as Fire Management Plans are in place » Mitigation of traffic related impacts	
Monitoring	» TGME, Mpumalanga Province, TCLM and local leaders must monitor indicators listed above to ensure that these have been met	

9.5. Minimise Negative Impacts of Nuisance Factors (Noise and Dust)

Objective	**Limit nuisance factors relate to noise and dust during the pre-construction, construction and operational phases**	
Mitigation: Action/control	**Responsibility**	**Timeframe**
The mitigation measures of the Noise and Air Quality Impact Assessments are relevant	TGME and contractor	All Phases
Dust suppression measures should be applied if and when necessary	TGME and contractor	All Phases

Operational mining activities with potential noise impacts should be mitigated and should not be undertaken during night time. Noise generating activities should thus be kept to normal working hours (e.g. 7 am until 5 pm) where possible	TGME and contractor	Operations
Heavy machinery and heavy vehicles should be kept in a good working order. Also, ensure that all vehicles and equipment comply with generally accepted noise levels and noise abatement regulations	TGME and contractor	All Phases
Personnel should be equipped with the necessary noise protection equipment	TGME and contractor	All Phases
The measures above should form part of the contractor management plan	TGME and Contractor	All Phases

Performance Indicator	» Good air quality » Noise levels within limits » Limited complaints from local community related to nuisance factors
Monitoring	» TGME, Mpumalanga Province, TCLM and local leaders must monitor indicators listed above to ensure that these have been met

9.6. Assist Initiatives to Develop the Local Tourism Industry

Objective	Limit negative impacts on the local tourism industry and assist in further development of the tourism industry

Mitigation: Action/control	**Responsibility**	**Timeframe**
Site rehabilitation should occur as soon as the construction process and the MWP allows	TGME	All Phases
The construction site should be kept litter free	TGME	Construction
The recommendations made by the Visual Impact Assessment should be adhered to.	TGME	All Phases
The mitigation measures of the Noise and Air Quality Impact Assessments should be adhered to	TGME	All Phases
Activities with potential noise impacts should be mitigated and should not be undertaken during night time. Noise generating activities should thus be kept to normal working hours (e.g. 7 am until 5 pm) where possible	TGME	All Phases
Heavy machinery and heavy vehicles should be kept in a good working order. Also, ensure that all vehicles and equipment comply with generally accepted noise levels and noise abatement regulations	TGME	All Phases
Dust suppression measures should be applied if and when necessary	TGME	All Phases
TGME should proceed in developing and implementing a detailed tourist strategy for Pilgrims Rest as part of its LED programme in close consultation with the local community. Some ideas that could be explored further include: • commitment from business visitors to mine to use overnight facilities in Pilgrim's Rest or immediate surroundings • develop old adits in tourist spots with view point to contrast with modern mining • caravan park space development (one part offices the other ablution blocks and ground clearance and maintenance for caravan standing areas) – TGME	TGME	Operations

already took over the golf course • Development of old TGME stall/space that sells memorabilia • upgrade road between Graskop and Pilgrim's (bush clearance and some repairs) • museum support (gold panning) • facilitate the establishment of ATM and petrol station in town • provide support by sponsoring transaction advisors to develop local SMMEs in vacant business areas		
Liaise directly with Mt Sheba resort and other business that might be negatively affected by the mining operations	TGME	All Phases
Liaise and assist with the promotion of Road safety on the R533	TGME	All Phases
Involve the SAPS and other relevant stakeholders (e.g. other business entities operating in the area, as well as Police Forums and Sector Forums) in the preventative security measures to be undertaken	TGME	All Phases
Any other recommendations above that relate to mitigating the negative impacts of in-migration also applies to this impact	TGME	All Phases
Other mitigation measures discussed under the other economic impacts below	TGME	All Phases
Facilitate the establishment of a local business and tourism chamber for Pilgrim's rest and engage on a regular basis with the tourism sector through the local business chambers (Sabie, Graskop and Pilgrim's Rest) to address issues that could negatively impact on local businesses, specifically tourist businesses.	TGME	All Phases
TGME can assist in changing the negative perception among South Africans, and possibly among international tourists of Pilgrim's Rest not being a popular tourist destination to a highly ranked tourism destination	TGME	All Phases
The measures above should form part of the contractor management plan	TGME and Contractor	All Phases
Performance Indicator	» Limited negative impacts on individual establishments » Job creation through the tourism industry » Increased number of visitors to the area per annum	
Monitoring	» TGME, Mpumalanga Province, TCLM ,and the local business community	

9.7. Minimise Impacts on other Local Economic Sectors and the Regional Economy

Objective	Limit negative impacts on other local and regional economic activities	
Mitigation: Action/control	**Responsibility**	**Timeframe**
The contractor could communicate the construction schedule and vehicle movements to the livestock owners and/or representative organisation namely the Maorabjang Communal Property Association	TGME and contractor	Construction
The movement of workers should be confined to the work site to avoid any trespassing on forestry and privately owned areas.	TGME and contractor	All phases

The construction site should be kept litter free	TGME and contractor	Construction
Site rehabilitation should occur as soon as the construction process allows	TGME and contractor	Construction
The recommendations made by the Visual Impact Assessment should be adhered to.	TGME and contractor	All phases
Dust suppression methods should be strictly implemented if and where required	TGME and contractor	All phases
Should local road users such as tourists be affected by the movement of the construction vehicles or by the construction activities of access roads taking place near main roads, sufficient warning signs should be erected	TGME and contractor	Construction
Involve the SAPS and other relevant stakeholders (e.g. other business entities operating in the area, as well as Police Forums and Sector Forums) in the preventative security measures to be undertaken	TGME	All phases
Effective management of the mining activities to avoid any environmental pollution focusing on water, and dust pollution, and limiting any increase in noise levels as per the respective environmental management plans	TGME and contractor	All phases
The contribution that other potential sources of pollution (e.g. agriculture, waste water treatments and settlements already have on the river's downstream water quality would be part of a Strategic Environmental Assessment which falls outside the ambit of this project. Such an assessment remains a high priority to provide a scientific baseline to be used for future auditing and monitoring. TGME could become part of a regional planning forum, to address such a strategic assessment. Such an initiative would have to be driven by the DWS, as the custodian of the water sources in South Africa.	TGME	All phases
A fire hazard management plan on and off site required	TGME	All phases
Set up a grievance mechanism by introducing a complaints register at the mine where concerns/complaints with regards to e.g. noise related to construction activities can be voiced.	TGME	All phases
Prioritise recruiting unskilled workers among the unemployed	TGME and contractor	All phases
Align unskilled wages to other sectors (tourism, agriculture, forestry) in the local economy	TGME and contractor	All phases
Working areas should be fenced to avoid unauthorised entry by animals onto the mining area	TGME and contractor	All phases
Specify the conduct of contract workers in worker related management plans	TGME and contractor	All phases

Performance Indicator	» No reports from property owners regarding pollution or impacts on farming activities » No illegal trespassing on mining, forestry and conservation areas
Monitoring	» TGME, TCLM and local leaders must monitor indicators listed above to ensure that these have been met.

9.8. Promote Socio-Economic Development in the Local Area

Objective	Promote socio-economic development in the local area

Mitigation: Action/control	Responsibility	Timeframe
Develop an updated Local Economic Plan as part of an updated SLP for the project in consultation with the local community	TGME	Operations
Determine whether the current allocation as per TGME's Mine Works Programme for the SLP is in line with the targets of the Mining Charter of 2018	TGME	Operations
Monitor and manage the social contribution of multinational suppliers (in-house as well as suppliers to contractor and direct service providers)	TGME	Operations
The measures above should form part of the contractor management plan	TGME and Contractor	All Phases
Performance Indicator	» Report on socio-economic development programmes as per the SLP	
Monitoring	» As per SLP	

9.9. Minimise the negative impacts related to concentration of local output in mining activities

Objective	**Minimise the negative impacts related to concentrated mining activities in the local economy**	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Focus on the support of non-mining related activities and domestic tourism in community development programmes	SLP officer, corporate social investment programme	During construction
Focus the local procurement programme on non-core mining inputs (e.g. catering, accommodation)	Supply chain/procurement	During construction
If a supplier development programme is established, focus the programme on non-core mining inputs in Pilgrim's Rest with a broader regional market		
Performance Indicator	» % spending on non-mining related sector support » % spending on non-core mining local inputs » % spending on non –core suppliers in enterprise development programmes	
Monitoring	» TGME, TCLM and local leaders must monitor indicators listed above to ensure that these have been met.	

9.10. Minimise the increase in local resource use intensity

Objective	**Minimise energy and water consumption**	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Develop a resource use plan with the specific objective to minimize the mining operations' energy and water use as far practical	Environmental officer	Planning/design phase
Performance Indicator	» Water use per revenues generated » Energy use pre revenues generated	
Monitoring	» TGME, TCLM and local leaders must monitor indicators listed above to ensure that these have been met.	

9.11. Minimise the negative economic impacts related to mine closure

Objective	Minimise the negative economic impacts related to mine closure	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Ensure that the mine investigates additional resources and increase its LoM in order to maintain and promote job security	TGME	During operations/ before closure
As per the requirements of the SLP develop mechanisms to assist employees, prior to retrenchment date in the transition phase after closure of the operations including portable skilled development programmes during the operational phase of the mine, providing assistance in accessing available and suitable jobs with other local mines or companies etc.	Human resources/ SLP officer/	During operations/ before closure
Focus on non-core related local supply links during the operational phases of the mine to facilitate easier transitioning of local suppliers to other costumers	Supply chain/procurement	During construction
Plan community projects with an exit strategy of which beneficiaries are aware of	SLP officer, corporate social investment programme	During operations/ before closure
Adhere to modern mining designs that makes it more difficult for illegal miners to entre mining areas after closure	TGME	During construction
Close any openings to underground mining sites in the vicinity	TGME	During operations/ before closure
Allocate funds to implement security measures to remove illegal miners from the local areas for another 5 years after closure	TGME	During operations/ before closure
Performance Indicator	» % spending on non-core mining local inputs » % of employees that receive portable skills training » % of retrenched employees placed in alternative employment » Exit strategies for every community investment programme	
Monitoring	» Annually/ just before closure	

9.12. Brown's Hill Resettlement

Objective	Undertake a process for the successful resettlement of the residents of the Brown's Hill Settlement	
Mitigation: Action/control	**Responsibility**	**Timeframe**
A comprehensive Resettlement Action Plan (RAP) must be developed in consultation with the affected inhabitants. This plan would include the number of dwellings and individuals to be affected, timeframes and the availability of a site where resettlement could occur.	TGME, appointed consultant and Brown's Hill residents	Prior to construction phase
Representatives of the DPW and TGME must liaise with the inhabitants and local councillor with regards to the resettlement process and timeframes. This communication must further ensure that the correct information regarding this issue is portrayed to the community members.	TGME and appointed consultant	Prior to construction phase

It would be desirable to address issues relating to resettlement as a matter of urgency and also to provide definitive timeframes linked to any possible resettlement	TGME, appointed consultant and Brown's Hill residents	Prior to construction phase
Performance Indicator	» Successful resettled families	
Monitoring	» Monitor the Resettlement process	

9.13. Community Development

Objective	Implement the following guidelines when undertaking community engagement as part of the socio-economic development plans	
Mitigation: Action/control	**Responsibility**	**Timeframe**
The rules of the social engagement programme should be communicated in clear terms from the outset of the project.	TGME	All Phases
Representatives of the community should be selected on the basis of their focus on the general interest of the larger community. In general, mine employees and suppliers should, on the basis of conflicted interest not be allowed to act as representatives of the local community but could represent their interests through other more appropriate forums (e.g. trade unions, local supplier representatives).	TGME and community representatives	All Phases
The difference between the 'common good' as opposed to 'the good of a select few' should be made clear to the local community.	TGME	All Phases
The focus should be on social investment programmes that encourage the local community to develop independent of the mine.	TGME	All Phases
The employee development and supply chain strategies should likewise focus on programmes to foster independence from Theta mine in particular and, where feasible, from the mining sector in general.	TGME	All Phases
Care should be taken to make attracting promises to the community only for the sake of short- term goodwill.	TGME	All Phases
In the case where social investment is channelled to collective community structures, investment should only be made into collective organisations that has sound governance structures in place.	TGME and community representatives	All Phases
Senior management at Theta mine should speak the same language and act as a unit when interacting with the local community	TGME	All Phases
Performance Indicator	» Inclusive and transparent community development and engagement	
Monitoring	» Monitor the inclusiveness and transparency of community development and community engagement processes	

10. SUMMARY AND CONCLUSIONS

The table below summarises the impact rating for the potential socio-economic impacts identified for the Theta project.

Table 41: Summary of Socio-Economic Impact Categories

Socio-economic Impact	Phase	Significance of Impact	
		Pre-mitigation	Post-mitigation
Employment and income generation	Construction	Medium (10) +	Medium (11) +
Project induced in-migration	Construction	Medium (11) -	Medium (10) -
Safety and Health Risks	Construction	Medium (8) -	Medium (7) -
Nuisance factors	Construction	Medium (7) -	Medium (7) -
Impact on other economic sectors in the local economy	Construction	Medium (9) -	Medium (8) -
Employment and income opportunities	Operations	High (12) +	High (12) +
Increase in Public revenues	Operations	High (13) +	High (13) +
Project Induced in-migration	Operations	High (12) -	High (12) -
Sense of place	Operations	Medium (11) -	Medium (10) -
Safety and health risks	Operations	Medium (9) -	Medium (8) -
Nuisance Factors	Operations	Medium (9) -	Medium (8) -
Impacts on Tourism Sector of Pilgrim's Rest	Operations	Medium (11) -	Medium (10) -
Impact on other economic sectors in the local and regional economy	Operations	High (12) -	Medium (11) -
Local Economic diversity and economic stability	Operations	Medium (11) -	Medium (11) -
Impact on resource use	Operations	Medium (11) -	Medium (10) -
Impact on Brown's Hill Settlement	Operations	Medium (11) -	Medium (11) +
Direct and flow-on job losses	Decommissioning and Closure	High (13) -	Medium (11) -
Decrease/Termination of community investment funds and support to local community	Decommissioning and Closure	High (13) -	Medium (10) -
Increase in illegal mining	Decommissioning and Closure	Medium (11) -	Medium (10) -
Sense of place	Decommissioning and Closure	High (13) -	Medium (10) -

Summary of Anticipated Positive Impacts

The project holds very high potential in terms of short-term job and income creation for the local community, the generation of local development funds as well as public revenues in the form of taxes and royalties.

Although it does not directly form part of the Theta Project and thus was not assessed, it must also be noted that the Theta Project can be seen as a huge economic driver for the area and is viewed by TGME as a steppingstone to build on production to further build on the economic environment. These initiatives will unlock further projects in future. Whilst operating, TGME will have significant positive economic spin-offs which would be critical for the local area especially in light of the negative socio-economic impacts of the Covid-19 Pandemic on the area.

In addition there are some of planned projects that could result in additional positive economic spin-offs including:

- Removal of alien invasive species with associated job creation;
- The development and upgrading of the former Caravan Park with community capacity building and skills training resulting in a future community owned and community based economically feasible tourism venture;
- Continuation of TGME's financial support to the Pilgrim's Rest Primary School;
- TGME's planned establishment of a tourism forum for the area;
- The launch of additional tourism related ventures focusing on the historical and existing mining activities within the Pilgrim's Rest area, together with the training of tourism guides to be involved in these ventures;
- Continued administrative support for the Management Committee of the Pilgrim's Rest Golf Course;
- Annual gold panning events and so forth.
- Through the rehabilitation plan, it is anticipated that the benefits of the project can be prolonged should the rehabilitation process consider sub-projects that would involve unskilled and semi-skilled local labourers e.g. a nursery where local labourers could be employed.
- Due to the sensitive natural environment and the mitigation measures proposed by the specialists as part of the EIA study, a Biodiversity offset is proposed. This offset can result in further job creation; it can advance rehabilitation in the catchment and it can attend to capacity building among community members.

Summary of Anticipated Negative Impacts

The majority of negative socio-economic impacts are rated medium and are typical of the socio-economic impacts that could be expected in mining projects. These impacts could largely be mitigated through proper management measures.

There are however, a number of potential socio-economic impacts on the local community that needs to be flagged as medium to high risks. These risks can be mitigated as summarised below:

Job Creation and project timeframe: The short operational period, combined with the large scale of the project could result in real challenges for the community in terms of job losses and the decline in local economic development funds after mine closure (rated as high risks). It is however noted that this project could unlock further underground mining opportunities in the area in future.

Project Induced formal and informal influx into Pilgrim's Rest: High levels of formal and informal population influx into Pilgrim's Rest (rated a medium to high risk) is highly probable and is rates a high risk. It is also a difficult risk to mitigate. Pilgrim's Rest face additional challenges in terms of local governance issues and uncertainty over the distribution of responsibilities between different government departments as well as the lack of available/safe land for further development of Newtown/Schoonplaas as its largest settlement. TGME would be able to manage the formal/structured in-migration through their employment and procurement strategies. Formally appointed employees from outside the area will typically stay in the local housing facilities provided by TGME as part of the proposed upgraded Caravan Park. Such formal and structured in-migration can, if associated with economic opportunity, result in downstream benefits for the local businesses with additional spin-offs in terms of employment, as well as the overall improvement in infrastructure and service in the Pilgrim's Rest area. TGME could continue, and possibly expand, their existing financial and socio-economic support to the local Pilgrim's Rest Primary School to assist the children affected by the socio-economic impacts of the in-migration of outsiders. It is recommended that TGME support TCLM and coordinate with the municipality to anticipate, manage and mitigate the impacts of in-migration. In this regard it is recommended that TGME assist in undertaking the necessary studies to enable the TCLM to implement the proposed townplanning process with regards to the expansion/development of residential units as part of Newtown/Schoonplaas. TGME can consider entering into partnerships with the TCLM to raise awareness and education on social issues and safe social behaviours, especially now in the light of the Covid-19 Pandemic. It could also be said that if mine management maintains a well-publicised tight control of illegal mining activities in the area it could assist in controlling the inflow of outsiders to the area.

Sense of place: The mining activities could have a negative sense of place on the predominantly rural and historic character of Pilgrim's Rest due to visual scarring of the landscape as well as a potential increase in noise and activity levels. The mine will be operational 6 days per week (excluding Sundays) and work will be done in two shifts 6am to 4pm and 4pm to 2am. This risk is rated medium. The recommendations of the Visual Impact Assessment would be implemented. A detailed Rehabilitation Plan would be developed and rehabilitation would occur concurrently with the mining activities. Such a Rehabilitation Plan would include the removal of Alien Invasive Species and would aim to develop a low-risk sustainable end-use.

Brown's Hill Settlement: The proposed mining activities would be in very close proximity to Brown's Hill. Although the impacts on the Brown's Hill Community are rated as medium, the location of the settlement requires resettlement. The impacts on the Brown's Hill Community (consisting of mainly two 2 families), are rated as medium. A Resettlement Action Plan (RAP) would have to be developed and implemented. Should resettlement be successful this negative impact can be reversed to a positive socio-economic impact.

Resource Use: There are real concerns over ground and water contamination resulting from the project that could have significant consequences not only for Pilgrim's Rest but also for the downstream regional economy. The probability of this impact materialising and the risk were rated as low, based on the findings of the geohydrology and hydrological reports.

The increased illegal mining activities, however, have a significant existing impact on the water quality and quantity of the Blyde River. The flow of the river is being changed by their activities and the risks of sedimentation have increased. At this stage, the illegal mining activities cannot be controlled. Should the project not proceed, the illegal mining activities are anticipated to significantly increase, with significant consequences for the local and downstream environment. If the project is authorised, it is anticipated that TGME could assist in controlling and possibly eradicating the illegal mining activities through their safety and security measures to be put in place. Adherence to environmental regulations and guidelines can then be managed and audited through the formal processes.

Tourism: In terms of the mine's potential impact on Pilgrim's Rest's tourism industry, there is conflicting views on the actual nature of the impact. While nature-based tourist activities in Pilgrim's rest, like Mount Sheba Resort are at a high risk to experience negative economic impacts from the mining project, other businesses (including the general dealer, petrol station and some tourist businesses in the historic town) could experience positive impacts. The risk however remains that the net impact of the mining project on the tourist sector could be some out-crowding of eco-based long-term tourism jobs while offering only short-term benefits to the town. The risk is rated medium.

Response to Risk: Considering the possible negative impacts of the Covid-19 Pandemic on the local Pilgrim's Rest tourism industry, it is noted that TGME proposes various tourism related ventures in the area with subsequent positive economic spin-offs. These include, inter alia, the following: The establishment of a tourism forum for the area; The launch of additional tourism related ventures focusing on the historical and existing mining activities within the Pilgrim's Rest area; annual gold panning events and so on.

Conclusions and Recommendations

The following recommendations are highlighted to address the potential negative impact of the project:

- Mitigation measures, responses to risks identified and the Social Management Plan must be adhered to.
- A Resettlement Action Plan needs to be developed for the Brown's Hill Community and the proposed process and possible implications should be discussed with the residents of the Brown's Hill Community.
- A serious effort is required in the development of a sustainable post-mining economy through the social investment programme of the project, covering social investment in sustainable non-mining related activities as well as through a portable skills programme. These programmes need to be developed and implemented at an early phase of the project.
- The contribution that other potential sources of pollution (e.g. agriculture, waste water treatments and settlements) already have on the river's downstream water quality would be part of a Strategic Environmental Assessment (to be done under the auspices of the DWS) which falls outside the ambit of this project. Such an assessment remains a high priority to provide a scientific baseline to be used for future auditing and monitoring
- A Biodiversity Offset Agreement (if finalised) must aim to create additional employment opportunities and must focus on capacity building among local community members.

The following recommendations should also be used as guiding principles with regards to future community engagements:

- The rules of the social engagement programme should be communicated in clear terms from the outset of the project.
- Representatives of the community should be selected on the basis of their focus on the general interest of the larger community. In general, mine employees and suppliers should, on the

basis of conflicted interest not be allowed to act as representatives of the local community but could represent their interests through other more appropriate forums (e.g. trade unions, local supplier representatives).

- The difference between the ‘common good’ as opposed to ‘the good of a select few’ should be made clear to the local community.
- The focus should be on social investment programmes that encourage the local community to develop independent of the mine.
- The employee development and supply chain strategies should likewise focus on programmes to foster independence from Theta mine in particular and, where feasible, from the mining sector in general.
- Care should be taken to make attracting promises to the community only for the sake of short-term goodwill.
- In the case where social investment is channelled to collective community structures, investment should only be made into collective organisations that has sound governance structures in place.
- Senior management at Theta mine should speak the same language and act as a unit when interacting with the local community.

In conclusion it needs to be mentioned that the negative economic impacts of the COVID -19 pandemic is expected to be experienced for at least another two years. South Africa’s economy is forecasted to decline by between 3 and 5 % in 2020 and only partially making for the lost in 2020 (IMF, 2020). In this context, the proposed project will make a significant positive contribution in providing much needed jobs and tax income not only for the local but also for the larger regional and national economy. Based on the findings of the socio-economic impact assessment for the project it is therefore recommended that the proposed Theta Project be approved.

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11.3. Consultation

Stakeholder	Date of interview
Gwilym Rees (Sabie Chamber of Commerce)	10 April 2019
Lisa Sheard (Kruger to Lowveld Tourism)	10 April 2019
Renee and Johnny Reinders (The Vine Restaurant)	15 April 2019
Lella Smythe (Royal Hotel)	15 April 2019
Agnes Dimakatso (Environmental Centre)	15 April 2019
Timothy Mashile (Maorabjang CPA)	15 April 2019
Neville Philpott (Clewer General Dealer)	15 April 2019
Nicolas Theron (Kruger to Canyons)	15 April 2019
Mike Dodds (Century 21 Wildlife Properties)	16 April 2019
Sindiswa Mathebula (TCLM Director: LED and Planning)	16 April 2019
Wilma Kok (Environmental Centre)	16 April 2019
Grace Masanga (Cullinan Tours)	16 April 2019
Edward Moreson (Cullinan Underground Tours)	16 April 2019
Liza Brown (Premier Tours- Cullinan)	16 April 2019
Chris Forster (SAFCOL)	16 April 2019
Emma Mathebula (Brown's Hill)	17 April 2019
Joyce Mathebula (Brown's Hill)	17 April 2019
Morice Mnisi (Brown's Hill)	17 April 2019
Jurie Conradie (adjacent farmer)	20 April 2019
Mandla Mokoena (TCLM Ward 13 Councillor)	23 April 2019
Lyll Smuts (Mpumalanga Angling Association)	23 April 2019
Fanie Fick (Mount Sheba Forever Resort)	23 April 2019

12. CURRICULUM VITAE OF SPECIALISTS

SOCIAL SPECIALIST: INGRID SNYMAN

Ms. Ingrid Snyman holds a BA Honours degree in Anthropology. She has 20 years' experience in the social field. Ms. Snyman has been involved in various Social Impact Assessments during her career as social scientist. These project themes consist of infrastructure development, waste management, road development, water and sanitation programmes, township and other residential type developments. She has also been involved in the design and management of numerous public participation programmes and communication strategies, particularly on complex development projects that require various levels and approaches.

:

Name:	**Ingrid Helene Snyman**		
Profession:	Social Development Consultant	**Name of firm:**	Batho Earth
Years of Experience:	20 years		

KEY QUALIFICATIONS

- Social Impact Assessment (SIA)
- Public Participation programmes
- Communication, development of community structures and community facilitation
- Community-based training and
- Workshop reports

EDUCATION

1992:	B A (Political Science) University of Pretoria
1995:	B A (Hons) Anthropology University of Pretoria
1996 - 1997:	Train the Trainers Centre for Development Administration - UNISA

EXPERIENCE RECORD

2000 to date **Independent Development Consultant: Batho Earth**

Some recent examples of Ingrid's work include:

- SIA for the proposed Manganese Mine North West of Hotazel, Northern Cape (Mukulu Environmental Authorisation Project)
- Proposed Ngonye Falls Hydro-Electric Power Plant Project, Western Province, Zambia: Biodiversity Assessment: Stakeholder Engangement Plan and Social Assessment for the Ecosystem Services Review (ESR)
- SIA for the proposed Mixed Land Use Development situated on the Remainder of Allandale 10 IR, known as Rabie Ridge Ext 7, Midrand, Gauteng
- SIA for the proposed Mixed Land Use Township Establishment on the Remainder of Portion 406 of the Farm Pretoria Town and Townlands 351 JR, Salvokop, Tshwane CBD
- SIA for the proposed Crowthorne-Lulamisa power line, Midrand, Gauteng
- SIA as part of the Basic Assessment for the proposed development of Project One (1) of the Vosloorus Extension 9 High Density Housing Project, Ekurhuleni Metropolitan Municipality
- Public Participation for the Water Use Licence Application Process for the proposed Water Uses at the Clewer Siding, Clewer, near Emalahleni, Mpumalanga Province

- Public Participation for the proposed development of a Truck Stop, Buffelspoort, North West Province
- SIA for the proposed cevelopment of the new Tshwane Regional General Waste Disposal Facility (Multisand Landfill), Pretoria, Gauteng Province
- SIA as part of the Basic Assessment for the proposed K97 Road northbound of the N4 at Bon Accord, Pretoria, Gauteng
- SIA for the proposed Mapochsgronde Residential Development, Roossenekal, Limpop Province
- the Ferrum substation (Kathu) and the Garona substation (Groblershoop), Northern Cape Province
- SIA as part of the Basic Assessment for the proposed construction of the Eskom Rhombus-Lethabong 88kv Powerline and Substation, North West Province
- Public Participation for Sable Platinum for the proposed prospecting application on the farm Doornpoort, Pretoria, Gauteng
- SIA for the proposed Aberdeen-Droerivier 400 kV Transmission Power Line, Eastern and Western Cape Province
- SIA for the proposed Houhoek Substation Upgrade and Bacchus-Palmiet Loop-In and Loop-Out, near Botrivier, Western Cape Province
- Public Participation for the prospecting application on the farms Frischgewaagd and Kleinfontein, Mpumalanga Province for PMG MINING
- Public Participation for the prospecting application on the farm Klipfontein, Gauteng for TGME
- SIA for the proposed Western Bushveld Joint Venture Project (Maseve Platinum Mine), North West Province
- SIA to determine the impact of the Tharisa Mine on the neighbouring properties and property owners, Buffelspoort area, near Marikana, North West Province
- SIA for the proposed Arnot-Gumeni 400 kV Transmission Power Line, Mpumalanga
- SIA for the proposed 400 kV Transmission Power Line for approximately 10km to the west of the existing Marathon Substation, Nelspruit area, Mpumalanga
- SIA for the proposed Christiana PV facility on the farm Hartebeestpan, North West Province
- SIA for the proposed Hertzogville PV facility on the farms Albert and Wigt, Free State Province
- SIA for the proposed Morgenzon PV facility on the farm Morgenzon, Northern Cape Province
- Public Participation Process for the proposed Western Bushveld Joint Venture Project, North West Province
- SIA for the proposed Aggeneis-Oranjemond Transmission Line project, Northern Cape Province
- SIA as part of the Basic Assessment Process for the Exxaro Photovoltaic Facility, Lephalale, Limpopo Province
- Various SIAs Solar Energy Projects in the Northern Cape Province
- SIA and public participation for the proposed Karoo Renewable Energy Facility, Northern Cape Province
- SIA for the Wag'nbiekiespan Solar Energy Facility, Northern Cape Province
- Public Participation and SIA for the proposed Thupela Waterberg Photovoltaic Plant, Limpopo Province
- SIA for the proposed Mitchells Plain-Firgrove-Stikland Transmission Line, Western Cape
- SIA for the proposed Ariadne-Venus Transmission Line, KwaZulu Natal
- Socio-Anthropological Study for the proposed Booysendal Mine, Steelpoort area, Mpumalanga
- Mooi-Mngeni Transfer Scheme Phase 2: Spring Grove Dam and Appurtenant Works: Social research as part of SIA
- Proposed Township Development on the Farm Klipfontein 268-JR, Soshanguve Ext 9, Gauteng: SIA
- Public Participation assistance: Proposed Wesizwe Platinum Mine: Application for mining rights, North West Province

- Public Participation for various exemption studies for proposed residential developments in the Gauteng area (Raslouw A.H., Rayton, Rooihuiskraal)
- Social training for the Bekkersdal Farmer Support Programme
- Public Participation for the Gautrain variant alignments in the Centurion area as proposed by the Bombela Consortium
- Public Participation for the upgrading of the Menlyn Road Network
- Public Participation for the New Multi-Products Pipeline project for Petronet: Jameson Park-Langlaagte section
- Public Participation for exemption from an Environmental Impact Assessment for the proposed Township Development on Portion 49 of The Farm Rooikopjes 483 JR, Rayton
- Public Participation for exemption from an Environmental Impact Assessment for the proposed Residential Development on the remainder of a Portion of Portion 1 Of The Farm Brakfontein 399 JR
- Public Participation for the proposed new coal-fired power station in the Lephalale area, Limpopo Province
- Public Participation for the proposed Open Cycle Gas Turbine (OCGT) plant and associated transmission lines and substation at Atlantis, Western Cape Province
- Public Participation for the proposed residential and commercial development of the Isidleke region in the western portion of the AECI Modderfontein site
- Public Participation for the upgrading of Boundary Road, Kya Sands area
- Marketing for the Eskom Energy Efficient Design Competition
- Management assistance for the public participation process for the development of the Tshwane Integrated Environmental Policy
- SIA and public participation for the proposed 765 kV transmission power line between Hydra Substation (near de Aar) and the proposed Gamma Substation (near Victoria West), Northern Cape Province
- Public Participation as part of the Environmental Scoping Study for the proposed upgrading of the intersection at Road D374 and Road D540 in the Muldersdrift area
- Public Participation and SIA as part of the Environmental Scoping Study for the proposed upgrading of the Waterval Water Care Works
- Public Participation for the return-to-service of the Camden Power Station, Mpumalanga
- Public Participation for the development of an Environmental Management Framework for the western part of the Kungwini Local Municipality area
- Public Participation for the proposed section of the PWV 5 from road K71 to road R21, including interchanges, Gauteng Province
- Public Participation and SIA for the proposed Poseidon-Grassridge No. 3 400 kV Transmission line and the extension of the Grassridge Substation, Eastern Cape Province

ECONOMIC IMPACT ASSESSMENT PRACTITIONER: AN KRITZINGER

An Kritzinger (Masters Economics) has been working as consultant in the economic development field for the past seventeen years. Her work has concentrated on applied economic modelling in South Africa, Namibia, Botswana and Mozambique including macro-economic impact analysis, economic cost benefit analysis, economic impact assessments, social incidence studies and macroeconomic forecast modelling. She also has extensive experience in the socio-economic profiling and economic development plans for local authorities and districts in South Africa and has designed and implemented a training project for capacity training in sustainable local economic development monitoring for district municipalities throughout South Africa in collaboration with the Development Bank of Southern Africa.

Name:	**Anna Sophia Kritzinger**		
Profession:	Economic Development Specialist	**Name of firm:**	Southern Economic Development
Years of Experience:	18 years		

KEY QUALIFICATIONS

- Economic impact assessments
- Applied economics (macro-economic and social impact analysis; economic cost benefit analysis, economic incidence analysis, scenario planning)
- Skills development in development profiling and strategies
- Economic databases & economic reviews
- Local social and economic development strategies
- Industry and market analysis
- Analyses of higher education systems in Africa (analyses of demand and supply factors)

EDUCATION

1985:	B.Admin (Hons) (Economics) (University of Pretoria
1992:	M.Admin (Economics) (University of Stellenbosch)

Some recent examples of An's work include:

Economic impact analyses:

- High level economic impact assessment for various projects (including tourism projects) related to the mine closure programme for Sishen Mine, Northern Cape (South Africa (2019)
- High level economic impact assessment including economic cost benefit assessment, direct and flow-on impacts for a number of tourism projects for the national tourism department South Africa (2018)
- Cost effectiveness assessment of a space technology applied for early fire detection in South Africa (BDO-UK, 2018)
- Socio-economic impact assessment of the Animal Health Technology Innovation Programme of the Technical Innovation Agency, South Africa (2017)
- Socio-economic impact assessment for the Cape Health Technology Park (South Africa (2016)
- VArious socio-economic impact assessments as part of EIAS including for the closure of Ezulwini gold mine, Gauteng (2016) ; Socio- economic impact assessment for Hernic Ferrochrome Complex, North West (2016)
- Socio- economic impact assessment of the Cape Health Technology Park, Western Cape (2016)

- Socio-economic impact assessment for route selection of power lines in Mpumalanga (2016)
- Study lead for revenue management study, entailing the identification of mitigation strategies related to project –related revenues (employment and public revenues) for a large-scale gas project for Anadarko petroleum in Mozambique (2012-2014)
- Economic impact assessment as part of Social Impact Assessment (SIA) of a Glencore/Xtrata chrome mine in Rustenburg, Mpumalanga (2014)
- Economic impact assessment as part of Social Impact Assessment (SIA) for the extension of a mining right application for Boschmanspoort coal mine in Mpumalanga (2014)
- Economic impact assessment as part of Social Impact Assessment (SIA) for a casino/retail project in Delmas, Mpumalanga (2014)
- Economic study for a private regional landfill in the Ga-Rankuwa area of City of Tshwane (2014)
- Economic impact assessment as part of SIA for a CFB coal plant in Delmas area, Mpumalanga, South Africa (2013)
- Economic impact assessment as part of SIA of a coal mine in Chrissiesmeer, Mpumalanga, South Africa (2013)
- Economic impact assessment as part of SIA for an existing vanadium mine in the Brits area (2012)
- Measured the impact of the global financial crisis on the mining industry of 8 SADC countries including South Africa (SADC countries; 2009)
- Conducted an analysis of the economic contribution of state owned enterprises to the Namibian economy (Namibia; 1999 and 2009)
- Conducted a socio economic impact analysis for the development of an Africa centre and sustainable housing development project in the Western Cape (South Africa; 2007)
- Developed economic criteria for the evaluation of projects for the Strategic Infrastructure Programme (SIP) for the Western Cape Province(2005)
- Conducted the economic evaluation of an infrastructure project in the Mosselbay area (South Africa;2001);
- Economic impact assessment for horse-mackerel industry (Namibia 2003)

Local Economic Development- related work:

- Conducted the economic impact analyses for a SMME development finance institution (CEDA) in Botswana, (Deloitte Botswana, 2016)
- Managed and conducted a research project pertaining to Business Retention and Attraction Strategies to inform strategic inputs to improve programmes on behalf of Deloitte Nambia for the Local Economic Development Association (LEDA) of Namibia (Namibia, 2013)
- Designed and implemented a training project for capacity training in sustainable local economic development (including the “green economy”) monitoring for district municipalities throughout South Africa. The project was developed in collaboration with Inwent and the Development Bank of Southern Africa (South Africa; 2008 – 2011). The project has been developed further as one of the courses that forms part of the University of Johannesburg’s Centre of Local Economic Development degree programme;
- Evaluated local economic development projects in the Western and Eastern Cape. These studies involved the evaluation of existing economic development projects and the identification of LED projects that the NGO-client could potentially get involved in (South Africa, 2002);
- Managed a team in conducting a business survey and Local Economic Development action plan for the eastern parts of Cape Town, including township areas such as Mfuleni and parts of Macasser. The project included extensive consultation sessions with community organisations (South Africa; 2007);
- Compiled various socio economic development profiles for various South African local authorities including profiles for George municipality; Drakenstein municipality, the Overberg region and Oudtshoorn municipality that were used to inform the Local Development for the towns and district. The profiles and identification of relevant projects involved community facilitation work (South Africa;1998-2008);

- Developed a socio economic database for the Cape Metropolitan Area. The study was updated to an extensive economic analysis of the city and some indicators were extended to include all the different regions of the Western Cape (South Africa;1998, 2001);

Economic cost benefit analysis:

- Conducted a high level economic cost benefit analyses for a regional landfill project in Ga-Rankuwa, City of Tshwane as extension for an economic impact assessment (South Africa, 2014)
- Conducted an economic cost benefit analyses for a coal mine near Chrissiesmeer, Mpumalanga as part of alternative land-use study for a mining application study (South Africa, 2013)
- Conducted an economic cost benefit analysis for an agricultural irrigation project in the Pandamatenga area (Botswana, 2010);
- Conducted an economic cost benefit analysis for Botswana Export Development Agency with Deloitte SA to investigate the feasibility of a tertiary education hub to diversify the Botswana economy (Botswana; 2009)

Other macro-economic modeling:

- Developed an economic forecast model for the City of Cape Town and the Western Cape economy (City of Cape Town; 2005 updated in 2011, extended to Western Cape in 2014);
- Conducted research to establish the economic contribution of agricultural research in South Africa to assist the motivation of increased public grants to the main agricultural research body (South Africa; 2011)

13. DECLARATION OF INDEPENDENCE

In terms of the National Environmental Management Act (Act No. 107 of 1998) (NEMA), as amended in respect of the EIA Regulations of December 2014, and GNR 982 published on 4 December 2014, an independent consultant must be appointed to act on behalf of the client. In this regard Batho Earth and SED submit that they have:

- The necessary required expertise to conduct a Social Impact Assessment, including the required knowledge and understanding of any guidelines or policies that are relevant to the proposed process;
- Undertaken all the work and associated studies in an objective and independent manner, even if the findings of these studies are not favourable to the project proponent;
- No vested financial interest in the proposed project or the outcome thereof, apart from remuneration for the work undertaken under the auspices of the above-mentioned regulations;
- No vested interest, including any conflicts of interest, in either the proposed project or the studies conducted in respect of the proposed project, other than complying with the required regulations; and
- Disclosed any material factors that may have the potential to influence the competent authority's decision and/or objectivity in terms of any reports, plans or documents related to the proposed project as required by the regulations.

SCIENTIFIC AQUATIC SERVICES
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SOIL, LAND USE AND LAND CAPABILITY ASSESSMENT AND IMPACT ASSESSMENTS AS PART OF THE ENVIRONMENTAL AUTHORISATION AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS FOR THE TGME THETA PROJECT TO INCLUDE THE THETA HILL, BROWNS HILL AND IOTA HILL NEAR PILGRIM'S REST, MPUMALANGA PROVINCE

Prepared for

Batho Earth

Social and Environmental Consultants

July 2020

Prepared by:	**Scientific Aquatic Services**
Report author :	**N.S. Sithole (Cand. Nat. Sci)**
Report reviewers:	**B.N. Mzila**
	S. van Staden (Pr.Sci.Nat)
Report Reference:	**SAS 219037**
Date:	**July 2020**
Revised:	**June 2020**

EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the Transvaal Gold Mining Estate (TGME) mine development project: amendment to MR83 to include the Theta hill, Browns hill and Iota hill projects, near Pilgrims Rest, Mpumalanga Province. The proposed mining project will henceforth be referred to as the "Focus Area".

Based on the observation during the field assessment, the current land use activities associated with the Focus Area and surrounding areas are largely dominated by wilderness, forestry, grazing, residential as well as some mining operations. No commercial agricultural activities were observed occurring within the Focus Area and the immediate (at least within a 3 km radius) surrounding areas except forestry.

The Focus Area resembles a Lithic and Anthropic catena, with Mispah/Glenrosa and Witbank (Anthrosols) being the dominant soil forms within the total surveyed area. Lithic soils such as Mispah/Glenrosa are regarded as shallow soils, attributed to their shallow pedogenic and effective depth. These soils constitute approximately 72.7% of the total Focus Area, whilst Witbank (Anthrosols) soils occupy approximately 2.69% of the total investigated Focus Area. The shallow nature of the dominant soil forms can be largely attributed to limited rock weathering or rejuvenation through natural erosion on steeper, convex slopes. Witbank soils have been extensively disturbed such that no recognisable diagnostic soil morphological characteristics could be identified, corresponding to Anthrosols in the international soil classification terminology. The remainder of the Focus Area comprises Dundee (Alluvial soils) soil form which occupy approximately 3.47%, and residential areas, mining and associated structures (i.e. mine plant complex, WRD, office areas, roads) which collectively occupy approximately 21.14% of the total investigated area.

Below is a tabular presentation of the dominant soils, with relative description of soil horizons as well as associated land capability. The land capability of the identified soils forms ranged between Class V and VIII due to land use limitations related to anthropogenic activities and shallow effective rooting depth.

Land Capability classes for soil forms identified within the Focus Area

Soil Form	Code	Diagnostic Horizon Sequence	Land Capability	Areal Extent (ha)	Percentage (%)
Mispah	Ms	Orthic/ Hard Rock	Grazing (Class VI)	237.06	82.82
Glenrosa	Gs	Orthic/ Lithic			
Dundee	Du	Orthic/ Alluvial	Grazing (Class V)	16.23	5.67
Witbank	Wb	Unspecified	Wildlife (Class VIII)	32.94	11.51
TOTAL				**286.23**	**100.00***

***Infrastructural areas were not included in the table above since they not considered in the land capability ratings**

The findings of this assessment suggest that the soil limiting factors within the Focus Area for land capability, with specific mention to rainfed cultivated agriculture include the following:

- Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa soil forms. As such, these soils are not considered to contribute significantly to agricultural productivity on a local, provincial as well as national scale;
- Susceptibility to erosion of Mispah/Glenrosa soils forms associated with the Focus Area due to their occurrence on sloping areas;
- Poor water and nutrient holding capacity of the Alluvial soils (Dundee) which disqualifies these soils for cultivated agriculture. However, preservation of these soils for conservation purposes is regarded important since they are associated with water course, parallel with the National Water Act, 1998 (Act No. 36 of 1998);

- For detailed descriptions of the vegetation types associated with the soil medium defined in the Focus Area refer to the floral assessment (Section B, STS190006); and
- Lack of soil medium for plants and crop growth for the mine infrastructure, surface water areas and Witbank (Anthrosols) soils.

The proposed mining project is not anticipated to cause significant cumulative loss of herbaceous material for grazing after mitigation measures have been put in place. In addition, since the majority of proposed activities are to occur on shallow soils. It should be noted that cumulative loss of wilderness soils is likely to occur particularly on sloping areas during opencast mining activities, some of which will be unavoidable even when mitigation measures have been implemented. The project will likely cause soil erosion and the associated sedimentation of downgradient areas, soil compaction, soil contamination and loss of land for potential forestry and grazing. However, if mitigation measures are carefully implemented during all phases of development, the project is not seen as fatally flawed from an agricultural potential, land use and land capability point of view and the cumulative impact on agricultural resources is limited, although the conservation value of the area must be considered. A site-specific soil rehabilitation plan should be put in place prior to commencement of mining and related activities to ensure that the natural topography and wildlife/wilderness land capability is reinstated post closure and residual impacts minimised.

Key Mitigation Measures include:

- The footprint of the proposed mining operation and related infrastructure areas should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible;
- Laydown areas should be located within disturbed soils (Anthrosols) to avoid compaction of natural soils as far as practically possible;
- An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur;
- Stockpile areas should be demarcated as “No Go Areas” to ensure that the disturbance of topsoil is minimal;
- Stockpiles should not exceed three (3) meters in height and should be treated with temporary soil stabilization measures. Should a topsoil stockpile height of three (3) meters be exceeded, erosion control measures should be implemented; and

  During the decommissioning phase the footprint should be thoroughly cleaned, and all construction material should be removed to a suitable disposal facility.

The post-mining land use should be clearly defined and included as part of the Environmental Impact Assessment (EIA) process. According to the Chamber of Mines guidelines for rehabilitation of mined land, the anticipated post-mining land uses are grazing and wilderness. These are attributed to the limited plant growing medium which limits rooting depth exhibited by the dominant soil form (Mispah/Glenrosa) occurring within the focus area. The standard of rehabilitation must be determined by the primary land capability pre-mining. It should be noted that at post-closure the grazing capacity will be reduced to some extent by residual and latent impacts.

After mitigation measures and recommendations have been considered, this project is considered acceptable from a soil, land use and land capability point of view. It is the opinion of the specialist therefore that this study provides the relevant information required for the Environmental Impact Assessment phase of the project to ensure that appropriate consideration of the agricultural resources in the Focus Area will be made in support of the principles of Integrated Environmental Management (IEM) and sustainable development.

DOCUMENT GUIDE

This report was compiled according to the following information guidelines for a specialist report in terms of the Environmental Impact Assessment (EIA) Regulation 326 of the National Environmental Management Act (NEMA), as summarised on the Table below.

Table a: Document guide according to the amended 2017 EIA Regulations (No. R. 326)

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix B
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix B
b)	A declaration that the specialist is independent	Appendix B
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.1
cA)	An indication of the quality and age of base data used for the specialist report	Section 3
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d)	The date of the site investigation	Section 2.3
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 2
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
h)	Map of the pre-determined soil and land capability data	Section 3
i)	A description of any assumption made and any uncertainties	Section 1.3
j)	A description of 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 4 and 5
k)	Any mitigation measures for inclusion in the EMPr	Section 5.1
l)	Any conditions for inclusion in the environmental authorisation	None
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	None
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 5 and 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 5 and 6
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	None
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
q)	Any other information requested by the competent authority	None

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GLOSSARY OF TERMS

Albic	Grey colours, apedal to weak structure, few mottles (<10 %)
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.
Catena	A sequence of soils of similar age, derived from similar parent material, and occurring under similar macroclimatic condition, but having different characteristics due to variation in relief and drainage.
Chromic:	Having within ≤150 cm of the soil surface, a subsurface layer ≥30 cm thick, that has a Munsell colour hue redder than 7.5YR, moist.
Ferralic:	Having a ferralic horizon starting ≤150 cm of the soil surface.
Ferralic horizon:	A subsurface horizon resulting from long and intense weathering, with a clay fraction that is dominated by low-activity clays and contains various amounts of resistant minerals such as Fe, Al, and/or Mn hydroxides.
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.
Hard Plinthic	Accumulative of vesicular Fe/Mn mottles, cemented
Hydrophytes:	Plants that are adaptable to waterlogged soils
Lithic	Dominantly weathering rock material, some soil will be present.
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.
Plinthic Catena	South African plinthic catena is characterised by a grading of soils from red through yellow to grey (bleached) soils down a slope. The colour sequence is ascribed to different Fe-minerals stable at increasing degrees of wetness
Red Apedal	Uniform red colouring, apedal to weak structure, no calcareous
Runoff	Surface runoff is defined as the water that finds its way into a surface stream channel without infiltration into the soil and may include overland flow, interflow and base flow.
Orthic	Maybe dark, chromic or bleached
Salinity:	High Sodium Adsorption Ratio (SAR) above 15% are indicative of saline soils. The dominance of Sodium (Na) cations in relation to other cations tends to cause soil dispersion (deflocculation), which increases susceptibility to erosion under intense rainfall events.
Sodicity:	High exchangeable sodium Percentage (ESP) values above 15% are indicative of sodic soils. Similarly, the soil dispersion.
Soil Map Unit	A description that defines the soil composition of a land, identified by a symbol and a boundary on a map
Soft Plinthic	Accumulation of vesicular Fe/Mn mottles (>10%), grey colours in or below horizon, apedal to weak structure
Witbank	Man-made soil deposit with no recognisable diagnostic soil horizons, including soil materials which have not undergone paedogenesis (soil formation) to an extent that would qualify them for inclusion in another diagnostic horizon

ACRONYMS

AGIS	Agricultural Geo-Referenced Information Systems
°C	Degrees Celsius.
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ET	Evapotranspiration
IUSS	International Union of Soil Sciences
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPS	Global Positioning System
M	Meter
MAP	Mean Annual Precipitation
NWA	National Water Act
PSD	Particle Size Distribution
SACNASP	South African Council for Natural Scientific Professions
SAS	Scientific Aquatic Services
SOTER	Soil and Terrain

1. INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the Transvaal Gold Mining Estate (TGME) Mine Development Project: Amendment to MR83 to include the Theta Hill, Browns Hill and Iota Hill projects near Pilgrim's Rest, Mpumalanga Province. The proposed mining project will henceforth be referred to as the "Mining Right Area (Focus Area)".

The Focus Area falls within the Thaba Chweu Local Municipality and the Greater Ehlanzeni District Municipality, within the Mpumalanga Province. The R533 runs along the northern and eastern sides of the Focus Area. The Focus Area is located immediately southwest of Pilgrim's Rest. Refer to Figure 1 and 2.

Agricultural potential is directly correlated to Land Capability Class (LCC), measured on a scale of I to VIII, with classes I to III considered as high agricultural potential soils, and classes V to VIII not suitable for cultivation. High potential agricultural land is defined as having "*the soil and terrain quality, growing season and adequate available moisture supply to sustain crop production when treated and managed according to best possible farming practices*" (Land Capability report, ARC, 2006). High agricultural potential land is a scarce non-renewable resource, which necessitates an Agricultural Potential assessment prior to land development, particularly for purposes other than agricultural land use which will affect extensive tracts of land, as per the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983).

A soil, land use and land capability survey was conducted in March 2019. This date of assessment is acceptable since seasonality has no bearing on the accuracy of soil, land use and land capability assessments. The assessment entailed evaluating physical soil properties and current limitations to various land use purposes.

1.1 *Project Description*

The Theta Project Mineral Resources traverse two mining right areas, namely MR83 for the portion within Ponieskrantz 543 KT, and MR341 for the portion within Grootfontein 562 KT. Only the portion within Ponieskrantz 543 KT, i.e. MR83, is investigated in this study. The entire 83MR is situated on various portions of the farms Frankfort 509-KT, Krugers Hoop 527-KT, van der Merwes Reef 526-KT, Morgenzon 525-KT, Peach Tree 544-KT and Ponieskrans 543-

KT, and encompasses an area of 9,413 hectares (ha). The extent of the area required for mining is 286 ha.

The existing and approved MR83 allows for the mining of gold ore, silver ore, copper ore and stone aggregate over the extensive 9,413 ha of land. It was granted, registered and executed and expires on 15 October 2023. An application for the amendment of the existing environmental authorisation has been submitted to include the proposed Theta Open Pit Project. In support of this, an Environmental Authorisation and IWULA amendment process is underway.

Historically the area on MR83 has operated in terms of open cut as well as underground gold mines. Theta Hill, Browns Hill and Iota Hill have historically been exploited as mainly underground mines with very limited open pitting. The Theta Hill, Browns Hill and Iota Hill surface projects, collectively referred to as the “TGME Theta Hill Project”, entails surface mining operations at the abovementioned three locations, with an anticipated Life of Mine (LoM) of seven years (excluding construction years).

To effectively establish the open pit mining operation, a number of infrastructure items will be required. Theextent of the area required for the proposed TGME Theta Hill Project is listed in the below table. A depiction of the proposed mine layout is provided in Figure 1. The existing TGME Plant falls within the MR341 mining licence area. Included in this area will be the newly proposed mining site (Offices, workshops, stores, etc.).

Table 1: Extent of the infrastructure associated with the TGME Theta Hill Project.

NAME	ENCLOSED AREA (Ha)	TOTAL LENGTH/ PERIMETER (Km)	HEIGHT metres above mean sea level (mamsl) / meters (m)
Access Road		6,98	
Balancing Dam	3,35		
Berms		10,44	
Browns Pit	17,45		1390 mamsl
Clean Water Channels		27,60	
Culverts	0,24		
Dirty Water Channel		52,24	
Haul Roads	9,54	9,60	
Iota Pit	25,53		1345 mamsl
Iota Pollution Control Dam	8,33		
Iota Waste Rock Dump North	45,88		1508 mamsl (210 m)
Iota Waste Rock Dump South	16,66		1375 mamsl (58 m)
Low Level River Crossing	0,49		
Mine Boundary		6,42	
Mine Contractor Area	1,82		
Outlet Structures	0,19		
Pipelines		3,39	
Powerline		2,35	
Silt Trap	0,04		
Spillway	0,30		
Stilling Basin	0,22		
Theta Pit 1	12,74		1395 mamsl

Theta Pit 2	6,29		1460 mamsl
Theta Satellite Pit 1	0,03		
Theta Satellite Pit 2	0,38		
Theta Satellite Pit 3	0,62		1460 mamsl
Topsoil Stockpile	12,82		3 m
Water Treatment Plant	0,21		
Whishbone Waste Rock Dump	23,14		208 m
Wishbone Pollution Control Dam	2,45		

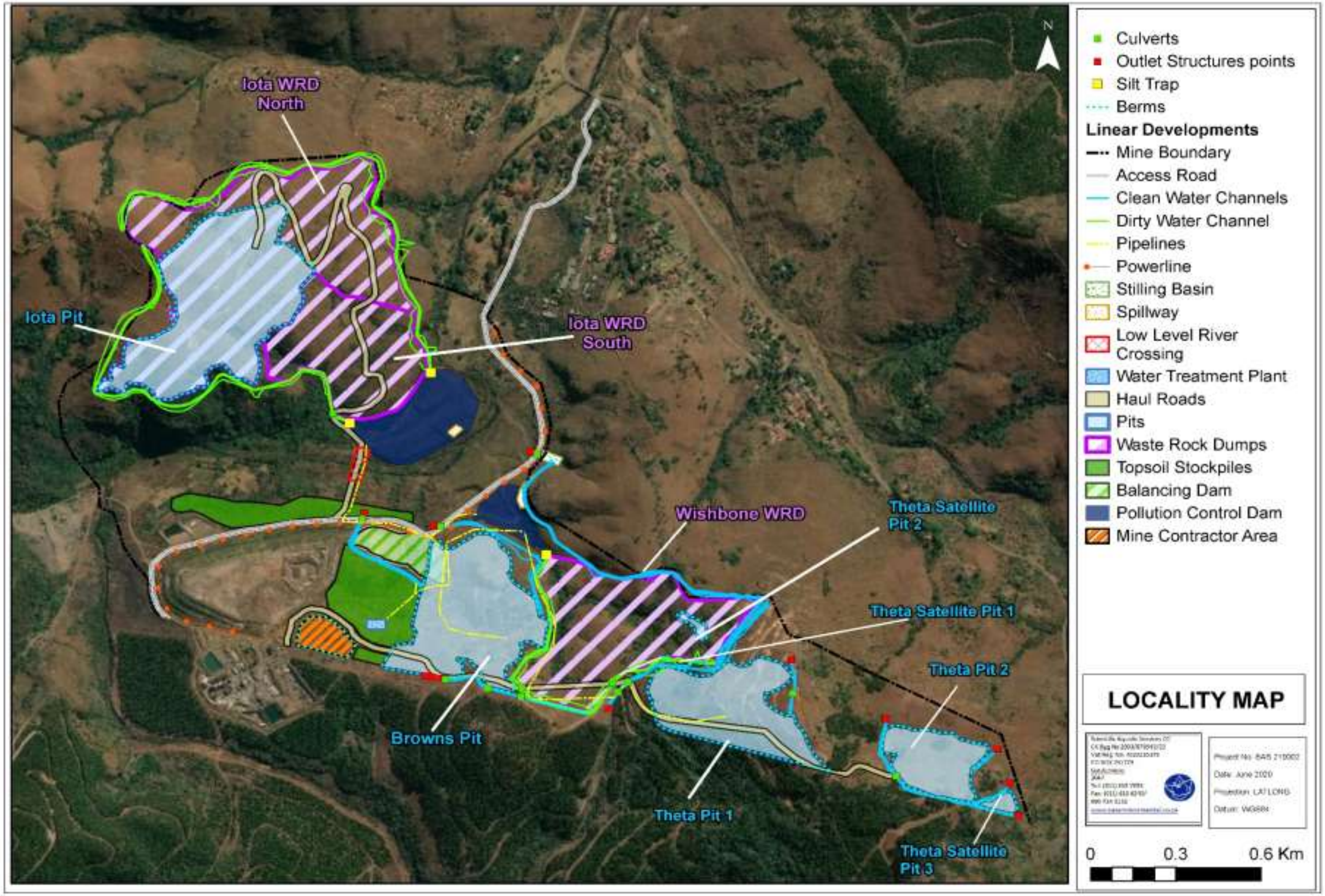


Figure 1: Digital satellite imagery depicting the locality of the proposed TGME Theta Mine in relation to the surrounding areas.

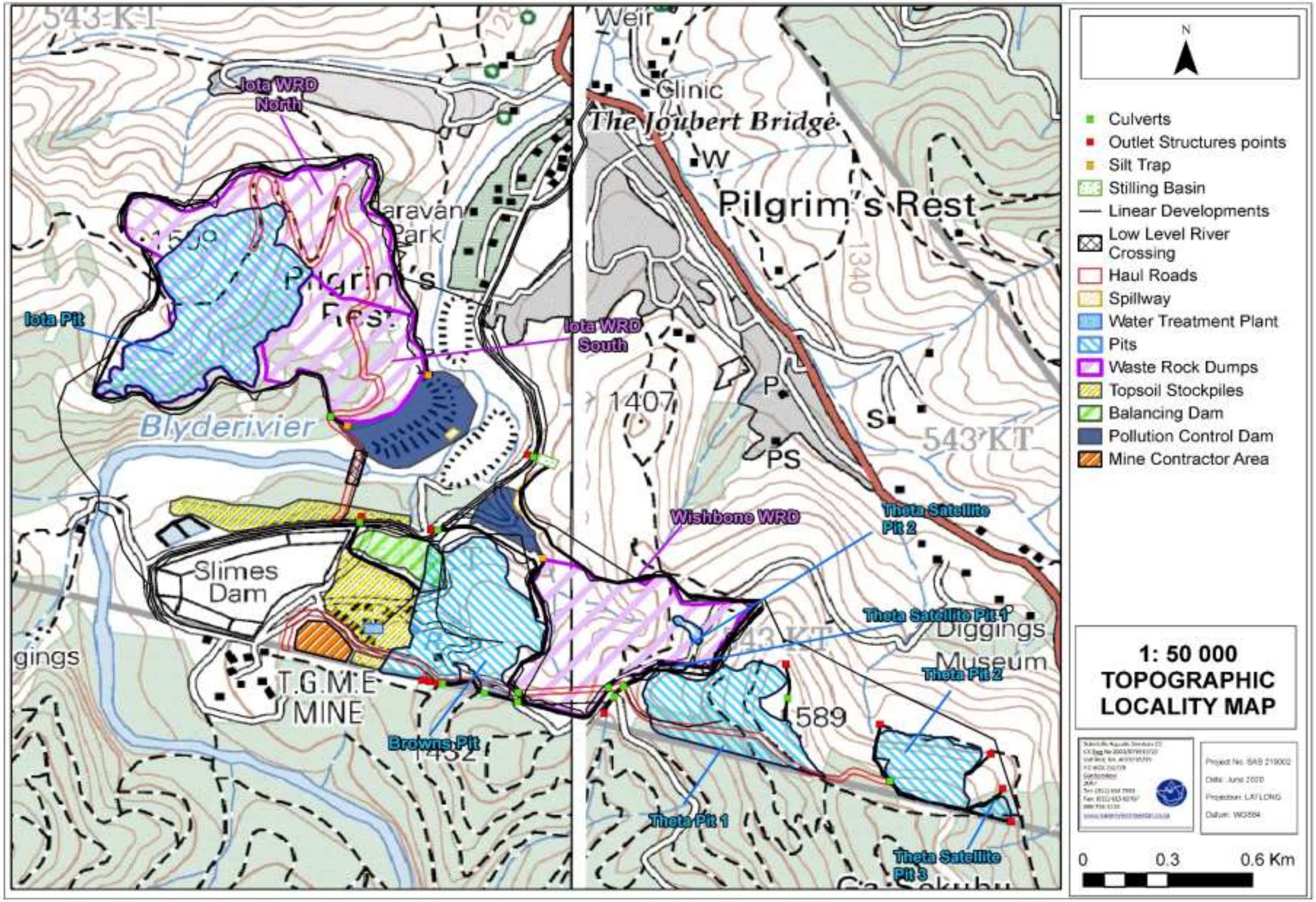


Figure 2: Location of the Focus Area depicted on a 1:50 000 topographical map in relation to surrounding area.

1.1.1 Proposed Mining Method

The mining method selected for this project is modified terrace mining because it is suited to the mountainous profile of the current topography. The mining method consists of continuous removal of overburden / waste material to expose ore. The mining method requires the removal of topsoil which will be stockpiled, to be utilised for rehabilitation purposes. The topsoil stockpile will also be utilised as a berm to divert the ingress of water and will be situated close to the mining area to enable short hauling for the rehabilitation of the backfilled areas. Topsoil will be removed as an ongoing process as the open pit progresses.

Due to the mountainous topography there is limited space available for Waste Rock Dumps (WRDs) on the project area. The planned mining strategy is to utilise space in the mined-out areas for backfilling of waste, this will ultimately reduce the WRD footprint.

Once mining has progressed, and enough area has been created in the pit, some overburden / waste material will be backfilled into this space.

1.1.2 Mining of Ore

The primary method of breaking rock on the project will be by means of Dozer ripping. Ripping is a method of loosening material by means of a pulling a ripper shank attached to the back of a tracked dozer through densely packed material. In areas where the planned dozer may not be capable of ripping the material an eccentric ripper will be used as the secondary method of breaking rock. Material requiring no breaking will be free dig and will be removed with a truck and shovel combination. Once material has been broken sufficiently via ripping the material will be loaded into dump trucks with excavators and hauled via dedicated haul roads to the Run of Mine (ROM) pad.

1.1.3 Mining of Waste

Waste material will be mined in a similar fashion to that of the ore. Broken waste - which will be achieved by nonexplosive breakage by ripping with a dozer or eccentric rippers - will be loaded onto haul trucks by an excavator and hauled to a waste storage facility keeping in mind the overall strategy remains to minimise the overall waste rock dump (WRD) footprint. During the early stages of mining there will be limited space available to backfill waste back into the pits and this material will have to be placed on a WRD.

1.1.4 General Information

The operational phase would require approximately 100 fulltime employees (at peak production) including contractors. Engineering and infrastructure for the mining project will include the establishment of a mining site to be utilised by the mining contractor including supporting infrastructure that will cater for the proper operation of the terrace mine. No project or mine housing is expected to be provided during construction and operational phases however this will depend on other housing availability in the area.

Material from the TGME Theta Project will be processed through the existing TGME plant and deposited onto the existing tailings dam. The TGME plant has operated in various phases since the mid 1980's and last produced gold in early 2015.

The operational phase for the mining activities is expected to run on a 7 day working week with a one shift system per day between 06:00 and 18:00, Monday to Sunday. It should be noted that there may be a requirement to run a 24 hour system and this will be considered as such in the impact assessment. The process plant will run on a 24 hours 7 days a week basis (TGME, 2019).

1.2 *Progression of site layouts from Environmental Scoping Phase to EIA Phase*

The site layouts changed throughout the course of this study from the Scoping Phase to the EIA Phase. Included in this section is a portrayal of the progression from an initial layout (Layout 1) through to the most resent "updated" Layout 3, which reflects a balanced layout of the project and takes into consideration the various environmental and economic drivers, amongst others.

The layout progression has, in the first instance, been significantly influenced by environmental considerations and thereafter engineering, economic and social considerations. These are described in detail in the subsequent sections.

1.2.1 Scoping Phase (Layout 1) - Engineering Feasibility Study

The applicant, TGME, through an engineering feasibility study, has identified the opportunity to mine gold bearing reefs via modified terrace mining and therefore the need to amend its current environmental authorisation linked to their existing mining right (MR83) to include the new mining sections to mine the near surface material. Three mining areas were identified based on exploration and evaluation work done within the study area. The three areas are referred to as the Theta Pit, Browns Pit and Iota Pit.

The engineering feasibility study formed the basis for the permitting phase, and informed the initial site layout (Figure 3) which was incorporated into the Environmental Authorisation application which comprises a Scoping Phase and an EIA Phase. These phases results in the develpoment of an Environmental Management Plan (EMP) for consideration by the competent authority, namely the Department of Mineral Resources and Energy (DMRE).

In terms of the placement of the related infrastructure, a few design or layout alternatives were initialy considered. Infrastructure included topsoil stockpiles, run-of mine ore stockpiles, WRDs, Pits and haul roads. The general mining site infrastructure included offices, change houses and laundry facilities, control room, first aid station, stores and laydown yard, salvage yard and waste sorting area, transformer substation, fuel storage facility, refuelling bay, wash bay, workshops, brake test ramp and parking areas. As part of the operational activities, two potential options were proposed for the locations of the associated WRDs at both Theta and Iota Hills. These are detailed in Figure 4 and briefly outlined below:

Theta/Browns Waste Rock Dump Option 1: This option is situated between both Browns and Theta Pit;

Theta/Browns Waste Rock Dump Option 2: Located to the north eastern side of Theta Pit, incorporates two smaller pockets separated by a tributary;

Iota Waste Rock Dump Option 1: Located to the north western corner of the Iota Pit; and

Iota Waste Rock Dump Option 2: Is located to the north eastern boundary of the Iota Pit.

These layouts were passed by the various specialists for consideration in their respective first round assessments. The engineering feasibility study informed the initial site layout plan, which was incorporated in the final scoping report (Layout 1) as submitted to the DMRE (dated 16 August 2019). The Scoping Report made provision for various biophysical and social studies which would determine the baseline conditions at the project site as well as make recommendations related to the feasibility of the proposed localities and alternatives as per the initial site layout plan.

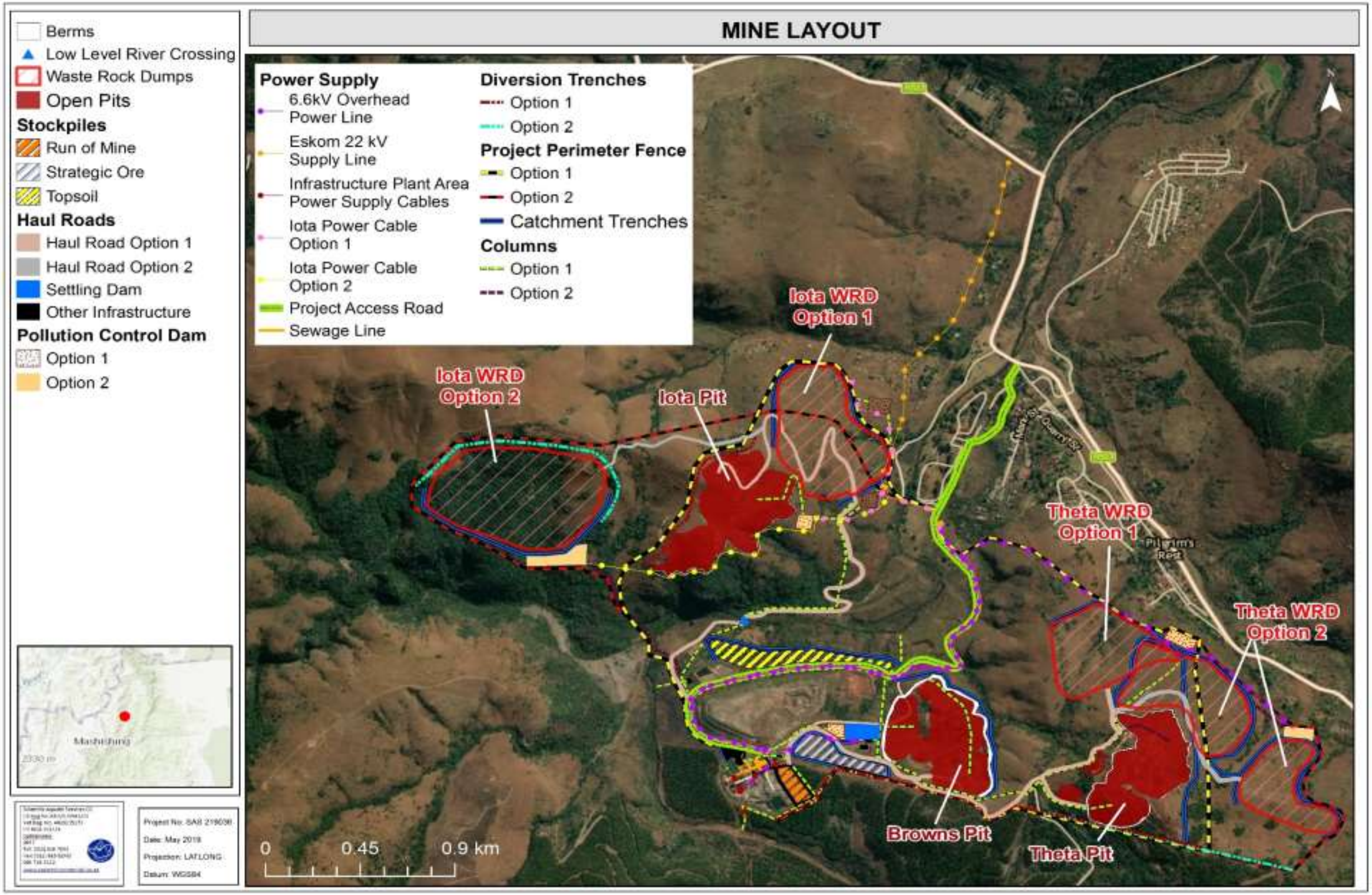


Figure 3: The initial proposed mine layout (Layout 1) for the TGME Theta Hill Project as part of the Scoping Phase.

1.2.2 Environmental Impact Assessment Phase (Layout 2)

Layout 2 indicated significant changes to the sizes of the various pits as well as changes to the locations of the WRDs which were all informed by biophysical and social specialist studies.

The plan of study proposed in the Scoping Report made provision for various biophysical and social studies which would determine the baseline conditions at the project site as well as make recommendations related to the feasibility of the proposed localities and alternatives as per the initial site layout plan. The outcome of these biophysical and social studies was used to inform Layout 2 (draft EIA phase mining layout), as is common practice in Integrated Environmental Management[1] (IEM). Environmental and social management practices are based on following the precautionary principle, which, simply defined, means developing actions on issues considered to be uncertain, for instance applied in assessing risk management.

Several biophysical and social baseline studies were conducted, including terrestrial ecology (fauna and flora), soils and land capability, air quality, noise and vibration, visual impact, socio-economic and health impact, water quality, heritage and rehabilitation objectives. These studies returned substantial environmental and social sensitivities and nuances.

The process of the EIA, within which the above-mentioned studies were undertaken, is inhibited in its ability to assess year-round baseline conditions due to the legislated timeframes imposed by South African law and regulation. In these instances, which is typical of EIA processes, the Environmental Assessment Practitioner (EAP) imposes the precautionary approach by informing the site layout plan from an environmental and social perspective to assist the applicant to achieve the most feasible site layout plan. Based on the outcome of these studies, a reduction in the pit shell sizes, the relocation of the WRDs and re-consideration of the PCD requirements resulted. The most significant changes made to Layout 2 include the following:

- Revised pit layouts, with the Theta Pit being affected most;
- Modification to WRD location to minimise potential environmental impact – here the concept and location of the Wishbone WRD is significant;
- Reduction in the number of PCDs to be constructed; and
- Optimisation of the overall project footprint.

[1] IEM is a philosophy that is concerned with finding the right balance between development and the environment. The difference between IEM and an EIA is that IEM is a whole philosophy whereas EIA is just one tool or technique used to gather and analyse environmental information that is a part of the IEM process (Source: Enviropaedia).

In the case of the TGME Theta Hill Project, the application of the precautionary approach resulted in an alteration of the site layout plan as initially presented in the Scoping Report (Layout 1). The altered site layout plan was achieved through the implementation of the following mitigation hierarchy:

1. Avoid the potential impact altogether;
2. Minimise the area of the potential impact as far as possible;
3. Rehabilitate and restore the affected area; and
4. Secure a biodiversity offset area as compensation for the affected area.

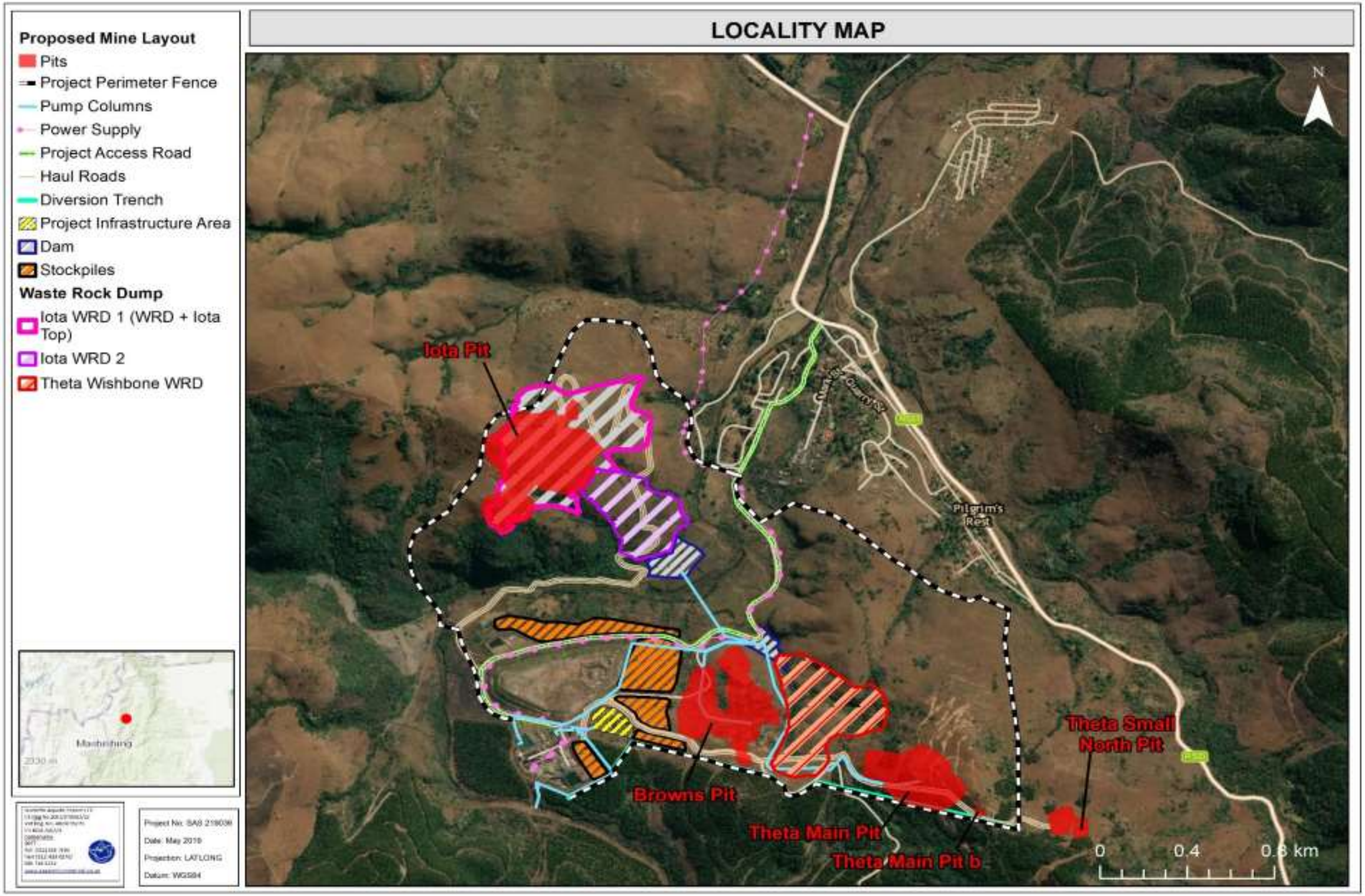


Figure 4: The revised site layout plan (Layout 2) which formed part of the draft EIA Phase for of the proposed TGME Theta Hill Project.

1.2.3 Environmental Impact Assessment Phase Draft (Layout 3)

Following the submission of Layout 2, further detailed design work was completed on the WRDs and PCDs as part of the existing water use licence application, to ensure that the structures would be stable and able to maximise successful concurrent rehabilitation outcomes. As part of this process, various stability and geotechnical activities were carried out which informed the designs. The design engineers were asked to adapt their designs to avoid various high biodiversity areas within the WRD footprints. The further studies included:

- **Structural design engineer assessments**: Mining area footprints had to change to ensure stable structures for the WRDs and PCDs;
- **Ecological Assessment**: Due to the change in the mining footprint, an additional site visit was required to assess the sensitive areas. This has led to the change in the mine layout plan to avoid areas of high value such as the protea stand located near the Wishbone WRD. Additional details on the various ecological site visits are presented in the Floral and Faunal Assessments (STS, 2020); and
- **Mining Engineers study**: Additional engineer studies were required to improve mining resource utilisation.

During the same period, TGME recognised that significant changes in the global market had resulted due to the COVID-19 pandemic. These changes have the potential to impact on the Applicant's project due to, among others, an increase in the gold price and the downgrade of the South African economy to junk status.

To respond to the expected changes in the global economic environment, TGME completed a re-evaluation of the TGME Theta Hill Project (i.e. MR83) with a view to improving the economic metrics of the project to further enhance the attractiveness to potential funders. This has resulted in a new mine schedule being developed which has changed the sequence of the pits being mined and has also resulted in the pits being made slightly larger to bring in more gold bearing material while still taking cognisance of the environmental conditions in the area.

The EIA/EMPr provides a detailed description of the amended layout plan referred to as **Layout 3** (Figure 5). This layout was identified by TGME as the only feasible alternative, which addressed both the environmental sensitivities and the global economic environment.

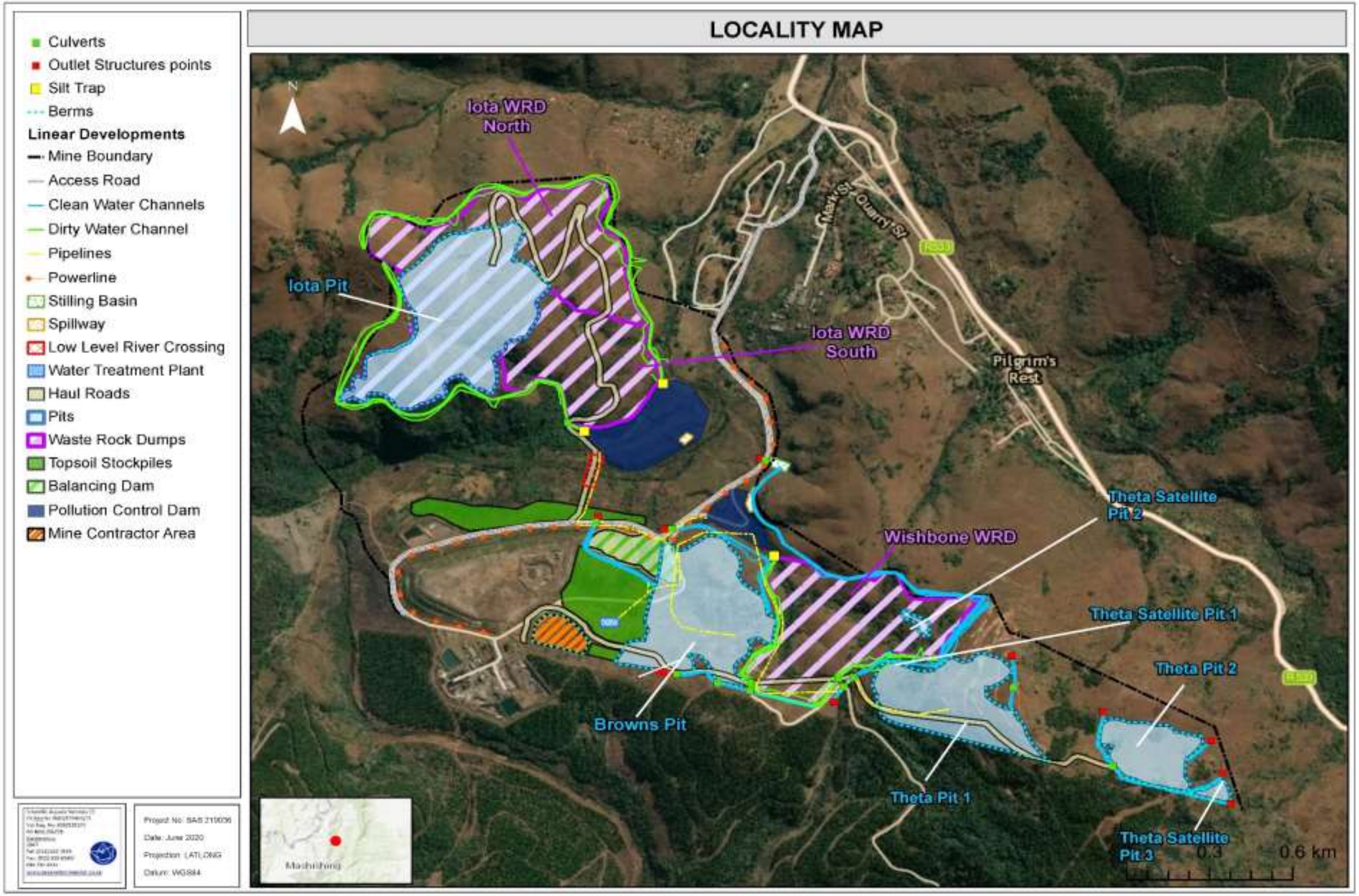


Figure 5: The revised site layout plan (Layout 3) which will be incorporated into the EIA Report and EMP for the proposed TGME Theta Hill Project.

1.3 *Terms of Reference and Scope of Work*

The EIA phase of the soil, land use and land capability assessment entailed the following aspects:

- A desktop review of existing land type maps, to establish broad baseline conditions and areas of environmental sensitivity and sensitive agricultural areas;
- Assess spatial distribution of various soil types within the Focus Area;
- Identify restrictive soil properties on land capability under prevailing conditions;
- Compile various maps depicting the on-site conditions, soil types and land capability based on desktop review of existing data;
- A soil classification survey has been conducted within the Focus Area;
- Subsurface soil observations and sampling undertaken by means of a manual bucket hand auger;
- Classify the dominant soil types according to the South African Soil Classification System (Soil Classification Working Group, 2018);
- Compile a report presenting the results of the desktop study and a description of the findings during the field assessment; and
- Provide recommended mitigation measures and management practices to implement in order to comply with applicable articles of legislation.

1.4 *Assumptions and Limitations*

For the purpose of this assessment, the following assumptions and limitations are applicable:

- The soil survey conducted as part of the land capability assessment was confined within the Focus Area, which is considered adequate for the purpose of this investigation;
- Sampling by definition means that not all areas are assessed, and therefore some aspects of soil and land capability may have been overlooked in this assessment. However, it is the opinion of the specialist that this assessment was carried out with sufficient sampling and in sufficient detail to enable the proponent, the Environmental Assessment Practitioner (EAP) and the regulating authorities to make an informed decision regarding the proposed mining activities;
- Land Capability was classified according to current soil restrictions, with respect to prevailing climatic conditions on site; however, it is virtually impossible to achieve 100% purity in soil mapping, the delineated soil map units could include other soil type(s) as the boundaries between the mapped soils are not absolute but rather form a continuum and gradually change from one type to another. Soil mapping and the findings of this

assessment were therefore inferred from extrapolations from individual observation points;

- Since soils occur in a continuum with infinite variances, it is often problematic to classify any given soils as one form, or another. For this reason, the classifications presented in this report are based on the "best fit" to the soil classification system of South Africa;
- Soil chemical analyses sampling was undertaken from optimal points within the Focus Area to allow for the best utilisable baseline soil chemistry data; and
- Soil fertility status was not considered a limitation, seeing as inherent nutrient deficiencies and/or toxicities would be rectified by appropriate liming and/or fertilization during rehabilitation phase.

2. METHOD OF ASSESSMENT

2.1 *Literature and Database Review*

A background study including a literature review was conducted prior to commencement of the field assessment. This is done in order to gather the pre-determined soil and land capability data within the Focus Area. The different data sources that are listed under reverences were used for the assessment, including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources.

2.2 *Soil Classification and Sampling*

- A soil survey was conducted in March 2019 by a qualified soil specialist at which time the identified soils within the proposed infrastructure areas were classified into soil forms according to the South African Soil Classification System (Soil Classification Working Group, 2018);
- Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses;
- A Global Positioning System (GPS) was used to record assessed survey and sampling points;
- It was also the objective of the assessment to provide recommended mitigation measures and management practices to implement in order to comply with applicable articles of legislation; and
- Representative soil samples were retrieved from the identified sampling points in the vicinity of the Focus Area. The retrieved soil samples were then submitted to an accredited laboratory (WaterLab Laboratories) for quantitative analysis to assess the chemical composition of these soils.

Table 2: Typical Arrangement of Master Horizons in Soil Profile

<table>
<tr><td rowspan="6">Soil</td><td rowspan="6">Zone in which soil processes are maximally expressed</td><th colspan="5">Arrangement of master horizons</th></tr>
<tr><td rowspan="5">O - Organic</td><td rowspan="3">C- Regic sand (c), Stratified alluvium, (c), Man -Made Soil Deposits</td><td rowspan="2">A</td><td colspan="2">Peat, Organic, Vertic, Melanic, Humic, Orthic</td></tr>
<tr><td colspan="2">E</td></tr>
<tr><td>B</td><td>Red Apedal, yellow Brown Apedal, Soft Plinthic, Hard Plinthic, Prismacutanic, Pedocutanic, Lithocutanic, Neocutanic, Neocarbonate, Podzol, Podzol with placic pan</td><td rowspan="3">G - Horizon</td></tr>
<tr><td>C</td><td colspan="2">Dorbank, Soft Carbonate horizon, Hard Carbonate horizon, Saprolite, Unconsolidated without signs of wetness, Unconsolidated with signs of wetness, Unspecified material with signs of wetness</td></tr>
<tr><td colspan="3">R-Hard Rock</td></tr>
</table>

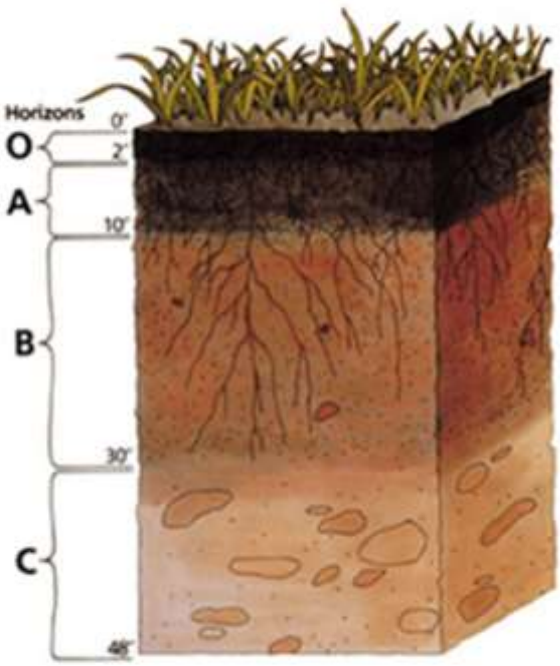


Figure 6: Schematic diagram depicting a conceptual presentation of a typical soil profile

2.3 Laboratory Soil Sample Analysis

Representative samples were sent to an SANAS accredited laboratory for selected soil chemical analyses. The chemical analyses included the following selected constituents and contaminants of potential concern:

- pH;
- Electrical conductivity (EC);
- Alkalinity;
- Anions; and
- heavy metals.

2.4 Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table 3 below; with Classes I to III classified as high potential agricultural land that is well suitable for annual cultivated crops. Whereas, Class IV soils may be cultivated under certain circumstances and management practices, whereas Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of 1 to 8, as illustrated in Table 4 below. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The anticipated impacts of the proposed land use on soil and land capability were assessed in order to inform the necessary mitigation measures.

Table 3: Land Capability Classification (Scotney et al., 1987)

Land Capability Group	Land Capability Class	Increased intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	Water course and land with wetness limitations
	VI	W	F	LG	MG	-	-	-	-	-	Limitations preclude cultivation. Suitable for perennial vegetation
	VII	W	F	LG	-	-	-	-	-	-	Very severe limitations. Suitable only for natural vegetation
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

W - Wildlife F - Forestry LG - Light grazing
MG – Moderate grazing IG - Intensive grazing LC - Light cultivation
MC - Moderate cultivation IC - Intensive cultivation. VIC – Very intensive cultivation

Table 4: Climate Capability Classification (Scotney et al., 1987)

Climate Capability Class	Limitation Rating	Description
C1	None to slight	Local climate is favourable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for good yield for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.
C3	Slight to moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.
C5	Moderate to severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops for which frequently experience yield loss.
C7	Severe to very severe	Severely restricted choice of crops due to heat, cold and/or moisture stress.
C8	Very severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.

3. LEGISLATIVE REQUIREMENTS

The following legislative requirements were taken into consideration during the assessment. A detailed description of these legislative requirements is presented in Appendix C:

- National Environmental Management Act, (Act 107 of 1998) (NEMA);
- National Environmental Management: Waste Act (Act 59 of 2008);
- Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA); and
- Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA).

4. DESKTOP ASSESSMENT RESULTS

The following data is applicable to the Focus Area, according to various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS)

- The majority of the Focus Area receives a Mean Annual Precipitation (MAP) ranging between 801 and 1000mm per annum; while the eastern portion is estimated to receive more than 1000mm per annum, as illustrated in Figure 5 below;
- According to the Geology 2001 layer, the majority of the Focus Area is underlain by Dolomite rock formations while the remaining portions (west and east) are underlain by Shale rock formation (Figure 6 below);

- The SOTER database indicates that the entire of the Focus Area comprised of the Rhodic Acrisols;
- According to the Soils 2001 database, the majority of the Focus Area is situated within an area where soils are classified to be oxidic soils (red-yellow apedal, freely drained soil, dystrophic and/ or mesotrophic. The average soil depth of these soil varies between 450mm - 750mm or more, refer Figure to 7;
- According to Soils 2001, these soils within the Focus Area are susceptible to water erosion to certain degrees varying with topography, which can be categorised into three classes, refer to Figure 8;
- The desktop assessment indicates that the majority of the Focus Area is suited for grazing land use (Class VI), whereas the central portion of the Focus Area is considered arable with some limitations such as erosion hazards (Class III), refer to Figure 9 below;
- According to the AGIS database, the livestock grazing capacity potential is estimated to be approximately 3.5 hectares per large animal unit (Morgenthal *et al.*, 2005); and
- The natural soil pH for the majority of the Focus Area is estimated to range between 0.5 and 5. While the eastern portion the Focus Area natural soil pH is estimated to range between 5.5 and 6.4, indicating that the soils are anticipated to be acidic to neutral, as interpolated from topsoil pH values obtained from the National Soil Profile Database (AGIS database), as illustrated in Figure 10 below.

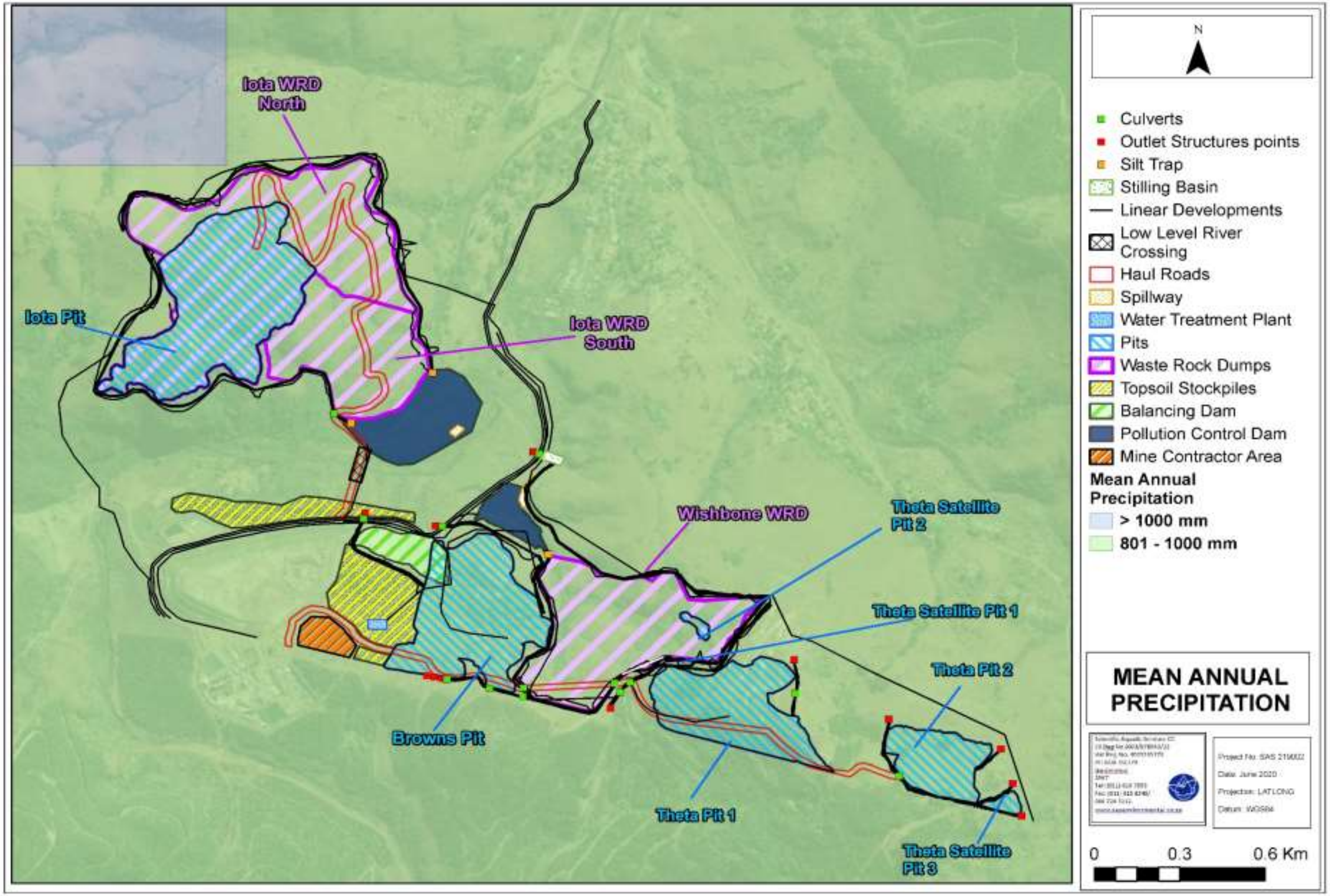


Figure 7: Mean annual precipitation associated with the TGME Theta Project Area.

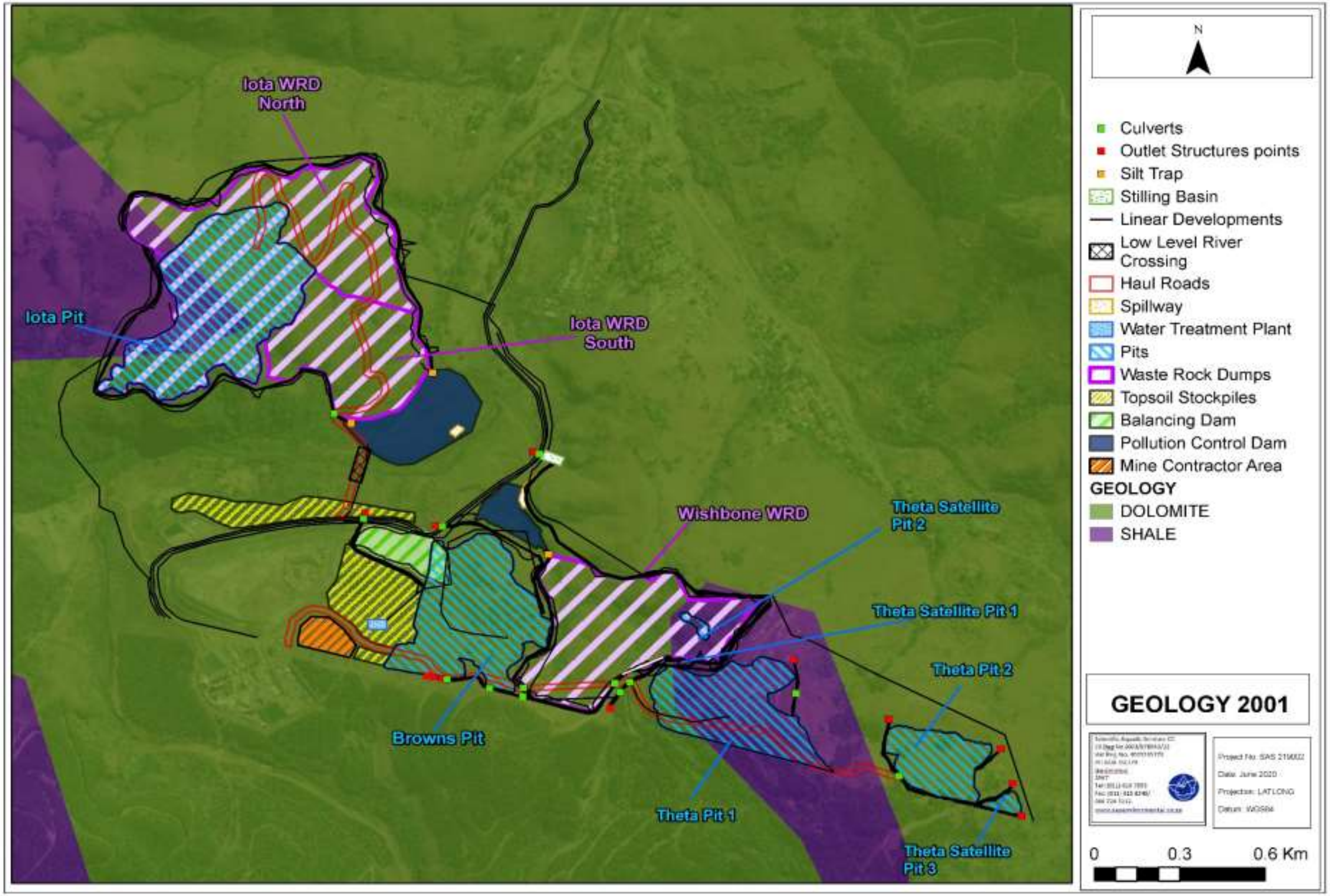


Figure 8: Geology (2001) associated with the TGME Theta Project Area.

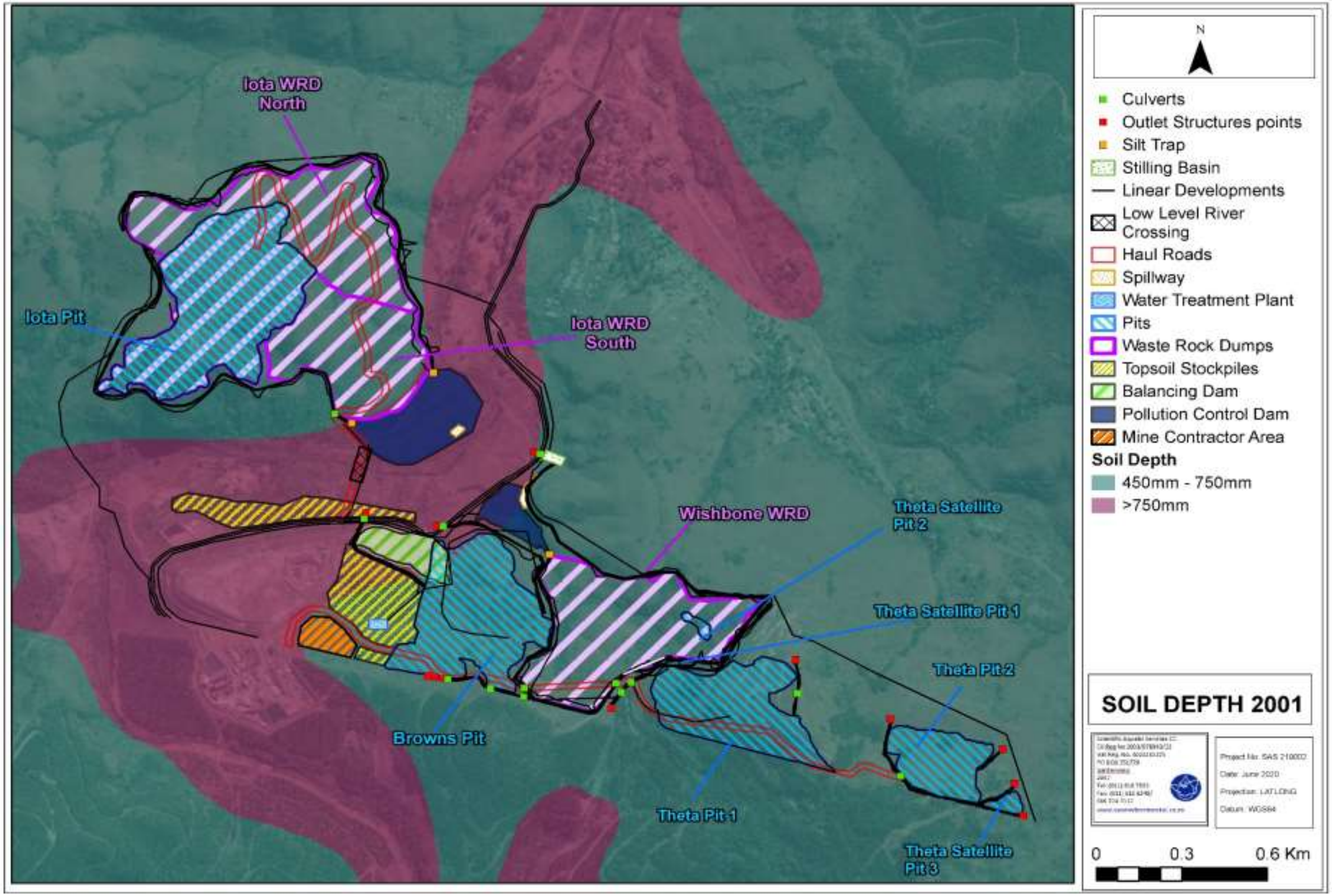


Figure 9: Soil depth (2001) associated with the TGME Theta Project Area.

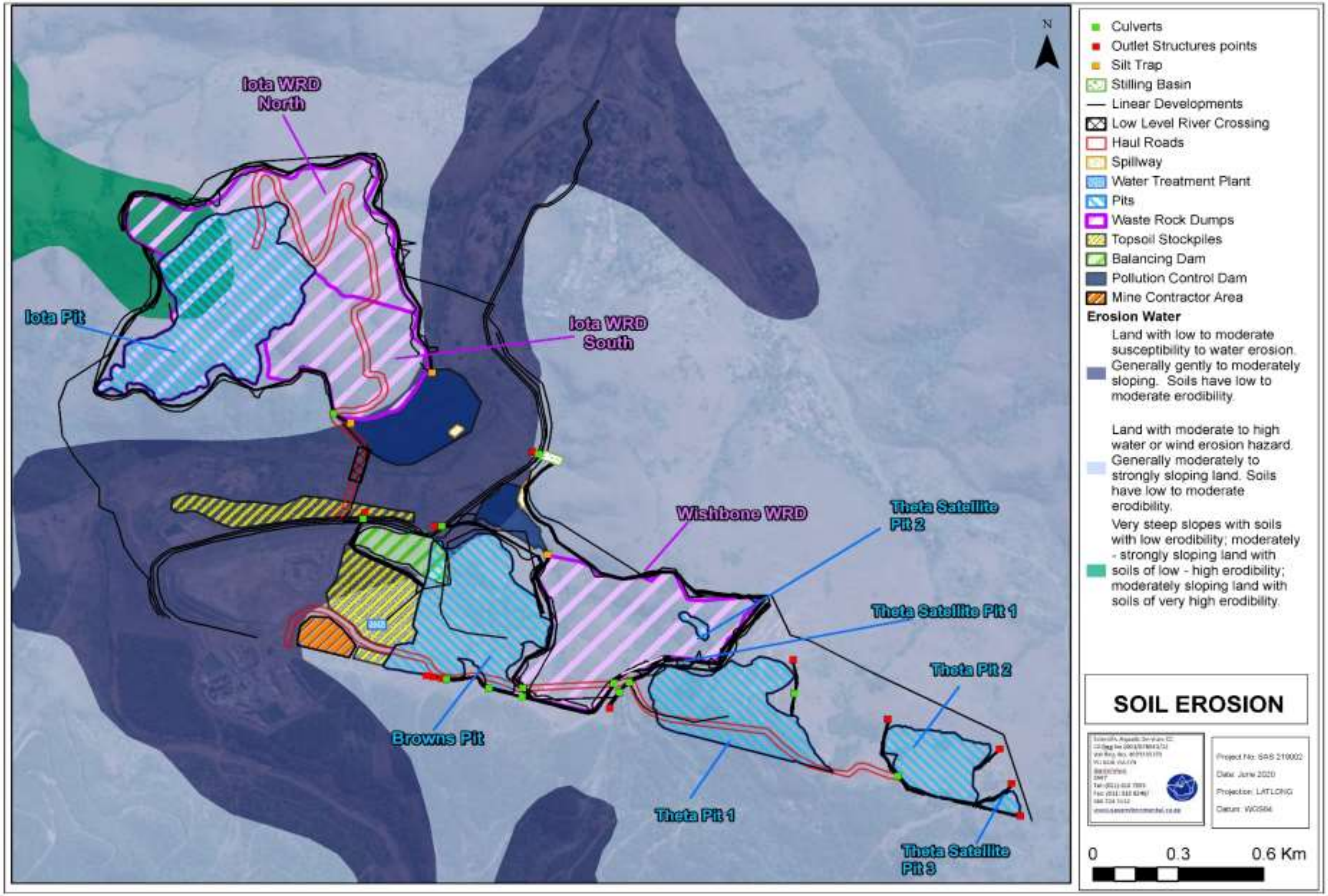


Figure 10: Soil susceptibility to water erosion within the TGME Theta Project Area.

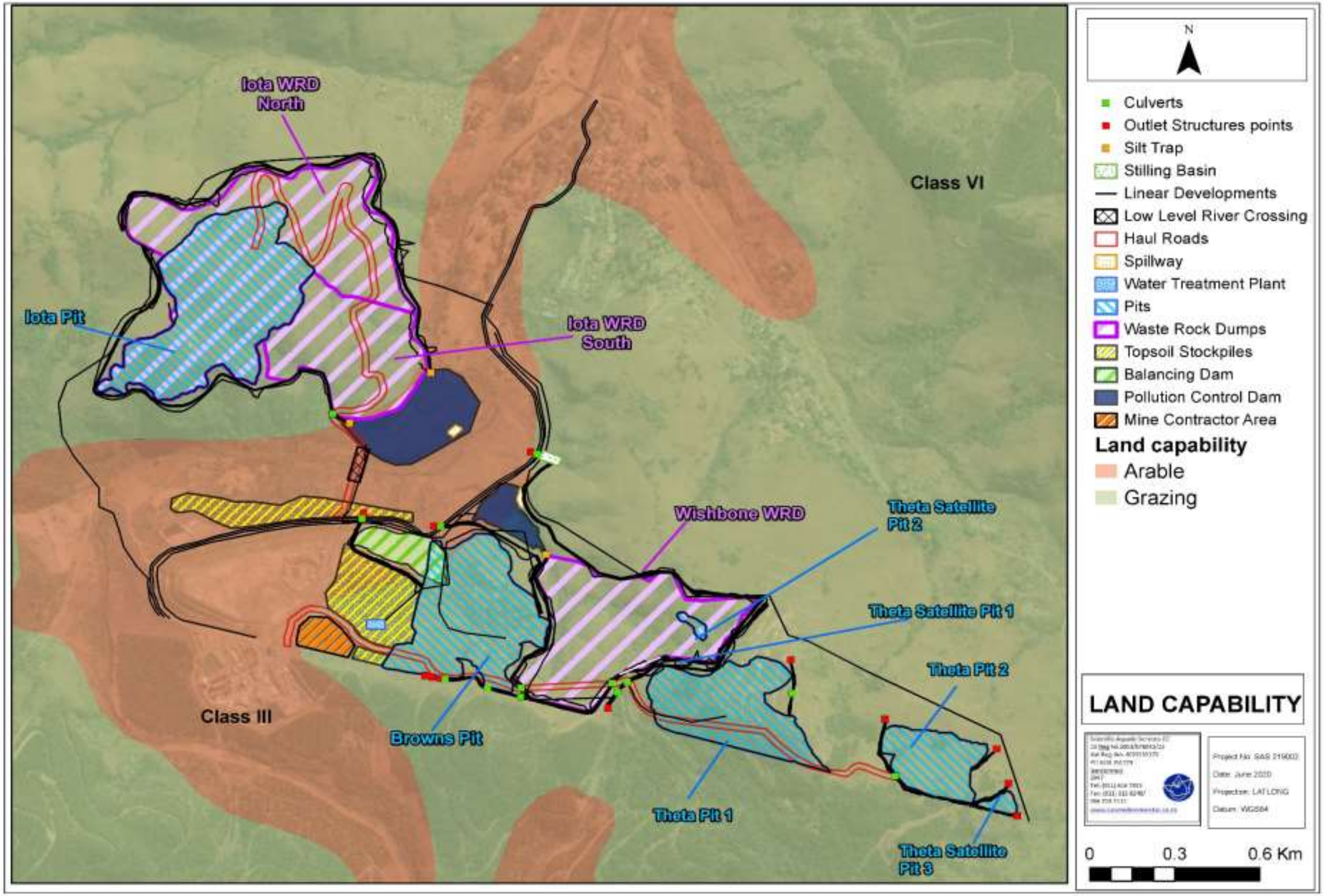


Figure 11: Land capability associated with the TGME Theta Project Area.

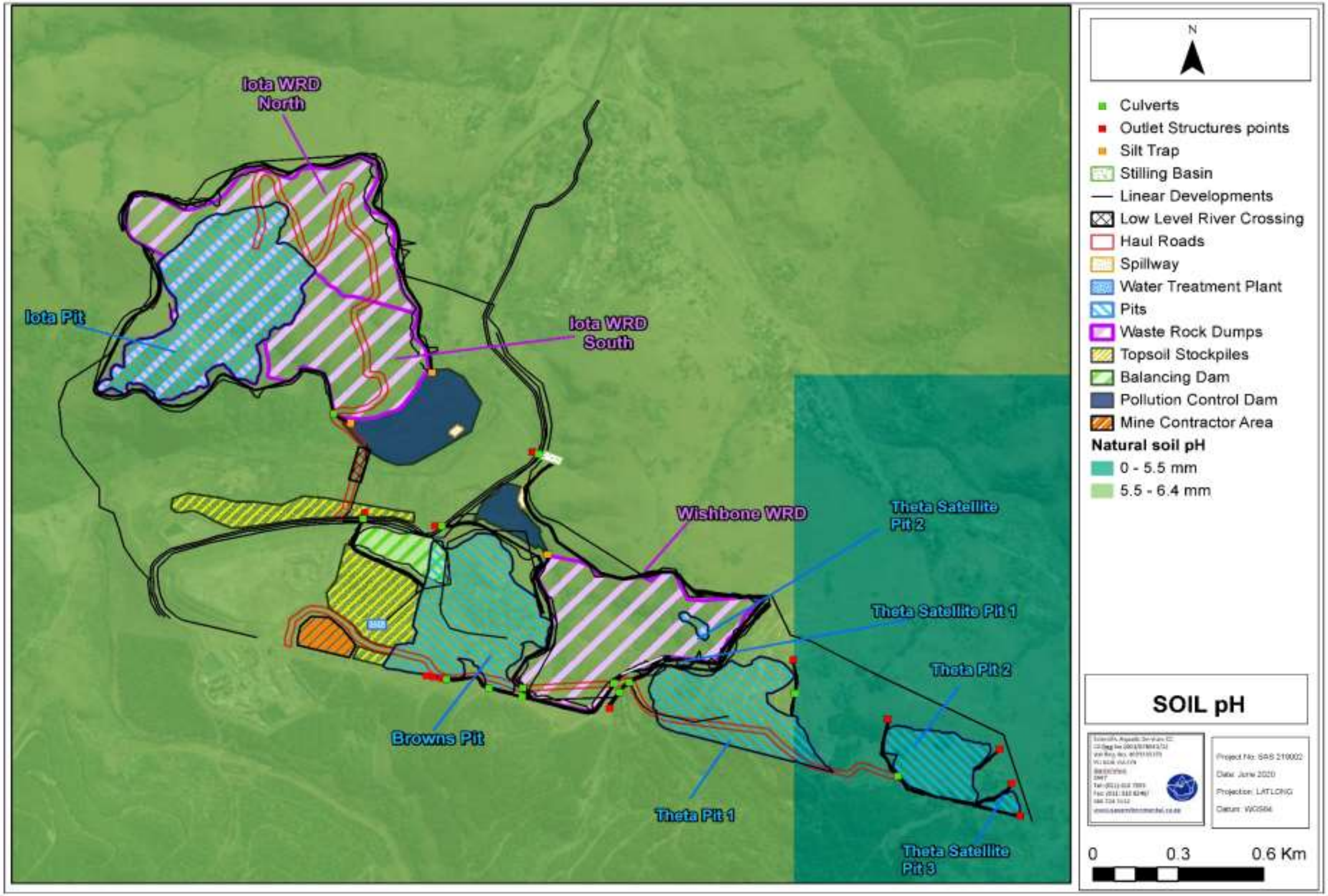


Figure 12: Soil pH associated with the TGME Theta Project Area.

5. FIELD ASSESSMENT RESULTS

5.1 *Current Land Use*

Current land use activities associated with the Focus Area and surrounding areas are largely dominated by wilderness, forestry, grazing, residential and mining operations. No commercial agricultural activities were observed to be occurring within the Focus Area and the immediate surrounding areas. Refer to land use map on Figure 13 and 14.

Figure 13: Photographic presentation of the dominant land uses within the Focus Area

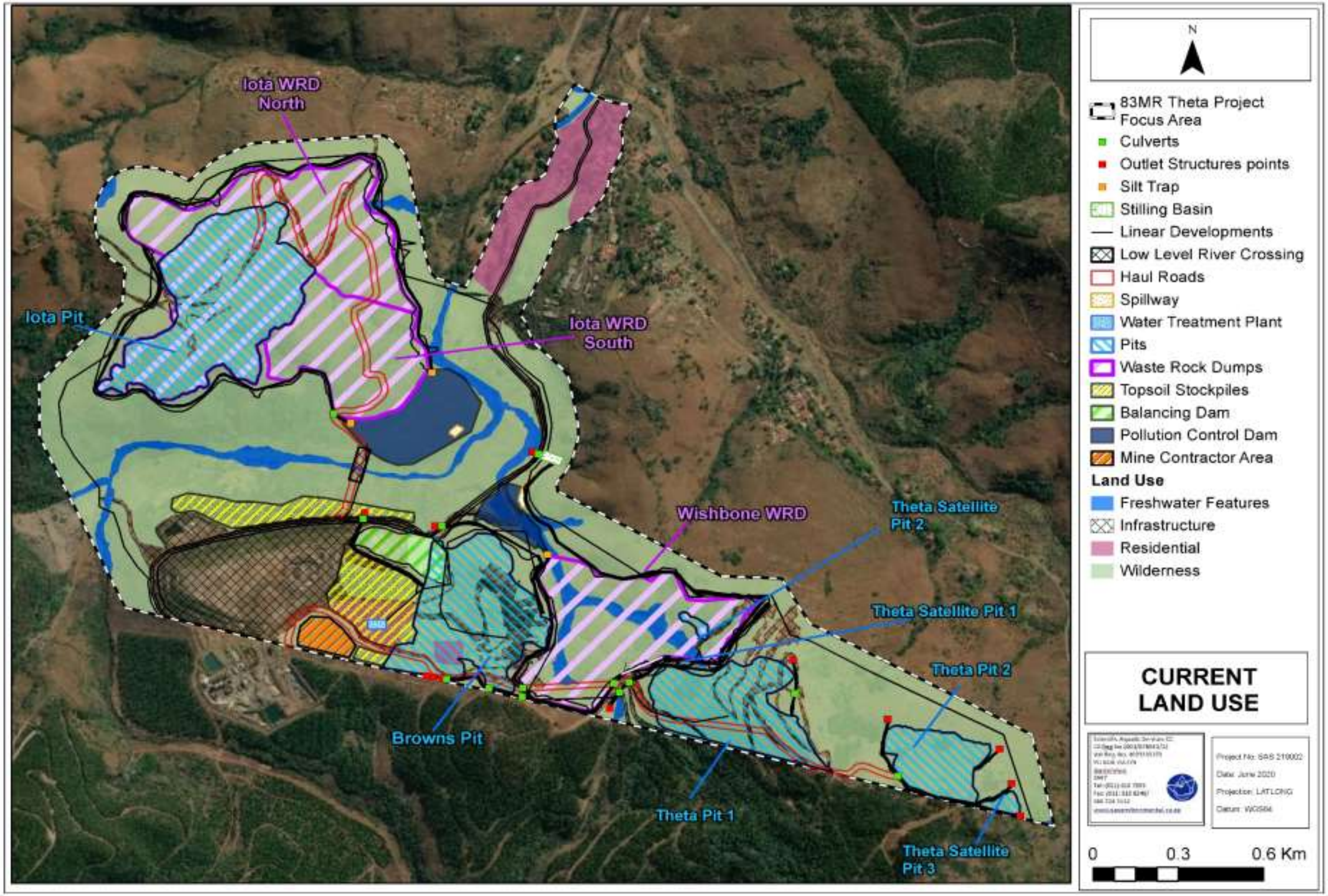


Figure 14: Map depicting land use within the TGME Theta Project Area.

5.2 *Dominant Soil Types*

The Focus Area resembles a Lithic and Anthropic catena, with Mispah/Glenrosa and Witbank (Anthrosols) being the dominant soil forms within the total surveyed area Lithic soils such as Mispah/Glenrosa, are regarded as shallow soils, attributed to their shallow pedogenic and effective depth. These soils constitute of approximately 72.7% of the total Focus Area, whilst Witbank (Anthrosols) soils occupy approximately 2.69% of the total investigated Focus Area. The shallow nature of the dominant soil forms can be largely attributed to limited rock weathering or rejuvenation through natural erosion on steeper, convex slopes. Witbank soils have been extensively disturbed such that no recognisable diagnostic soil morphological characteristics could be identified, corresponding to Anthrosols in the international soil classification terminology. The remainder of the Focus Area comprised of Dundee (Alluvial soils) which occupy approximately 3.47%, and residential areas, mining and associated structures (i.e. mine plant complex, WRD, office areas, roads) which collectively occupy approximately 21.14% of the total investigated area. The spatial distribution of all identified soil forms within the Focus Area is presented in soil map in Figure **14** below. **Table 5** below presents the dominant soil forms and their respective diagnostic horizon sequence.

Table 5: Dominant soil forms occurring within the Focus Area

Soil Form	Code	Diagnostic Horizon Sequence
Dundee	Du	Orthic/Alluvial (thick)
Mispah	Ms	Orthic/ hard Rock
Glenrosa	Gs	Orthic/ Lithic
Witbank	Wb	Unspecified

***Infrastructural areas were not included in the table above since they not considered in the land capability ratings**

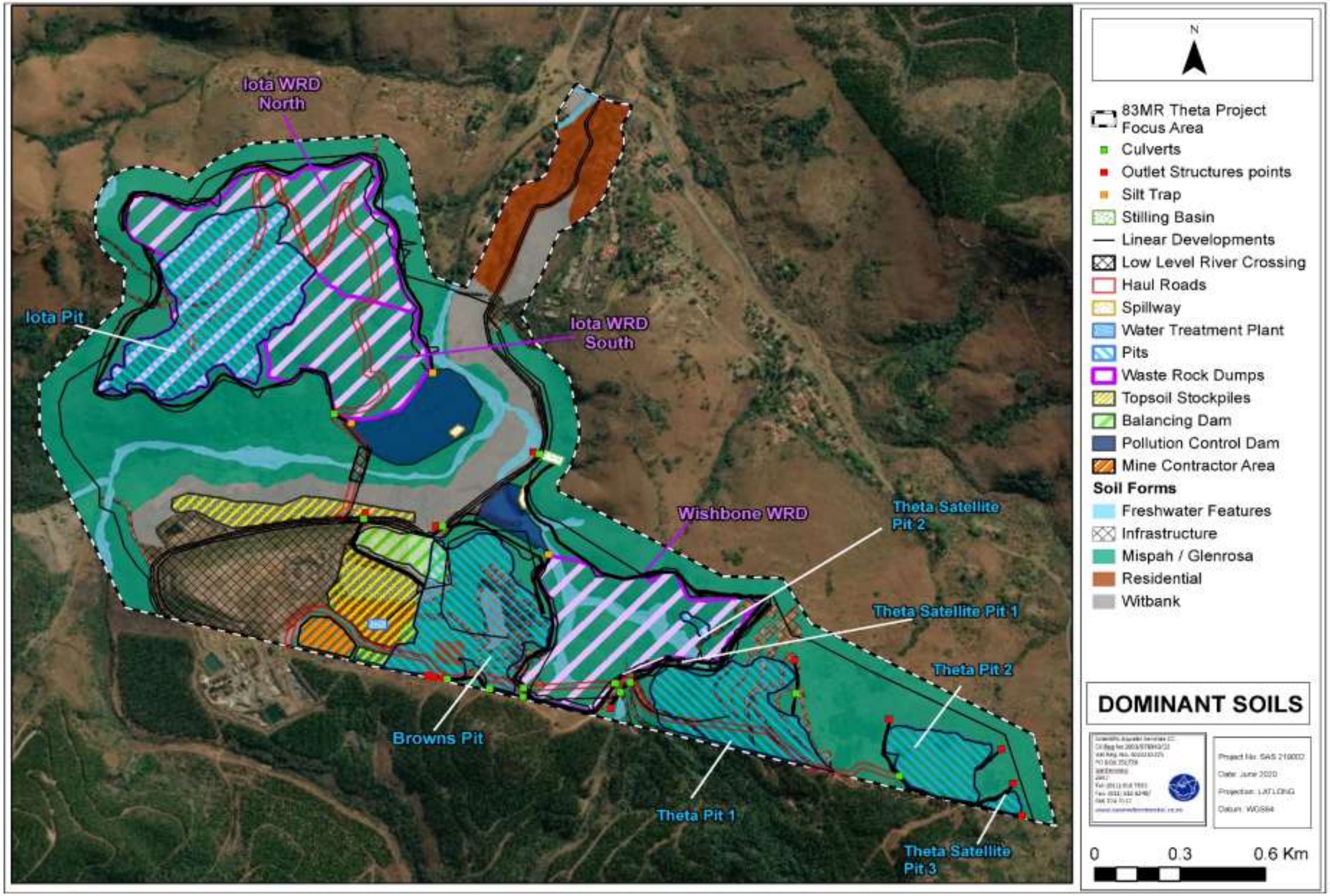


Figure 15: Soil map depicting identified soil forms associated with the mine infrastructure

5.3 *Land Capability Classification*

In South Africa, agricultural land capability is usually restricted by climatic conditions, with specific mention to water availability (Rainfall). Even within similar climatic zones, different soil types typically have different land use capabilities attributed to their inherent characteristics. High potential agricultural land is defined as having the soil and terrain quality, growing season and adequate available moisture supply needed to produce sustained economically high crops yields when treated and managed according to best possible farming practices (Scotney et al., 1987). For this assessment, land capability was inferred in consideration of observed limitations to land use due to physical soil properties and prevailing climatic conditions. Climate Capability (measured on a scale of 1 to 8) was therefore considered in the agricultural potential classification.

The Focus Area falls into Climate Capability Class 1, with local climate that is favourable for good yield for a wide range of adapted crops throughout the year. The identified soils were classified into land capability classes using the Scotney *et. Al*. Land Capability Classification system (Scotney et al., 1987), as presented in **Figure 15**. The identified land capability limitations for the identified soils are discussed in comprehensive "dashboard style" summary tables presented from Tables 7 to 9 below. The dashboard reports aim to present all the pertinent information in a concise and visually appealing fashion. **Table 6** below presents the dominant soil forms and their respective diagnostic horizon sequence.

Table 6: Land capability classes for the soils occurring within the Focus Area

Soil Form	Land Capability	Areal Extent (ha)	Percentage (%)
Dundee	Grazing (Class V)	16.23	5.67
Mispah	Grazing (Class VII)	237.06	82.82
Glenrosa			
Witbank	Wildlife (Class VIII)	32.94	11.51
TOTAL	**286.23**		**100.00***

***Infrastructural areas (21.14%) were not included in the table above since they not considered in the land capability ratings**

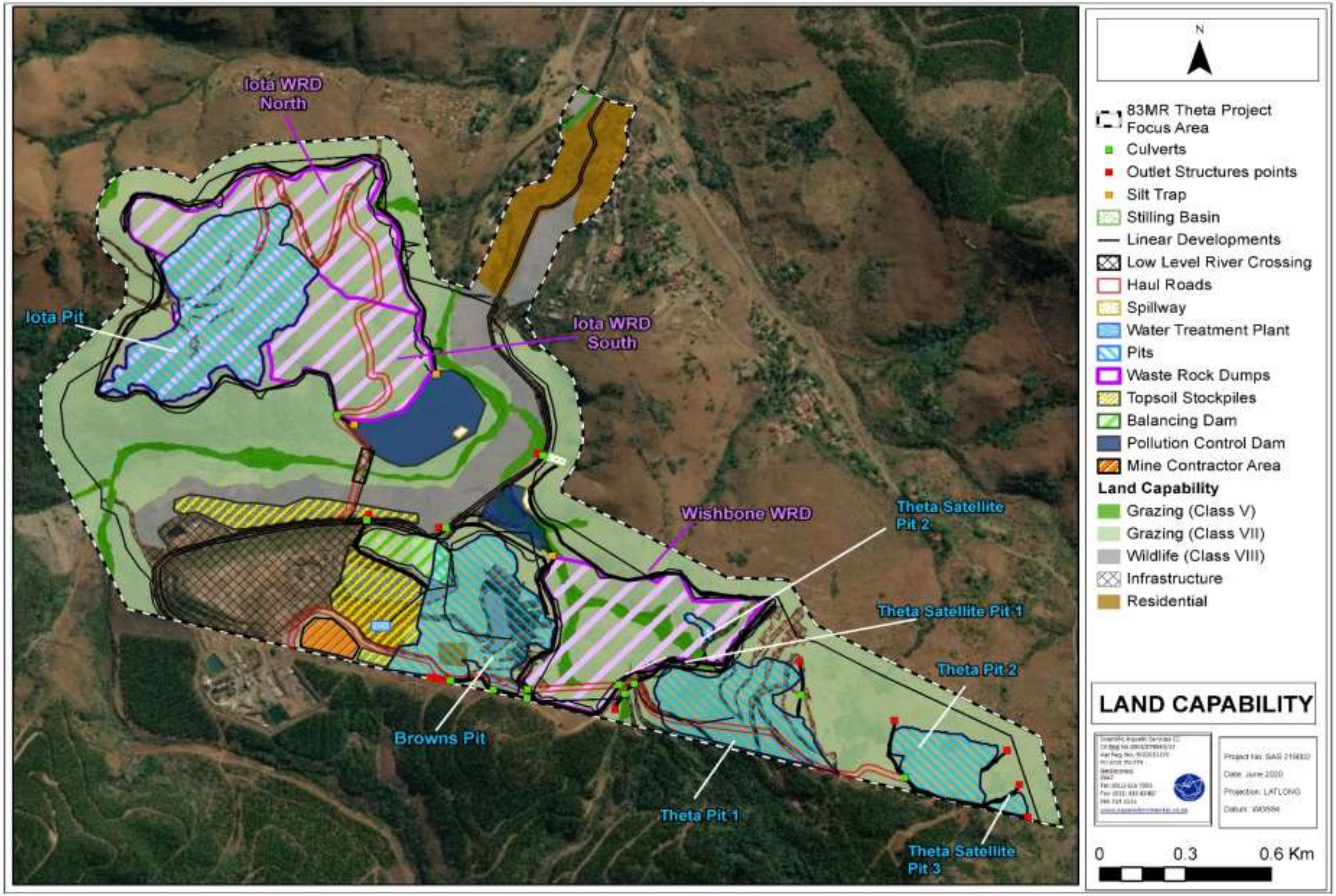


Figure 16: Map depicting land capability classes of soils within the Focus Area

Table 7: Summary discussion of the Grazing (Class V) land capability class

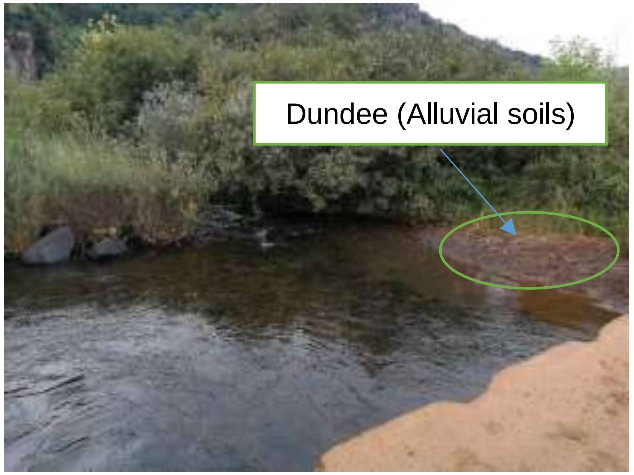
<table>
<tr><td colspan="3">Land Capability: Grazing - Class V</td><td colspan="2" rowspan="2"></td></tr>
<tr><td colspan="3">Occurrence within the Focus Area
View of the watercourses where Dundee soils were encountered.
</td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>Valley bottoms and gently landscapes of < 0.5% slope gradient</td><td>Photograph notes</td><td>View of the identified Dundee (Alluvial soils)</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Dundee</td><td>Area Extent</td><td>16.23 ha which constitutes 5.67% of the total Focus Area</td></tr>
<tr><td colspan="2">Diagnostic Horizon Sequence</td><td>Orthic/ Alluvial (thick)</td><td colspan="2" rowspan="2">Land Capability
These soils were classified as class V land capability due to land use limitations related to their occurrence within a water course. These soils are not considered to contribute significantly to local, provincial and/or national agricultural productivity</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>These soils are not ideal for cultivation due to their occurrence within watercourses. Furthermore, the lack of soil structure and nutrients disqualifies these soils from commercial agriculture.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed mining activities on the land capability of these soils is anticipated to be relatively low due to their inherently poor land capability. On the contrary, the ecological functionality of these soils as an essential medium for supporting freshwater habitats is considered highly significant, and, the recommendations and management measures of the freshwater resource's assessment should be considered and implemented.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
Although not considered to be of significant agricultural productivity, these soils are however considered to be of significant value as part of the freshwater habitats, and as such the recommendations and management measures of the freshwater resource assessment report conducted as part of the EIA and WULA process take precedence.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 8: Summary discussion of the Grazing (Class VII) land capability class

<table>
<tr><td colspan="3">Land Capability: Grazing - Class VII</td><td colspan="2" rowspan="2"> </td></tr>
<tr><td colspan="3">Occurrence within the Focus Area
</td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>Very Steep landscape</td><td>Photograph notes</td><td>View of the morphology of the identified Mispah/Glenrosa soil forms</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Mispah/Glenrosa</td><td>Area Extent</td><td>237.06 ha which constitutes 82.82% of the total Focus Area</td></tr>
<tr><td colspan="2">Diagnostic Horizon Sequence</td><td>0-35 cm: Orthic A
≥ 35 cm: Hard rock/Lithic</td><td colspan="2" rowspan="2">Land Capability
The identified Mispah/Glenrosa soil forms are considered to be of poor (Class VII) land capability and are not suitable for arable agricultural land use. Theses soils are, at best, suitable for natural pastures for light grazing. Therefore, these soils are not considered to make a substantial contribution to extensive subsistence farming on a local scale.</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>Shallow effective rooting depth is the primary limitation of the land capability of the Mispah/Glenrosa soil forms, which is due to the occurrence of a rocky layer at relatively shallow depth, which hinders penetration of plant roots.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed mining activities on the land capability of these soils is anticipated to be Medium Low (ML) due to the limited potential grazing opportunities. These soils are however not ideal for cultivated agriculture due to their low yield contribution to regional and provincial agricultural production</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
The identified soil forms are, at best, suited for grazing and/or wilderness practices. This is due to the relatively shallow parent rock and lithocutanic material. The impact of the proposed mining activities on the land capability of these soils is anticipated to be low after mitigation. Although these soils are not considered prime agricultural soils, these soils are important for potential grazing opportunities. Therefore, implementation of rehabilitation and the proposed integrated mitigation measures is recommended to reinstate the natural topography of the area post mining.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 9: Summary discussion of the Wildlife/Wilderness (Class VIII) land capability class

Land Capability: Wildlife/Wilderness - Class VIII			
Occurrence within the Focus Area These soils were observed within the Focus Area (Anthrosols) 		 	
Terrain Morphological Unit (TMU)	Not applicable; highly disturbed areas	**Photograph notes**	View of the identified Witbank soil forms
Soil Form(s)	Witbank (Anthrosols)	**Area Extent**	32.94 ha; which constitutes 11.51% of the total Focus Area
Diagnostic Horizon Sequence	Not applicable; highly disturbed soils	**Land Capability** These identified Witbank soils have very poor (class VIII) land capability attributed to forestry and mining activities. In addition, some of these soils have been subjected to long term compaction and erosion. This land capability class also includes areas where the original soil has been buried and/or extensively modified by anthropogenic activities. These soils are not considered to make a significant contribution to agricultural productivity even on a local scale.	
Physical Limitations	Comprises of significantly disturbed areas due to anthropogenic activities to an extent that no recognisable diagnostic soil horizon properties could be identified. These soils are characterised by various limitations, primarily the absence of soil as a growth medium.		
Overall impact significance prior to mitigation	**L** — The overall impact of the proposed development on the land capability of these soils is anticipated to be low due to their very poor land capability.	**Business case, Conclusion and Mitigation Requirements:** The current state of these soils requires significant rehabilitation already. These areas can be rehabilitated holistically at closure of the surrounding mines.	
Overall impact significance post mitigation	**L**		

6. CHEMICAL CHARACTERISTICS OF SOIL

While soil functionality cannot be directly measured, physico-chemical parameters such as pH and Electrical Conductivity (EC) are sensitive to disturbance and responsive to management practices. These parameters can be used as indicators of the response of the soil, and ecosystem to current (and/or former) management practices. Soil pH measurement is useful since it is a predictor of various chemical activities within the soil. Depending on the applied techniques and level of monitoring, the soil chemistry is likely to change during mining activities. Impacts will mostly depend upon the severity, and the type of contaminants introduced to the soils within the vicinity of the Focus Area. Potential impacts include:

- Soil quality deterioration;
- Soil contamination; and
- Introduction of toxicants to soil.

The chemical soil analyses indicate that the soil pH ranges between 3.7 and 5.3, whereas, the electrical conductivity (EC) ranges between 2.6 and 6.1 mS/m. The pH value of the soil samples fell outside of the optimum pH range (6.5 < pH <7.2) and based on the indicated pH levels, these soils are considered acidic. Typically, acidic soils have low agricultural potential due to the unavailability of essential plant nutrients for plant uptake within this pH range. It should be noted that the pH levels presented above are representative of natural pH levels of soils occurring within the vicinity of the Focus Area with the soil samples taken in areas currently unaffected by mining.

The EC is a measure of the amount of soluble salts in the soil solution. However, there is no formally derived guideline value for EC, however an arbitrary threshold value of 80 to 120 mS/m is commonly used for contamination assessment. The laboratory analysis indicates that EC levels of all samples were below the recommend range of 80 to 120 mS/m. The majority of the plants can thrive under these conditions, except those that are highly sensitive to elevated salt concentrations in soils.

Should the pH and EC status of these soils deviate from the current recorded values prior to commencement of rehabilitation phase, this will imply that the proposed mining activities have had an influence on the chemical status of soils occurring within the vicinity of the Focus Area. It should be noted that the chemical analysis results presented on this report on the Appendix B. must be regarded as the baseline soil chemical status of soil continuum within the Focus Area.

6.1 Macronutrients Analysis

For this baseline soil chemical investigation, only essential macro and trace elements were selected for analysis. Micronutrients are required by a plant for growth, and the amount needed is small in comparison to macronutrients (N, P, K). However, deficiency of a micronutrient can be just as yield limiting as the deficiency of a macronutrient. From this analysis selected essential major elements include N (Nitrogen) S (Sulphur) and K, (Potassium). The current concentrations of these macronutrients (N, S and K) are provided in Appendix B and they should be used as the reference state of soil chemistry during the rehabilitation phase for the proposed mining project. The soil pH influences the availability of these elements for plant uptake. When the soil pH is at its optimum scale ($6.5 < pH < 7.2$) make them to be in a soluble and exchangeable form. However, the soils occurring within the Focus Area are acidic soils subsequently availability of the macronutrients for plant uptake at this pH is limited.

6.2 Toxicants Analysis

The soil toxicant analysis was conducted with an aim of quantifying the concentration of the toxicant elements within the soil continuum in vicinity of the Focus Area. The toxicant of interest for this study is cyanide (CN). The concentration of CN on soil samples collected within the vicinity of the Focus Area, ranges from <0.08 to 0.12 mg/kg and a detailed result of CN on each soil samples are presented on the appendix B of this report. The low concentration of CN within the soil samples are attributed to the acidic condition. The presence of high concentrations of cyanide (CN) in soil is considered toxic and may cause environment and human health hazards. The behaviour of cyanide in soil is largely governed by the solubility of the CN containing compounds, which are relatively insoluble under acidic conditions. Since the acidic soils are occurring within the Focus Area, it can be assumed that the CN containing compound is insoluble under this acidic condition.

Uranium (U) is one of the heavy metals which were tested on soil samples collected within the vicinity of the Focus Area. Uranium is a toxic heavy metal which is naturally occurring radioactive element that is present in most of geological formations (rocks) and the soil continuum. Uranium (U) may be redistributed in the environment by both natural and anthropogenic processes, which includes mining related activities such as improper disposal of uranium rich mine tailings, processing of uranium containing ores or uranium end products and production of phosphate fertilizers for which the phosphorus is extracted from phosphate rock containing uranium. The soil controlling factors for mobility of uranium include oxidation-reduced potential, pH and sorbing characteristics of soil particles. Soil properties may increase the mobility of and plant accumulation of uranium include acidic soils with low adsorptive potential, soils with carbonates mineral and the presence of the critic acid. The toxicity limit of U concentration in soils ranges from 3 to 4 mg/kg. Consequently, the concentration of U within the soil was found to be relatively low (<0.004 mg/kg) for all chemical tested soil samples.

Toxicity of iron (Fe) in soil continuum is mainly attributed to poorly drained valley bottom often with lateral seepages and/ or upwelling Fe containing water, coastal saline soils, peat soils acidic sulphate soils and other hydromorphic soils. The intensity of Fe toxicity varies with pH, organic carbon, water table level and also the nutrients status. According to Suresh (2005) the critical limit of Fe toxicity in soil medium ranges from 125-300 mg/kg. Therefor the soil occurring within the vicinity of the Focus Area are not likely to lead to iron toxicity at this point in time as the chemical concentrations ranges from 0.212 to 19 mg/kg.

7. IMPACT ASSESSMENT AND MITIGATION MEASURES

The Focus Area is predominantly used for mining, residential and wildlife/wilderness with no active crop cultivation due to soil constraints, attributable to the shallow nature of the dominant surrounding soils. As the Focus Area is predominantly comprised of low potential agricultural soils, low impact is foreseen on these soils from a land capability point of view after mitigation measures have been carefully implemented during all phases of development. The dominant soils have little bearing on agricultural productivity, with limited contribution to the local, regional, provincial as well as national food production. However, their protection, where feasible is deemed imperative to ensure that the area remains functional post closure. The impact is anticipated to be very low in areas where soils have been anthropogenically transformed since these soils are not regarded as important for cultivated agricultural production as their genic character has been largely destroyed. Thus, these soils could not be assigned to neither arable nor grazing land capability classes. Hereafter the impact assessment will be conducted in a combined fashion for both proposed mining options within the Focus Area.

Mining Activities

The potential impact triggers at various phases of the proposed mining operation are presented in Table 10 below.

Table 10: Summary of the anticipated Activities for the proposed mining operation

Phase	Activities
Construction	- Land and footprint clearing; - Topsoil stripping and stockpiling; - Establishment of surface infrastructure; and - Waste Management
Operational	- Operation of Met Grade Product Stockpile; - Operation and use of Diesel Storage and Supply; - Implementation of Opencast Operation and Concurrent Rehabilitation; - Transportation (Load out area, roads); - Operation of infrastructure and roads; and - Waste Management
Closure	- Rehabilitation of Opencast pits - Dismantling and decommissioning of infrastructure and buildings, including product stockpiles; - Earth moving, shaping and ripping of ground; - Waste Management; and - Revegetation of disturbed areas.

7.1.1 Impact: soil erosion

Parameters determining the extent and severity of soil erosion are highly complex, with water and wind as the main geomorphic agents, and soil erosion is largely dependent on land use and soil management and is generally accelerated by human activities such as tillage practices and vegetation cover disturbances such as overgrazing.

The Focus Area is characterised by steep and gradual slopes in areas comprised of shallow soils. The mining activities will be located among the mountainous setting and thus the risk of erosion is considered moderately high. The natural and undisturbed soils will become more vulnerable to erosion once the vegetation is cleared for construction activities, and the soils will inevitably be exposed to wind and some surface runoff during intensive rainfall events. The significance of this impact is anticipated to be moderate and can be reduced to a moderately low impact if mitigation measures outlined in this document are adhered to, as illustrated on the impact rating table below.

Table 11: Aspects and activities register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential poor planning leading to excessive placement of infrastructure outside of the demarcated infrastructure areas.	Site clearing, removal of vegetation, and associated disturbances to soils, leading to, increased runoff, erosion and consequent sedimentation of down gradient receiving environment, and loss of land capability in cleared areas.	Constant disturbances of soils, resulting in reduced soil quality and land capability, and risk of erosion, attributed to mining activities.	Disturbance of soils as part of demolition activities as well as backfilling, which may lead to further loosening of soil in undisturbed areas and the formation of Witbank soils (Anthrosols) which reduce long term land capability.
Potential poor planning and control mechanisms leading to excessive vegetation clearance within infrastructure areas	Stockpiling of topsoil material on sloping areas leading to increased runoff and erosion.	Ineffective rehabilitation may lead to terrestrial habitat transformation, which will ultimately lead to lower soil quality	Decommissioning activities may lead to habitat transformation and increased alien plant species proliferation, and potential changing the nutrient status of the soils.
	Potential frequent movement of equipment/machinery within lose and exposed soils, leading to excessive erosion	Ongoing soil erosion and sedimentation of freshwater resources downgradient.	Ineffective rehabilitation may lead to further habitat transformation and increased alien vegetation encroachment, which will lead to further loosening of the soil and subsequent erosion
			Shortage of adequate volumes of topsoil is anticipated to be challenge during the rehabilitation phase as result of shallow (effective and pedogenic depth) of soils dominating the Focus Area.

Table 12: Impact assessment results for the mining operation, which include, site preparation, for Opencast mining operation and construction of mining related infrastructure.

Unmanaged							
Phase	Status of Impact	Extent of Impact	Duration of Impact	Probability	Intensity of Impact	Magnitude of Impact	Significance
Construction	-1	1	2	3	-3	-9	Medium
Operational	-1	1	2	3	-3	-9	Medium
Decommissioning and Closure	-1	1	2	3	-3	-9	Medium
Managed							
Construction	-1	1	1	2	-1	-5	Low
Operational	-1	1	1	2	-1	-5	Low
Decommissioning and Closure	-1	1	1	2	-1	-5	Low

7.1.2 Impact: Soil compaction

Heavy equipment traffic during construction and mining operation activities is anticipated to cause soil compaction. The severity of this impact is anticipated to be low as Alluvial soils (Dundee) contain minimal clay. Soils with a relatively shallow bedrock and lithocutanic character (partly weathered rock material) such as the Glenrosa/Mispah soil forms are anticipated to be less at risk due to the resistance offered by the underlying bedrock.

Table 13: Soil compaction Aspects and activities register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential poor planning leading to excessive or unnecessary placement of infrastructure, laydown areas on compaction prone soil resources.	Movement/placement of equipment/machinery within the soils occurring with the Focus Area are associated with minimal to low of compaction potential.	Ongoing disturbances to soils, resulting from mining and related activities, leading to some soil compaction and subsequent impact on soil structure.	Disturbance of soils as part of demolition activities and backfilling.
		Ineffective rehabilitation may lead to significant soil transformation leading to lower infiltration rate, and consequently increased surface runoff.	Decommissioning activities may lead to further soil compaction and increased runoff.
		Further movement of construction equipment/machinery leading to some soil compaction.	Ineffective rehabilitation may lead to significant soil transformation leading to lower infiltration rate, and consequently increased surface runoff and reduced land capability.

Table 14: Impact assessment results for the mining operation, which include, site preparation, for Opencast mining operation and construction of mining related infrastructure.

Unmanaged							
Phase	Status of Impact	Extent of Impact	Duration of Impact	Probability	Intensity of Impact	Magnitude of Impact	Significance
Construction	-1	1	1	2	-1	-5	Low
Operational	-1	1	1	2	-1	-5	Low
Decommissioning and Closure	-1	1	1	2	-1	-5	Low
Managed							
Construction	-1	1	1	2	-1	-5	Low
Operational	-1	1	1	2	-1	-5	Low
Decommissioning and Closure	-1	1	1	2	-1	-5	Low

7.1.3 Impact: Potential Soil Contamination

All the identified soils are considered equally predisposed to potential contamination (i.e. hydrocarbons), as contamination sources are generally unpredictable and often occur as incidental spills or leak for construction developments. The significance of soil contamination is considered to be medium-high for all identified soils, largely depending on the nature, volume and/or concentration of the contaminant of concern. Therefore, strict contamination (i.e. accidental spill and leakages) and waste management protocols and activity specific Environmental Management Programme (EMP) guidelines should be adhered to during the construction activities.

Table 15: Potential soil contamination Aspects and activities register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential inadequate design of infrastructure leading to risks of contamination of soils and freshwater due to seepages and runoff.	Spillage of petroleum hydrocarbons during construction of new facilities	Ongoing disturbances to soils, resulting in increased leaching of soil nutrients and risk of erosion, attributed to mining activities.	Contamination of soils during demolition activities and backfilling.
	Soil contamination through leakages of hydrocarbons resulting from constructing machinery	Seepage and runoff from mining infrastructure (e.g. overburden stockpiles and tailings dams) to the surrounding soils.	Decommissioning activities may lead to soil transformation and increased alien plant species proliferation, which will ultimately alter the
	Potential indiscriminate disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits	Increased seepage and potential increase in concentrations of contaminant concentration in the soil.	Potential contamination from the decommissioning of mining infrastructure.

Pre-Construction	Construction	Operational	Decommissioning and Closure
			Ineffective rehabilitation may lead to decant which can affect soil chemistry

Table 16: Impact assessment results for the mining operation, which include, site preparation, for Opencast mining operation and construction of mining related infrastructure.

Unmanaged							
Phase	Status of Impact	Extent of Impact	Duration of Impact	Probability	Intensity of Impact	Magnitude of Impact	Significance
Construction	-1	1	2	3	-3	-9	Medium
Operational	-1	1	2	3	-3	-9	Medium
Decommissioning and Closure	-1	1	2	3	-3	-9	Medium
Managed							
Construction	-1	1	1	2	-1	-5	Low
Operational	-1	1	1	2	-1	-5	Low
Decommissioning and Closure	-1	1	1	2	-1	-5	Low

7.1.4 Impact: Loss of Agricultural Land Capability

The proposed mining and related infrastructure are not anticipated to result in a significant loss of agricultural land capability since the majority of the soils where mining and associated infrastructure is to occur are shallow and disturbed in some instances. These soils are therefore not considered to contribute to the provincial and national agricultural production grid. Although this may be the case, rehabilitation is deemed necessary. The land capability loss is anticipated to be low for Mispah and Glenrosa as these soils are not considered ideal for cultivation, attributable to their shallow nature and high erosion hazard. From a land capability perspective, Witbank (Anthrosols) soils have no bearing on agricultural production, and as such the impacts on these soils is anticipated to be low.

Table 17: Loss of agricultural land capability Aspects and activities register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential inadequate design of infrastructure leading to risks of contamination of soils due to seepages and runoff.	Site clearing, the removal of vegetation, and associated disturbances to soils, leading to increased nutrient leaching, runoff and erosion and consequent sedimentation	Ongoing disturbances to soils, resulting in increased leaching of soil nutrients and risk of erosion, attributed to mining activities.	Compaction and contamination of soils during demolition activities and backfilling.
.	Loss of topsoil as a growth medium due to mining activities and inadequate rehabilitation efforts	Ongoing disturbance as a result of maintenance activities, leading to altered terrestrial vegetation community structures, and consequently altering the quality and nutrient status of the soil	Decommissioning activities may lead to soil transformation and increased alien plant species proliferation, which will ultimately alter the chemical composition and nutrient status of the soil.
	Potential indiscriminate disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.		Disturbance of soils as part of demolition activities as well as backfilling, which may lead to the formation of Witbank soils (Anthrosols) which reduce long term land capability.

Table 18: Impact assessment results for the mining operation, which include, site preparation, for Opencast mining operation and construction of mining related infrastructure.

Phase	Status of Impact	Extent of Impact	Duration of Impact	Probability	Intensity of Impact	Magnitude of Impact	Significance
Unmanaged							
Construction	-1	1	1	2	-1	-5	Low
Operational	-1	1	1	2	-1	-5	Low
Decommissioning and Closure	-1	1	1	2	-1	-5	Low
Managed							
Construction	-1	1	1	2	-1	-5	Low
Operational	-1	1	1	2	-1	-5	Low
Decommissioning and Closure	-1	1	1	2	-1	-5	Low

7.1.5 Cumulative impacts

The surrounding areas within which the proposed mining and related infrastructure is to occur are dominated by wilderness, forestry, residential, and mining activities land uses, and no cultivated agricultural activities were observed in the vicinity. Therefore, the proposed mining operation project is not anticipated to cause significant cumulative loss of herbaceous material for grazing after mitigation measures have been put in place. It should be noted however that cumulative loss of wilderness soils is likely to occur particularly on sloping areas during opencast mining activities, some of which will be unavoidable even when mitigation measures have been implemented. However, the project is not seen as fatally flawed from an agricultural potential and land use perspective and the addition to the cumulative impact on the region scale is considered relatively minor.

7.1.6 Latent Impacts

The Focus Area within which the proposed mining and related infrastructure is to occur on land use dominated by wilderness, forestry, residential and mining land uses, and no cultivated agricultural activities were observed in the vicinity. The proposed mining operation project is not anticipated to cause significant latent impacts after mitigation and rehabilitation measures have been put in place. The post mining land use is anticipated to be grazing, wilderness and forestry. However, the latent impacts of the proposed Browns pit and portion of waste rock dump will be permanent since no backfilling of Brown pits will be executed as it will form part of the later expansion. From land capability point of view the post mining land uses mentioned above can be achievable. Only those pits areas (Theta and Iota pits) including other mining related infrastructure where rehabilitation intervention will be conducted.

8. SUMMARY OF MITIGATION MEASURES

Based on the findings of the soil, land use and land capability assessment, mitigation measures have been developed to minimise the impact on the soil resources of the area, should the proposed project proceed.

8.1 Soil Erosion and Management

- The footprint of the proposed mining operation and related infrastructure areas should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible;
- If possible, vegetation clearance and commencement of construction activities can be scheduled to coincide with low rainfall conditions when the erosive stormwater and wind are anticipated to be low;
- Bare soils can be regularly dampened with water to suppress dust during the construction phase, especially when strong wind conditions are predicted according to the local weather forecast;

- All disturbed areas adjacent to the infrastructural areas can be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission; and
- Temporary erosion control measures may be used to protect the disturbed soils during the construction phase until adequate vegetation has established. This is regarded critical for the Focus Area due to very steep topographic setting.

8.2 Soil Compaction Management

- Laydown areas should be located within disturbed soils (Anthrosols) to avoid compaction of natural soils; and
- If possible, vegetation clearance and commencement of construction and mining activities, can be scheduled to coincide with low rainfall conditions when soil moisture is anticipated to be relatively low such that the soils are less prone to compaction.

8.3 Soil Contamination Management

- Contamination prevention measures should be addressed in the Environmental Management Programme (EMP) for the proposed development, and this should be implemented and made available and accessible at all times to the contractors and construction crew conducting the works on site for reference;
- A spill prevention and emergency spill response plan should be compiled to guide the construction works; and
- An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur.

8.4 Waste Management

- Burying of any waste including rubble, domestic waste, empty containers on the site should be strictly prohibited;
- All construction rubble waste must be removed to an approved disposal facility; and
- Contractors and construction crew conducting the works on site should be informed about approved waste disposal facilities.

8.5 *Soil Loss and Stockpile Management*

- Excavation and long-term stockpiling of soil should be limited within the demarcated areas as far as practically possible;

- Separate stockpiling of different soil type groups (to obtain the highest post-mining land capability
- Separate stripping, stockpiling and replacing of soil horizons in the original natural sequence to combat hardsetting and compaction, and maintain soil fertility;
- Stockpiling of topsoil must be undertaken on areas/ locations characterized with free draining conditions to minimise erosion loses and waterlogging conditions;
- Stockpiles should not exceed three (3) meters in height and should be treated with temporary soil stabilization. Should three (3) meters be exceeded, erosion control measures should be implemented;
- Stockpiles should be revegetated to establish a vegetation cover as an erosion control measure. These stockpiles should also be kept alien vegetation free at all times to prevent loss of soil quality;
- Temporary berms can be constructed, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion; and
- The recovered soils should be re-used to rehabilitate the mine footprint following mine closure.

8.6 *Loss of Land Capability Management*

- During the decommissioning phase the footprint should be thoroughly cleaned, and all building material should be removed to a suitable disposal facility;
- The footprint should be ripped to alleviate compaction;
- Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface;
- The landscape should be backfilled and reprofiled to mimic the natural topography for potential agricultural activities and grazing opportunities post mining. If possible, ensure a continuation of the pre mining surface drainage pattern;
- Slopes of the backfilled surface should change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation;
- The topsoil should be ameliorated according to soil chemical analysis;
- The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation. Soil amelioration should be done according soil analyses as recommended by a soil specialist, to correct the pH and nutrition status before revegetation; and
- The footprint should be re-vegetated with a grass seed mixture as soon as possible, preferably in spring and early summer to stabilise the soil and prevent soil loss during the rainy season.

9. CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the Transvaal Gold Mining Estate (TGME) mine development project: amendment to MR83 to include the Theta hill, Browns hill and Iota hill projects, near Pilgrims Rest, Mpumalanga Province.

Based on the observation during the field assessment, the current land use activities associated with the Focus Area and surrounding areas are largely dominated by wilderness, forestry, grazing, residential as well as some mining operations. No commercial agricultural activities were observed occurring within the Focus Area and the immediate (at least within a 3 km radius) surrounding areas except forestry.

The Focus Area resembles a Lithic and Anthropic catena, with Mispah/Glenrosa and Witbank (Anthrosols) being the dominant soil forms within the total surveyed area. Lithic soils such as Mispah/Glenrosa are regarded as shallow soils, attributed to their shallow pedogenic and effective depth. These soils constitute of approximately 72.7% of the total Focus Area, whilst Witbank (Anthrosols) soils occupy approximately 2.69% of the total investigated Focus Area. The shallow nature of the dominant soil forms can be largely attributed to limited rock weathering or rejuvenation through natural erosion on steeper, convex slopes. Witbank soils have been extensively disturbed such that no recognisable diagnostic soil morphological characteristics could be identified, corresponding to Anthrosols in the international soil classification terminology. The remainder of the Focus Area comprises Dundee (Alluvial soils) soil form which occupy approximately 3.47%, and residential areas, mining and associated structures (i.e. mine plant complex, WRD, office areas, roads) which collectively occupy approximately 21.14% of the total investigated area.

Below is a tabular presentation of the dominant soils, with relative description of soil horizons as well as associated land capability. The land capability of the identified soils forms ranged between Class V and VIII due to land use limitations related to anthropogenic activities and shallow effective rooting depth.

Land Capability classes for soil forms identified within the Focus Area

Soil Form	Code	Diagnostic Horizon Sequence	Land Capability	Areal Extent (ha)	Percentage (%)
Mispah	Ms	Orthic/ Hard Rock	Grazing (Class VI)	237.06	82.82
Glenrosa	Gs	Orthic/ Lithic			
Dundee	Du	Orthic/ Alluvial	Grazing (Class V)	16.23	5.67
Witbank	Wb	Unspecified	Wildlife (Class VIII)	32.94	11.51
TOTAL				**286.23**	**100.00***

Infrastructural areas were not included in the table above since they not considered in the land capability ratings

The findings of this assessment suggest that the soil limiting factors within the Focus Area for land capability, with specific mention to rainfed cultivated agriculture include the following:

- Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa soil forms. As such, these soils are not considered to contribute significantly to agricultural productivity on a local, provincial as well as national scale;
- Susceptibility to erosion of Mispah/Glenrosa soils forms associated with the Focus Area due to their occurrence on sloping areas;
- Poor water and nutrients holding capacity of the Alluvial soils (Dundee) which disqualifies these soils for cultivated agriculture. However, preservation of these soils for conservation purposes is regarded important since they are associated with water course, parallel with the National Water Act, 1998 (Act No. 36 of 1998); and
- Lack of soil medium for plants and crop growth for the mine infrastructure, surface water areas and Witbank (Anthrosols) soils.

The proposed mining project is not anticipated to cause significant cumulative loss of herbaceous material for grazing after mitigation measures have been put in place. It should be noted that cumulative loss of wilderness soils is likely to occur particularly on sloping areas during opencast mining activities, some of which will be unavoidable even when mitigation measures have been implemented. The project will likely cause soil erosion and the associated sedimentation of downgradient areas, soil compaction, soil contamination and loss of land for potential forestry and grazing. However, if mitigation measures are carefully implemented during all phases of development, the project is not seen as fatally flawed from an agricultural potential, land use and land capability point of view and the cumulative impact on agricultural resources is limited, although the conservation value of the area must be considered. A site-specific soil rehabilitation plan should be put in place prior to commencement of mining and related activities to ensure that the natural topography and wilderness land capability, or other land capability depending on the proposed end land use is reinstated post closure and residual impacts minimized. The standard of rehabilitation must be determined by the primary land capability pre-mining. It should be noted that at post-closure the grazing capacity will be reduced to some extent by residual and latent impacts.

Key Mitigation Measure include:

- The footprint of the proposed mining operation and related infrastructure areas should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible;
- Laydown areas should be located within disturbed soils (Anthrosols) to avoid compaction of natural soils as far as practically possible;
- An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur;
- Stockpile areas should be demarcated as “No Go Areas” to ensure that the disturbance of topsoil is minimal;
- Stockpiles should not exceed three (3) meters in height and should be treated with temporary soil stabilization. Should a topsoil stockpile height of three (3) meters be exceeded, erosion control measures should be implemented; and
- During the decommissioning phase the footprint should be thoroughly cleaned, and all construction material should be removed to a suitable disposal facility.

After mitigation measures and recommendations have been considered, this project is considered acceptable from a soil, land use and land capability point of view. It is the opinion of the specialist therefore that this study provides the relevant information required for the Environmental Impact Assessment phase of the project to ensure that appropriate consideration of the agricultural resources in the Focus Area will be made in support of the principles of Integrated Environmental Management (IEM) and sustainable development.

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APPENDIX A: METHOD OF ASSESSMENT

Desktop Screening

Prior to commencement of the field assessment, a background study, including a literature review, was conducted in order to collect the pre-determined soil and land capability data in the vicinity of the investigated **Focus Area.** Various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed under references were used for the assessment.

Soil Classification and Sampling

- A soil survey was conducted from March 2019 by a qualified soil specialist, at which time the identified soils within the infrastructure areas and associated access roads were classified into soil forms according to the South African Soil Classification System (Soil Classification Working Group, 2018). Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses.

Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table A1 below; with Classes I to III classified as prime agricultural land that is well suitable for annual cultivated crops. Whereas, Class IV soils may be cultivated under certain circumstances and management practices, whereas Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of 1 to 8, as illustrated in Table A2 below. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The anticipated impacts of the proposed land use on soil and land capability were assessed in order to inform the necessary mitigation measures.

Table A1: Land Capability Classification (Scotney et al., 1987)

Land Capability Group	Land Capability Class	Increased intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	Water course and land with wetness limitations
	VI	W	F	LG	MG	-	-	-	-	-	Limitations preclude cultivation. Suitable for perennial vegetation
	VII	W	F	LG	-	-	-	-	-	-	Very severe limitations. Suitable only for natural vegetation
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

W - Wildlife F - Forestry LG - Light grazing
MG – Moderate grazing IG - Intensive grazing LC - Light cultivation
MC - Moderate cultivation IC - Intensive cultivation. VIC – Very intensive cultivation

Table A2: Climate Capability Classification (Scotney et al., 1987)

Climate Capability Class	Limitation Rating	Description
C1	None to slight	Local climate is favourable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for good yield for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.
C3	Slight to moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.
C5	Moderate to severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops for which frequently experience yield loss.
C7	Severe to very severe	Severely restricted choice of crops due to heat, cold and/or moisture stress.
C8	Very severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.

Impact Assessment Methodology

The evaluation of impacts is conducted in terms of the criteria detailed in Table presented below. The various environmental impacts and benefits of this project are discussed in terms of impact status, extent, duration, probability, and intensity. Impact significance is regarded as the sum of the impact extent, duration, probability and intensity and a numerical rating system has been applied to evaluate impact significance. Therefore, an impact magnitude and significance rating is applied to rate each identified impact in terms of its overall magnitude and significance.

In order to adequately assess and evaluate the impacts and benefits associated with the project, it was necessary to develop a methodology that would scientifically achieve this and to reduce the subjectivity involved in making such evaluations. To enable informed decision-making, it is necessary to assess all legal requirements and clearly defined criteria in order to accurately determine the significance of the predicted impact or benefit on the surrounding natural and social environment.

Impact Status

The nature or status of the impact is determined by the conditions of the environment prior to construction and operation. A discussion on the nature of the impact will include a description of what causes the effect, what will be affected and how it will be affected. The nature of the impact can be described as negative, positive or neutral.

Status of Impact

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment	P
Neutral	No cost or benefit to the receiving environment	-
Negative	A cost to the receiving environment	N

Impact Extent

The extent of an impact is considered as to whether impacts are either limited in extent or if it affects a wide area or group of people. Impact extent can be site specific (within the boundaries of the development area), local, regional or national and/or international.

Extent of Impact

Rating	Description	Quantitative Rating
Low	Site Specific; Occurs within the site boundary	1
Medium	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5 km from the Project Site boundary).	2
High	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5 km and more from the Project Site boundary).	3
Very High	National and/or international; Extends far beyond the site boundary; Widespread effect	4

Impact Duration

The duration of the impact refers to the time scale of the impact or benefit.

Duration of Impact

Rating	Description	Quantitative Rating
Low	Short term; Quickly reversible; Less than the project lifespan; 0 – 5 years.	1
Medium	Medium term; Reversible over time; Approximate lifespan of the project; 5 – 17 years.	2
High	Long term; Permanent; Extends beyond the decommissioning phase; >17 years	3

Impact Probability

The probability of the impact describes the likelihood of the impact actually occurring.

Probability of Impact

Rating	Description	Quantitative Rating
Improbable	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%	2
Highly Probable	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; Chance of occurrence >90%.	4
Definite and Cumulative	Impact will occur regardless of any prevention measures; Chance of occurrence >90% and is likely to result in in cumulative impacts	5

Impact Intensity

The intensity of the impact is determined to quantify the magnitude of the impacts and benefits associated with the proposed project.

Intensity of Impact

Rating	Description	Quantitative Rating
Maximum Benefit	Where natural, cultural and / or social functions or processes are positively affected resulting in the maximum possible and permanent benefit.	+5
Significant Benefit	Where natural, cultural and / or social functions or processes are altered to the extent that it will result in temporary but significant benefit.	+4
Beneficial	Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified, beneficial way.	+3
Minor Benefit	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally benefited	+2
Negligible Benefit	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly benefited.	+1
Neutral	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are not affected.	0
Negligible	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly affected	-1

Rating	Description	Quantitative Rating
Minor	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally affected.	-2
Average	Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified way.	-3
Severe	Where natural, cultural and / or social functions or processes are altered to the extent that it will temporarily cease.	-4
Very Severe	Where natural, cultural and / or social functions or processes are altered to the extent that it will permanently cease.	-5

Impact Significance

The impact magnitude and significance rating is utilised to rate each identified impact in terms of its overall magnitude and significance.

Impact Magnitude and Significance Rating

Impact	Rating	Description	Quantitative Rating
Positive	High	Of the highest positive order possible within the bounds of impacts that could occur. +	+12-16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort	+6-11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming	+ 1–5
No Impact	No Impact	Zero Impact	
Negative	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged.	-1-5
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form). Modification of the project design or alternative action may be required	-6-11
	High	Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt.	-12-16

Legislative, Policy and Best Practice Framework for Impact Mitigation

'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other landuse. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.

The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DEA *et. al* 2013):

1. **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases, if impacts are expected to be too high the "no project" option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
2. **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;
3. **Rehabilitate impact** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation can however not be considered as the primary mitigation toll as even with significant resources and effort rehabilitation that usually does not lead to adequate replication of the diversity and complexity of the natural system. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project. Practical rehabilitation should consist of the following phases in best practice:
    a. **Structural rehabilitation** which includes physical rehabilitation of areas by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long terms sustainable ecological structure;
    b. **Functional rehabilitation** which focuses on ensuring that the ecological functionality of the ecological resources on the subject property supports the intended post closure land use. In this regard special mention is made of the need to ensure the continued functioning and integrity of wetland and riverine areas throughout and after the rehabilitation phase;
    c. **Biodiversity reinstatement** which focuses on ensuring that a reasonable level of biodiversity is re-instated to a level that supports the local post closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community of community suitable for supporting the intended post closure land use; and
    d. **Species reinstatement** which focuses on the re-introduction of any ecologically important species which may be important for socio-cultural reasons, ecosystem functioning reasons and for conservation reasons. Species re-instatement need only occur if deemed necessary.
4. **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

According to the DEA *et. al* (2013) 'Closure' refers to the process for ensuring that mining operations are closed in an environmentally responsible manner, usually with the dual objectives of ensuring sustainable post-mining land uses and remedying negative impacts on biodiversity and ecosystem services.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of very high significance and when residual impacts are considered to be of very high significance, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have medium to high significance, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.

APPENDIX B: SOIL CHEMISTRY RESULTS

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CERTIFICATE OF ANALYSES
TCLP / ACID RAIN / DISTILLED WATER EXTRACTIONS

Date received:	**4/3/2019**		**Date completed:**
Project number:	**244**	**Report number: 82172**	**Order number:**

Client name:	**Scientific Aquatic Services**	**Contact person:**
Address:	**347 Highland Road, Kensington, 2094**	**Email:**
Telephone:	**0116167893**	**Cell:**

Analyses			
	1851	**570**	**1831**
Sample Number	**59910**	**59911**	**59912**
TCLP / Acid Rain / Distilled Water / H_2O_2	**Distilled Water**	**Distilled Water**	**Distilled Water**
Dry Mass Used (g)	**250**	**250**	**250**
Volume Used (mℓ)	**1000**	**1000**	**1000**
pH Value at 25˚C	4.7	3.7	4.1
Electrical Conductivity in mS/m at 25˚C	3.8	2.6	4.6

Inorganic Anions	mg/ℓ	mg/kg	mg/ℓ	mg/kg	mg/ℓ	mg/kg
Sulphate as SO_4	6	24	4	16	10	40
Nitrate as N	<0.1	<0.4	0.6	2.4	0.8	3.2
Ortho-Phosphate as P	<0.1	<0.4	<0.1	<0.4	<0.1	<0.4
Cyanide as CN [s]	<0.02	<0.08	<0.02	<0.08	<0.02	<0.08
ICP-OES Quant	See ICP DW tab					
ICP-MS Quant	See ICP DW tab					

Analyses						
	1928		**1964**		**1896**	
Sample Number	**59913**		**59914**		**59915**	
TCLP / Acid Rain / Distilled Water / H_2O_2	**Distilled Water**		**Distilled Water**		**Distilled Water**	
Dry Mass Used (g)	**250**		**250**		**250**	
Volume Used (mℓ)	**1000**		**1000**		**1000**	
pH Value at 25˚C	5.3		4.1		4.5	
Electrical Conductivity in mS/m at 25˚C	6.1		3.4		3.2	
Inorganic Anions	mg/ℓ	mg/kg	mg/ℓ	mg/kg	mg/ℓ	mg/kg
Sulphate as SO_4	12	48	5	20	5	20
Nitrate as N	1.2	4.8	<0.1	<0.4	0.1	0.4
Ortho-Phosphate as P	<0.1	<0.4	<0.1	<0.4	<0.1	<0.4
Cyanide as CN [s]	0.03	0.12	<0.02	<0.08	<0.02	<0.08
ICP-OES Quant	See ICP DW tab					
ICP-MS Quant	See ICP DW tab					

WATERLAB (PTY) LTD

CERTIFICATE OF ANALYSES

ICP-OES QUANTITATIVE ANALYSIS

Date received: 4/3/2019
Project number: 244
Date Completed: 4/23/2019
Report number: 82172

Client name: Scientific Aquatic Services
Address: 347 Highland Road, Kensington, 2094
Telephone: 0116167893
Contact person: Ndumiso Sithole
Email: ndumiso@sasenvgroup.co.za
Facsimile: 073 434 7462

Extract	Sample Dry Mass	Volume	Mass (g/l)	Factor
Distilled Water	250	1000	250	4

Sample Id	Sample number	Fe	Fe	K	K	U*	U*
		mg/l	mg/kg	mg/l	mg/kg	mg/l	mg/kg
Det Limit		<0.025	<0.100	<0.5	<2.0	<0.001	<0.004
1851	59910	4.79	19	1.9	7.4	<0.001	<0.004
570	59911	0.238	0.952	<0.5	<2.0	<0.001	<0.004
1831	59912	0.053	0.212	0.9	3.6	<0.001	<0.004
1928	59913	2.20	8.80	6.4	26	<0.001	<0.004
1964	59914	1.94	7.74	1.0	4.1	<0.001	<0.004
1896	59915	2.86	11	0.7	2.6	<0.001	<0.004

[*] = Analysed on ICP-MS Instrument

APPENDIX C LEGISLATION

LEGISLATIVE REQUIREMENTS

National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA)	The National Environmental Management Act,1998 (Act No. 107 of 1998) (NEMA) and the associated Regulations as amended in 2017, states that prior to any development taking place within the environment, 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.
Mineral and Petroleum Resources Development Act, 2002 (Act No.28 of 2002) (MPRDA)	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 EIA, an Environmental Management Programme (EMP), and a Public Participation Process (PPP).
National Environmental Management: Waste Act, 2008 (Act No.59 of 2008) (NEMWA)	NEMWA, which reforms the law regulating waste management in order to protect the health and the environment by providing reasonable measures for the prevention of pollution; provides for national norms and standards for regulating the management of waste by all spheres of government, and provides for the licensing and control of waste management activities
Conservation of Agricultural Resources Act, 1983 (Act No.43 of 1983) (CARA)	The Conservation of Agricultural Resources Act 1983 (Act No. 43 of 1983) promote the protection, management and conservation of soil resources during various land uses, by providing reasonable measures in prevention of losses and quality degradation of soil continuum. Especially, the valuable arable soils which are regarded as scarce resource and have significant contribution in supporting the local, provincial and national agricultural sector in sustaining the food security of South Africa.

APPENDIX D DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

Ndumiso Sithole BSc (Environmental Hydrology and Soil Science) (University of KwaZulu Natal)
Braveman Mzila BSc (Hons) Environmental Hydrology (University of KwaZulu-Natal)
Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

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 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		

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

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Signature of the Project Manager

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist with focus on Freshwater Ecology
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust and emerald Management Trust

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;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member pf the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for wetland Assessment short course Rhodes University	2016

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leone
Central Africa – Democratic Republic of the Congo

PROJECT EXPERIENCE (Over 2500 projects executed with varying degrees of involvement)

1 Mining Coal, Chrome, PGM's, Mineral Sands, Gold, Phosphate, river sand, clay, fluorspar
2 Linear developments
3 Energy Transmission, telecommunication, pipelines, roads
4 Minerals beneficiation
5 Renewable energy (wind and solar)
6 Commercial development
7 Residential development
8 Agriculture
9 Industrial/chemical

REFERENCES

- Terry Calmeyer (Former Chairperson of IAIA SA)
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- Marietjie Eksteen
  Managing Director: Jacana Environmental
  Tel: 015 291 4015

Yours faithfully

STEPHEN VAN STADEN

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF NDUMISO SITHOLE

PERSONAL DETAILS

Position in Company	Wetland Ecologist and Soil Scientist
Date of Birth	21 February 1992
Nationality	South African
Languages	IsiZulu, English
Joined SAS	2019

EDUCATION

Qualifications

BSc Hydrology and Soil Science (University of Kwazulu-Natal) 2014

COUNTRIES OF WORK EXPERIENCE

South Africa – Mpumalanga, Kwa-Zulu Natal, Limpopo and North West

SELECTED PROJECT EXAMPLES

Freshwater Resource Assessment

Freshwater Ecological Assessments

- Freshwater ecological assessment as part of the water use authorisation application Welgemeend Mine, Mpumalanga province.
- Wetland verification as part of the environmental assessment and authorization process for the proposed development Rhenostersruit, North West province.
- Wetland Monitoring as part of water use license requirement Rietvlei Mine, Mpumalanga province
- Wetland verification as part of the environmental assessment and authorization process for the proposed alluvial diamonds mine, EJ Diamonds, North West province.

Soil, Land Use and Land Capability Assessments

- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed, Royal Sheba Mine Mpumalanga Province.
- Soil, Land Use and Land Capability Assessment as Part of the Environmental Assessment and Authorisation Process for the Proposed Bierspruit opencast, Tumela Mining Project, Limpopo Province.
- Soil, Land Use and Land Capability Assessment as Part of The Environmental Assessment and Authorisation Process for The Proposed Dorstfontein west Mining Project, Mpumalanga Province.

- Soil, Land Use and Land Capability Assessment as Part of the Environmental Assessment and Authorisation Process for the Proposed Fine chrome recovery plant and Product Pads Tumela Mining Project, Limpopo Province.
- Soil, Land Use and Land Capability Assessment as Part of The Environmental Assessment and Authorisation Process for The Proposed Kangra, Kusipongo Mining Project, Mpumalanga Province.
- Soil, Land Use and Land Capability Assessment as Part of The Environmental Assessment and Authorisation Process for The Proposed Kangra, Maquasa Mining Project, Mpumalanga Province.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF BRAVEMAN MZILA

PERSONAL DETAILS

Position in Company	Wetland Ecologist and Soil Scientist
Date of Birth	03 January 1991
Nationality	South African
Languages	IsiZulu, English
Joined SAS	2017

EDUCATION

Qualifications

BSc (Hons) Environmental Hydrology (University of KwaZulu-Natal)	2013
BSc Hydrology and Soil Science (University of KwaZulu-Natal)	2012

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, KwaZulu-Natal, Eastern Cape, Northern Cape, North West, Limpopo, Western Cape, Mpumalanga, Free State.

SELECTED PROJECT EXAMPLES

Freshwater Resource Assessment

- Freshwater ecological assessment as part of the water use authorisation relating to stormwater damage of a tributary of the Sandspruit, Norwood, Gauteng province.
- Wetland verification as part of the environmental assessment and authorization process for the proposed development in Crowthorne extension 67, Gauteng province.
- Freshwater assessment as part of the section 24g rectification process for unauthorised construction related activities that took place on erf 411, Ruimsig extension 9, Gauteng province
- Baseline aquatic and freshwater assessment as part of the environmental assessment And authorisation process for the N11 Ring Road, Mokopane, Limpopo Province
- Wetland Resource Scoping Assessment As Part Of The Environmental Assessment And Authorisation Process For The Kitwe TSF Reclamation Project, Kitwe, Zambia
- Wetland delineation as part of the environmental assessment and authorization process for the proposed development in Boden Road, Benoni, Ekurhuleni Metropolitan Municipality, Gauteng Province.

Soil, Land Use and Land Capability Assessments

- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Witfontein Study area Project Near Bethal, Mpumalanga Province
- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Heuningkranz Mine, Postmasburg, Northern Cape Province

Hydropedological Wetland Impact Assessments

- Hydropedological Assessment as Part of the Environmental Assessment and Authorisation Process for the proposed Vandyksdrift Central Dewatering Project
- Hydropedological Assessment for the Proposed Evander Gold Elikhulu Tailings Storage Facility (TSF) Expansion, Mpumalanga Province

- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Palmietkuilen Mine, Springs, Gauteng Province
- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Uitkomst Colliery Mine expansion, Newcastle, KwaZulu-Natal Province
- Hydropedological Assessment for The Proposed Khutala Water Treatment Plant and Kendal 5 Seam Underground Mine Dewatering at Khutala Colliery, Near Ogies, Mpumalanga Province

Soil Rehabilitation Assessments

- Soil rehabilitation plan, a water resource assessment and develop a management plan in support of the water use license for the Driefontein operations, Carletonville, Gauteng

SCIENTIFIC TERRESTRIAL SERVICES

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BIODIVERSITY ASSESSMENT AND IMPACT ASSESSMENTS AS PART OF THE ENVIRONMENTAL AUTHORISATION AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS FOR THE TGME THETA PROJECT TO INCLUDE THE THETA HILL, BROWNS HILL AND IOTA HILL NEAR PILGRIM'S REST, MPUMALANGA PROVINCE

Prepared for

Batho Earth

Social and Environmental Consultants

First submission: May 2019
Updated: July 2020

Prepared by:	**Scientific Terrestrial Services**
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	S. Van Staden (Pr.Sci.Nat)
	C. Hooton
Report Reference:	**STS 190006**

SAS Environmental Group of Companies

EXECUTIVE SUMMARY

Based on the results of the floral assessment, it is the opinion of the specialist that this project will have negative impacts on the floral ecology within the focus area and potentially on a local to regional scale. The rehabilitation phase, if well-planned and implemented, may restore some ecological function; however, the current floral communities, especially in terms of floral species of conservation concern (SCC), are unlikely to return to a pre-mining condition. The vegetation associated with the three focus areas vary across a spatial scale but could broadly be grouped into four habitat units, namely the Mountain Outcrops, Montane Grassland, Riparian Habitat and Forest Remnants as well as the Degraded Habitat. Each habitat unit has been exposed to varying levels of disturbances and the resultant ecological sensitivity of the habitat units thus varied accordingly, fluctuating between High to Intermediate (Mountain Outcrops and Montane Grasslands), Moderately high to Moderately Low (Riparian Habitat and Forest Remnants) and Moderately low to Low (Degraded Habitat). Within all habitat units, floral SCC were recorded with the highest abundance and diversity associated with the Montane Grasslands and Mountain Outcrops. All habitat units, with the Degraded Habitat unit to a lesser degree, have habitat that can support floral SCC that were not recorded during the site assessment. The potential for floral SCC to be present was determined by considering the suitability of the habitat on site and took previously recorded localities of such species in the region into account - provided by the Mpumalanga Tourism and Parks Agency. The Theta Project is highly likely to result in the loss of floral SCC individuals as the success of rescue and relocation is uncertain for many species.

The faunal assessment revealed a three faunal Species of Conservation Concern (SCC) present in the focus area namely *Pelea capreolus* (Grey Rhebok, NT), *Rhinolophus smithersi* (Smithers Horseshoe Bat, NT) and *Rhinolophus blasii* (Blasius's Horseshoe Bat, NT). Based on information gathered from databases as well as data obtained during the March 2019 and January 2020 assessments, there is an increased likelihood that other faunal SCC may also occur, either permanently or temporarily within the focus area. The habitat units within the focus area have all been exposed to varying levels of disturbances, with the net result being that the ecological sensitivity of the habitat units varied accordingly, fluctuating between High (Blyde River) to Moderately high (Mountain Outcrops, Montane Grasslands, Riparian and Forest Remnants), Intermediate (Forest Remnants) and Moderately low (Degraded Habitat). The Theta Project will lead to significant habitat and species diversity loss, in addition to potential faunal SCC. The loss of habitat will lead to the displacement of species from the focus leading to increased competition for space and resources in the surrounding areas. The rehabilitation phase, if well-planned and implemented, may restore some ecological function; however, it is unlikely that the faunal biodiversity will ever return to pre-mining conditions as even the best rehabilitation activities will not be able to replicate the pre-mining micro habitats currently observed within the focus area.

The focus area is considered sensitivity and important for both faunal and floral communities, thus from a biodiversity perspective the focus area is of high conservation value. The Mpumalanga Biodiversity Sector Plan (MTPA, 2019) also recognises this and have categorised the area to be an Optimal and Irreplaceable Critical Biodiversity Area (CBA). Thus, where the proposed Theta Project mine layout falls within Irreplaceable and Optimal CBAs, both opencast and underground mining is considered to be a land-use that will compromise the CBA's biodiversity objective and is deemed a conflicting land use to the management objective for the area. The entire focus area is located within the 5 km Ecological Support Area (ESA): Protected Area Buffer, in which opencast mining projects are land-uses that will compromise biodiversity objectives for protected areas and are not permissible. The proposed Theta Project will further impact negatively on several threatened vegetation types and ecosystems. The proposed Theta Project is fatally flawed from a floral perspective. If the project is authorised, strict adherence to the management of impacts in line with the mitigation hierarchy is deemed essential to attempt no net loss of biodiversity. The impact of the proposed project must however be contrasted with the risk that uncontrolled artisanal mining poses.

If the project is to be approved for overriding socio-economic reasons, and the mitigation hierarchy has been exhausted, an appropriate biodiversity offset and compensation plan, as

well as appropriate funding of this initiative is considered essential. Refer to the proposed offset plan (Botha et al., 2020).

Management Summary

Scientific Terrestrial Services (STS) was appointed to conduct a Faunal and Floral Ecological Assessment and Impact Assessments as part of the environmental assessment and Environmental Impact Assessment (EIA) process for the Transvaal Gold Mining Estate (TGME) Mine Development Project: Application for the amendment of the existing environmental authorisation to include the proposed Theta Open Pit Project comprising the Theta Hill, Browns Hill and Iota Hill projects near Pilgrim's Rest, Mpumalanga Province. The areas to be assessed will henceforth be referred to as the "focus area", except when specifically referring to the activities associated with Theta Hill, Browns Hill or Iota Hill.

The purpose of the biodiversity assessment is to define the terrestrial ecology of the focus area, including both floral and faunal aspects, with specific attention to the proposed footprint areas. Furthermore, the assessment includes mapping and defining areas of increased Ecological Importance and Sensitivity (EIS) and defining the Present Ecological State (PES) of the focus area. It is the objective of this study to provide detailed information to guide the activities associated with the proposed TGME Mine Development Project within the focus area, to ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area is sufficiently considered in the decision-making process.

SUMMARY RESULTS OF THE DESKTOP ASSESSMENT

The focus area is located in an area that is of increased conservation importance, based on several datasets assessed as part of the desktop assessment:

- The focus area falls within two threatened vegetation's types, i.e. the Northern Escarpment Dolomite Grassland (**Endangered**) and Northern Escarpment Quartzite Sourveld (**Vulnerable**). Further to this, most of the focus area is located within the remaining extent of the **Malmani Karstlands endangered ecosystem**;
- According to the National Biodiversity Assessment (2018), a small section of the Long Tom Pass Montane Grassland, which is Well Protected but Near Threatened, is within the footprint of the Iota Pit, Iota WRD North and the Iota Dirty Water Drainage. The Iota Pit, Iota WRD North and portions of the Iota Dirty Water Drainage also fall within the sections of the Northern Mistbelt Forest, a vegetation type that is considered Well Protected and of Least Concern, i.e. not currently under threat. Small sections of the Northern Escarpment Quartzite Sourveld, a Moderately Protected vegetation type that is now considered of Least Concern, are within the footprint of the Wishbone WRD, Theta Pit 1, Theta Satellite Pit 2 and the associated Haul Road and Clean and Dirty Water Drainage. Most of the focus area falls within the Poorly Protected Northern Escarpment Dolomite Grassland, a Vulnerable ecosystem;
- The focus area falls within several areas of conservation and biodiversity importance, i.e. **Irreplaceable** and **Optimal Critical Biodiversity Areas** (**CBAs**) (MTPA, 2014), an **Ecological Support Area** (**ESA**) **Protected Areas Buffer**, as well as areas of **Highest and High Biodiversity Importance** according to the Mining and Biodiversity Guidelines (2013);
- Several Protected and Conservation Areas are located within 10 km of the focus area, with the entire proposed layout falling within the Kruger to Canyons Biosphere Reserve. The focus area is also located within 6 km of the north-eastern Escarpment focus area (National Protected Areas Expansion Strategy [NPAES, 2009]) and is approximately 2 km west of the Blyde River Canyon Important Bird and Biodiversity Area (IBA, 2015); and
- Finally, the focus area falls within two areas of increased floral sensitivity, i.e. the Wolkberg Centre of Endemism and the Drakensberg Afromontane Region of Endemism (Mpumalanga BioBase Report, 2002).

SUMMARY RESULTS OF THE FLORAL ASSESSMENT

The focus area is floristically diverse, and a broad range of floral SCC are present, some occurring in abundance in certain areas of the focus area. The desktop assessment indicated that the focus area covers four vegetation types as per Mucina and Rutherford (2018 database, Section A – Figure 10), encompassing grassland and forest biomes. The focus area therefore falls within the ecotone of these four vegetation types, leading to the potential for a complex and diverse floral species composition associated with the focus area - this was confirmed for all remaining natural vegetation within the focus area during the field assessment. The vegetation communities distinguished during the field assessment are described under four broad habitat units, namely:

- **Mountain outcrops:**
  - Cliff faces with associated Forest-like Thickets; and
  - Dolomite/quartzite outcrops.
- **Montane Grassland,** encompassing rocky grasslands along mountain slopes with species represented by all three grassland vegetation types indicated for the focus area (Mucina and Rutherford 2018 database), i.e. Long Tom Pass Montane Grassland, Northern Escarpment Quartzite Sourveld and Northern Escarpment Dolomite Grassland;
- **Riparian Habitat & Forest Remnants:**
  - Riparian vegetation associated with drainage lines and the Blyde River (freshwater resources); and
  - Forest Remnants – including indigenous forest and degraded forest which typically occur adjacent to the Riparian Habitat.
- **Degraded Habitat,** including transformed/built-up areas and alien and invasive plant (AIP) dominated vegetation**.**

Although all habitat units have been affected by anthropogenic activities to some degree, the severity of the impacts differs significantly. Apart from the Degraded Habitat unit, all other habitat units remain largely intact and their habitat integrity is only slightly compromised due to existing roads (i.e. habitat fragmentation) and some AIPs encroaching into natural areas. The potential for the various habitat units to support floral SCC also differ with the Mountain Outcrops harbouring the highest abundance and diversity of floral SCC, followed by the Montane Grasslands.

Floral SCC

One tree species protected under the National Forest Act, 1998 (Act 84 of 1998, as amended in September 2011) (NFA) was recorded within the Forest Remnants during the field assessment, i.e. *Pittosporum viridiflorum.* Suitable habitat is available for several additional species within the forest-like thickets associated with Mountain outcrops, as well as within the woody drainage lines associated with Riparian Habitat and within the Indigenous Forest Remnants. Several floral SCC listed in the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998) (MNCA) were recorded within the focus area (coordinates provided in Section B: Appendix B - Table C1):

- Woody Species:
  - *Faurea galpinii;*
  - *Olea europaea* subsp*. africana;*
  - *Protea caffra* subsp*. caffra;*
  - *Protea gaguedi;* and
  - *Protea roupelliae* subsp*. roupelliae*.
- Forb Species:
  - *Boophone disticha;*
  - *Clivia caulescens (*NT, MNCA*);*
  - *Clivia* sp*.;*
  - *Cyrtanthus tuckii;*
  - *Disa patula* var*. transvaalensis;*
  - *Eulophia foliosa;*
  - *Eulophia streptopetala;*
  - *Gladiolus ecklonii;*
  - *Gloriosa modesta;*
  - *Graderia sp.;*
  - *Habenaria sp.;*
  - *Haemanthus humilis* subsp*. hirsutus;*
  - *Kniphofia linearifolia;*

  - *Kniphofia sp.;*
  - *Merwilla plumbea (*Near Threatened*);*
  - *Orthochilus aculeatus;*
  - *Satyrium cristatum;*
  - *Scadoxus multiflorus* subsp*. katharinae;*
  - *Scadoxus puniceus;*
  - *Stenoglottis fimbriata;* and
  - *Zantedeschia albomaculata.*
- Succulent Species:
  - *Aloe alooides;*
  - *Aloe arborescens;*
  - *Aloe barbertoniae;*
  - *Aloe* cf*. graciliflora;*
  - *Aloe cooperi;*
  - *Aloe dyeri;* and
  - *Aloe greatheadii* var*. davyana*.

The majority of SCC were found within the Mountain Outcrops, mostly concentrated on Theta Hill. The Montane Grasslands further harboured several floral SCC. The Degraded Habitat only supported a few SCC due to the disturbed conditions that are present within this habitat unit. Before any construction activities can take place, a detailed walk-down of the area is necessary, during which all SCC must be marked and either considered for rescue and relocation or, if planning to destroy or move these species, permits would be required from relevant authorities. As the MBSP Handbook (2014) and Ferrar and Lotter (2007) point out, the large number of rare and endangered species in grasslands is a particular problem for EIAs because these plants are mostly small, have a very localised distribution and are only visible for only a few weeks in the year when they flower – which means that they can easily be missed with once-off field assessments. It is expected that the floral SCC encountered on site is not a complete representation of the floral SCC associated with the focus area and many more are expected to occur, especially within the sensitive Mountain Outcrops, Montane Grasslands and Riparian Habitat and Forest Remnants (where still indigenous). To ensure saturation of data considering the floral SCC occurring within the focus area, marking of such species will need to take place during specific times of the year, across several seasons, under the guidance of an MTPA approved, suitably qualified and experienced specialist.

<u>Alien and Invasive Plant Species</u>
The focus area had several sections where AIPs have severely proliferated and this includes the riparian zone of the Blyde River and immediate surrounding habitat. The main sources of introduction, and cause of spread, identified for the focus area includes the commercial plantations and anthropogenic disturbances (primarily mine-related activities). It is evident that AIP management (if any) is currently not adequate and these species have been allowed to spread profusely. The presence of AIPs was highest within the Degraded Habitat, Riparian Habitat and Forest Remnants (where degraded), although the Mountain Outcrops and Montane Grasslands are not devoid of AIPs. If AIPs are not prevented from further encroaching into the Riparian Habitat, severe downstream impacts can be expected – resulting in potential decreases in water yields and overall loss of niche habitat for floral species adapted to moisture-rich or inundated soil conditions.

Due to the extent of AIPs within the focus area (and beyond), it is of utmost importance that strict control of AIPs located on the mine’s property, especially areas associated with increased disturbances, be undertaken on a regular basis as part of maintenance activities. For all species listed within the NEMBA: Alien and Invasive Species Regulations, GN R864 of 2016, their control, as stipulated within the regulations, should be implemented.

***Solanum mauritianum* proliferating within a Pine plantation south of Browns Hill (left), *Eucalyptus grandis* encroaching into natural vegetation south of Theta Hill (centre) and *Acacia dealbata* encroaching into drainage lines and cliffs within the focus area.**

<u>Floral Habitat Sensitivity</u>

The ecological sensitivity of the identified floral habitat units varies between High to Intermediate (Mountain Outcrops and Montane Grasslands), Moderately high to Moderately Low (Riparian Habitat and Forest Remnants) and Moderately low to Low (Degraded Habitat). The table below indicates the sensitivity of the habitat units along with an associated conservation objective and implications for development – followed by a sensitivity map.

Table A: A summary of the sensitivity of each habitat unit and implications for development.

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
Mountain Outcrops	High	Iota Pit North-eastern portion of the Wishbone WRD Several stretches of the Haul Road and Linear Developments associated with Iota Hill and Theta Pit	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered Offsetting or compensation for residual loss to be considered **only as a last resort**	The Mountain Outcrops were determined to be the most sensitive of the habitat units encountered within the focus area, especially those associated with Theta Hill. The Theta Hill and Browns Hill Mountain Outcrops are highly sensitive from both an ecological and conservation perspective, owing to their high floral diversity, an abundance of floral SCC and the presence of intact vegetation and habitat integrity. The Mountain Outcrops associated with Iota Hill had lower species diversity and fewer SCC but is still considered highly important due to its presence within an Irreplaceable CBA. From a floral resource management and conservation perspective, these areas must be excluded from surface developments, as far as is feasibly possible. The EIA Phase layout has reduced its footprint considerably, especially within the northern and eastern portions of Theta Hill. The current highest risk to the Mountain Outcrops will thus be on Iota Hill, where the proposed layout will lead to the direct loss of favourable habitat for floral communities and floral SCC numbers **locally**. Several of the highly sensitive floral communities are located within Irreplaceable CBAs, ESAs and threatened ecosystems; there is thus a conflict between the intended land use and the conservation requirements for the region.
	Moderately High	Iota Pit, Iota WRD North and Iota WRD South Theta Pit Northern Section of Browns Hill Several stretches of the Haul Road and Linear Developments associated with Iota Hill and Theta Pit	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered **only as a last resort**	
	Intermediate	Iota Pit and Browns Pit	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered only as a last resort	

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
Montane Grasslands	High	Most of the Iota Pit and Iota WRD North, as well as central portion of Iota WRD South Northern portion of the Wishbone WRD	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered Offsetting or compensation for residual loss to be considered only as a last resort	The Montane Grasslands are characterised by a high floral diversity and several floral SCC were recorded in this habitat unit. However, in some sections, habitat integrity was lower for this habitat unit than for the Mountain Outcrops due to the presence of several anthropogenic-related disturbances, including roads excavated along the slopes of Iota Hill (habitat fragmentation) and AIPs encroaching into natural areas throughout. Thus, the Montane Grasslands range from intermediate to high importance from a floral ecological and conservation perspective. Along the south-eastern slopes of Iota Hill, where several roads have been excavated, the grasslands have been fragmented and it is evident that floral diversity is lower in these sections. Thus, considering the impact of habitat fragmentation, together with the conservation significance of South African montane grasslands, no further destruction of these grasslands should take place. The high probability of rare and endemic species occurring in this habitat unit further necessitates the conservation, rather than destruction, of this habitat unit. Several of the highly sensitive floral communities are located within Irreplaceable CBAs, ESAs and threatened ecosystems; there is thus a conflict between the intended land use and the conservation requirements for the region.
	Moderately High	Scattered sections within the Iota WRD North. Northern-most portion of the Iota WRD South Theta Pit 1, Theta Pit and much of the Wishbone WRD Haul Roads associated with Iota Hill and Theta Hill Several stretches of the Linear Developments	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance Offsetting or compensation for residual loss to be considered only as a last resort	
	Intermediate	Browns Pit Iota Pits and Iota WRDs Theta Pit 1	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered only as a last resort	
Riparian Habitat and Forest Remnants	Moderately High	Eastern arm of the Wishbone WRD	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance Offsetting or compensation for residual loss to be considered only as a last resort	The Riparian Habitat and Forest Remnants are of moderately low to moderately high ecological and conservation significance from a floral resource management and conservation perspective. The habitat integrity of the Riparian Habitat within the focus area has been greatly compromised by the proliferation of AIPs, e.g. *Acacia dealbata, Eucalyptus grandis, Jacaranda mimosifolia, Rubus cuneifolius* and *Solanum mauritianum* have encroached into most drainage lines and comprise the majority of vegetation along the Blyde River. Floristically this habitat unit is significant due to the provision of water and the creation of niches for facultative or obligate wetland plants. However, in its current AIP-encroached condition, many native species have been displaced. With the potential for additional disturbances

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
	Intermediate	Sections of the Wishbone WRD Linear developments, mainly Haul Roads and Linear Developments Browns PCD	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered only as a last resort	that would stem from the proposed mining-related activities, it is likely that the Riparian Habitat will suffer further loss of native species diversity and down-stream effects of possible siltation, water contamination and AIP proliferation could lead to additional impacts on floral communities within the larger region. The section of the Forest Remnants where indigenous forest species still form the dominant vegetation component is floristically more sensitive and provides unique habitat for forest species. The remnants of Northern Mistbelt Forest should be excluded from planned mining activities and as per the DEFF recommendations, no mining activities should occur within 30 m of this vegetation type. Activities that are planned within freshwater resources as delineated by the Freshwater Ecologist or within the zones of regulation, as identified in the Freshwater Report, will require authorisation from the Department of Water and Sanitation (DWS). Mining-related activities within this habitat unit will require cogent mitigation measures to ensure no additional, or cumulative, impacts on floral communities occur.
	Moderately Low	Iota Pit	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	
Degraded Habitat	Moderately Low	Sections of Iota Pit, Iota WRD North and Iota WRD South. Most of Browns Pit and southern sections of the Theta Pit 1, Theta Satellite Pit 1, 2 and 3, as well as sections of the Wishbone WRD Haul Roads and several stretches of the Linear Developments Stockpiles and Mine Contractors Site	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	This habitat unit is of moderately low to low sensitivity, from a floral ecological and conservation perspective. Development within this habitat unit should not pose significant threats to native floral communities within the central part of the focus area. However, edge effects will need to be carefully managed, especially the potential spread of AIPs. Development within this habitat unit on Theta and Iota Hills have a greater potential for edge effects to impact on the adjacent, more sensitive habitat units. Ecological functioning and habitat integrity are significantly compromised, and these areas can be optimised for development.
	Low	Powerline Balancing Dam Sections of the Topsoil Stockpiles and Haul Road Southern portion of the Theta Pit 1 and a small section of the Theta Pit 2	Optimise development potential.	

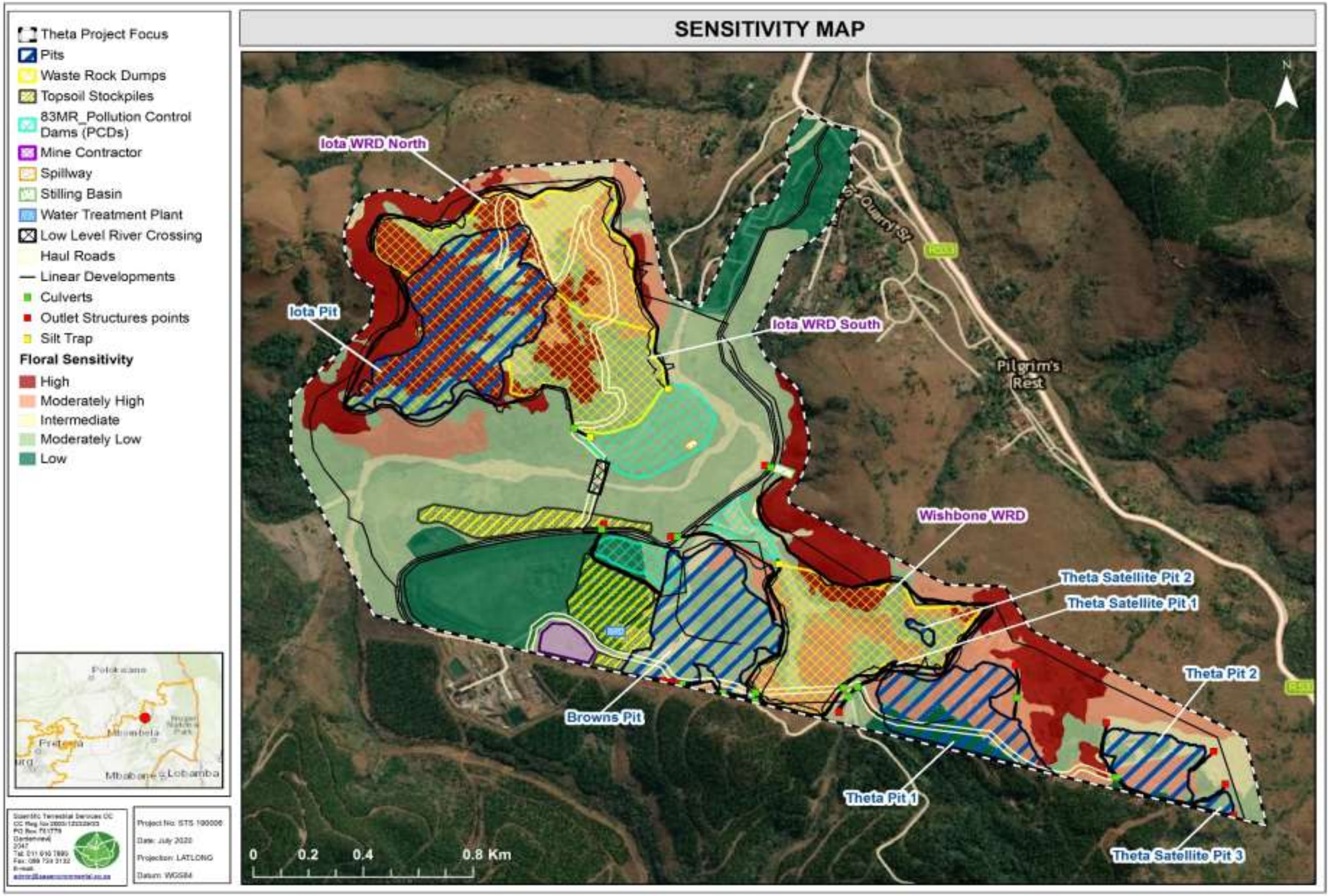

Figure A: The proposed mining-related infrastructure and layouts in relation to the floral sensitivity mapped for the focus area.

Floral Impact Assessment
The perceived impact significance of the proposed mining activities prior to mitigation affecting floral habitat, diversity and SCC are mostly high significance impacts, with some considered medium significance impacts. Even with effective mitigation taking place, most of the impacts will retain a high significance rating, with only a few reduced to a medium significance rating. Low significance ratings were only obtained for areas that are currently degraded and already have a loss of floral diversity and very few (if any) floral SCC present. Positive impacts are deemed likely for the decommissioning phase if current degraded habitat is rehabilitated to restore some ecological functioning that has been lost due to AIP proliferation and habitat transformation.

Placement of infrastructure and mining activities within areas of intact floral habitat of the Mountain Outcrops Habitat, Montane Grasslands Habitat, the Riparian Habitat and indigenous Forest Remnants will negatively impact on floral diversity and habitat within the focus area and potentially within the region if mitigation measures are not fully implemented. The proposed project, if authorised, will result in the loss of not only rare and/or protected plant life, but also primary grasslands with habitat suitable to sustain and support diverse ecosystems. The impacts will be especially significant associated with the Iota Pit, Iota WRDs, Wishbone WRD and Theta Pits. Below is a size estimation of fair to good habitat that will be directly impacted:

- **Pits**: approximately 23 ha of Irreplaceable CBA, 33 ha of Optimal CBA and 40 ha of Malmani Karstlands;
- **Waste Rock Dimps** (including the portion within the Iota Pit area): approximately 45 ha of Irreplaceable CBA, 37 ha of Optimal CBA and 80 ha of Malmani Karstlands;
- **Pollution Control Dams and Balancing Dam**: approximately 2 ha of Optimal CBA and 2 ha of Malmani Karstlands; and
- **Topsoil Stockpiles**: approximately 2 ha of Optimal CBA and 2 ha of Malmani Karstlands.

Assessing the No-go Alternative, or the scenario of a project not going ahead, requires that all possible scenarios be taken into account, including the implications of not authorising the project. For the Theta Project, four scenarios were identified, and their anticipated impacts on floral ecology for the focus area and larger region (where applicable), assessed below:

- No-go with no management from relevant stakeholders;
- No-go with management from relevant stakeholders;
- Authorised mining in an ideal scenario; and
- Authorised mining practically achievable.

If the No-go Alternative is pursued, there will be no immediate and/or direct impact on sensitive floral communities within the proposed mine footprint and will thus avoid the loss of CBAs, threatened ecosystems and floral SCC. The No-go Alternative therefore better aligns with the intended land use and the conservation requirements for the region (see MTPA, 2014). With the No-go Alternative, the existing threats to biodiversity however remain present. To prevent negative impacts on floral communities, there would need to be agreement from government authorities to manage the current risks posed by illegal mining and AIP proliferation. This scenario is not deemed likely as the required resources are unlikely to be made available.

The proposed project, if authorised, will result in the loss of not only rare and/or protected plant life, but also primary grasslands with habitat suitable to sustain and support diverse ecosystems. With authorisation comes the inclusion of mitigation measures that the mine would be obligated to implement, adhere to and be audited on. Control over existing impacts such as AIP proliferation and pollution from illegal mining activities will be better managed if the Theta Project is authorised. Large mining operations can have greater potential for impact than small-scale artisanal mining (illegal mining in this case), but they also have a greater capacity to minimise damage where artisanal mining practises rarely take responsibility for environmental damage.

The following tables represent a summary of the findings of the impact assessment pertaining to the proposed Theta Project:

Table B: Summary of the impact significance of the proposed mining activities.

Pre-construction Phase		
Proposed Activities	UNMANAGED	MANAGED
Iota Pit	High	High
Browns Pit	Medium	Medium
Theta Pits	High	High
Iota WRDs	High	High
Wishbone WRD	High	High
Stockpiles; Mine Contractors Site	Medium	Low
Iota PCD	Medium	Low
Wishbone PCD	High	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	Medium	Medium
Construction Phase		
Proposed Activities	UNMANAGED	MANAGED
Iota Pit	High	High
Browns Pit	High	Medium
Theta Pits	High	Medium
Iota WRDs	High	High
Wishbone WRD	High	High
Stockpiles; Mine Contractors Site	Medium	Low
Iota PCD	Medium	Low
Wishbone PCD	Medium	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	Medium	Medium
Operational Phase		
Proposed Activities	UNMANAGED	MANAGED
Iota Pit	High	Medium
Browns Pit	Medium	Low
Theta Pits	Medium	Medium
Iota WRDs	High	Medium
Wishbone WRD	High	Medium
Stockpiles; Mine Contractors Site	Medium	Low
Iota PCD	Medium	Low
Wishbone PCD	Medium	Low
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	Medium	Low
Decommissioning and closure Phase		
Proposed Activities	UNMANAGED	MANAGED
Iota Pit	High	Medium
Browns Pit	Medium	Low
Theta Pits	High	Medium
Iota WRDs	High	Medium
Wishbone WRD	High	Medium
Stockpiles; Mine Contractors Site	Medium	Low (+)
Iota PCD	Medium	Low (+)
Wishbone PCD	Medium	Low (+)
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	Medium	Low

NO GO ALTERNATIVE VS MINING	
Proposed Activities	Significance
No-go with no management from all stakeholders	High-
No-go with effective management from all stakeholders	High+
Authorised mining in an ideal scenario	Low-
Authorised mining practically achievable	High-

Concerns from a floral ecological perspective include:

1) Many rare or endemic species occur in mountain grasslands, mostly restricted to either quartzite or dolomite, and these grasslands must be considered a conservation priority (Schmidt et al., 2002). Where grasslands formerly spanned 61% of Mpumalanga, agriculture and other development (such as mining and afforestation) have led to approximately 44% to be irreversibly transformed (Ferrar and Lotter, 2007). The conservation of remaining untransformed grasslands with natural vegetation cover should be prioritised to conserve biodiversity.
2) The current assessment on floral SCC for the focus areas is likely not a full representation of conservation important species that occur on site. Additional summer assessments are deemed essential and must take place across all seasons. Summer, autumn and spring assessments have taken place and MTPA recommends additional surveys in winter and in the rainy season (November / December). This will allow for a fully saturated species lists to be developed as part of the study and to ensure the EMP is comprehensive in the management of floral SCC and robust to ensure appropriate execution.
3) Most of the focus area falls within poorly protected grassland ecosystems (National Biodiversity Assessment, 2011) and according to the MBSP Handbook (2014), only 2.3% of South African grasslands are protected, making them of high conservation value. Thus, further pressures on these grasslands from high impact land uses such as surface mining, will hamper the potential for biodiversity targets to be reached for the grassland biome.
4) The entire focus area is located within the 5 km ESA Protected Area Buffer (MBSP, 2014). These are zones around protected areas where changes in land-use may affect the ecological functioning or tourism potential of the adjacent protected area(s). The MBSP Handbook indicates that mining activities such as the activities associated with the proposed Theta Project are land-uses that will compromise biodiversity objectives and are not permissible within the allocated 5 km buffer around protected areas. According to Goal 3 of the Biodiversity Policy and Strategy for South Africa: Strategy on Buffer Zones for National Parks, published under Government Notice 106 in Government Gazette 35020, mining as a whole is described as a development which may have a negative impact or effect on a national park. Such developments are discouraged. However, it is worth mentioning that the current condition of the 5 km Buffer is already extensively transformed by plantations, various agricultural practices and some areas have seen urbanisation. Using the Mpumalanga Biodiversity Sector Plan database (2014), which likely does not have the full extent of transformed land, there is an estimated 60% already modified within this PA buffer (calculated for a 7 km buffer around the Theta Project). On the one hand, this is strong motivation to prevent any further transformation within the buffer; however, the Theta Project will partially fall within the historically mined areas and partially within land transformed by AIPs or plantations, thus forming part of the existing transformed landscape where impact from mining will be limited. Iota Hill is within untransformed land and conflicts with Protected Areas outcomes.
5) Rehabilitation potential: Due to the presence of sensitive floral habitat of high conservation value, it is necessary that all affected areas should be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated. Due to the location of the focus area in Irreplaceable and Optimal CBAs (MBSP, 2014), rehabilitation must be to a pre-mined condition in order for biodiversity targets to be met. If this is not possible, which the findings of this report deem likely, offsetting must be considered for **Optimal CBAs**. Biodiversity offsetting, on the other hand, is not feasible for **Irreplaceable CBAs** (MBSP Handbook, 2014); however, if the proposed MR83-amendment application is approved after consideration of the principles of Integrated Environmental Management (IEM), it is recommended that it be on the bases that there will be compensation for lost habitat in accordance with National and Provincial Offset Guidelines (preferably as a like for like offset[1]). According to the DEA (2017) and the DEA&DP (2011), offsets need to be undertaken according to various ratios based on the ecological importance and sensitivity and vulnerability of the ecosystem:
   - Large sections of the focus area are located within the **Malmani Karstlands Endangered ecosystem**. Basic offset ratio: Endangered ecosystems at least 10 but up to 20 times the impacted area.

[1] "*Like for like*" - Undertaking positive management interventions to restore an area or stop degradation: improving the conservation status of an area of land by restoring habitats or ecosystems and reintroducing native species. Where proven methods exist or there are no other options, reconstructing or creating ecosystems can be undertaken. Also, reducing or removing current threats or pressures by, for instance, introducing sustainable livelihoods or substitute materials. This can either be done on the development site (on-site offset) or a distance from the site (off-site offset) [Business and Biodiversity Offsets Programme (BBOP) Handbook (2009)].

- Large sections of the focus area, and particularly Iota Hill, are located within the **endangered Northern Escarpment Dolomite Grassland.** Basic offset ratio: Endangered ecosystems at least 10 but up to 20 times the impacted area.
- **Areas of composite biodiversity significance (Optimal CBAs)**: Offset ratio at minimum 20 times the impacted area.
- **Areas of irreplaceable biodiversity (Irreplaceable CBAs)**: Very little flexibility for these areas. Offset at 30:1 only where no alternatives to the development project are deemed feasible and where project is of overriding public importance.

6) South Africa is a signatory to the Convention on Biological Diversity and has committed to achieving the Aichi Targets. The proposed Theta Project could compromise these commitments in terms of the following Aichi Targets:
   - **Target 9 (Invasive Species):** The extent of AIPs currently within the focus area (and beyond) suggests that no formal AIP management has been implemented by the mine – or not sufficiently. This has already caused displacement of indigenous floral species and compromises habitat integrity of the area. Regardless of whether the proposed Theta Project proceeds, an AIP Management and Control Plan should be implemented.
   - **Target 11 (Protected Areas and identification of Key Biodiversity Areas)**: The focus area is located in CBAs and Endangered Ecosystems which will be lost or significantly impacted by the proposed Theta Project.
   - **Target 12 (conservation of species)**: The focus area is associated with floral SCC of which several individuals is likely to be directly impacted by the proposed Theta Project.

Based on the results of the floral assessment, it is the opinion of the specialist that this project will have negative impacts on the floral ecology within the focus area and potentially on a local to regional scale and the impacts are relatively irreversible. If the project is to be approved for overriding socio-economic reasons, an appropriate biodiversity offset and compensation plan as well as appropriate funding of this initiative is considered essential.

SUMMARY RESULTS OF THE FAUNAL ASSESSMENT

The Five habitat units were defined within the Focus Area from a faunal perspective included the Mountain Outcrops, Montane Grassland, Forest Remnants (Divided into AIP Dominated Forest Remnants and Indigenous Forest areas), Riparian Habitat and Degraded Habitat Unit.

- Three faunal SCC were recorded within the focus area, namely *Pelea capreolus* (Grey Rhebok, NT), *Rhinolophus smithersi* (Smithers Horseshoe Bat, NT) and *Rhinolophus blasii* (Blasius's Horseshoe Bat, NT);
- Montane Grassland habitat unit offers potential habitat for foraging and breeding for a diversity of faunal species including mammals, reptiles and avifaunal SCC such as *Eupodotis senegalensis* (White-bellied Korhaan, VU), *Falco peregrinus* (Peregrine Falcon, VU), *Geronticus calvus* (Southern Bald Ibis, VU);
- The Mountain Outcrops habitat unit extends throughout the focus area. The distinguishing characteristic of this habitat unit is the composition of prominent rock features that support a diversity of faunal and floral species. The Mountain Outcrops habitat unit offers ideal habitat for numerous reptile SCC and arachnid species which will take advantage of the crevices for shelter such as *Amblyodipsas concolor* (Natal Purple-glossed Snake, VU), *Bradypodion transvaalensis* (Northern Dwarf Chameleon, VU). There is also an increased likelihood that *Panthera pardus* (Leopard, VU) would use the rocky outcrops as cover whilst hunting;
- The Forest Remnants have been split into 2 sub-habitats, namely Degraded Forest (AIP dominated) located within portions of the Iota footprint area and Indigenous Forest located south of the Iota footprint as well as in the Theta Wishbone WRD. These areas provide increased habitat for avifaunal species whilst also serving as areas of refuge for several other faunal species;
- The Blyde River and associated riparian habitat runs through the centre of the focus area and is considered of increased sensitivity and ecological importance. Several smaller drainage lines were also observed, all feeding into the Blyde, providing habitat for a diversity of faunal species. The Riparian Habitat, notably the Blyde River, has an increased potential of providing habitat to several SCC, including avifauna and amphibians. In addition, this habitat provides a permanent and important source of water to specie sin the region;

- ➢ The Transformed habitat unit comprises of areas where indigenous vegetation has been cleared for mining, housing and forestry purposes leaving limited habitat available for faunal species; and
- ➢ Degraded Habitat is characterised by been historically disturbed areas which are notably dominated by Alien Invasive Plants (AIP). This habitat unit supports several common and widely occurring faunal species but is unsuitable for SCC due to the levels of habitat degradation.

Faunal Habitat Sensitivity

The faunal ecological sensitivity of the habitat units varied between High (Blyde River), Moderately high (Mountain Outcrops, Montane Grasslands, Drainage Lines and Forest Remnants), Intermediate (Portions of the Degraded Forest and Drainage Lines) and Moderately low (Degraded Habitat and portions of the Degraded Forest), the sensitivities are discussed in the table below:

Table C: **A summary of the sensitivity of each habitat unit and implications for development.**

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
Montane Grasslands	Moderately High	Iota Pit, Iota WRD north and south Section of Browns Hill Several stretches if the Haul Road Portions of the Wishbone WRD Portions of the Theta Pits	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential in an ecologically sensitive manner. Offsetting or compensation for residual loss to be considered only as a last resort	This habitat unit offers ideal habitat for wide variety of species including mammals, reptiles and avifaunal species. Mining activities should be kept to a minimum within this habitat unit. In this regard, maintaining migratory corridors and connectivity is deemed essential in the remaining areas and as such footprint creep and edge effects must be strictly managed. Where mining is planned within habitat unit, care must be taken to prevent any negative impacts on vegetation and as such edge effects on the surrounding habitats, should be limited. All mitigation measure as set out in this report are to be correctly implemented.
Mountain Outcrops				The Mountain Outcrops habitat unit offers ideal habitat for numerous reptile SCC and arachnid species which will take advantage of the crevices for shelter. Any disturbance of sensitive faunal habitat must be actively avoided. In this regard, maintaining migratory corridors and connectivity along the Mountain Outcrops and with the Montane Grassland is deemed essential. If development will take place within a close proximity of this habitat unit, care must be taken to prevent any negative impacts on vegetation and as such edge effects on this, and surrounding habitats, should be limited. All mitigation measure as set out in this report are to be correctly implemented.
Forest Remnants	Moderately High	Wishbone WRD Downslope of and close proximity to Iota Pit	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential in an ecologically sensitive manner. Offsetting or compensation for residual loss to be considered only as a last resort	This habitat unit provides good habitat for arboreal mammal and reptile species, avifauna and invertebrates. In addition, there is a high likelihood that large raptors will also take advantage of the area for nesting purposes. Any disturbance of sensitive faunal habitat must be actively avoided. Portions of this habitat unit within the Wishbone WRD will be completely lost if current plans are approved, impacting notably on avifaunal species who roost and next in this area. Where development will take place within close proximity of this habitat unit (Iota Pit), care must be taken to prevent any negative impacts on vegetation and as such edge effects on this, and surrounding habitats, should be limited. All mitigation measures as set out in this report are to be correctly implemented.
Blyde River	High	Linear developments, mainly Haul Roads, Pump Column Iota PCD Downslope risk from Iota Pits and WRD's	Mining activities should be actively avoided in this habitat unit Offsetting or compensation for residual loss to be	This habitat unit provides ideal refuge for amphibians, small mammals, reptiles and waterfowl. Mining activities and infrastructure should be minimised in this habitat unit as far as possible due to the possible presence of several faunal SCC. Additionally, the Blyde River plays a pivotal and important function in terms of species support, notably as a corridor of movement and as a permanent source of drinking water. The proposed mining may pose a significant risk to

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
			considered only as a last resort	the downstream habitat should activities not be suitably managed.
Riparian Habitat -Drainage Lines	**Moderately High**	Small portion of Iota WRD and linear infrastructure	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential in an ecologically sensitive manner. Offsetting or compensation for residual loss to be considered only as a last resort	The habitat integrity of the drainage lines (tributaries of the Blyde) have been compromised as a result of the proliferation of AIPs. Although AIP species are present, there are still indigenous plant species present. This habitat unit still provides habitat for several faunal species, and whilst AIP species are present, these species still provide seasonal food resources (berries, seeds and flowers) for fauna. The increased vegetation density further provides areas of refuge for fauna.
	Intermediate	Wishbone WRD Linear developments Wishbone Dam	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	The habitat integrity of the drainage line have been compromised as a result of the proliferation of AIPs, outcompeting much of the indigenous plant species leading to notable habitat loss. Common faunal species do still utilise these areas, although to a lesser degree than the more intact habitats. In addition, these drainage lines are often used as access points by illegal miners, resulting in increased anthropogenic impacts and disturbances.
Degraded Habitat and Degraded Forest	**Moderately Low**	Sections of Iota Pit, Iota WRD North and Iota WRD South. Most of Browns Pit and southern sections of the Theta Pits, as well as sections of the Wishbone WRD Haul Roads and several stretches of the Linear Developments Stockpiles and Mine Contractors Site	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	This habitat is of moderately low importance for faunal species in the region. The degraded state of the habitat and proliferation of AIPs limit faunal habitation opportunities. Although faunal species do traverse, and in some instance common species inhabit this unit, the continued mismanagement of the areas will further result in habitat loss and degradation through AIP proliferation. Development within this habitat unit is not expected to lead to high impacts to the faunal community of the region.
Transformed Habitat	**Low**	Stockpiles, Dams, Potions of Theta Pit and areas of the Haul Road	Optimise development potential.	Development in this area is unlikely to have any impact on faunal species given the already large extent of habitat loss that has occurred. In order to ensure that no further species and habitat loss occurs, it is imperative that edge effects are managed and that no footprint creep occurs into the surrounding areas.

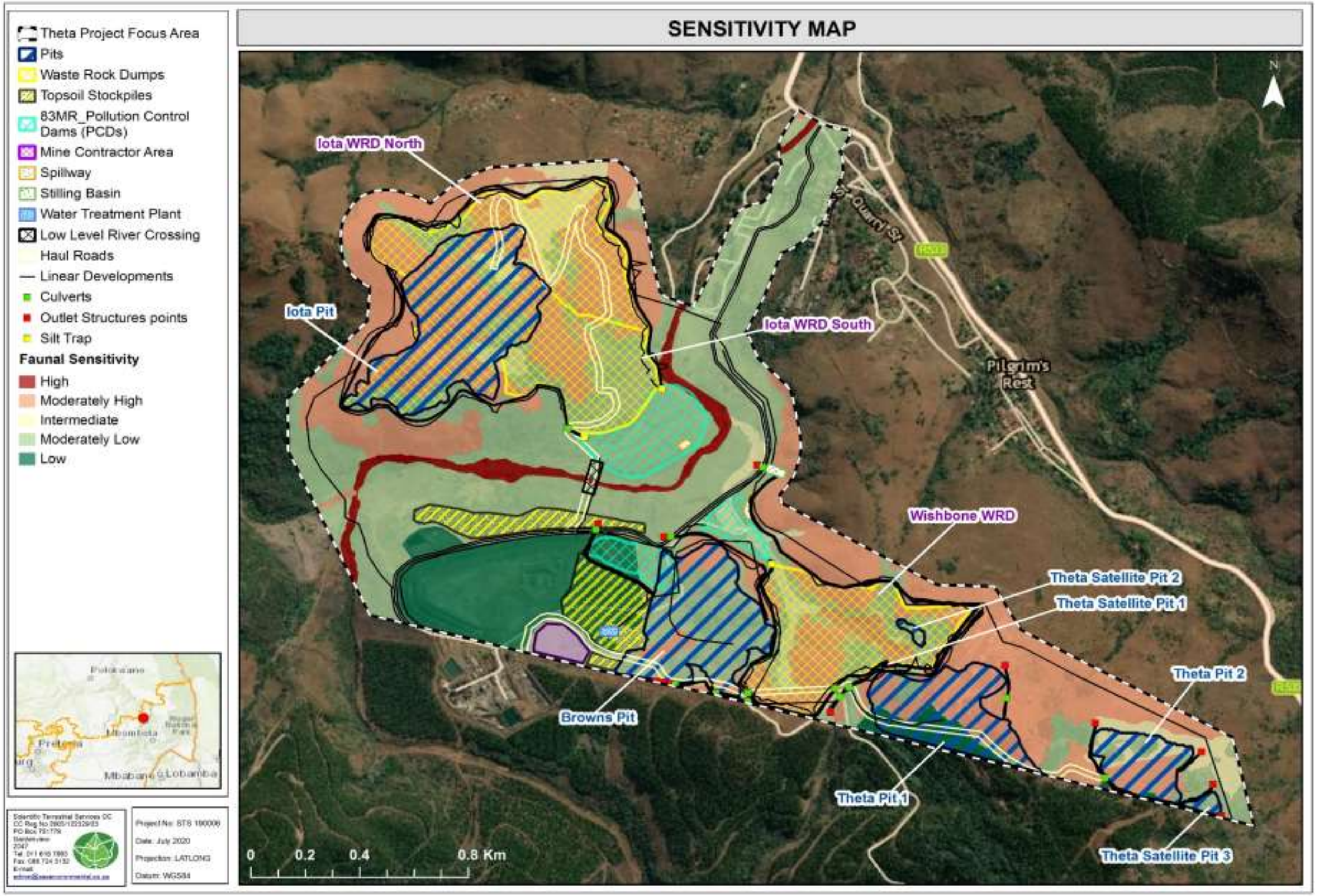

Figure B: Faunal sensitivities associated with the focus area.

Impact Assessment

The proposed Iota, Browns and Theta pits, Wishbone Waste Rock Dump and Iota Waste Rock Dumps are expected to have high impacts regardless of mitigation implementation; however, it must be noted that the extent and manageability of these impacts will decrease with mitigation measures. The remaining impacts associated with the project can be mitigated to medium levels of impact, provides mitigation measures are implemented.

The proposed mining activities will in addition to the loss of faunal habitat and diversity, lead to the following approximate area loss for the associated CBA's:

- Iota WRD (including the Iota Pit area): 34 ha of CBA Irreplaceable with 8 ha of Optimal CBA and 42 ha of Malmani Karstlands;
- Wishbone WRD: 0.001 ha of CBA Irreplaceable, 16 ha of Optimal CBA and 15ha of Malmani Karstlands;
- Iota Pit: 14 ha of Irreplaceable CBA with 5 ha of Optimal CBA and 19 ha of Malmani Karstlands;
- Theta Pits: 5 ha of CBA Irreplaceable with 8 ha of CBA Optimal and 6 ha of Malmani Karstlands;
- Browns Pit: 6 ha of CBA Optimal with 5 ha of Malnani Karstlands; and
- Pollution Control Dams: approximately 1 ha of Malmani Karstlands and 1 ha of CBA Optimal.

Assessing the No-go Alternative, or the scenario of a project not going ahead, requires that all possible scenarios be taken into account, including the implications of not authorising the project. For the Theta Project, four scenarios were identified, and their anticipated impacts on floral ecology for the focus area and larger region (where applicable), assessed below:

- No-go with no management relevant stakeholders;
- No-go with management from relevant stakeholders;
- Authorised mining in an ideal scenario; and
- Authorised mining practically achievable.

Should the mining application not be successful, and the No-go route be taken, there will be no immediate and/or direct impact to the faunal habitat or faunal species within the proposed mine footprint. In addition, this will avoid the loss of CBAs and threatened ecosystems within the footprint, and as such not compromise the current land use and conservation goals for the area (see MTPA, 2014). With the No-go Alternative, the existing threats to biodiversity remain present. To prevent negative impacts to faunal habitat and biodiversity, there would need to be agreement from government authorities to manage the current risks posed by illegal mining and AIP proliferation. Unfortunately, given the realities of the situation and the limited resources available to authorities and stakeholders, this scenario is unlikely to happen.

Should the mine receive authorisation, they will be obligated to implementing a list of mitigation measures to ensure sound and best practice environmental management in a mining scenario, to which they will be audited on. Strict control of mining activities, along with sound engineering designs, where AIPs are controlled and areas rehabilitated and no mine-related activities result in pollution or sedimentation of the Blyde River and downstream habitat, should be the goal. Large mining operations can have a greater impact potential when compared to small-scale artisanal mining, but they also have a greater capacity to minimise damage where artisanal mining practises rarely take responsibility for environmental damage. In addition, the artisanal mining, whilst small scale now, will likely ramp up over time to levels that are beyond any control of government, leading to widescale damage of ecosystems, significant degradation of the Blyde River and significantly increased levels of poaching.

The following tables represent a summary of the findings of the impact assessment pertaining to the proposed Theta Project:

Table D: Summary of the impact significance of the proposed mining activities.

Pre-construction Phase		
Proposed Activities	**Unmanaged**	**Mitigated**
Iota Pit	High	High
Browns Pit	High	High
Theta Pit	High	High
Iota WRD	High	High
Theta Wishbone WRD	High	High
Stockpiles and Project Infrastructure	High	Medium
Iota Dam	High	Medium
Browns Dam	High	Medium
Linear Development (Powerlines, Haul Roads, Access Roads and Diversion Trenches)	High	Medium
Construction Phase		
Proposed Activities	**Unmanaged**	**Mitigated**
Iota Pit	High	High
Browns Pit	High	High
Theta Pit	High	High
Iota WRD	High	High
Theta Wishbone WRD	High	High
Stockpiles and Project Infrastructure	High	Medium
Iota Dam	High	Medium
Browns Dam	High	Medium
Linear Development (Powerlines, Haul Roads, Access Roads and Diversion Trenches)	High	Medium
Operational Phase		
Proposed Activities	**Unmanaged**	**Mitigated**
Iota Pit	High	Medium
Browns Pit	High	Medium
Theta Pit	High	Medium
Iota WRD	High	Medium
Theta Wishbone WRD	High	Medium
Stockpiles and Project Infrastructure	High	Medium
Iota Dam	High	Medium
Browns Dam	High	Medium
Linear Development (Powerlines, Haul Roads, Access Roads and Diversion Trenches)	High	Medium
Decommissioning and closure Phase		
Proposed Activities	**Unmanaged**	**Mitigated**
Iota Pit	High	Medium
Browns Pit	High	Medium
Theta Pit	High	Medium
Iota WRD	High	High
Theta Wishbone WRD	High	Medium
Stockpiles and Project Infrastructure	High	Medium
Iota Dam	High	Medium
Browns Dam	High	Medium
Linear Development (Powerlines, Haul Roads, Access Roads and Diversion Trenches)	High	Medium

NO GO ALTERNATIVE VS MINING	
Proposed Activities	**Significance**
No-go with no management from all stakeholders	High-
No-go with effective management from all stakeholders	Low+
Authorised mining in an ideal scenario	Low-
Authorised mining practically achievable	Medium-

Concluding Remarks

The Riparian Habitat, Intact Forest Remnants and Rocky Outcrops are considered to be niche areas of habitat that support unique diversities of species often not found in other areas. The Montane Grassland and Mountain Outcrops habitat units are deemed to be sensitive due to the capacity of providing habitat and support a diversity of faunal species as well as several faunal SCC. It is of the highly recommended that if approval is granted, the proposed mining footprints and infrastructure locations be inspected by a suitably qualified and experienced ecologist to conduct thorough walkdowns prior to ground/vegetation clearing of the proposed areas to minimize the possible impact to SCC, as far as possible.

With proposed mitigations employed, most impacts may be reduced to medium, however impacts associated with the construction phase of Iota, Browns and Theta pits and Wishbone and Iota Waste Rock Dump are expected to remain high regardless of mitigation measures. It must be noted however that the extent and manageability of these impacts will decrease with mitigation measures. The proposed haul roads are anticipated to impact upon the Blyde River itself as well as the riparian habitat due to the upgrading of the river crossing and road network. Clearing activities of the riparian areas associated with the haul roads are likely to result in the displacement of amphibian and avifaunal species which inhabit and utilise these areas, whilst potentially providing an opportunity for AIPs to establish in the disturbed areas. Additional surface water runoff and sedimentation if not managed may result in amphibian habitat degradation.

Based on the results of the faunal assessment, it is the opinion of the specialist that this project will have negative impacts on the faunal ecology within the focus area and potentially on a local to regional scale. Of further importance it is expected that the impacts stemming from this project will be relatively irreversible. The impact of the proposed project must however be contrasted with the risk that uncontrolled artisanal mining poses. If the project is to be approved for overriding socio-economic reasons, an appropriate biodiversity offset and compensation plan as well as appropriate funding of this initiative is considered essential.

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BIODIVERSITY ASSESSMENT AND IMPACT ASSESSMENTS AS PART OF THE ENVIRONMENTAL AUTHORISATION AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS FOR THE TGME THETA PROJECT TO INCLUDE THE THETA HILL, BROWNS HILL AND IOTA HILL NEAR PILGRIM'S REST, MPUMALANGA PROVINCE

Prepared for

Batho Earth

Social and Environmental Consultants

First submission: May 2019
Updated: July 2020

Section A: Background Information

Prepared by:	**Scientific Terrestrial Services**
Report author	**C. Steyn**
Report reviewer	**N. Cloete (Pr.Sci.Nat)**
Report Reference:	**STS 190006**
Date:	**June 2020**

SAS Environmental Group of Companies

DOCUMENT GUIDE

The Document Guide below is for reference to the procedural requirements for environmental authorisation applications in accordance to GN267 of 24 March 2017, as it pertains to National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA).

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Section A, Appendix E
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Section A, Appendix E
b)	A declaration that the specialist is independent	Section A, Appendix E
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section A, Section 1.1 – 1.3 Section B, Section 1.1 – 1.3 Section C, Section 1.1 – 1.3
cA)	An indication of the quality and age of base data used for the specialist report	Section A, Section 2.1 and 3.1 Section B, Section 2 Section C, Section 2
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section B and C
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section A, Section 1.4 and 2.1 Section B, Section 2 Section C, Section 2
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section B and 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 B and C
g)	An identification of any areas to be avoided, including buffers	Section B and C
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 B and C
i)	A description of any assumptions made and any uncertainties or gaps in knowledge	Section A, Section 1.5 Section B, Section 1.4 Section C, Section 1.4
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 B and C
k)	Any mitigation measures for inclusion in the EMPr	Section B and C
l)	Any conditions for inclusion in the environmental authorisation	Section B and C
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section B and C
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section B and C
(iA)	Regarding the acceptability of the proposed activity or activities	Section B and C
(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 B and C
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 and Invasive species	A species that is not an indigenous species; or an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.
CBA (Critical Biodiversity Area)	A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges.
Endangered	Organisms in danger of extinction if causal factors continue to operate.
Endemic species	Species that are only found within a pre-defined area. There can therefore be sub-continental (e.g. southern Africa), national (South Africa), provincial, regional or even within a particular mountain range.
ESA (Ecological Support Area)	An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation.
IBA (Important Bird and Biodiversity Area)	The IBA Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that: are globally threatened, have a restricted range, are restricted to specific biomes/vegetation types or sites that have significant populations.
Indigenous vegetation (as per the definition in NEMA)	Vegetation occurring naturally within a defined area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
Invasive species	Means any species whose establishment and spread outside of its natural distribution range; they threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and may result in economic or environmental harm or harm to human health
Least Threatened	Least threatened ecosystems are still largely intact.
Phyto Centres and Regions of Endemism	Most of southern Africa's endemic plants are concentrated in only a few, relatively small areas, known as regions or centres of endemism. Not only do these centres hold clues to the origin and evolution of the botanical diversity within a particular area, but these are also areas that, if conserved, would safeguard the greatest number of plant species (Van Wyk & Smith 2001).
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.
SCC (Species of Conservation Concern)	The term SCC in the context of this report refers to all RDL (Red Data) and IUCN (International Union for the Conservation of Nature) listed threatened species as well as protected species of relevance to the project.

LIST OF ACRONYMS

AIP	Alien and Invasive Plants
BGIS	Biodiversity Geographic Information Systems
CARA	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
CBA	Critical Biodiversity Area
CR	Critically Endangered
DMRE	Department of Mineral Resources and Energy (DMRE)
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
ESA	Ecological Support Area
GIS	Geographic Information System
GPS	Global Positioning System
IBA	Important Bird Area
IEM	Integrated Environmental Management
IUCN	International Union for the Conservation of Nature
LoM	Life of Mine
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential for Evaporation
MASMS	Mean Annual Soil Moisture Stress
MAT	Mean Annual Temperature
MFD	Mean Frost Days
MPRDA	Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002)
NBA	National Biodiversity Assessment (2011)
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NEMBA	National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004)
NPAES	National Protected Areas Expansion Strategy
NT	Near Threatened
PES	Present Ecological State
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square (1:50,000 topographical mapping references)
RDL	Red Data List
ROM	Run of Mine
SABAP 2	Southern African Bird Atlas 2
SANBI	South African National Biodiversity Institute
SAPAD	South Africa Protected Area Database
SCC	Species of Conservation Concern
STS	Scientific Terrestrial Services CC
TGME	Transvaal Gold Mining Estates
TSP	Threatened Species Programme
VU	Vulnerable
WRD	Waste Rock Dump

1 INTRODUCTION

1.1 *Background*

Scientific Terrestrial Services (STS) was appointed to conduct a Biodiversity Assessment and Impact Assessments as part of the environmental assessment and Environmental Impact Assessment (EIA) process for the Transvaal Gold Mining Estate (TGME) Mine Development Project: Application for the amendment of the existing environmental authorisation to include the proposed Theta Project comprising the Theta Hill, Browns Hill and Iota Hill open pit projects near Pilgrim's Rest, Mpumalanga Province. The areas to be assessed will henceforth be referred to as the "focus area", except when specifically referring to the activities associated with Theta Hill, Browns Hill or Iota Hill.

The focus area falls within the Thaba Chweu Local Municipality and is located on Portion (Ptn) 42 of the Farm Ponieskrans 543KT (owned by Public Works) (Figures 2 and 3), which forms part of six farm portions making up the existing Mining Right Area (MRA, Figure 1). The focus area is situated immediately to the south and west of Pilgrim's Rest, a provincial heritage site, with the R533 running along the northern and eastern sides of the focus area. Apart from Mashishing (previously known as Lydenburg) (approximately 35 km southwest), no major towns are nearby; however, several tourist attractions are located close to the focus area, including the tourist town Graskop and the scenic tourist destination God's Window (approximately 8.2 km southeast). On a regional setting, the landscape consists of far-stretching hills with large portions still in a natural, undisturbed condition. The major contributor of disturbance of natural habitat within the region includes mining, forestry and cultivation.

The purpose of this report is to define the terrestrial ecology of the focus area from a desktop conservation database perspective. It is the objective of this study to provide detailed information to guide the fieldwork components to ensure that all relevant ecological aspects were considered prior to performing the field assessments. This report is not a standalone report and should be considered together with the outcomes of the floral and faunal assessments (Section B and C).

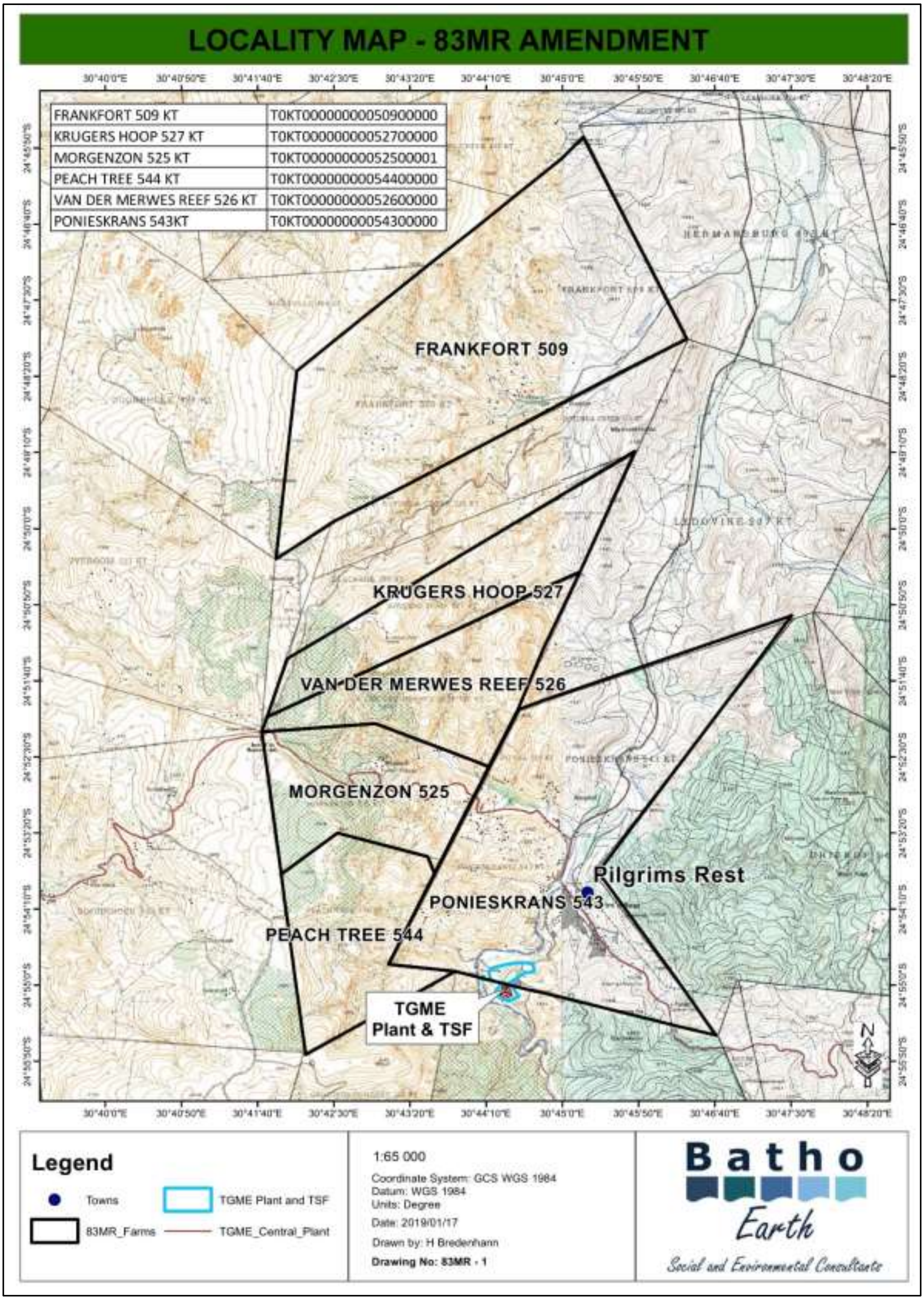

Figure 1: 2019.01.17. Updated Locality Map as provided by Batho Earth.

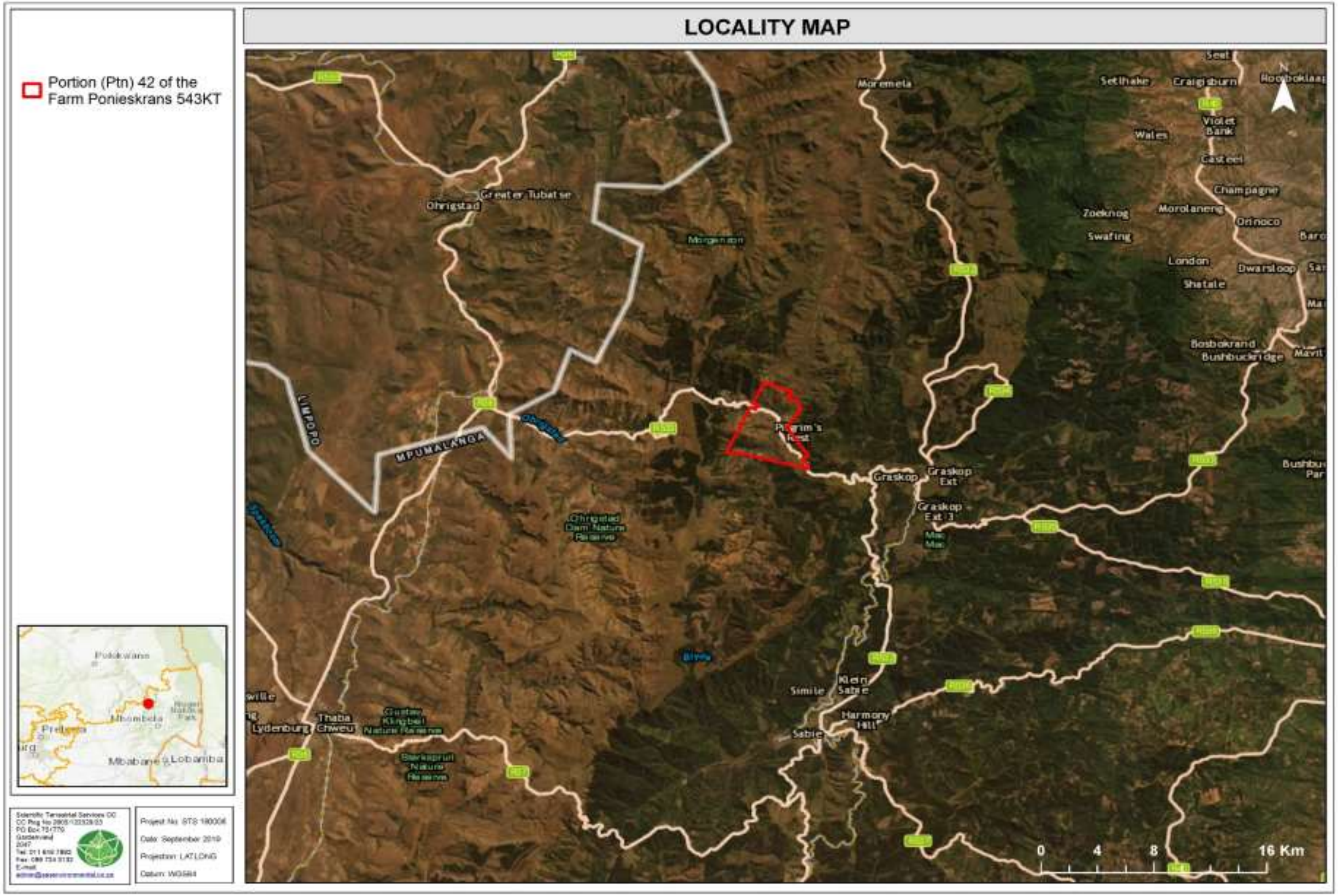

Figure 2: Digital satellite image depicting Portion (Ptn) 42 of the Farm Ponieskrans 543KT in relation to surrounding areas.

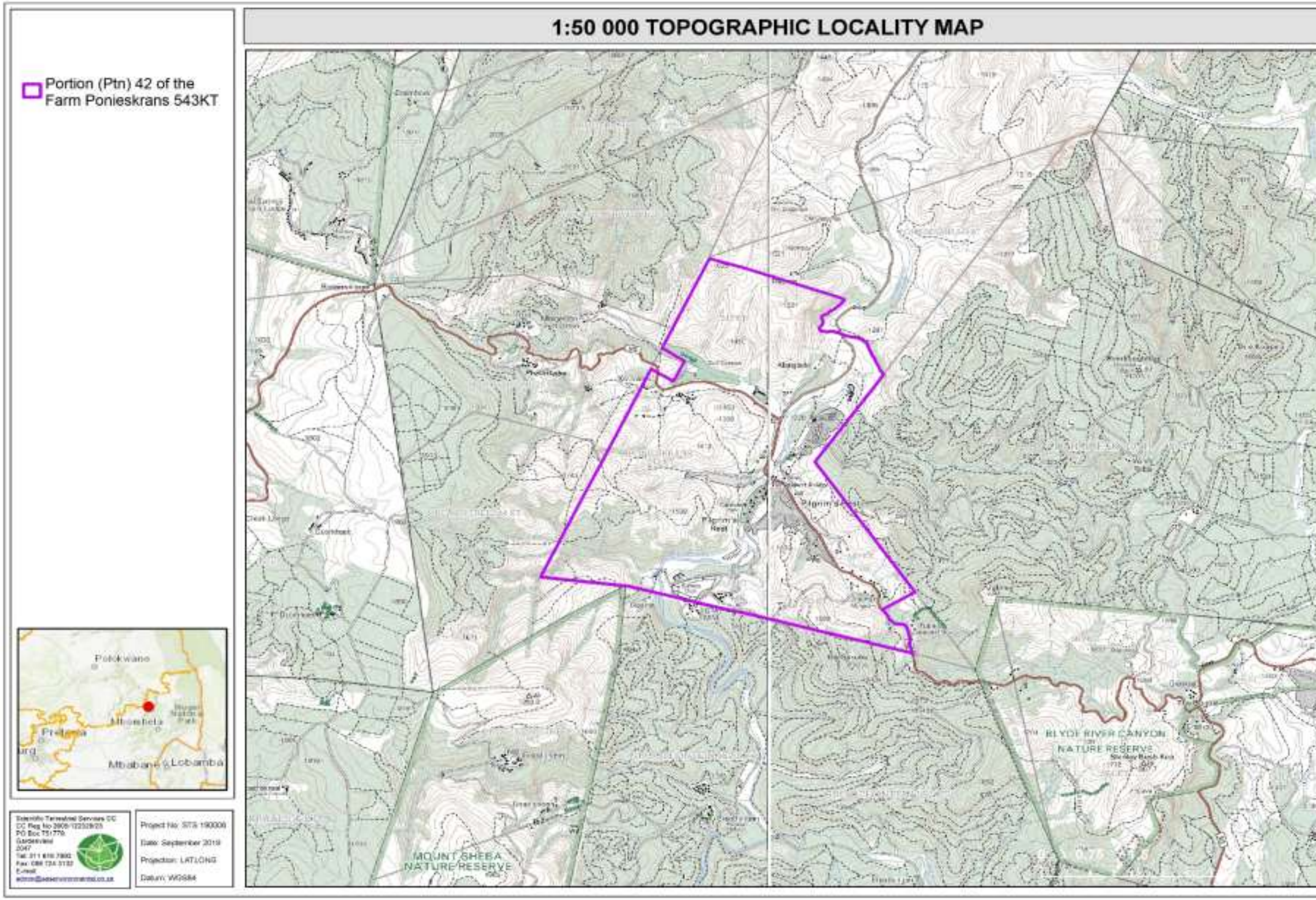

Figure 3: Location of Portion (Ptn) 42 of the Farm Ponieskrans 543KT depicted on a 1:50 000 topographical map in relation to surrounding area.

1.2 *Project Description*[2]

The Theta Project Mineral Resources traverse two mining right areas, namely 83MR for the portion within Ponieskrantz 543 KT, and 341MR for the portion within Grootfontein 562 KT. Only the portion within Ponieskrantz 543 KT, i.e. 83MR, is investigated in this study. The entire 83MR is situated on various portions of the farms Frankfort 509-KT, Krugers Hoop 527-KT, van der Merwes Reef 526-KT, Morgenzon 525-KT, Peach Tree 544-KT and Ponieskrans 543-KT, and encompasses an area of 9,413 hectares (ha). Extent of the area required for mining is 286 ha.

The existing and approved 83MR allows for the mining of gold ore, silver ore, copper ore and stone aggregate over the extensive 9,413 ha of land. It was granted, registered and executed and expires on 15 October 2023. An application for the amendment of the existing environmental authorisation has been submitted to include the proposed Theta Open Pit Project. In support of this, an Environmental Authorisation and IWULA amendment process is underway.

Historically the area on 83MR has operated in terms of open cut as well as underground gold mines. Theta Hill, Browns Hill and Iota Hill have historically been exploited as mainly underground mines with very limited open pitting. The Theta Hill, Browns Hill and Iota Hill surface projects, collectively referred to as the “Theta Project”, entails surface mining operations at the abovementioned three locations, with an anticipated Life of Mine (LoM) of five and a half years.

To effectively establish the open pit mining operation, a number of infrastructure items will be required. Extent of the area required for the proposed Theta mine is listed in the below table. A depiction of the proposed mine layout is provided in Figure 5. The existing TGME Plant falls within the MR341 mining licence area. Included in this area will be the newly proposed mining site (Offices, workshops, stores, etc.).

[2] Mining Work Programme submitted in support of an application for an amendment to a Mining Right as required in terms of Section 23 (a), (b) and (c) read together with Regulation 11(1) (g) of the Mineral and Petroleum Resources Development Act (Act 28 of 2002). This application is made in support of an amendment in terms of Section 102 of the Mineral and Petroleum Resources Development Act (act 28 of 2002).

Table 1: Extent of the infrastructure associated with the Theta Project.

NAME	ENCLOSED AREA (Ha)	TOTAL LENGTH/ PERIMETER (Km)
Access Road		6,98
Balancing Dam	3,35	
Berms		10,44
Browns Pit	17,45	
Clean Water Channels		27,60
Culverts	0,24	
Dirty Water Channel		52,24
Haul Roads	9,54	9,60
Iota Pit	25,53	
Iota Pollution Control Dam	8,33	
Iota Waste Rock Dump North	45,88	
Iota Waste Rock Dump South	16,66	
Low Level River Crossing	0,49	
Mine Boundary		6,42
Mine Contractor Area	1,82	
Outlet Structures	0,19	
Pipelines		3,39
Powerline		2,35
Silt Trap	0,04	
Spillway	0,30	
Stilling Basin	0,22	
Theta Pit 1	12,74	
Theta Pit 2	6,29	
Theta Satellite Pit 1	0,03	
Theta Satellite Pit 2	0,38	
Theta Satellite Pit 3	0,62	
Topsoil Stockpile	12,82	
Water Treatment Plant	0,21	
Whishbone Waste Rock Dump	23,14	
Wishbone Pollution Control Dam	2,45	

1.2.1 Proposed Mining Method

The mining method selected for this project is modified terrace mining because it is suited to the mountainous profile of the current topography. The mining method consists of continuous removal of overburden / waste material to expose ore. The mining method requires the removal of topsoil which will be stockpiled to be utilised for rehabilitation purposes. The topsoil stockpile will also be utilised as a berm to divert the ingress of water and will be situated close to the mining area to enable short hauling for the rehabilitation of the backfilled areas. Topsoil will be removed as an ongoing process as the open pit progresses.

Due to the mountainous topography there is limited space available for Waste Rock Dumps (WRDs) on the project area. The planned mining strategy is to utilise space in the mined-out areas for backfilling of waste, this will ultimately reduce the WRD footprint.

Once mining has progressed, and enough area has been created in the pit, some overburden / waste material will be backfilled into this space.

1.2.2 Mining of ore

The primary method of breaking rock on the project will be by means of Dozer ripping. Ripping is a method of loosening material by means of pulling a ripper shank attached to the back of a tracked dozer through densely packed material. In areas where the planned dozer may not be capable of ripping the material an eccentric ripper will be used as the secondary method of breaking rock. Material requiring no breaking will be free dug and will be removed with a truck and shovel combination. Once material has been broken sufficiently via ripping, the material will be loaded into dump trucks with excavators and hauled via dedicated haul roads to the Run of Mine (ROM) pad.

1.2.3 Mining of waste

Waste material will be mined in a similar fashion to that of the ore. Broken waste - which will be achieved by nonexplosive breakage by ripping with a dozer or eccentric rippers - will be loaded onto haul trucks by an excavator and hauled to a waste storage facility keeping in mind the overall strategy remains to minimise to overall WRD footprint. During the early stages of mining there will be limited space available to backfill waste back into the pits and this material will have to be place on a WRD.

1.2.4 Back filling

As mining progresses, waste removed from the pit will be hauled directly to dedicated areas within the pit - this is very similar to roll-over mining. The dedicated areas for backfilling are selected based on available area and overall slope angles to ensure safe placement of waste material in the pit. Once a pit is mined out there will be a void remaining – this void is a function of the initial material placed in WRDs and other constraints limiting complete backfill. The philosophy is to not re-handle any waste material.

1.3 *Progression of site layouts from Environmental Scoping Phase to EIA Phase*

The site layouts changed throughout the course of this study from the Scoping Phase to the EIA Phase. Included in this section is a portrayal of the progression from an initial layout (Layout 1) through to the most resent "updated" Layout 3, which reflects a balanced layout of the project and takes into consideration the various environmental and economic drivers, amongst others.

The layout progression has, in the first instance, been significantly influenced by environmental considerations and thereafter engineering, economic and social considerations. These are described in detail in the subsequent sections.

1.3.1 Scoping Phase (Layout 1) - Engineering Feasibility Study

The applicant, TGME, through an engineering feasibility study, has identified the opportunity to mine gold bearing reefs via modified terrace mining and therefore the need to amend its current environmental authorisation linked to their existing mining right (83MR) to include the new mining sections to mine the near surface material. Three mining areas were identified based on exploration and evaluation work done within the focus area. The three areas are referred to as the Theta Pit, Browns Pit and Iota Pit.

The engineering feasibility study formed the basis for the permitting phase, and informed the initial site layout (Figure 4) which was incorporated into the Environmental Authorisation application which comprises a Scoping Phase and an EIA Phase. These phases results in the develpoment of an Environmental Management Plan (EMP) for consideration by the competent authority, namely the Department of Mineral Resources and Energy (DMRE).

In terms of the placement of the related infrastructure, a few design or layout alternatives were initialy considered. Infrastructure included topsoil stockpiles, run-of mine ore stockpiles, WRDs, Pits and haul roads. The general mining site infrastructure included offices, change houses and laundry facilities, control room, first aid station, stores and laydown yard, salvage yard and waste sorting area, transformer substation, fuel storage facility, refuelling bay, wash bay, workshops, brake test ramp and parking areas. As part of the operational activities, two potential options were proposed for the locations of the associated WRDs at both Theta and Iota Hills. These are detailed in Figure 4 and briefly outlined below:

- Theta/Browns Waste Rock Dump Option 1: This option is situated between both Browns and Theta Pit;

- Theta/Browns Waste Rock Dump Option 2: Located to the north eastern side of Theta Pit, incorporates two smaller pockets separated by a tributary;
- Iota Waste Rock Dump Option 1: Located to the north western corner of the Iota Pit; and
- Iota Waste Rock Dump Option 2: Is located to the north eastern boundary of the Iota Pit.

These layouts were passed by the various specialists for consideration in their respective first round assessments. The engineering feasibility study informed the initial site layout plan, which was incorporated in the final scoping report (Layout 1) as submitted to the DMRE (dated 16 August 2019). The Scoping Report made provision for various biophysical and social studies which would determine the baseline conditions at the project site as well as make recommendations related to the feasibility of the proposed localities and alternatives as per the initial site layout plan.

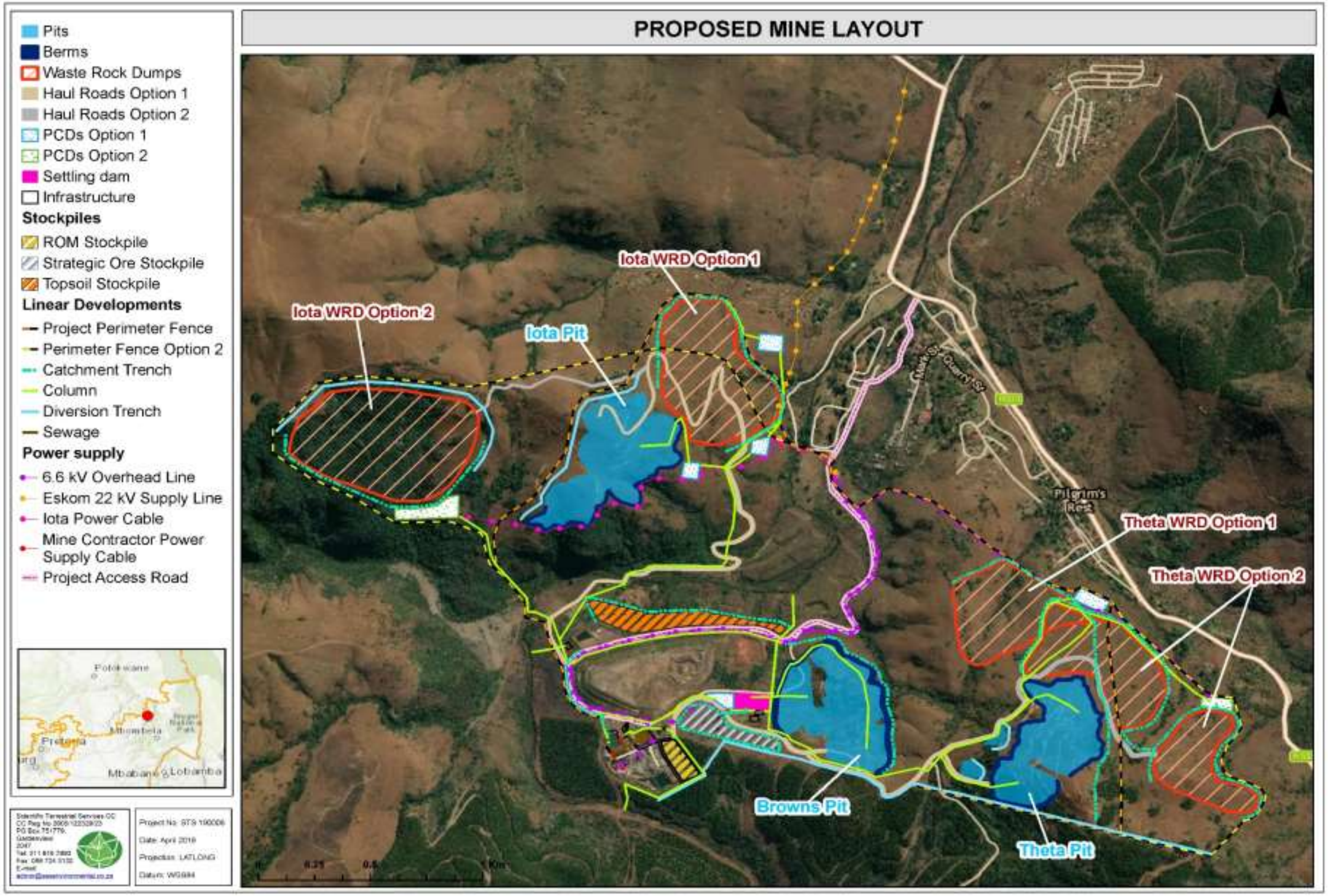

Figure 4: The initial proposed mine layout (Layout 1) for the Theta Project as part of the Scoping Phase.

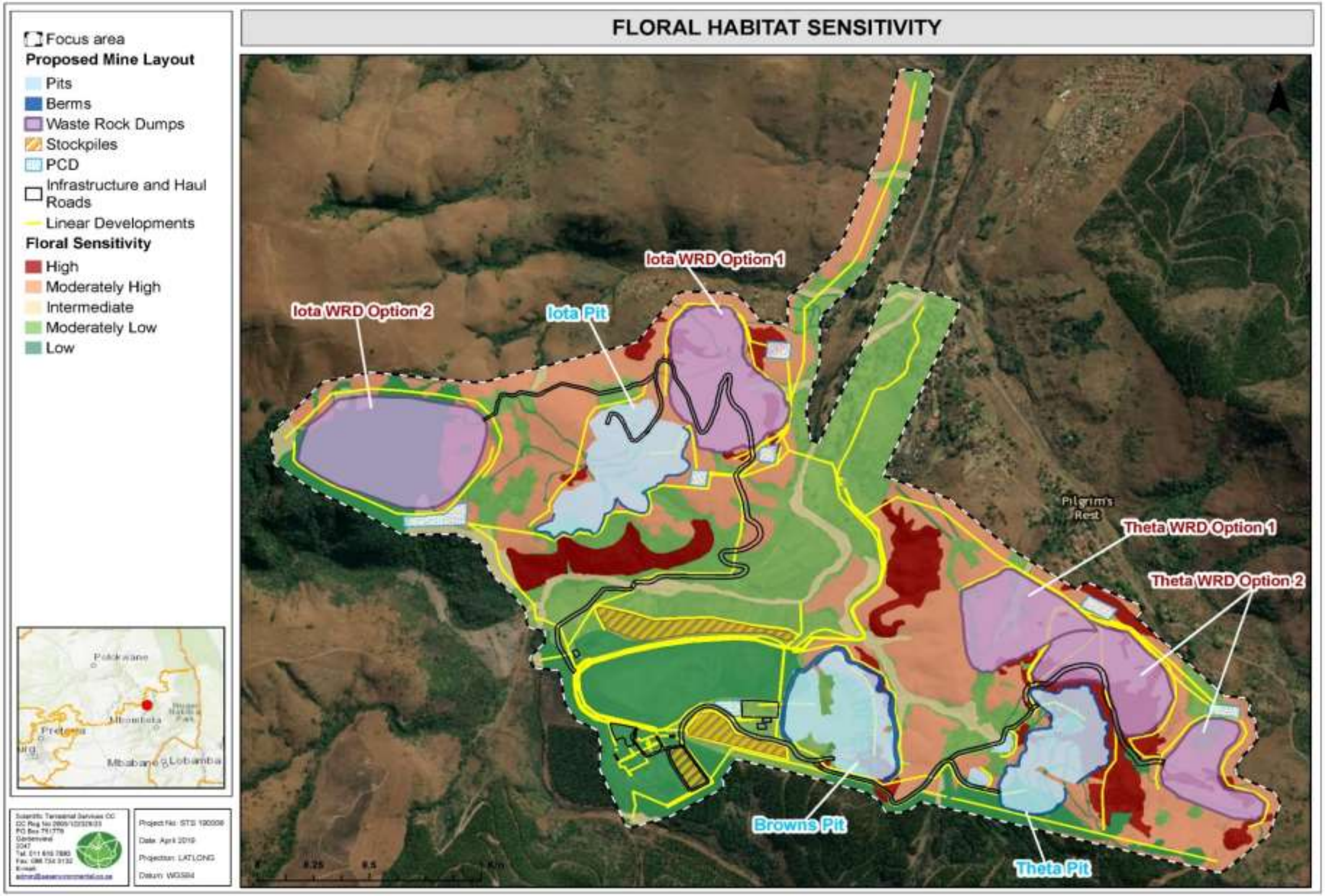

Figure 5: Baseline floral sensitivity map for the focus area as part of Scoping Phase (Layout 1).

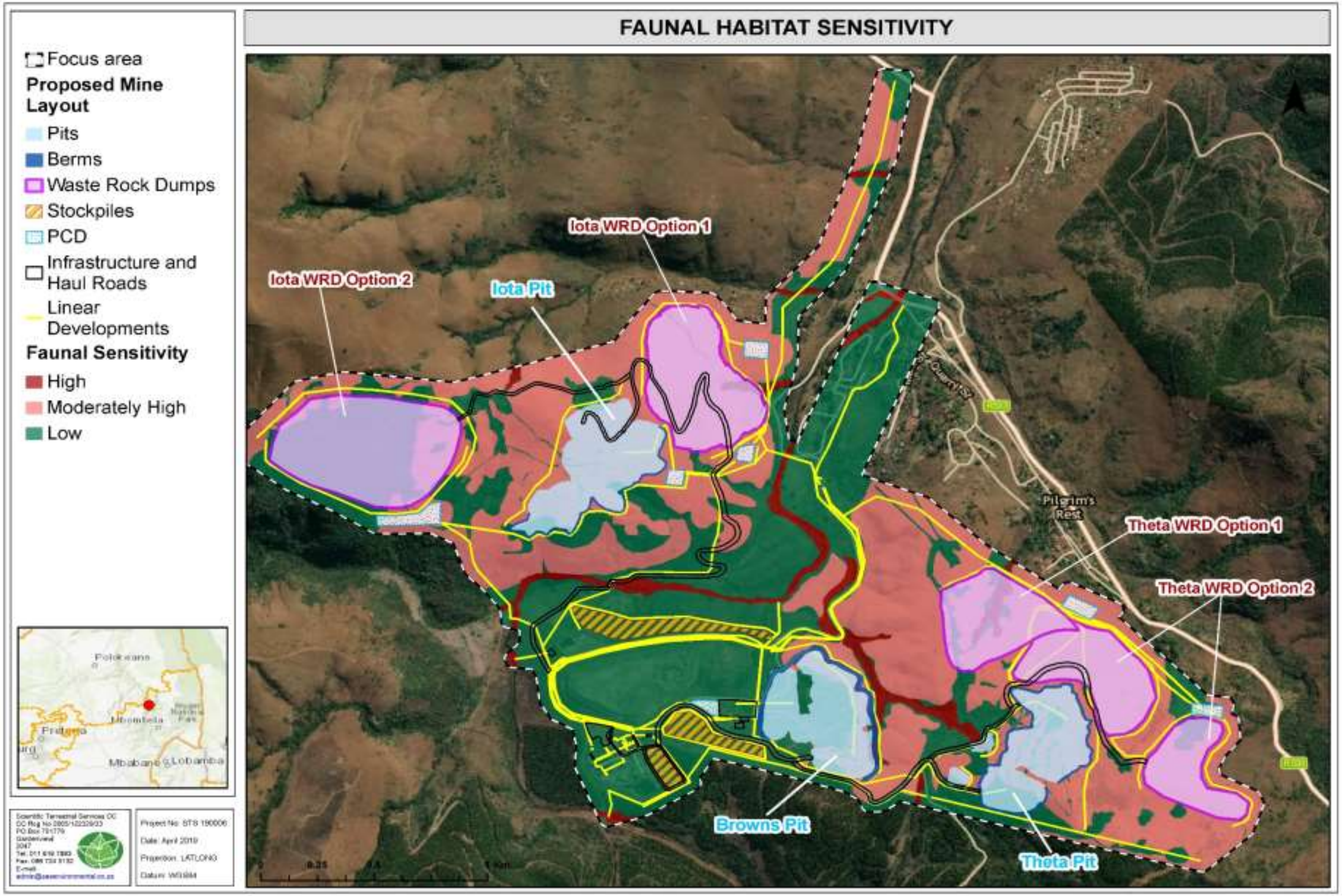

Figure 6: Baseline faunal sensitivity map for the focus area as part of Scoping Phase (Layout 1).

1.3.2 Environmental Impact Assessment Phase (Layout 2)

Layout 2 saw significant changes to the sizes of the various pits as well as changes to the locations of the WRDs which were all informed by biophysical and social specialist studies.

The plan of study proposed in the Scoping Report made provision for various biophysical and social studies which would determine the baseline conditions at the project site as well as make recommendations related to the feasibility of the proposed localities and alternatives as per the initial site layout plan. The outcome of these biophysical and social studies was used to inform Layout 2 (draft EIA phase mining layout), as is common practice in Integrated Environmental Management[3] (IEM). Environmental and social management practices are based on following the precautionary principle, which, simply defined, means developing actions on issues considered to be uncertain, for instance applied in assessing risk management.

Several biophysical and social baseline studies were conducted, including terrestrial ecology (fauna and flora), soils and land capability, air quality, noise and vibration, visual impact, socio-economic and health impact, water quality, heritage and rehabilitation objectives. These studies returned substantial environmental and social sensitivities and nuances. The faunal and floral habitat sensitivity maps are provided in Figures 5 and 6 above for comparison.

The process of EIA, within which the above-mentioned studies were undertaken, is inhibited in its ability to assess year-round baseline conditions due to the legislated timeframes imposed by South African law and regulation. In these instances, which is typical of EIA processes, the Environmental Assessment Practitioner (EAP) imposes the precautionary approach by informing the site layout plan from an environmental and social perspective to assist the applicant to achieve the most feasible site layout plan. Based on the outcome of these studies, a reduction in the pit shell sizes, the relocation of the WRDs and re-consideration of the PCD requirements resulted. The most significant changes made to Layout 2 (Figure 7) include the following:

- Revised pit layouts, with the Theta Pit being affected most;
- Modification to WRD location to minimise potential environmental impact – here the concept and location of the Wishbone WRD is significant;
- Reduction in the number of PCDs to be constructed;

[3] IEM is a philosophy that is concerned with finding the right balance between development and the environment. The difference between IEM and an EIA is that IEM is a whole philosophy whereas EIA is just one tool or technique used to gather and analyse environmental information that is a part of the IEM process (Source: Enviropaedia).

- Optimisation of the overall project footprint.

In the case of the Theta Project, the application of the precautionary approach resulted in an alteration of the site layout plan as initially presented in the Scoping Report (Layout 1). The altered site layout plan was achieved through the implementation of the following mitigation hierarchy:

1. Avoid the potential impact altogether;
2. Minimise the area of the potential impact as far as possible;
3. Rehabilitate and restore the affected area; and
4. Secure a biodiversity offset area as compensation for the affected area.

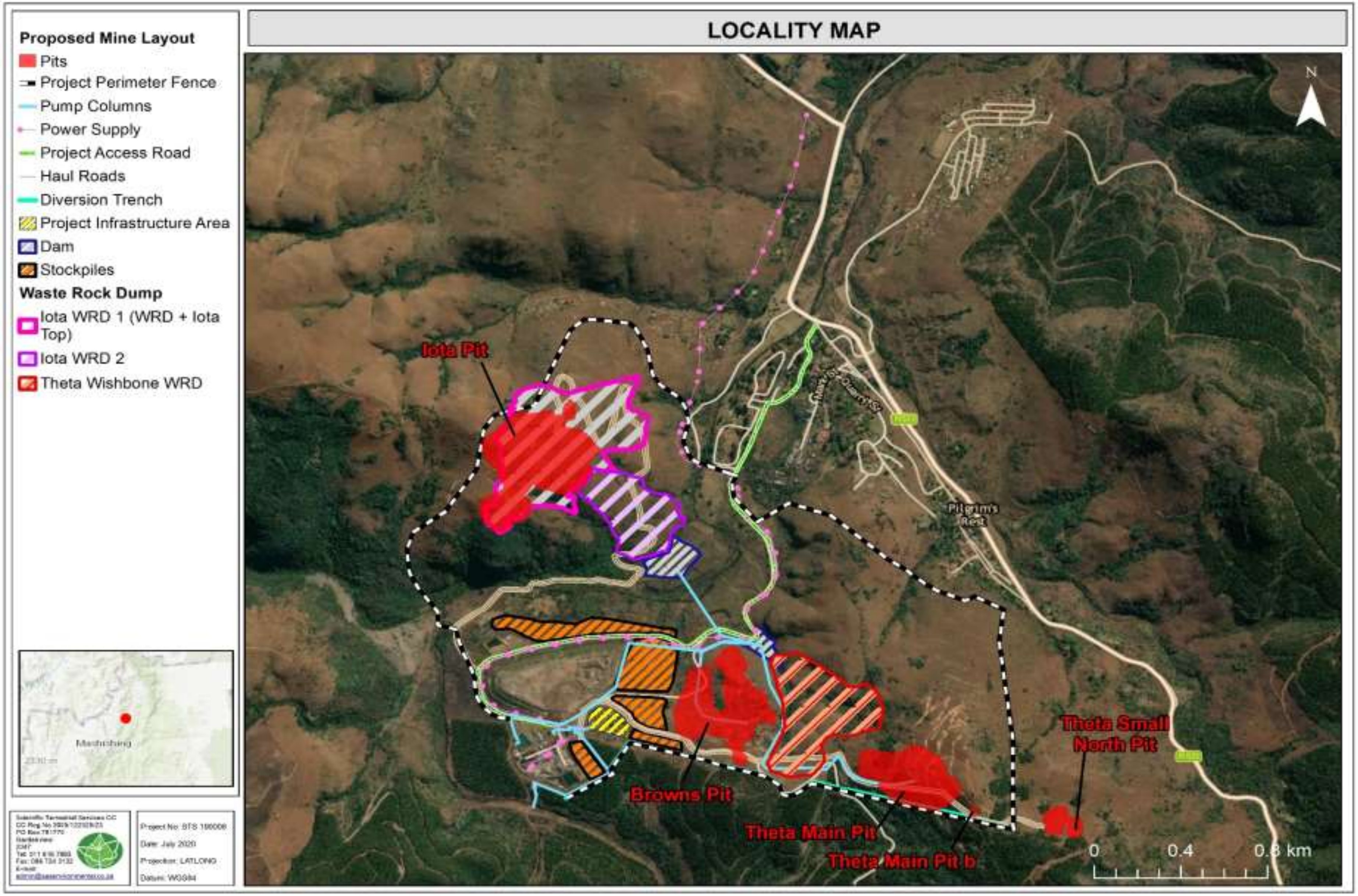

Figure 7: The revised site layout plan (Layout 2) which formed part of the draft EIA Phase for of the proposed Theta Project.

1.3.4 Environmental Impact Assessment Phase Draft (Layout 3)

Following the submission of Layout 2, further detailed design work was completed on the WRDs and PCDs as part of the existing water use licence application, to ensure that the structures would be stable and able to maximise successful concurrent rehabilitation outcomes. As part of this process, various stability and geotechnical activities were carried out which informed the designs. The design engineers were asked to adapt their designs to avoid various high biodiversity areas within the WRD footprints. The further studies included:

- **Structural design engineer assessments**: Mining area footprints had to change to ensure stable structures for the WRDs and PCDs;
- **Ecological Assessment**: Due to the change in the mining footprint, an additional site visit was required to assess the sensitive areas. This has led to the change in the mine layout plan to avoid areas of high value such as the protea stand located near the Wishbone WRD. Additional details on the various ecological site visits are presented in the Floral and Faunal Assessments (Section B and C); and
- **Mining Engineers study**: Additional engineer studies were required to improve mining resource utilisation.

During the same period, TGME recognised that significant changes in the global market had resulted due to the COVID-19 pandemic. These changes have the potential to impact on the Applicant's project due to, among others, an increase in the gold price and the downgrade of the South African economy to junk status.

To respond to the expected changes in the global economic environment, TGME completed a re-evaluation of the Theta Project (i.e. 83MR) with a view to improving the economic metrics of the project to further enhance the attractiveness to potential funders. This has resulted in a new mine schedule being developed which has changed the sequence of the pits being mined and has also resulted in the pits being made slightly larger to bring in more gold bearing material while still taking cognisance of the environmental conditions in the area.

The EIA/EMPr provides a detailed description of the amended layout plan referred to as **Layout 3** (Figure 8). This layout was identified by TGME as the only feasible alternative, which addressed both the environmental sensitivities and the global economic environment.

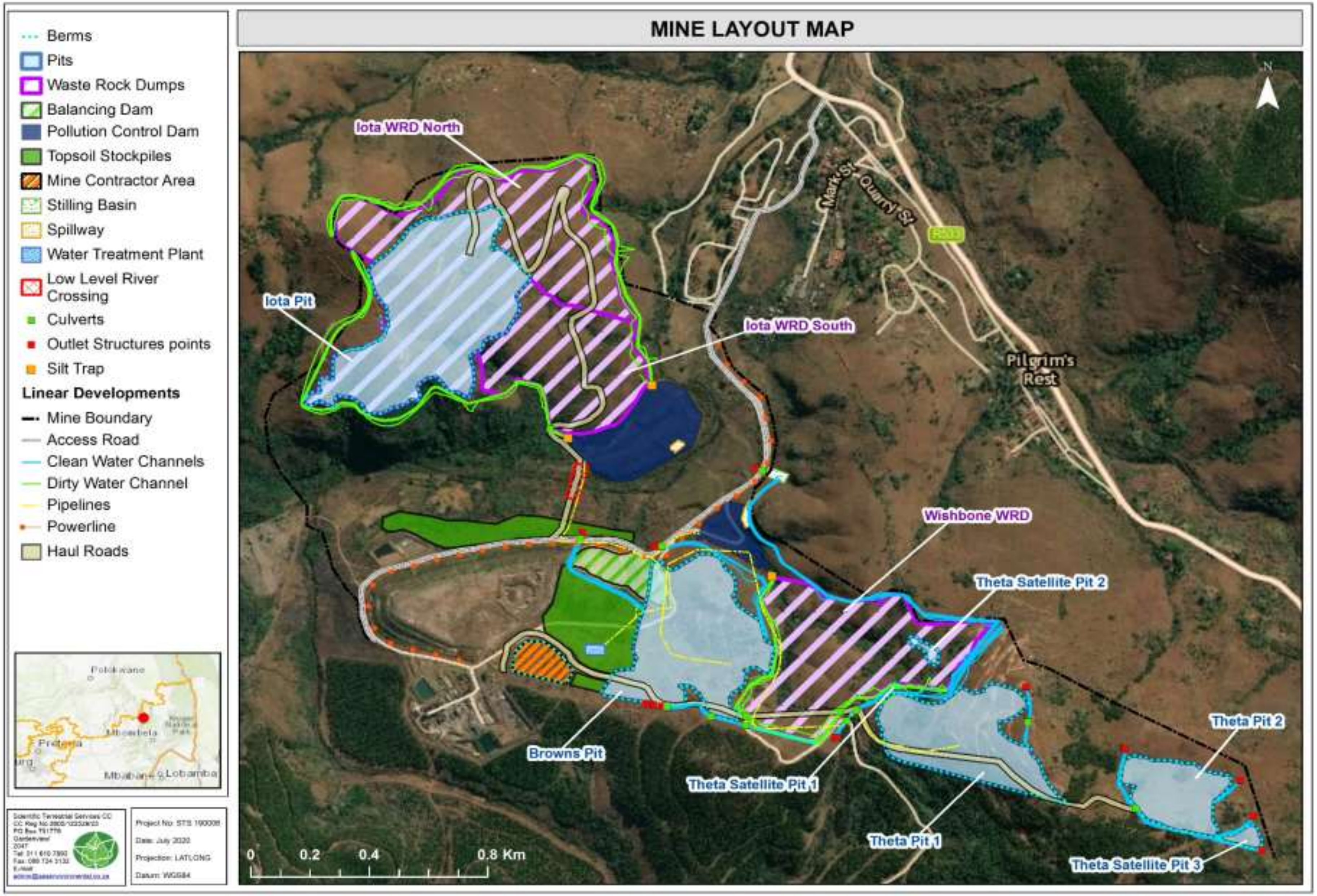

Figure 8: The revised site layout plan (Layout 3) which will be incorporated into the EIA Report and EMP for the proposed Theta Project.

1.4 *Scope of Work*

Specific outcomes in terms of the report are as follows:

- Compile a desktop study with all relevant information as presented by South African National Biodiversity Institute's (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org), including the Mpumalanga Biodiversity Sector Plan (MBSP, 2019), to gain background information on the physical habitat and potential floral and faunal biodiversity associated with the focus area;
- To state the indemnity and terms of use of this report (Appendix A) as well as to provide the details of the specialist who prepared the reports (Appendix E);
- To outline the legislative requirements that were considered for the assessment (Appendix B of this report); and
- To provide the methodologies followed relating to the impact assessment and development of the mitigation measures (Appendix C) that was applied in the floral and faunal assessments.

1.5 *Assumptions and Limitations*

The following assumptions and limitations are applicable to this report:

- The biodiversity desktop assessment is confined to the focus area and does not include detailed results of the neighbouring and adjacent properties, although the sensitivity of surrounding areas is included on the respective maps; and
- The results of this report contain data accessed as part of the desktop assessment for the focus area. It is important to note that although all data sources used provide useful and often verifiable high-quality data, the various databases do not always provide an entirely accurate indication of the focus area's actual biodiversity characteristics. However, this information is considered useful as background information to the study. To ground-truth the results of the desktop assessment an initial field assessment was undertaken from the 26th to the 29th of March 2019 (autumn season), to determine the ecological status of the focus area (scoping phase layouts). This was followed by an assessment of the vegetation taking place from the 2nd to the 4th of September 2019 (spring season) to assess changes made to the proposed EIA Phase layout. Due to the nature of the layout changes, a follow-up summer assessment was required and took place from the 28th January 2020 to the 31st January 2020. At the request of the Department of Environment, Forestry and Fisheries (DEFF), an assessment of the forest areas and drainage lines on Iota Hill and within the Wishbone WRD was undertaken from the 29th to the 30th of April 2020.

1.6 *Legislative Requirements*

The following legislative requirements were considered during the assessment:

- The Constitution of the Republic of South Africa, 1996[4];
- National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA);
- National Environmental Management: Protected Areas Amendment Act, 2003 (Act 57 of 2003) as amended by National Environmental Management: Protected Areas Amendment Act 21 of 2014 (NEMPAA) – Government Notice 445 in Government Gazette 37710 dated 2 June 2014;
- Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA);
- Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA);
- The National Forest Act, 1998 (Act 84 of 1998, as amended in September 2011) (NFA); and
- Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998) (MNCA).

The details of each of the above, as they pertain to this study, are provided in Appendix B of this report.

2 ASSESSMENT APPROACH

2.1 *General Approach*

Maps and digital satellite images were generated prior to the field assessments in order to determine broad habitats, vegetation types and potentially sensitive sites. Relevant databases and documentation that were considered during the desktop assessment of the focus area included [5]:

- National Protected Areas Expansion Strategy (NPAES) Focus Areas for Protected Area Expansion, 2009 (Formally and Informally Protected Areas):
- South African Conservation Area Database, Quarter 4, 2019;

[4] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 1996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

[5] Datasets obtained from:

- SANBI BGIS (2019). The South African National Biodiversity Institute - Biodiversity GIS (BGIS) [online]. URL: http://bgis.sanbi.org as retrieved in 2019; and
- Department of Environmental Affairs (DEA) Environmental Geographical Information Systems (E-GIS) website. URL: https://egis.environment.gov.za/

- South African Protected Area Database, Quarter 4, 2019;
- South African National Biodiversity Institute (SANBI) Threatened Species Programme (TSP);
- The Mpumalanga Biodiversity Sector Plan (2019);
- Mucina and Rutherford, 2018:
  - Biomes, Bioregions and Vegetation Type(s);
- National Biodiversity Assessment, 2011 and 2018;
- Mining and Biodiversity Guidelines, 2013;
- Important Bird and Biodiversity Areas (IBAs), 2015, in conjunction with the South African Bird Atlas Project (SABAP2); and
- International Union for Conservation of Nature (IUCN), and Pretoria National Herbarium Computer Information Systems (PRECIS).

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 *Conservation Characteristics of the Focus area based on National and Provincial Datasets*

The following section contains data accessed as part of the desktop assessment and are presented as a "dashboard" report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible in order to allow for improved assimilation of results by the reader to take place. Where required, further discussion and interpretation are provided.

Table 2: Summary of the vegetation characteristics associated with the focus area [Quarter Degree Squares (QDS) 2430DC & 2430DD].

DETAILS OF THE FOCUS AREA IN TERMS OF MUCINA & RUTHERFORD (2012 and 2018)	
Biome (Figure 9)	According to Mucina and Rutherford (2018) the focus area falls within two biomes. The overarching biome is the **Grassland Biome**, with small sections of the Iota Pit, Iota WRD South and the Iota Dirty Water Drainage falling within the **Forest Biome.**
Bioregion (Figure 10)	The majority of the project focus area falls within the **Mesic Highveld Grassland Bioregion** (within the Grassland Biome), with small sections of the Iota Pit, Iota WRD South and the Iota Dirty Water Drainage falling within the **Zonal and Interzonal Forests Bioregion** (within the Forest Biome).
Vegetation Type (Figure 11)	Based on the Mucina and Rutherford database (2018 (final version)), four vegetation types are associated with the project focus area); however, the **Northern Escarpment Dolomite Grassland** makes up the largest of the vegetation types associated with the project focus area. All proposed Pits, WRDs and Linear Developments fall either fully or partially within the **Northern Escarpment Dolomite Grassland**. The proposed Stockpiles, Dams and Mine Contractors Site are fully within this vegetation type. Portions of the proposed Iota Pit and associated Iota WRD North fall within the **Long Tom Pass Montane Grassland** (western sections) and the **Northern Mistbelt Forest** (southern sections) vegetation types. Most of the proposed Theta Pit 1 and Theta Satellite Pit 2, along with sections of the associated haul road and Clean Water drainage, fall within the **Northern Escarpment Quartzite Sourveld** vegetation type.

DESCRIPTION OF THE VEGETATION TYPE(S) RELEVANT TO THE FOCUS AREA (MUCINA & RUTHERFORD 2012, 2018)								
Vegetation Type	**GM 31 Long Tom Pass Montane Grassland**		**Gm 22 Northern Escarpment Dolomite Grassland**		**Gm 23 Northern Escarpment Quartzite Sourveld**		**FOz 4 Northern Mistbelt Forest**	
Climate Information	Climate is a seasonally arid temperate region with hot summers reaching 22°C and cool and dry winters with average July temperatures as low as 4°C.		Summer rainfall. Most of this unit occurs in the mistbelt, with increased precipitation. Warm-temperate climate, with low frequency of frost.		Summer rainfall, but orographic effects enhance precipitation. Mist common along the highest areas. Warm-temperate climate, with infrequent frost.		No available information in Mucina and Rutherford	
	MAP* (mm)	1067	**MAP* (mm)**	1034	**MAP* (mm)**	1176	**MAP* (mm)**	1084
	MAT* (°C)	14.3	**MAT* (°C)**	16.5	**MAT* (°C)**	16.6	**MAT* (°C)**	16.7
	MFD* (Days)	14	**MFD* (Days)**	5	**MFD* (Days)**	3	**MFD* (Days)**	-
	MAPE* (mm)	1864	**MAPE* (mm)**	1905	**MAPE* (mm)**	1913	**MAPE* (mm)**	1946
	MASMS* (%)	14	**MASMS* (%)**	67	**MASMS* (%)**	64	**MASMS* (%)**	-
Altitude (m)	1500 m - 1650 m		1 000–1 620 m		1 000–1 740 m		1 050 to1 650 m	
Distribution	Occurring along the escarpment east of Lydenburg, from Morgenzon Reserve just north of Crystal Springs Mountain Lodge, Pilgrim's Rest, southwards to the Schoemanskloof.		Mpumalanga Province: From the high-lying dolomite grasslands of the Abel Erasmus Pass and Motlatse (Blyde) River (Vaalhoek) areas in the north, it extends southwards in a broad dolomite band along the Northern Escarpment, to as far south as the vicinity of Kaapsehoop.		Limpopo and Mpumalanga Provinces: Occurring along the high-altitude crests of the Northern Escarpment, from Haenertsburg in the north, southeastwards, then bending southwards past Blyde River Canyon, Graskop and as far south as the vicinity of Kaapsehoop.		Limpopo and Mpumalanga as well as in Swaziland: Occurring along the Soutpansberg from Blouberg in the northwest to the Samandou Plateau in the northeast and further southwards (along the Northern Escarpment) from Abel Erasmus Pass (Olifants River) to the surroundings of Badplaas and Barberton.	
Geology, Soils & Hydrology	The geology forms part of the Pretoria Group, which predominantly consists of shale and quartzite in the Rooihoogte,		Malmani dolomites of the Chuniespoort Group (Transvaal Supergroup) which overlies the Black Reef Quartzite Formation.		Black Reef Group and Wolkberg Group quartzite (formed 2.5 gya and occurring at the base of the Transvaal Supergroup), covered		Highly weathered, clayey soils mainly of Avalon and Hutton soil forms, derived from shales (Pretoria Group), quartzite (Black Reef Formation), dolomite (Chuniespoort Group),	

	Timeball Hill and Boshoek Formations, and the distinctive volcanic elements of the Hekpoort Andesite Formations which are on the summits of the highest lying areas.	Soils usually have a high pH, are rich in calcium and magnesium, and with low phosphorus status. Deep Hutton and Griffin soil forms are common. Land types Fa, Ab and Ac.	with shallow rocky soils of the Mispah form. Dominant land type Ab, with Ib, Fa and Ac of subordinate importance.	granite (Nelspruit Basement) and diabase (Mokolian intrusives).
Conservation	As much as 60.1% of this unit is still natural where a large proportion of this unit has been afforested (39%) or cultivated (0.6%). This unit is well protected where its target of 27% has been met in the current reserve network. However gold mining is still a threat as this unit contains a few current gold mines and many abandoned and shafts and mine dumps.	**Endangered**. Target 27%. Only 2% protected within the Blyde River Canyon National Park, but larger portion protected in private Driekop Caves and London heritage sites in the north and in the Mooifontein and Mondi Cycad Reserve heritage sites in the south. More than half of this unit has been transformed (52%), mainly by plantations (47%) and cultivated lands (5%). Erosion potential very low (17%), low (51%) and moderate (28%).	**Vulnerable**. The conservation target is 27% and 15% is protected within the Lekgalameetse and Blyde River Canyon National Park. As much as 38% of this unit has been transformed mainly by plantations (37%), with limited cultivated areas. Estimated erosion potential levels very low (39%), low (47%) and moderate (14%).	**Least threatened**. Target 30%. About 10% statutorily conserved in Blyde River Canyon, Lekgalameetse, Songimvelo, Makobulaan, Malalotja, Nelshoogte, Barberton, Starvation Creek Nature Reserves. More than 25% enjoys protection in privately owned nature reserves, including for instance Wolkberg Wilderness Area, In-De-Diepte, Sudwala, Mac, Buffelskloof, Mount Sheba etc. Below the escarpment between Mariepskop and Graskop, the natural forest has expanded into former grassland areas due to the protection of the timber plantations against fire.
Vegetation & landscape features	The landscape has a diverse physiography, which includes subalpine peaks, level terraces and rolling plains in the higher lying areas with steeply sloping mountain slopes. The highest point is Mount Anderson (2280 m), occurring just north of Long Tom Pass.	Very species-rich grasslands that occur along the Escarpment dolomite belt. The grasslands are characterised by a very diverse shrub layer which varies in height and density. The herbaceous component becomes more dense northwards as the climate becomes drier.	The landscape is characteristically very rugged, with steep east-facing cliffs. This escarpment is intersected in some areas with large east-flowing rivers. Short, closed grassland rich in forb species with scattered trees and shrubs. This unit is very rocky and occurs on weather-resistant quartzite. The nutrient-poor soils lead to a lower biomass which, together with the rocky landscape, results in a reduced frequency and intensity of fires. It therefore has slightly more woody elements than the adjacent units.	Tall, evergreen afrotemperate mistbelt forests occurring primarily in east-facing fire refugia such as subridge scarps and moist sheltered kloofs where they form small, fragmented patches. The most common canopy trees include *Xymalos monospora, Podocarpus latifolius, Combretum kraussii, Cryptocarya transvaalensis Schefflera umbellifera, Syzygium gerrardii, Olea capensis* subsp. *macrocarpa, Psydrax obovata* subsp. *elliptica, Pterocelastrus galpinii*. In the understorey *Psychotria zombamontana, Canthium kuntzeanum, Gymnosporia harveyana, Peddiea africana, Pavetta inandensis, Mackaya bella, Sclerochiton harveyanus* etc. are found. The herb layer supports a number of dominating Acanthaceae (Isoglossa), Lamiaceae (*Plectranthus, Stachys*) and Rubiaceae (*Galopina*) herbs and so called 'soft shrubs', geophytic herbs and ferns (*Asplenium, Dryopteris, Polystichum*). Of lianas and climbers *Dalbergia armata, Combretum edwardsii, Jasminum abyssinicum, Rhoicissus rhomboidea* and *Keetia gueinzii* are the most conspicuous vines, as is the scandent grass *Prosphytochloa prehensilis*.

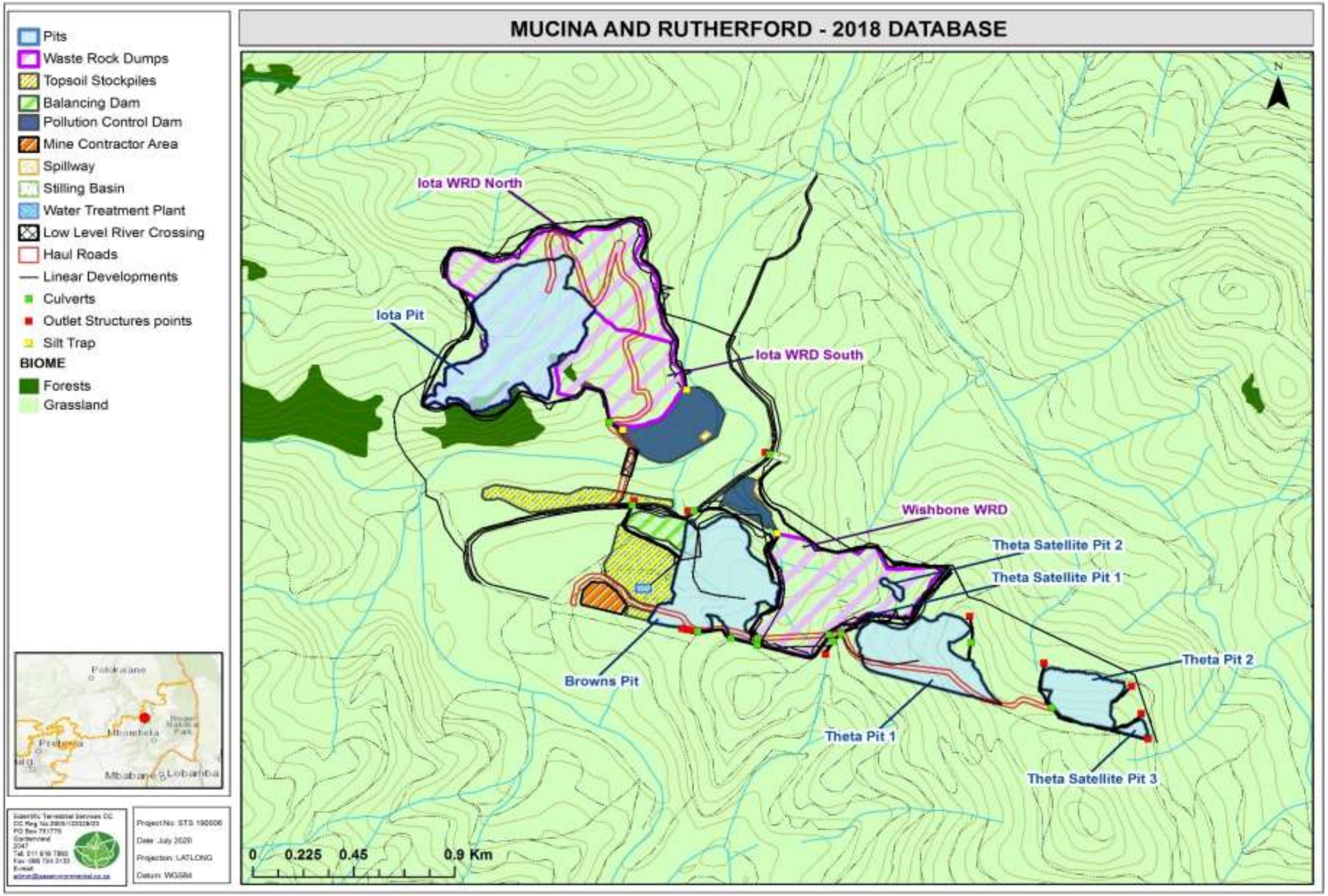

Figure 9: Biomes associated with the focus area (Mucina and Rutherford, 2018 databases).

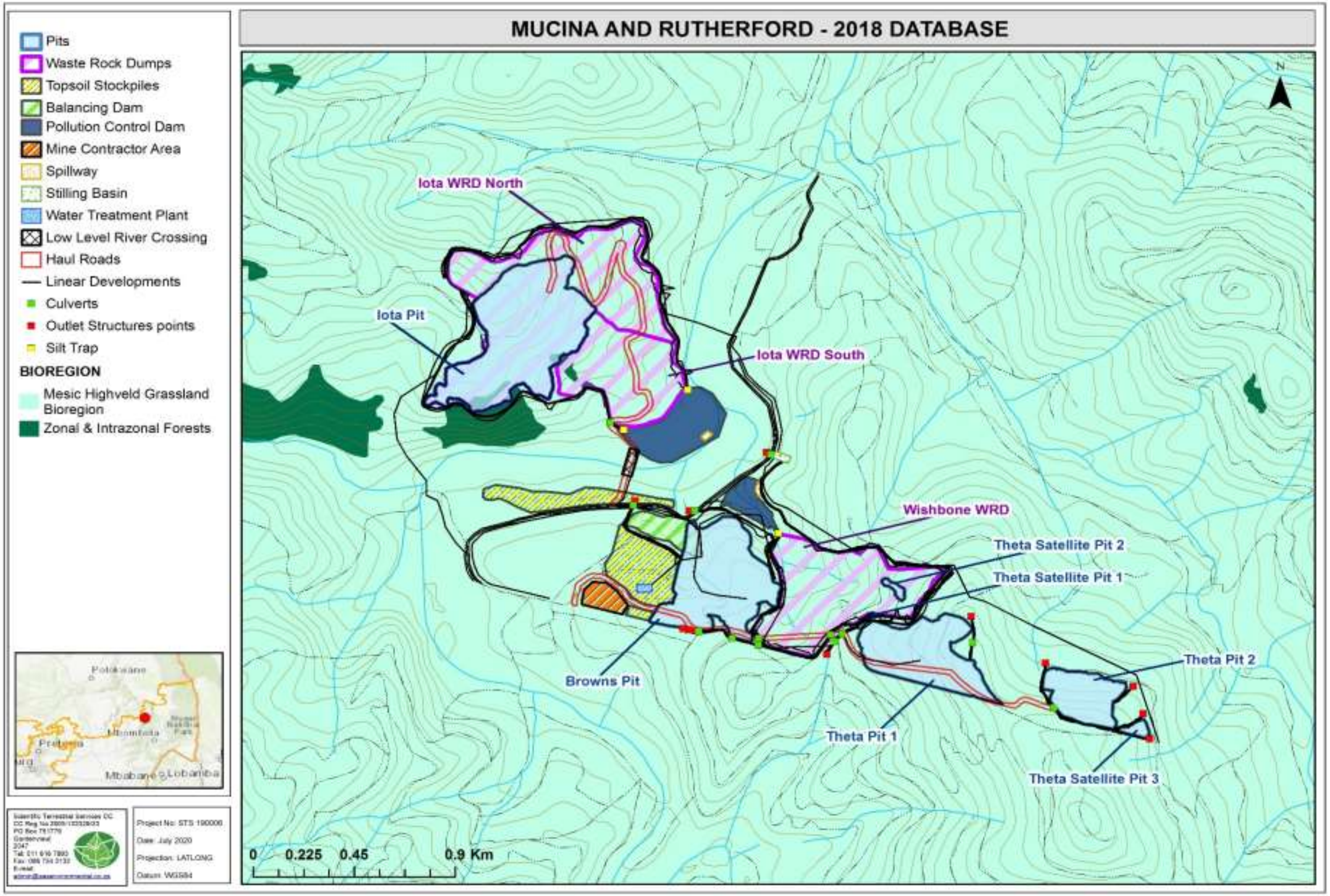

Figure 10: Bioregions associated with the focus area (Mucina and Rutherford, 2012 & 2018 databases).

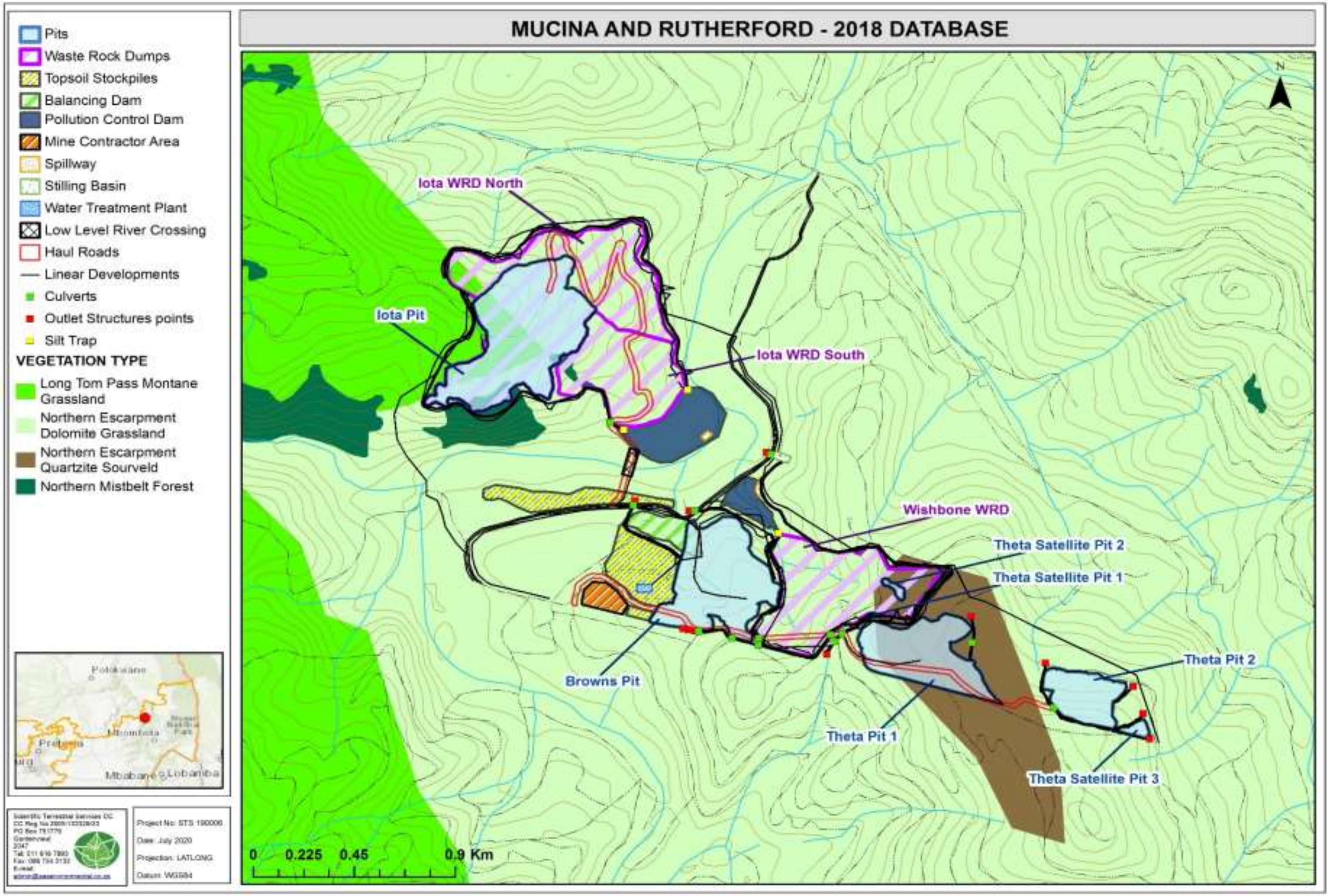

Figure 11: Vegetation types associated with the focus area (Mucina and Rutherford, 2012 & 2018 databases).

Table 3: Summary of the terrestrial conservation characteristics for the focus area (QDS 2430DC & 2430DD).

CONSERVATION DETAILS PERTAINING TO THE FOCUS AREA (VARIOUS DATABASES)	
NBA (2011 and 2018)	Ecosystem types are categorised as "not protected", "poorly protected", "moderately protected" and "well protected" based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act, 2003 (Act No. 57 of 2003), and compared with the biodiversity target for that ecosystem type. The ecosystem protection level status is assigned using the following criteria: i. If an ecosystem type has more than 100% of its biodiversity target protected in a formal protected area either A or B we classify it as Well Protected; ii. When less than 100% of the biodiversity target is met in formal A or B protected areas it is classified it as Moderately Protected; iii. If less than 50% of the biodiversity target is met, it is classified it as Poorly Protected; and iv. If less than 5% it is Hardly Protected. **NBA 2011 dataset (Figure 12):** All proposed Pits, WRDs and infrastructure fall within an ecosystem that is currently **Poorly Protected.** Portions of the proposed Iota Pit, Iota WRD North and the Iota Dirty Water Drainage, as well as most of the proposed Theta Pit 1 and Theta Satellite pit 2, along with sections of the associated haul road and Clean Water drainage, fall within a **moderately protected** ecosystem. **NBA 2018 dataset (Figure 13):** A small section of the Long Tom Pass Montane Grassland, which is **Well Protected** but **Near Threatened**, is within the footprint of the Iota Pit, Iota WRD North and the Iota Dirty Water Drainage. The Iota Pit, Iota WRD North and portions of the Iota Dirty Water Drainage also fall within the sections of the Northern Mistbelt Forest, a vegetation type that is considered **Well Protected** and of **Least Concern,** i.e. not currently under threat**.** Small sections of the Northern Escarpment Quartzite Sourveld, a **Moderately Protected** vegetation type that is now considered of **Least Concern**, are within the footprint of the Wishbone WRD, Theta Pit 1, Theta Satellite Pit 2 and the associated Haul Road and Clean and Dirty Water Drainage. Most of the focus area falls within the **Poorly Protected** Northern Escarpment Dolomite Grassland, a **Vulnerable** ecosystem.
National Threatened Ecosystems (2011)	Most of the focus area is located within the remaining extent of the Malmani Karstlands **endangered (EN) ecosystem**[6] (Figure 14). The Theta Pit 2, Theta Satellite Pit 3 and the small stretches of haul roads, linear developments and the Mine Contractors Site are located outside of the remaining extent of this ecosystem.
IBA (2015) (Figure 15)	The proposed layout does not fall within any Important Bird and Biodiversity Areas (IBA); however, the focus area is approximately 2 km west of the Blyde River Canyon IBA. This IBA was extended in 2014 to include the previous Graskop Grasslands and Mac-Mac Escarpment & Forests IBAs. This is the only site in South Africa that supports breeding Taita Falcon (*Falco fasciinucha)*.

[6] GN 1002 of the 9 December 2011. National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (G 34809, GN 1002), the 9th of December 2011.

<table>
<tr>
<td>SAPAD (2018); SACAD (2018) and NPAES (2009) (Figure 16)</td>
<td colspan="3">According to the South African Conservation Areas Database (SACAD, 2018), the entire proposed layout falls within the Kruger to Canyons Biosphere Reserve and, therefore, is recognised under the UNESCO (United Nations Educations, Scientific and Cultural Organisation) Man and the Biosphere Programme. Depending on the spatial zonation of a Biosphere Reserve (core area, buffer zone or transitional zone), these areas can be granted legal protection or can be used for sustainable developments. The Theta Focus Area falls outside of the core area.

The proposed layout does not fall within any nationally or provincially protected areas; however, the South African Protected Areas Database (SAPAD, 2018) indicates that the following nature reserves (NR) are located within 10 km of the focus area:
· Blyderivierspoort NR (± 9 km east);
· Henra Private NR (± 8 km west);
· Mac Reserve (10km east); - Forest Nature Reserve
· Morgenzon Reserve (7.8 km northwest); - Forest Nature Reserve
· Mount Sheba Private Nature Reserve is located approximately 0.84km south-southwest of the focus area;
· Ohringstad Dam NR (7.8 km southwest);
· Oribi Private NR (3.3 km south-southwest); and
· Tweefontein Reserve (9.3 km south) – Forest Nature Reserve

Additional protected areas were provided by Mpumalanga Tourism and Parks Agency and included the Graskop Grassland Unique Community. The National Protected Areas Expansion Strategy (NPAES, 2009) further indicates that the Motlatse Canyon Provincial Nature Reserve is located approximately 1.6 km southeast of the focus area. This NR is not in the SAPAD 2018 database.

The focus area is located within 6 km of the Northeast Escarpment NPAES focus area, which is an extremely diverse area important for ecological processes and resilience to climate change. It is an important Grassland centre of endemism and includes opportunities for protecting intact river reaches with threatened river types. These are deemed excellent opportunities for expanding the Legalametse, Wolkberg and Blyde Canyon Reserves.</td>
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<tr>
<th colspan="2">MPUMALANGA BIODIVERSITY SECTOR PLAN (2014) TERRESTRIAL DATABASE</th>
<th colspan="2">MINING AND BIODIVERSITY GUIDELINES (2013) – FIGURE 19</th>
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<tr>
<td>CBA Irreplaceable Figure 17</td>
<td>The Mpumalanga Biodiversity Sector Plan (2019, Figure 17) indicates that the project focus area falls within several areas of biodiversity importance, most notably Irreplaceable Critical Biodiversity Areas (CBAs). CBAs are areas of high biodiversity value and need to be maintained in a natural state.
The north-eastern sections of the proposed Iota Pit, Iota WRD North and Iota WRD South, along with associated PCD and Haul Roads fall within an Irreplaceable CBA. Sections of the proposed Stockpiles and stretches of the Powerlines, as well as Theta Pit 2 and Theta Satellite Pit 3 are within Irreplaceable CBAs.
The CBA Irreplaceable category includes:
1) Areas required to meet targets and with irreplaceability values of more than 80%;
2) Critical linkages or pinch-points in the landscape that must remain natural;
3) Critically Endangered Ecosystems.</td>
<td>Highest Biodiversity Importance</td>
<td>According to the Mining and Biodiversity Guidelines database (2013, Figure 6), apart from small portions of the Theta Pit 1 and the Theta Satellite Pit 3, the majority of the project footprint falls within an area considered to be of Highest Biodiversity Importance.

<u>Risk for mining</u>: Highest risk for mining.

<u>Implications for mining</u>: Environmental screening, EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide a site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision making for mining, water use licences, and environmental authorisations. If they are confirmed, the likelihood of a fatal flaw for new mining projects is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services.</td>
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CBA Optimal **Figure 17**	Large sections of the focus area are located within an **Optimal CBA**. The CBA Optimal Areas (previously called 'important and necessary' in the MBCP) are the areas optimally located to meet both the various biodiversity targets and other criteria defined in the analysis. Although these areas are not 'irreplaceable' they are the most efficient land configuration to meet all biodiversity targets and design criteria. Within the focus area, the south-western section of the proposed Iota Pit, Iota WRD North and Iota WRD South, along with associated PCD and portions of the Haul Roads fall within an Optimal CBA. The proposed Browns Pit, Theta Pit, along with the associated Wishbone WRD and PCD are located within Optimal CBAs. The Optimal CBA is also intersected by the several of the proposed Stockpiles, the Mine Contractors Site and stretches of the Haul Roads and Linear Developments.
ESA Protected Area Buffer **Figure 18**	The entire focus area falls within an Ecological Support Area (ESA) Protected Area Buffer. These are areas surrounding protected areas that moderate the impacts of undesirable land-uses that may affect the ecological functioning or tourism potential of PAs. Buffer distance varies according to reserve status: · National Parks — 10 km; · Nature Reserves — 5 km buffer; and · Protected Environments — 1 km buffer.
Heavily modified **Figure 17**	Portions of the proposed Stockpiles, Theta Pit 1, Balancing Dam and stretches of the surrounding Linear Developments are located within a heavily modified area. These are areas currently modified to such an extent that any valuable biodiversity and ecological functions have been lost.

High Biodiversity Importance	The southern portion of the proposed Theta Pits as well as stretches of the associated Haul Roads fall within an area of **High Biodiversity Importance**. **<u>Risk for mining</u>:** High risk to mining **<u>Implications for mining</u>**: An EIA should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. Mining options may be limited in these areas, and red flags for mining projects are possible. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations.
MPUMALANGA BIOBASE (2002) – FIGURE 20	
The demarcation of floristic regions is based on groups of taxa with more or less similar geographical distributions. Floristic regions can be classified hierarchically to reflect similarities and differences between regions. A phytochorion is a floristic (phytogeographical) region of any rank. At a particular scale, a phytochorion may also be called a 'centre of endemism' when distinguished by a high concentration of endemic plant taxa (Van Wyk & Smith 2001). Phytochoria usually incorporates different vegetation types, so it may include forest, grassland and bushveld, but these will have common recurring floristic elements.	
Phyto Centres of Endemism	Browns Hill and Theta Hill, including most of the proposed mine infrastructure, fall within the Wolkberg Centre of Phyto (plant) Endemism.
Phyto Regions of Endemism	The proposed Iota Pit and the Iota WRD North and Iota WRD South are located within the Drakensberg Afromontane Region of Phyto (plant) Endemism.

CBA = Critical Biodiversity Area, ESA = Ecological Support Area, IBA = Important Bird and Biodiversity Area, MAP = Mean Annual Precipitation, MAT = Mean Annual Temperature, MFD = Mean Frost Days, MAPE = Mean Annual Potential for Evaporation, MASMS = Mean Annual Soil Moisture Stress, NBA = National Biodiversity Assessment, NPAES = National Protected Areas Expansion Strategy, SACAD = South African Conservation Areas Database, SAPAD = South African Protected Areas Database.

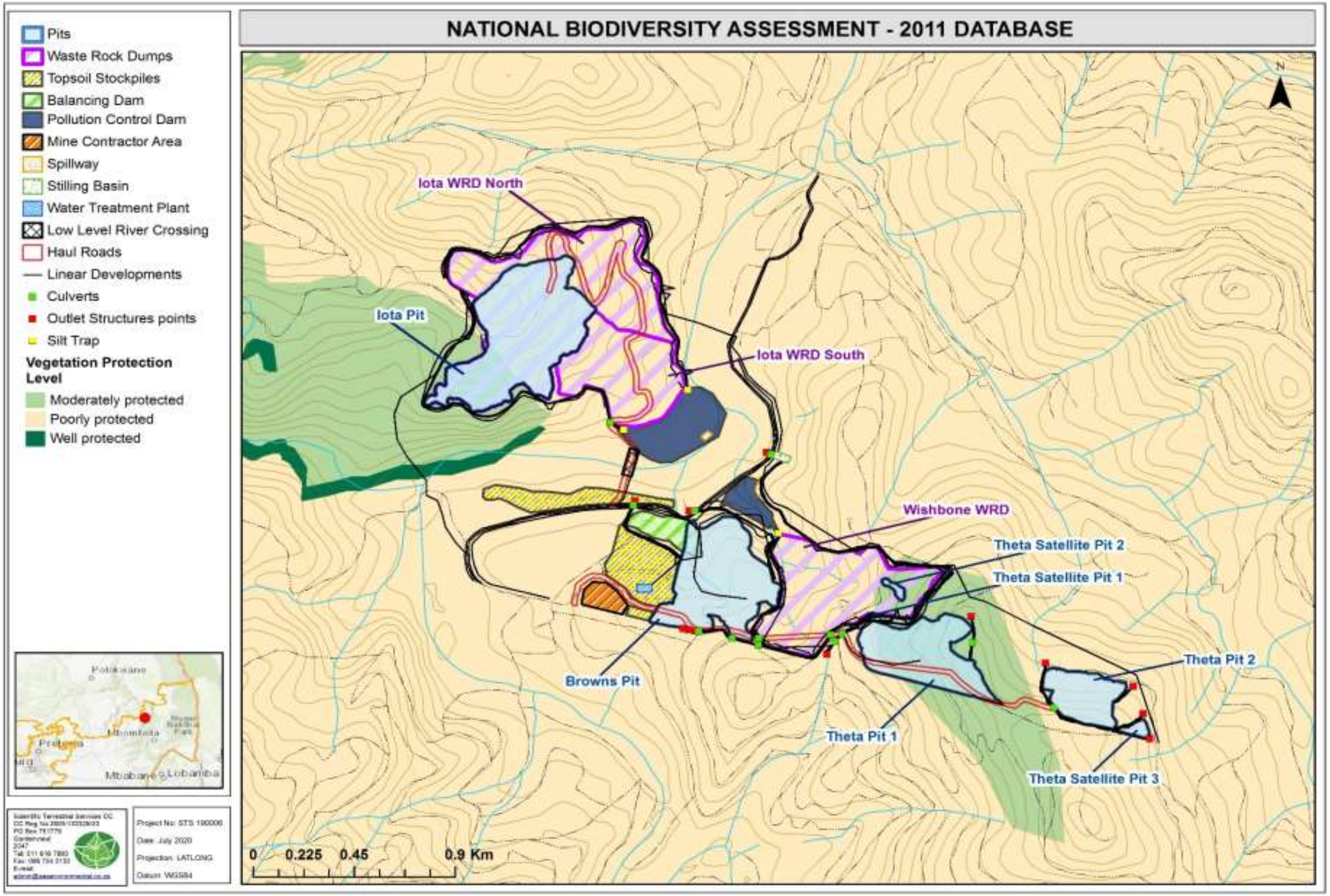

Figure 12: Protection level of the vegetation types associated with the focus area (National Biodiversity Assessment, 2011).

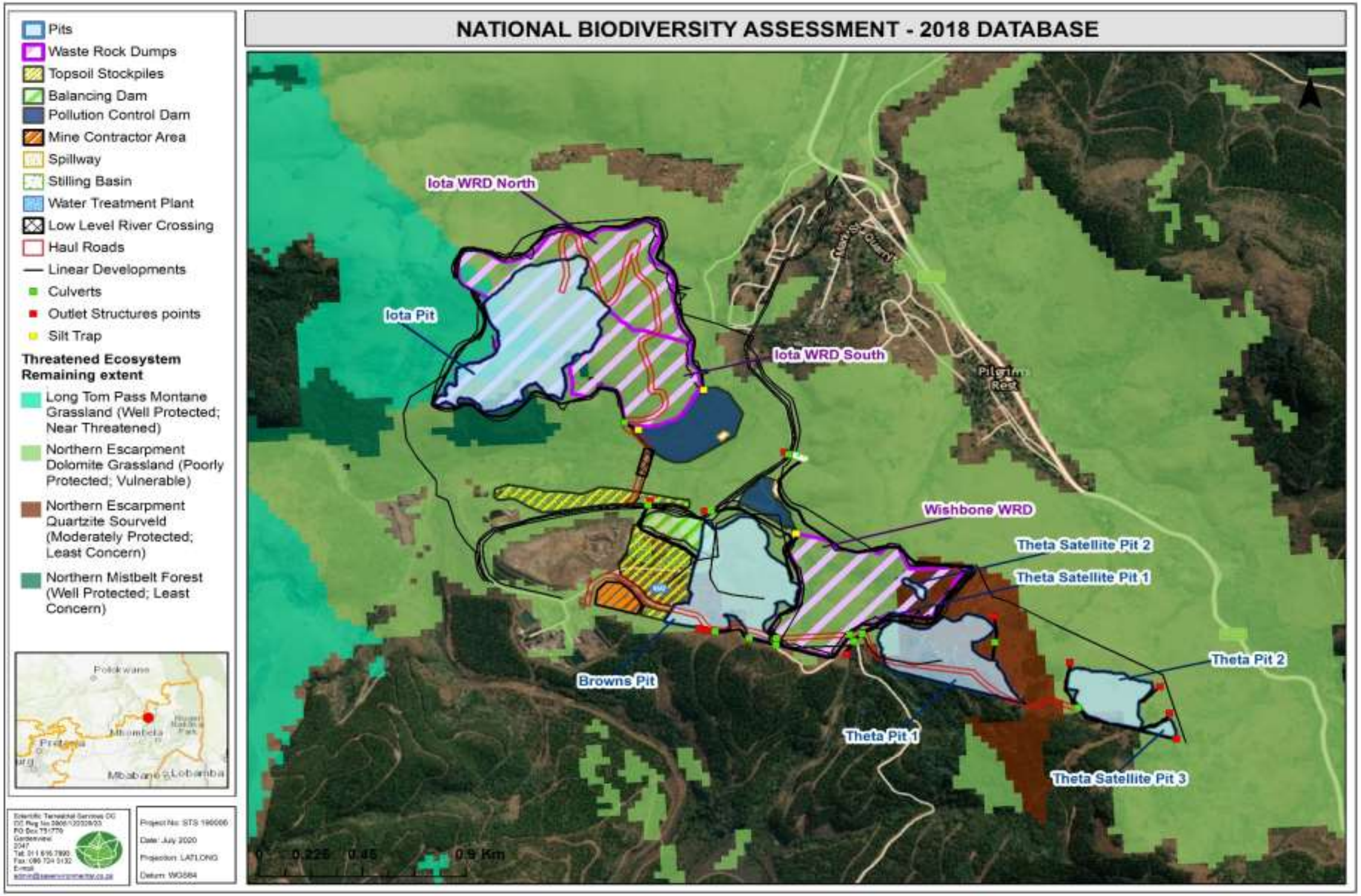

Figure 13: Protection level and threat status of the remaining extent of vegetation types associated with the focus area (National Biodiversity Assessment, 2018).

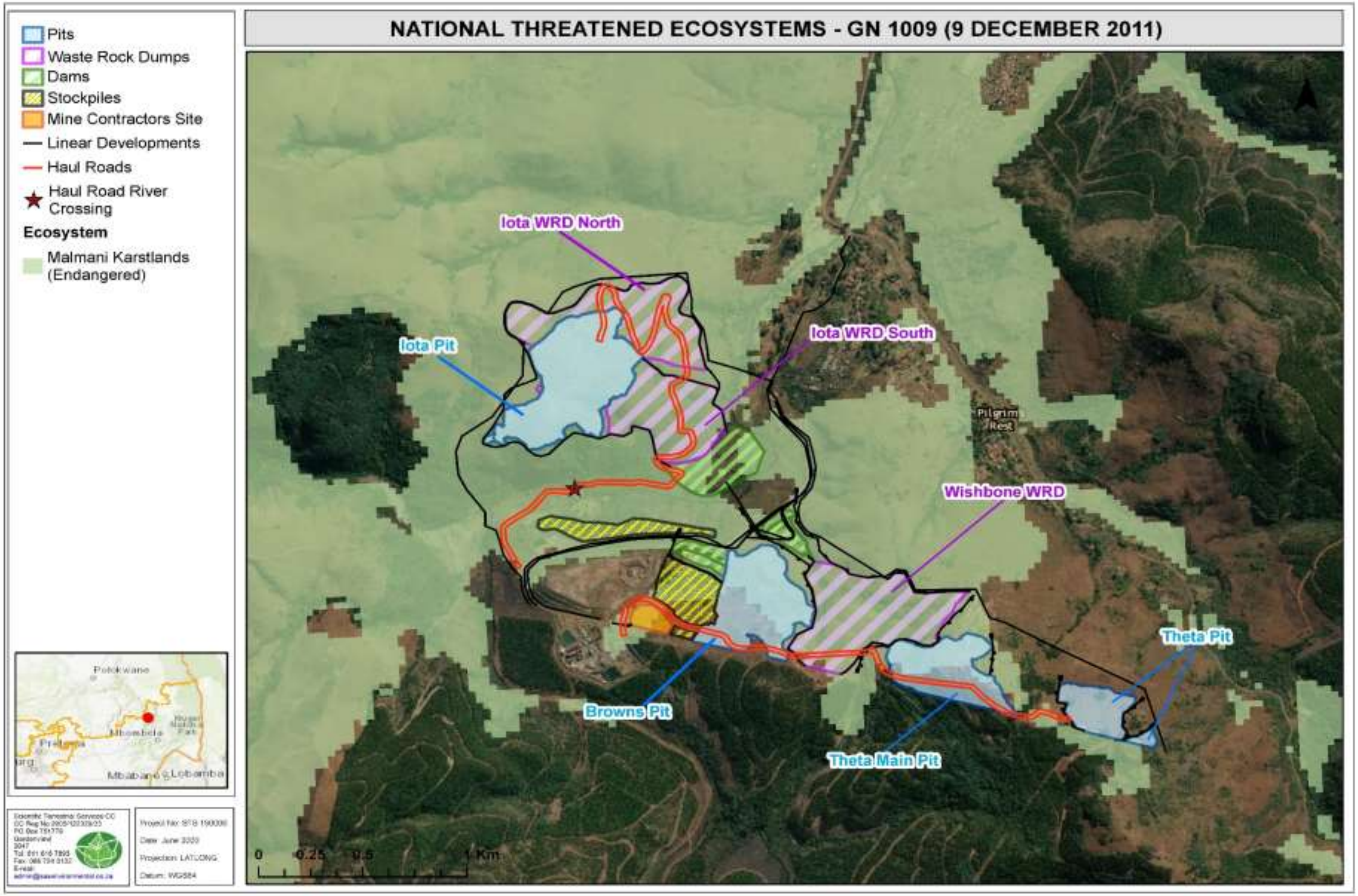

Figure 14: The focus area in relation to the remaining sections of the Malmani Karstlands endangered (EN) ecosystem (National Threatened Ecosystems, 2011).

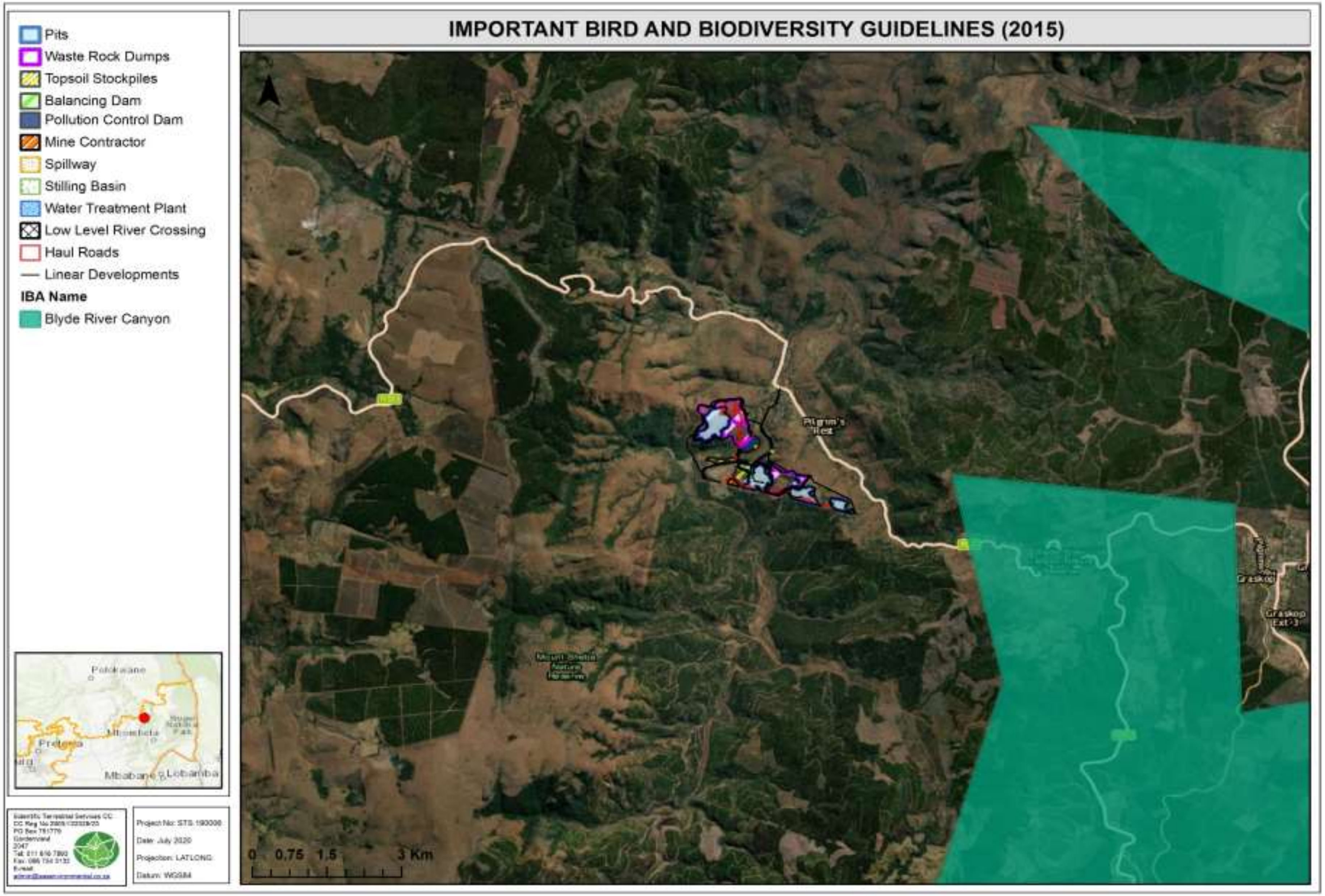

Figure 15: The focus area in relation to the Blyde River Canyon Important Bird and Biodiversity Area (2015).

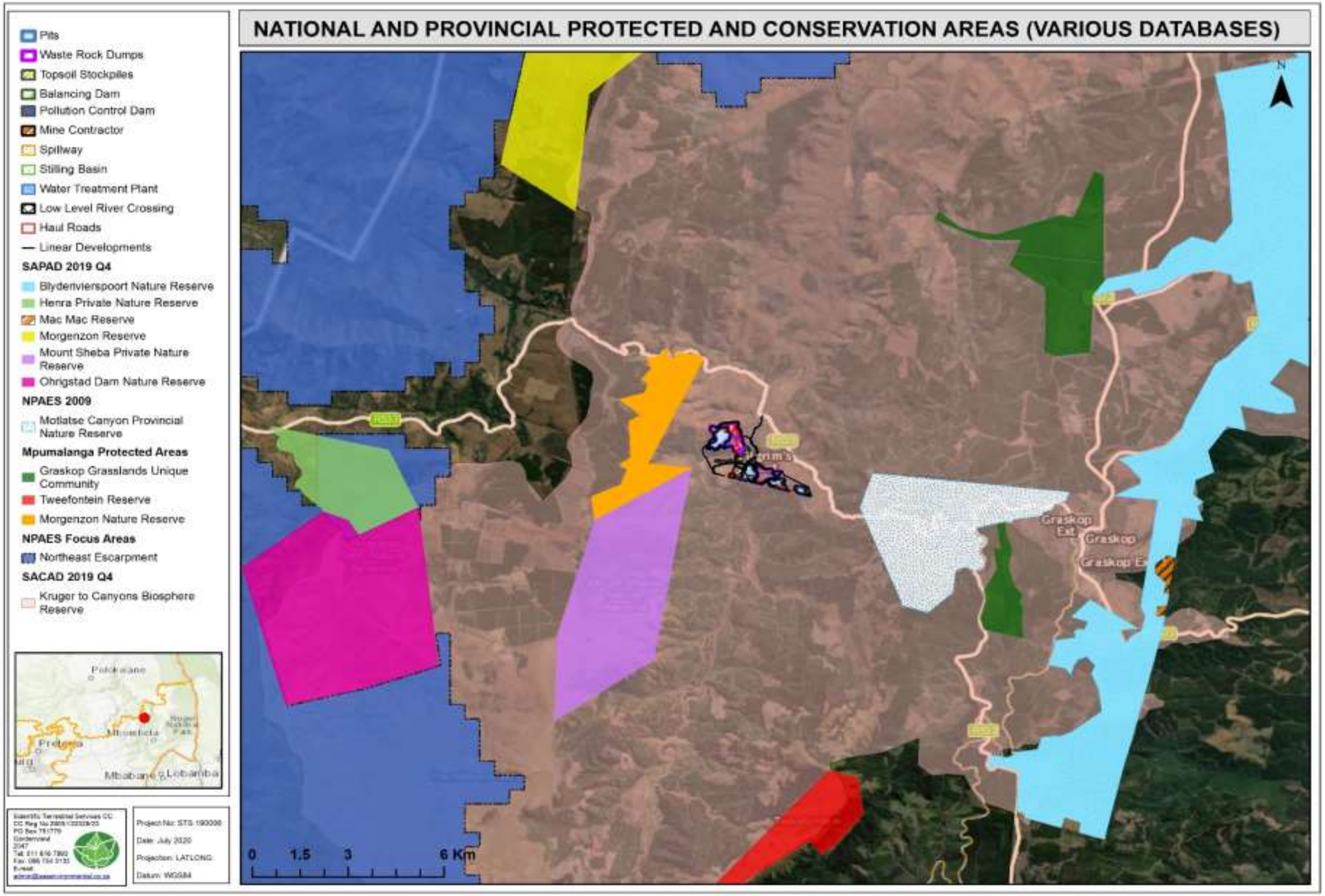

Figure 16: Protected and Conservation Areas in close proximity (within 10 km) of the focus area (SAPAD, 2018; SACAD, 2018; NPAES, 2009).

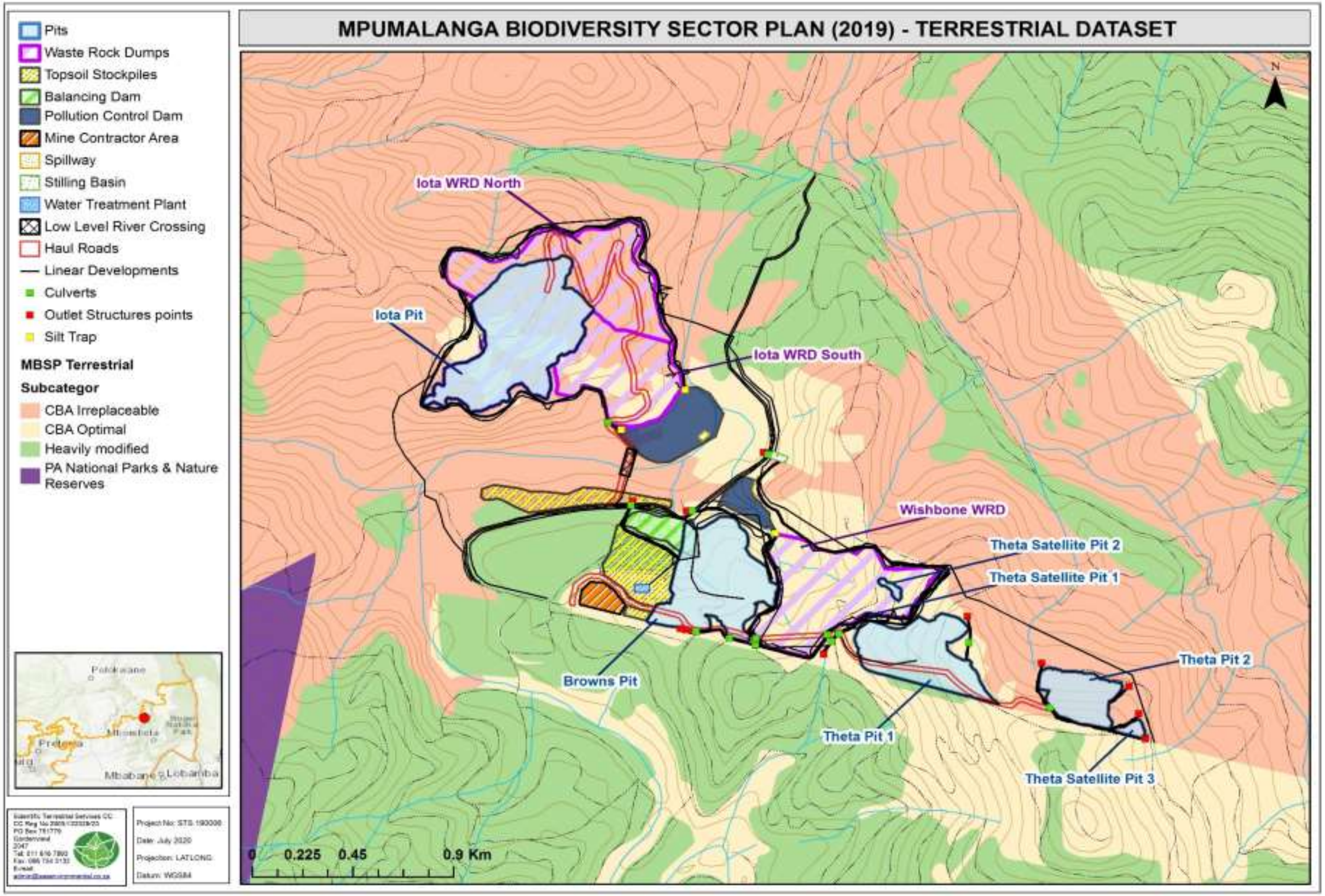

Figure 17: The focus area in relation to Critical Biodiversity Areas (CBA Irreplaceable and Optimal) (Mpumalanga Biodiversity Sector Plan, 2014).

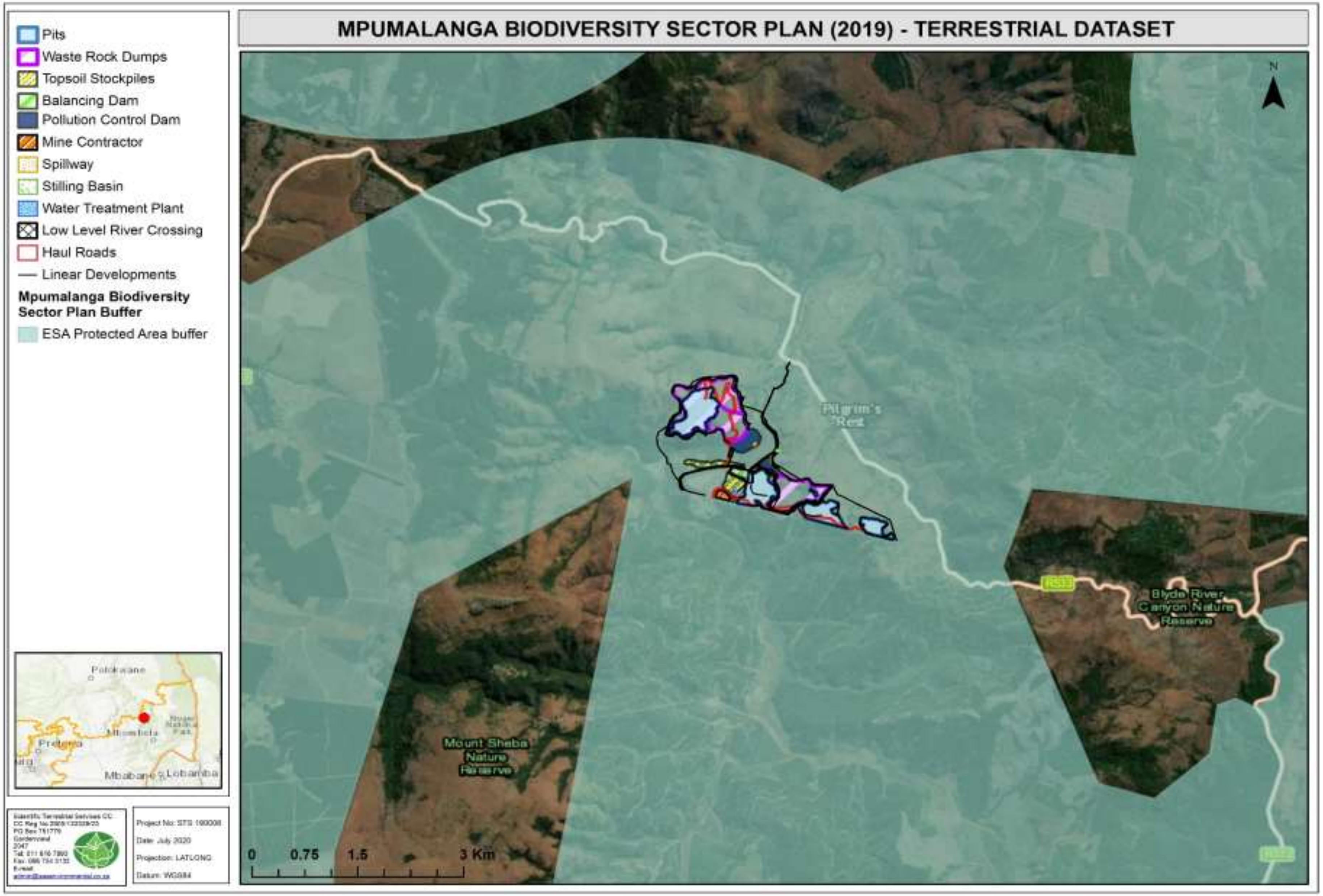

Figure 18: ESA Protected Area buffer associated with the focus area (Mpumalanga Biodiversity Sector Plan, 2014).

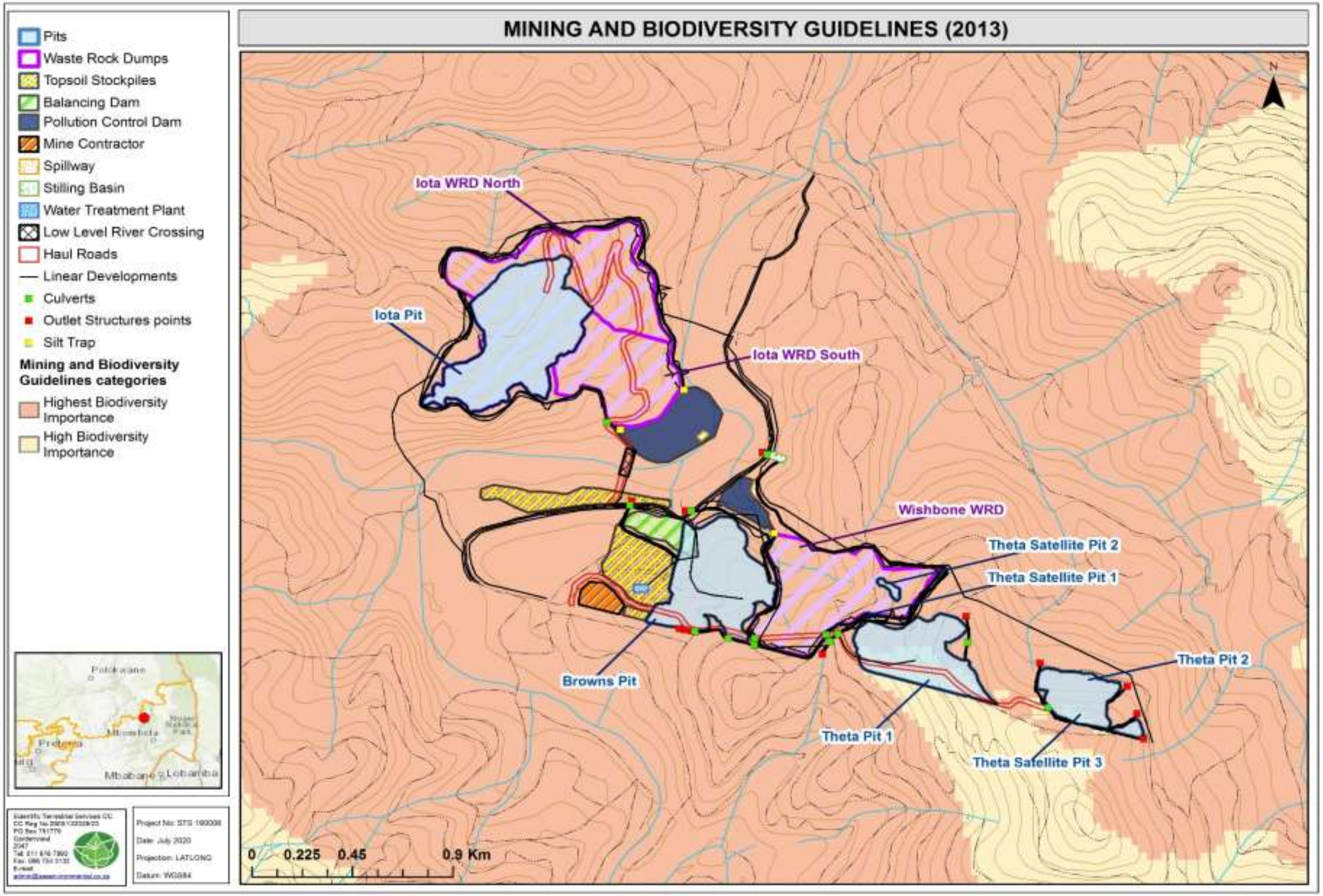

Figure 19: Importance of the focus area according to the Mining and Biodiversity Guidelines (2013).

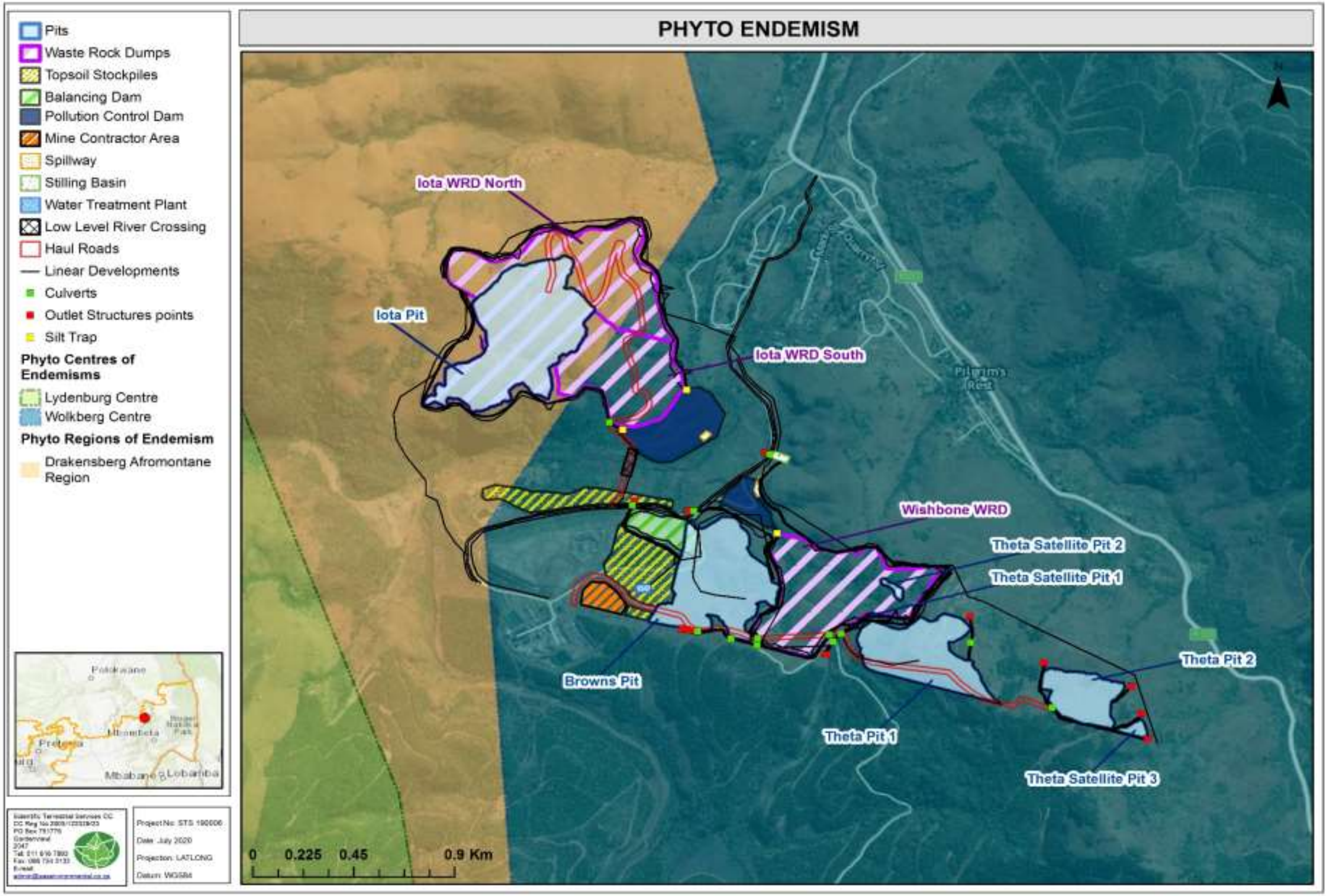

Figure 20: Centres and Regions of Phyto Endemism associated with the focus area (Mpumalanga BioBase Report, 2002).

4 STRUCTURE OF THE REPORT

Section A of this report served to provide an introduction to the focus area, as well as the general approach to the study. Section A also presents the results of general desktop information reviewed as part of the study including the information generated by the relevant authorities as well as the context of the site in relation to the surrounding anthropogenic activities and ecological character.

Section B presents the results of the floral field assessment, data analyses and discussion of the results. The section then presents the results of the impact assessment where the impacts on floral ecology and biodiversity are discussed.

Section C presents the results of the faunal field assessment, data analyses and discussion of the results. The section then presents the results of the impact assessment where the impacts on faunal ecology and biodiversity are discussed.

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APPENDIX A: 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 STS 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 and at the discretion of the authors.

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This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

APPENDIX B: Legislative Requirements

Constitution of the Republic of South Africa, 1996 (Act 108 of 1996)

The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive realisation of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.

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

The National Environmental Management Act (NEMA; Act 107 of 1998) and the associated Environmental Impact Assessment (EIA) Regulations (GN R982 of 2014) and well as listing notices 1, 2 and 3 (GN R983, R984 and R985 of 2014), state that prior to any development taking place which triggers any activity as listed within the abovementioned regulations, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment process or the EIA process depending on the nature of the activity and scale of the impact.

Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA)

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: Protected Areas Amendment Act, 2003 (Act 57 of 2003) as amended by National Environmental Management: Protected Areas Amendment Act 21 of 2014 (NEMPAA) – Government Notice 445 in Government Gazette 37710 dated 2 June 2014

The objective of this act is to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological biodiversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; for the continued existence, governance and functions of South African National Parks; and for matters in connection thereof.

Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)

Removal of the alien and weed species encountered in the application area must take place in order to comply with existing legislation (amendments to the regulations under the CARA, 1983 and Section 28 of the NEMA, 1998). Removal of species should take place throughout the construction and operation, phases.

National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA)

The objectives of this act are (within the framework of NEMA) to provide for:

- The management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity;
- The use of indigenous biological resources in a sustainable manner;
- The fair and equitable sharing among stakeholders of the benefits arising from bio prospecting involving indigenous biological resources;
- To give effect to ratify international agreements relating to biodiversity which are binding to the Republic;
- To provide for cooperative governance in biodiversity management and conservation; and
- To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.

This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of the surrounding areas are not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of the benefits arising from indigenous biological resources.
Furthermore, a person may not carry out a restricted activity involving either:

a) A specimen of a listed threatened or protected species;
b) Specimens of an alien species; or
c) A specimen of a listed invasive species without a permit.

National Environmental Management Biodiversity Act (NEMBA) (Alien and Invasive Species Regulations, Notice number 864 of 29 July 2016 in Government Gazette 40166)

NEMBA is administered by the Department of Environmental Affairs and aims to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA. In terms of alien and invasive species. This act in terms of alien and invasive species aims to:

- Prevent the unauthorized introduction and spread of alien and invasive species to ecosystems and habitats where they do not naturally occur,
- Manage and control alien and invasive species, to prevent or minimize harm to the environment and biodiversity; and
- Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats.

Alien species are defined, in terms of the National Environmental Management: Biodiversity Act, 2004 (Act no 10 of 2004) as:

(a) A species that is not an indigenous species; or
(b) An indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.

Categories according to NEMBA (Alien and Invasive Species Regulations, 2017):

- **Category 1a:** Invasive species that require compulsory control;
- **Category 1b:** Invasive species that require control by means of an invasive species management programme;
- **Category 2:** Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread; and
- **Category 3:** Ornamentally used plants that may no longer be planted.

The National Forest Act, 1998 (Act 84 of 1998, as amended in September 2011) (NFA)

According to the department of Agriculture, Land Reform and Rural Development (previously the Department of Agriculture, Forestry and Fisheries (DAFF)) ©2019 website (https://www.daff.gov.za/daffweb3/): "In terms of the National Forests Act of 1998 certain tree species (types of trees) can be identified and declared as protected. The Department of Water Affairs and Forestry followed an objective, scientific and participative process to arrive at the new list of protected tree species, enacted in 2004. All trees occurring in natural forests are also protected in terms of the Act. Protective actions take place within the framework of the Act as well as national policy and guidelines. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization."

Applicable sections of the NFA pertaining to the proposed project include the below:

Section 12:
Declaration of trees as protected

(1) The Minister may declare-

a) particular tree,
b) a particular group of trees,
c) a particular woodland; or
d) trees belonging to a particular species,

to be a protected tree, group of trees, woodland or species.

(2) The Minister may make such a declaration only if he or she is of the opinion that the tree, group of trees, woodland or species is not already adequately protected in terms of other legislation.

(3) In exercising a discretion in terms of this section, the Minister must consider the principles set out in section 3(3) of the NFA.

Section 15(1):
No person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a licence granted by the Minister or in terms of an exemption from the provisions of this subsection published by the Minister in the Gazette.

Contravention of this declaration is regarded as a first category offence that may result in a person who is found guilty of being sentenced to a fine or imprisonment for a period up to three years, or both a fine and imprisonment.

The Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA)

The Mpumalanga Nature Conservation Act (MNCA; Act 10 of 1998) provides for the protection of indigenous plants. Subject to the provisions of this Act, no person shall:

- Pick, be in possession of, sell, purchase, donate, receive as a gift, import into, export or remove from the Province, or convey:
  - A specially protected plant; or
  - A protected plant.
- Pick any indigenous plant:
  - On a public road;
  - On land next to a public road within 100m measured from the centre of the road;
  - Within an area bordering any natural watercourse, whether wet or dry, up to and within a distance of 50m from the high watermark on either side of the natural watercourse; or
  - In a Provincial Park, a site of Ecological Importance or a Protected Natural Environment.

The below schedules were applicable for the floral and faunal assessments (Part B and C):

- Schedule 1: SPECIALLY PROTECTED GAME (SECTION 4 (1) (a));
- Schedule 2: PROTECTED GAME (SECTION 4 (1) (b));
- Schedule 4: PROTECTED WILD ANIMALS (SECTION 4 (1) (d));
- Schedule 7: INVERTEBRATES (SECTION 35 (1));
- Schedule 11: PROTECTED PLANTS (SECTION 69 (1) (a)); and
- Schedule 12: SPECIALLY PROTECTED PLANTS (SECTION 69 (1) (b)).

APPENDIX C: Impact Assessment Methodology

Criteria of assigning significance to potential impacts

The evaluation of impacts is conducted in terms of the criteria detailed in Table C1 to Table C6. The various environmental impacts and benefits of this project are discussed in terms of impact status, extent, duration, probability, and intensity. Impact significance is regarded as the sum of the impact extent, duration, probability and intensity and a numerical rating system has been applied to evaluate impact significance. Therefore, an impact magnitude and significance rating are applied to rate each identified impact in terms of its overall magnitude and significance (Table C6).

In order to adequately assess and evaluate the impacts and benefits associated with the project, it was necessary to develop a methodology that would scientifically achieve this and to reduce the subjectivity involved in making such evaluations. To enable informed decision-making, it is necessary to assess all legal requirements and clearly defined criteria in order to accurately determine the significance of the predicted impact or benefit on the surrounding natural and social environment.

Impact Status

The nature or status of the impact is determined by the conditions of the environment prior to construction and operation. A discussion on the nature of the impact will include a description of what causes the effect, what will be affected and how it will be affected. The nature of the impact can be described as negative, positive or neutral.

Table C1: Status of Impact

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment	P
Neutral	No cost or benefit to the receiving environment	-
Negative	A cost to the receiving environment	N

Impact Extent

The extent of an impact is considered as to whether impacts are either limited in extent or if it affects a wide area or group of people. Impact extent can be site specific (within the boundaries of the development area), local, regional or national and/or international.

Table C2: Extent of Impact

Rating	Description	Quantitative Rating
Low	Site Specific; Occurs within the site boundary	1
Medium	Local; Extends beyond the site boundary; Affects the immediate surrounding environment (i.e. up to 5 km from the Project Site boundary).	2
High	Regional; Extends far beyond the site boundary; Widespread effect (i.e. 5 km and more from the Project Site boundary).	3
Very High	National and/or international; Extends far beyond the site boundary; Widespread effect	4

Impact Duration

The duration of the impact refers to the time scale of the impact or benefit.

Table C3: Duration of Impact

Rating	Description	Quantitative Rating
Low	Short term; Quickly reversible; Less than the project lifespan; 0 – 5 years.	1
Medium	Medium term; Reversible over time; Approximate lifespan of the project; 5 – 17 years.	2
High	Long term; Permanent; Extends beyond the decommissioning phase; >17 years	3

Impact Probability

The probability of the impact describes the likelihood of the impact actually occurring.

Table C4: Probability of Impact

Rating	Description	Quantitative Rating
Improbable	Possibility of the impact materialising is negligible; Chance of occurrence <10%.	1
Probable	Possibility that the impact will materialise is likely; Chance of occurrence 10 – 49.9%	2
Highly Probable	It is expected that the impact will occur; Chance of occurrence 50 – 90%.	3
Definite	Impact will occur regardless of any prevention measures; Chance of occurrence >90%.	4
Definite and Cumulative	Impact will occur regardless of any prevention measures; Chance of occurrence >90% and is likely to result in in cumulative impacts	5

Impact Intensity

The intensity of the impact is determined to quantify the magnitude of the impacts and benefits associated with the proposed project.

Table C5: Intensity of Impact

Rating	Description	Quantitative Rating
Maximum Benefit	Where natural, cultural and / or social functions or processes are positively affected resulting in the maximum possible and permanent benefit.	+5
Significant Benefit	Where natural, cultural and / or social functions or processes are altered to the extent that it will result in temporary but significant benefit.	+4
Beneficial	Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified, beneficial way.	+3
Minor Benefit	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally benefited	+2
Negligible Benefit	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly benefited.	+1
Neutral	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are not affected.	0
Negligible	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are negligibly affected	-1
Minor	Where the impact affects the environment in such a way that natural, cultural and / or social functions or processes are only marginally affected.	-2
Average	Where the affected environment is altered but natural, cultural and / or social functions or processes continue, albeit in a modified way.	-3
Severe	Where natural, cultural and / or social functions or processes are altered to the extent that it will temporarily cease.	-4
Very Severe	Where natural, cultural and / or social functions or processes are altered to the extent that it will permanently cease.	-5

Impact Significance
The impact magnitude and significance rating is utilised to rate each identified impact in terms of its overall magnitude and significance.

Table C6: Impact Magnitude and Significance Rating

Impact	Rating	Description	Quantitative Rating
Positive	High	Of the highest positive order possible within the bounds of impacts that could occur. +	+12-16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort	+6-11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming	+ 1–5
No Impact	No Impact	Zero Impact	
Negative	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged.	-1-5
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and fairly possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form). Modification of the project design or alternative action may be required	-6-11
	High	Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt.	-12-16

Mitigation measure development

According to the DEA *et al.,* (2013) "Rich biodiversity underpins the diverse ecosystems that deliver ecosystem services that are of benefit to people, including the provision of basic services and goods such as clean air, water, food, medicine and fibre; as well as more complex services that regulate and mitigate our climate, protect people and other life forms from natural disaster and provide people with a rich heritage of nature-based cultural traditions. Intact ecological infrastructure contributes significant savings through, for example, the regulation of natural hazards such as storm surges and flooding by which is attenuated by wetlands".
According to the DEA *et al.,* (2013) Ecosystem services can be divided into 4 main categories:

- Provisioning services are the harvestable goods or products obtained from ecosystems such as food, timber, fibre, medicine, and fresh water;
- Cultural services are the non-material benefits such as heritage landscapes and seascapes, recreation, ecotourism, spiritual values and aesthetic enjoyment;
- Regulating services are the benefits obtained from an ecosystem's control of natural processes, such as climate, disease, erosion, water flows, and pollination, as well as protection from natural hazards; and
- Supporting services are the natural processes such as nutrient cycling, soil formation and primary production that maintain the other services.

Loss of biodiversity puts aspects of the economy, wellbeing and quality of life at risk, and reduces socio-economic options for future generations. This is of particular concern for the poor in rural areas who have limited assets and are more dependent on common property resources for their livelihoods. The importance of maintaining biodiversity and intact ecosystems for ensuring on-going provision of ecosystem services, and the consequences of ecosystem change for human well-being, were detailed in a global assessment entitled the Millennium Ecosystem Assessment (MEA, 2005), which established a scientific basis for the need for action to enhance management and conservation of biodiversity.
Sustainable development is enshrined in South Africa's Constitution and laws. The need to sustain biodiversity is directly or indirectly referred to in a number of Acts, not least the National Environmental Management: Biodiversity Act (No. 10 of 2004) (hereafter referred to as the Biodiversity Act) and is fundamental to the notion of sustainable development. In addition, International guidelines and commitments as well as national policies and strategies are important in creating a shared vision for sustainable development in South Africa (DEA *et al.,* 2013).
The primary environmental objective of the Mineral and Petroleum Resources Development Act (MPRDA) is to give effect to the environmental right contained in the South African Constitution. Furthermore, Section 37(2) of the MPRDA states that "any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of prospecting and mining projects in order to ensure that exploitation of mineral resources serves present and future generations".
Pressures on biodiversity are numerous and increasing. According to the DEA *et al.,* (2013) Loss of natural habitat is the single biggest cause of biodiversity loss in South Africa and much of the world. The most severe transformation of habitat arises from the direct conversion of natural habitat for human requirements, including[7]:

- Cultivation and grazing activities;
- Rural and urban development;
- Industrial and mining activities, and
- Infrastructure development.

Impacts on biodiversity can largely take place in four ways (DEA *et al.,* 2013):

- **Direct impacts:** are impacts directly related to the project including project aspects such as site clearing, water abstraction and discharge of water from riverine resources;
- **Indirect impacts:** are impacts associated with a project that may occur within the zone of influence in a project such as surrounding terrestrial areas and downstream areas on water courses;
- **Induced impacts:** are impacts directly attributable to the project but are expected to occur due to the activities of the project. Factors included here are urban sprawl and the development of associated industries; and

[7] Limpopo Province Environment Outlook. A Report on the State of the Environment, 2002. Chapter 4.

- **Cumulative impacts:** can be defined as the sum of the impact of a project as well as the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity resources. Examples include numerous mining operations within the same drainage catchment or numerous residential developments within the same habitat for faunal or floral species.

Given the limited resources available for biodiversity management and conservation, as well as the need for development, efforts to conserve biodiversity need to be strategic, focused and supportive of sustainable development. This is a fundamental principle underpinning South Africa's approach to the management and conservation of its biodiversity and has resulted the definition of a clear mitigation strategy for biodiversity impacts.

'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other land use. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.

The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DEA *et al.,* 2013):

- **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases, if impacts are expected to be too high the "no project" option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
- **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;
- **Rehabilitate impact:** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation can however not be considered as the primary mitigation tool as even with significant resources and effort rehabilitation that usually does not lead to adequate replication of the diversity and complexity of the natural system. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project. Practical rehabilitation should consist of the following phases in best practice:
  - **Structural rehabilitation** which includes physical rehabilitation of areas by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long terms sustainable ecological structure;
  - **Functional rehabilitation** which focuses on ensuring that the ecological functionality of the ecological resources on the focus area supports the intended post closure land use. In this regard special mention is made of the need to ensure the continued functioning and integrity of wetland and riverine areas throughout and after the rehabilitation phase;
  - **Biodiversity reinstatement** which focuses on ensuring that a reasonable level of biodiversity is re-instated to a level that supports the local post closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community of community suitable for supporting the intended post closure land use; and
  - **Species reinstatement** which focuses on the re-introduction of any ecologically important species which may be important for socio-cultural reasons, ecosystem functioning reasons and for conservation reasons. Species re-instatement need only occur if deemed necessary.
- **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of *very high significance* and when residual impacts are considered to be of *very high significance*, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have *medium to high significance*, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.[8]

In light of the above discussion the following points present the key concepts considered in the development of mitigation measures for the proposed development.

- Mitigation and performance improvement measures and actions that address the risks and impacts[9] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, with estimates of the resources (including human resource and training requirements) and responsibilities for implementation wherever possible.

Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through to construction and operation.

[8] Provincial Guideline on Biodiversity Offsets, Western Cape, 2007.

[9] Mitigation measures should address both positive and negative impacts

APPENDIX D: Vegetation Types

GM 31 Long Tom Pass Montane Grassland

The Long Tom Pass Montane Grasslands have links to Zimbabwean flora (e.g. *Disa zimbabweensis, Morella microbracteata, Helichrysum swynnertonii*) as well as the southern Drakenberg (e.g. *Polypodium vulgare, Helichrysum melanacme*). It is also sharing a few endemics with the adjacent Steenkampsberg Montane Grasslands to the west (*Indigofera hedyantha* subsp. *steenkampsbergensis*).

Remarks: A floristic analysis of the vegetation supports the recognition of a new centre of plant endemism (Lydenburg Centre) with the proposal of two subcentres of plant endemism, namely the Long Tom Pass Subcentre and the Steenkampsberg subcentre. Total species richness for the Lydenburg centre is around 2266 species and 51 endemic plant species. The Long Tom Pass subcentre has at least 19 plant taxa endemic to this unit.

Table D1: Important taxa associated with the Long Tom Pass Montane Grassland (Mucina & Rutherford, 2006).

Woody Layer	
Small Trees	*Apodytes dimidiata, Protea roupelliae* subsp. *roupelliae* (d), *Protea caffra* subsp. *caffra, Faurea galpinii, Hypericum revolutum, Myrsine africana, Buddleja auriculata, Buddleja salviifolia, Searsia tumulicola* var. *tumulicola, Searsia pyroides, Syncolostemon eriocephalus, Passerina montana.*
Low Shrubs	*Protea parvula* (d), *Phymaspermum acerosum* (d), *Psoralea latifolia* (d), *Erica drakensbergensis, Cliffortia repens, Cliffortia nitidula* subsp. *pilosa* (d), *Erica woodii* (d), *Rotheca hirsuta, Lasiosiphon caffer, Berkheya echinacea, Pelargonium dispar, Aeschynomene rehmannii* var. *leptobotrya, Erica cerinthoides* var. *cerinthoides, Hebenstretia comosa, Anisopappus smutsii, Euryops pedunculatus, Clutia abyssinica.*
Succulent Shrubs	*Aloe arborescens, Crassula sarcocaulis* subsp. *sarcocaulis, Lopholaena disticha.*
Forb layer	
Herbs	*Helichrysum wilmsii* (d), *Helichrysum acutatum, Helichrysum glomeratum* (d), *Helichrysum spiralepis* (d), *Helichrysum subluteum* (d), *Helichrysum polycladum, Helichrysum pilosellum, Sopubia cana* (d), *Eriosema kraussianum* (d), *Drosera burkeana, Selago atherstonei* (d), *Gladiolus longicollis* var. *platypetalus* (d), *Gerbera ambigua, Monsonia transvaalensis, Oxalis obliquifolia, Pseudopegolettia thodei, Psammotropha* myriantha (d), *Xysmalobium acerateoides* (d), *Pearsonia obovata, Pearsonia* sessilifolia subsp. *sessilifolia, Cycnium racemosum, Berkheya radula, Helichrysum coriaceum, Helichrysum nudifolium* var. *pilosellum, Syncolostemon albiflorus, Syncolostemon subvelutina* (d), *Diclis reptans, Hypoxis filiformis, Inezia integrifolia, Kohautia amatymbica, Senecio coronatus, Senecio glaberrimus, Senecio scitus, Pentanisia prunelloides* subsp. *latifolia, Nidorella auriculata, Pteridium aquilinum, Sebaea bojeri, Hilliardiella hirsuta, Alepidea peduncularis, Alepidea setifera, Rhynchosia monophylla, Craterocapsa tarsodes, Geranium wakkerstroomianum, Cyphia elata* var. *elata, Wahlenbergia lycopodioides. Trachyandra saltii, Chlorophytum cooperi.*
Succulent Herbs	*Anthospermum herbaceum.*
Grass layer	
Graminoids	*Andropogon schirensis* (d), *Festuca costata* var. *costata* (d), *Themeda triandra, Alloteropsis semialata* subsp. *eckloniana* (d), *Ctenium concinnum* (d), *Loudetia densispica* (d), *Microchloa altera* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme, Sporobolus centrifugus, Bromus firmior, Andropogon appendiculatus, Diheteropogon filifolius* (d), *Harpochloa falx* (d), *Koeleria capensis* (d), *Panicum ecklonii, Panicum natalense, Sporobolus centrifugus, Tristachya leucothrix, Agrostis lachnantha* var. *lachnantha, Eragrostis racemosa, Trachypogon spicatus, Scleria dieterlenii* (d), *Cyperus semitrifidus, Cyperus obtusiflorus var. flavissimus, Restio schoenoides. Xyris capensis*

(d) = dominant species

(The genus for all *Searsia* spp. was formerly *Rhus*)

Table D2: Biogeographically important taxa associated with the Long Tom Pass Montane Grassland (Mucina & Rutherford, 2006).

BIOGEOGRAPHICALLY IMPORTANT TAXA (REGIONAL ENDEMICS)	
Woody Layer	
Shrubs	*Morella microbracteata.*
Forb layer	
Herbs	*Helichrysum swynnertonii*
Geophytic herbs	*Brachystelma stellatum*
Succulent Herbs	*Aloe affinis, Khadia alticola*

(d) = dominant species

Table D3: Endemic taxa associated with the Long Tom Pass Montane Grassland (Mucina & Rutherford, 2006).

ENDEMIC TAXA	
Woody Layer	
Low Shrubs	*Callilepis normae*, *Erica atherstonei*, *Erica revoluta*, *Erica subverticillaris*, *Helichrysum summo-montanum.*
Forb layer	
Herbs	*Helichrysum-aureum* sp nov., *Streptocarpus cyaneus* subsp. *long-tommi*, *Streptocarpus hilburtii.*
Geophytic Herbs	*Disa amoena, Disa clavicornis, Disa vigilans, Hesperantha saxicola, Gladiolus calcaratus, Gladiolus exiguus, Ledebouria mokobulanensis, Watsonia wilmsii*

(d) = dominant species

Gm 22 Northern Escarpment Dolomite Grassland

Figure D1: Gm 22 Northern Escarpment Dolomite Grassland: Rocky dolomite grassland on the Farm Dientjie (Blyde River Canyon National Park, Mpumalanaga) with the grass *Loudetia simplex* and scattered woody species such as *Cussonia paniculata, Protea caffra, Ziziphus mucronata* and *Smilax kraussiana*. Mucina and Rutherford (2006) page 409.

Remarks: Large variation in altitude and rainfall results in differences in species composition. These dolomites support species usually associated with the Wolkberg Centre of Plant Endemism, although some species are also shared with the Sekhukhune Centre of Plant Endemism (e.g. *Dombeya autumnalis*).

Table D4: Important taxa associated with the Northern Escarpment Dolomite Grassland (Mucina & Rutherford, 2006).

Woody Layer	
Small Trees	*Seemannaralia gerrardii* (d), *Cussonia natalensis*, *Faurea rochetiana*, *Faurea saligna*, *Hippobromus pauciflorus*, *Ozoroa albicans*, *Protea caffra* subsp. *caffra*, *Protea roupelliae* subsp. *roupelliae*.
Tall Shrubs	*Pavetta lanceolata* (d), *Diospyros lycioides* subsp. *sericea*, *Protea gaguedi*, *Searsia rehmanniana*, *Tarchonanthus parvicapitulatus*.
Low Shrubs	*Argyrolobium transvaalense*, *Athrixia arachnoidea*, *Chaetacanthus burchellii*, *Erica drakensbergensis*, *Helichrysum splendidum*, *Pelargonium dolomiticum*, *Phymaspermum acerosum*, *Searsia tumulicola* var. *meeuseana*, *Schistostephium rotundifolium*, *Stoebe plumosa*, *Tenrhynea phylicifolia*.
Forb layer	
Herbs	*Hypodematium crenatum* (d), *Barleria ovata*, *Conostomium natalense*, *Dicoma anomala*, *Helichrysum miconiifolium*, *Helichrysum thapsus*, *Pearsonia sessilifolia* subsp. *marginata*, *P. sessilifolia* subsp. *sessilifolia*, *Rhynchosia monophylla*, *Senecio panduriformis*, *Hilliardiella aristata*, *Xerophyta retinervis*.
Geophytic Herbs	*Cheilanthes pentagona* (d), *Pteris vittata* (d).
Succulent Herbs	*Aloe fouriei*, *Crassula sarcocaulis*
Grass layer	
Graminoids	*Cymbopogon caesius* (d), *Cymbopogon nardus* (d), *Elionurus muticus* (d), *Eragrostis capensis* (d), *Hyparrhenia filipendula* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Schizachyrium sanguineum* (d), *Trichopteryx dregeana* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon schirensis*, *Digitaria maitlandii*, *Diheteropogon filifolius*, *Eragrostis plana*, *Eragrostis racemosa*, *Festuca costata*, *Melinis nerviglumis*, *Melinis repens* subsp. *repens*, *Microchloa altera*, *Sporobolus africanus*, *Sporobolus pectinatus*, *Stiburus alopecuroides*, *Themeda triandra*.

(d) = dominant species

(The genus for all *Searsia* spp. was formerly *Rhus*)

Table D5: Biogeographically important taxa associated with the Northern Escarpment Dolomite Grassland (Mucina & Rutherford, 2006).

BIOGEOGRAPHICALLY IMPORTANT TAXA ([N]Northern sourveld endemic, [W]Wolkberg endemic)	
Woody Layer	
Low Shrubs	*Berkheya pauciflora*[W], *Heteromorpha pubescens*[N].
Forb layer	
Herbs	*Syncolostemon transvaalensis*[N] (d), *Phymaspermum argenteum*[N], *Scabiosa transvaalensis*[W].

(d) = dominant species

Table D6: Endemic taxa associated with the Northern Escarpment Dolomite Grassland (Mucina & Rutherford, 2006).

ENDEMIC TAXA	
Woody Layer	
Small Trees	*Ozoroa* sp. nov. ('*laetans*').
Low Shrubs	*Salvia dolomitica* (d), *Pelargonium album*.
Succulent Shrubs	*Aloe alooides*.
Semiparasitic Shrub	*Thesium davidsonae*.
Forb layer	
Geophytic Herbs	*Gladiolus macneilii, G. pavonia*, *Ledebouria parvifolia*.

(d) = dominant species

Gm 23 Northern Escarpment Quartzite Sourveld

Figure D3: Gm 23 Northern Escarpment Quartzite Sourveld: Complex of short grassland with scattered woody vegetation (*Protea roupelliae, P. rubropilosa, Schefflera umbellofera* and *Erica caffrorum*) occurring on quartzite outcrops of the Wolkberg summit on the eastern escarpment. Mucina and Rutherford (2006) page 410.

Remark 1: This vegetation type closely coincides with the Wolkberg Centre of Endemism and is rich in endemic plants. Although this centre does incorporate the dolomites of Gm 22 Northern Escarpment Dolomite Grassland and SVcb 25 Poung Dolomite Mountain Bushveld, it is also comprised of two subcentres, namely the Serala and Blyde Subcentres. The Serala Subcentre is found to the north of the Olifants River along the Northern Escarpment, with approximately 36 endemics and near-endemics. The Blyde Subcentre is found to the south of the Olifants River along the Northern Escarpment, with approximately 15 endemic or near-endemic species.

Remark 2: Patches of FOz 4 Northern Mistbelt Forest are common in protected rocky areas.

Table D7: Important taxa associated with the Northern Escarpment Quartzite Sourveld (Mucina & Rutherford, 2006).

Woody Layer	
Small Trees	*Protea roupelliae* subsp. *roupelliae* (d), *Faurea galpinii*, *F. rochetiana*, *Syzygium cordatum* var. *cordatum*.
Tree Fern	*Cyathea dregei*.
Tall Shrubs	*Gymnanthemum myrianthum*.
Low Shrubs	*Athrixia phylicoides*, *Clutia monticola*, *Crotalaria doidgeae*, *Erica woodii*, *Euryops pedunculatus*, *Helichrysum kraussii*, *H. obductum*, *H. wilmsii*, *Phymaspermum acerosum*, *P. bolusii*, *Searsia tumulicola* var. *meeuseana*.
Succulent Shrubs	*Lopholaena coriifolia* (d), *Aloe arborescens*, *Crassula sarcocaulis*.
Forb layer	
Herbs	*Rhynchosia woodii* (d), *Acalypha glandulifolia*, *Anisopappus smutsii*, *Aster harveyanus*, *Berkheya echinacea*, *Craterocapsa tarsodes*, *Dicoma anomala*, *Eriosema angustifolium*, *Geigeria burkei* subsp. *burkei*, *Gerbera ambigua*, *Helichrysum acutatum*, *Helichrysum appendiculatum*, *Helichrysum cephaloideum*, *Helichrysum nudifolium* var. *pilosellum*, *Helichrysum oreophilum*, *Helichrysum umbraculigerum*, *Indigofera sanguinea*, *Kohautia amatymbica*, *Lobelia flaccida*, *Monsonia attenuata*, *Pearsonia sessilifolia* subsp. *marginata*, *Plectranthus calycinus*, *Selago hyssopifolia*, *Senecio panduriformis*, *Senecio scitus*, *Oocephala centaureoides*, *Hilliardiella aristata*, *Polydora poskeana*, *Wahlenbergia squamifolia*.
Herbaceous Climber	*Rhynchosia caribaea*.
Geophytic Herbs	*Asplenium aethiopicum*, *Cheilanthes hirta*, *Pteridium aquilinum*, *Schizocarphus nervosus*.
Succulent Herbs	*Crassula alba*, *Crassula vaginata*, *Craterostigma wilmsii*.
Grass layer	
Graminoids	*Aristida junciformis* subsp. *galpinii* (d), *Loudetia simplex* (d), *Melinis nerviglumis* (d), *Monocymbium ceresiiforme* (d), *Panicum ecklonii* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *Cymbopogon nardus*, *Digitaria maitlandii*, *Diheteropogon filifolius*, *Elionurus muticus*, *Festuca costata*, *Hyparrhenia poecilotricha*, *Restio schoenoides*, *Juncus lomatophyllus*, *Koeleria capensis*, *Merxmuellera drakensbergensis*, *Microchloa caffra*, *Pentaschistis natalensis*, *Microchloa altera*, *Schizachyrium sanguineum*, *Sporobolus pectinatus*, *Stiburus alopecuroides*, *Themeda triandra*, *Trichopteryx dregeana*.

(d) = dominant species

(The genus for all *Searsia* spp. was formerly *Rhus*)

Table D8: Biogeographically important taxa associated with the Northern Escarpment Quartzite Sourveld (Mucina & Rutherford, 2006).

BIOGEOGRAPHICALLY IMPORTANT TAXA ([N]northern Sourveld Endemic, [W]wolkberg Endemic)	
Woody Layer	
Small Trees	*Protea rubropilosa*[N] (d), *Encephalartos paucidentatus*[N].
Tall Shrubs	*Tricalysia capensis* var. *galpinii*[N].
Low Shrubs	*Asparagus rigidus*[W], *Berkheya carlinopsis* subsp. *magalismontana*[N], *Helichrysum mimetes*[N], *Helichrysum reflexum*[N], *Helichrysum rudolfii*[N], *Helichrysum uninervium*[N], *Syncolostemon parvifolia*[N], *Helichrysum rehmannii*[W], *Helichrysum subvelutina*[N], *Kotschya parvifolia*[N], *Protea parvula*[N], *Sutera polelensis* subsp. *fraterna*[N], *Syncolostemon eriocephalus*[N].
Succulent Shrubs	*Aloe chortolirioides* var. *woolliana*[N].
Semiparasitic Shrubs	*Thesium gracilentum*[W], *T. multiramulosum*[N].
Forb layer	
Herbs	*Anisopappus junodii*[W], *Cyanotis pachyrrhiza*[N], *Syncolostemon transvaalensis*[N], *Monsonia transvaalensis*[N], *Pearsonia aristata*[N], *Scabiosa transvaalensis*[W].
Geophytic Herbs	*Agapanthus inapertus* subsp. *hollandii*[N], *A. inapertus* subsp. *parviflorus*[N], *Aspidonepsis shebae*[N], *Brachystelma stellatum*[N], *Cyrtanthus thorncroftii*[N], *Disa extinctoria*[N], *Gladiolus calcaratus*[N], *G. exiguus*[N], *G. varius*[N], *G. vernus*[N], *Ledebouria minima*[N], *Tulbaghia transvaalensis*[N].
Succulent Herbs	*Aloe affinis*[N], *Aloe thompsoniae*[W].

(d) = dominant species

Table D9: Endemic taxa associated with the Northern Escarpment Quartzite Sourveld (Mucina & Rutherford, 2006).

ENDEMIC TAXA	
Woody Layer	
Small Trees	*Encephalartos brevifoliolatus*, *E. cupidus*, *E. nubimontanus*, *Protea laetans*.
Low Shrubs	*Erica rivularis*, *Euclea dewinteri*, *Syncolostemon, Lopholaena festiva*.
Forb layer	
Herbs	*Cineraria hederifolia*, *Inezia speciosa*, *Monopsis kowynensis*, *Monsonia lanuginosa*, *Schistostephium artemisiifolium*, *Streptocarpus decipiens*.
Geophytic Herbs	*Brachystelma pachypodium*, *Crocosmia mathewsiana*, *Cyrtanthus huttonii*, *C. junodii*, *Dierama adelphicum*, *Disa aristata*, *Drimiopsis davidsonae*, *Ledebouria* sp. nov. (‘*rupestris*’), *L. galpinii*, *L. petiolata*, *Schizochilus crenulatus*, *Tulbaghia coddii*, *T. simmleri*, *Watsonia strubeniae*.
Succulent Herbs	*Aloe nubigena*.
Grass layer	
Graminoids	*Schoenoxiphium schweickerdtii*.

(d) = dominant species

FOz 4 Northern Mistbelt Forest

Figure D4: FOz 4 Northern Mistbelt Forest: Strand of tree fern *Cyathea capensis* on the edge of mistbelt forest in a shady gully below the escarpment near Graskop (Mpumalanga). Mucina and Rutherford (2006) page 601.

Remarks: These forests border on sourveld grasslands on their upper boundary, whereas they often border on bushveld on their lower boundary. The Northern Mistbelt Forests are typically species rich, containing a mixture of afrotemperate elements and species of subtropical provenience, indicating a floristic (and possibly also biogeographic-evolutionary) link of these forests to the Scarp Forests. This phenomenon is clearly observed along the Northern Escarpment below God's Window and Marieskop, and in the Barberton region (Morgenthal & Cilliers 1999).

Table D10: Important taxa associated with the Northern Mistbelt Forest (Mucina & Rutherford, 2006).

Woody Layer	
Tall Trees	*Brachylaena transvaalensis* (d), *Combretum kraussii* (d), *Curtisia dentata* (d), *Drypetes gerrardii* (d), *Kiggelaria africana* (d), *Ocotea kenyensis* (d), *Olea capensis* subsp. *macrocarpa* (d), *Podocarpus latifolius* (d), *Psydrax obovata* subsp. *elliptica* (d), *Searsia chirindensis* (d), *Schefflera umbellifera* (d), *Syzygium gerrardii* (d), *Xymalos monospora* (d), *Aphloia theiformis*, *Chionanthus battiscombei*, *Chionanthus foveolatus* subsp. *major*, *Maytenus acuminata*, *Pterocelastrus galpinii*, *Rapanea melanophloeos*, *Rothmannia capensis*, *Trichilia dregeana*.
Small Trees	*Cassipourea malosana* (d), *Oxyanthus speciosus* subsp. *gerrardii* (d), *Englerophytum magalismontanum*, *Gymnosporia harveyana*, *Mackaya bella*, *Ochna arborea* var. *oconnorii*, *Peddiea africana*, *Rinorea angustifolia*.
Woody Climber	*Senegalia ataxacantha* (d), *Keetia gueinzii* (d), *Rhoicissus rhomboidea* (d), *Bauhinia galpinii*, *Dalbergia armata*.
Tall Shrubs	*Psychotria capensis* (d), *Canthium kuntzeanum*, *Carissa bispinosa* subsp. *zambesiensis*, *Pavetta kotzei*, *Sclerochiton harveyanus*.
Soft Shrubs	*Galopina circaeoides*, *Hypoestes triflora*.
Forb layer	
Herbs	*Begonia sonderiana*, *Plectranthus rubropunctatus*, *Plectranthus tetragonus*, *Streptocarpus meyeri*, *Streptocarpus pentherianus*.
Geophytic Herbs	*Dietes iridioides* (d), *Asplenium aethiopicum*, *Asplenium boltonii*, *Asplenium splendens*, *Crocosmia aurea*, *Dryopteris inaequalis*, *Elaphoglossum acrostichoides*, *Polypodium polypodioides* subsp. *ecklonii*, *Polystichum macleae*, *Pteris catoptera*.
Grass layer	
Climbing Graminoids	*Prosphytochloa prehensilis* (d).
Graminoids	*Carex spicato-paniculata* (d), *Cyperus albostriatus* (d), *Oplismenus hirtellus* (d).

(d) = dominant species

(The genus for all *Searsia* spp. was formerly *Rhus*)

(The genus for all *Senegalia* was formerly *Acacia*)

Table D11: Biogeographically important taxa associated with the Northern Mistbelt Forest (Mucina & Rutherford, 2006).

BIOGEOGRAPHICALLY IMPORTANT TAXA (^{S}Southern distribution limit, ^{B}Endemic of Barberton Centre)	
Woody Layer	
Tall Trees	*Anthocleista grandiflora*^{S}, *Faurea galpinii*.
Tall Shrubs	*Psychotria zombamontana*^{S} (d), *Coptosperma rhodesiacum*^{S}.
Soft Shrubs	*Duvernoia adhatodoides*^{B}. Megaherbs: *Ensete ventricosum*^{S}, *Strelitzia caudata*^{S}.
Forb layer	
Herbs	*Plectranthus swynnertonii*^{S}, *Sphaerocionium capillare*^{S}.

(d) = dominant species

Table D12: Endemic taxa associated with the Northern Mistbelt Forest (Mucina & Rutherford, 2006).

ENDEMIC TAXA	
Woody Layer	
Tall Trees	*Cryptocarya transvaalensis* (d), *Ochna gamostigmata*.
Small Trees	*Dombeya pulchra*, *Heteropyxis canescens*.
Tall Shrubs	*Pavetta barbertonensis* (d).
Forb layer	
Herbs	*Streptocarpus davyi*, *Streptocarpus fenestra-dei*, *Streptocarpus micranthus*, *Streptocarpus parviflorus*, *Streptocarpus roseo-albus*, *Streptocarpus wilmsii.*
Epiphytic Herbs	*Mystacidium brayboniae*.
Geophytic Herbs	*Clivia caulescens* (d).

(d) = dominant species

APPENDIX E: 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)
Nelanie Cloete	MSc Botany and Environmental Management (University of Johannesburg)
Christopher Hooton	BTech Nature Conservation (Tshwane University of Technology)
Christien Steyn	MSc Plant Science (University of Pretoria)
Jacobus Johannes du Plessis	B(Hons) Zoology (University of Johannesburg)

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

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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 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		

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

I, Christien Steyn, 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

I, Jacobus Johannes du Plessis, 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

I, Stephen van Staden, declare that -

- I act as the **independent specialist (reviewer)** 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

I, Nelanie Cloete, declare that -

- I act as the **independent specialist (reviewer)** 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

I, Christopher Hooton, declare that -

- I act as the **independent specialist (reviewer)** 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.

____

Specialist Signature

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTIEN STEYN

PERSONAL DETAILS

Position in Company	Floral Ecologist
Joined SAS Environmental Group of Companies	2018

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Association of Botanists (SAAB)
Member of the Botanical Society of South Africa (BotSoc)

EDUCATION

Qualifications

MSc (Plant Science) (University of Pretoria)	2017
BSc (Hons) Plant Science (Invasion Biology) (University of Pretoria)	2014
BSc Environmental Science (University of Pretoria)	2013

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Northern Cape, Free State

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Terrestrial Ecological and Biodiversity Scoping Assessments
- Terrestrial Ecological and Biodiversity Screening Assessments
- Floral Assessments
- Input into Terrestrial Rehabilitation Plan design with the focus on the re-establishment of vegetation
- Floral Rescue and Relocation Plans
- Alien and Invasive Control Plan (AICP)
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Desktop Studies, Mapping and Background Information Research

Training

- Alien and Invasive Plant Identification and awareness

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF JACOBUS JOHANNES DU PLESSIS

PERSONAL DETAILS

Position in Company	Ecologist
Date of Birth	7 August 1991
Nationality	South African
Languages	English, Afrikaans

EDUCATION

Qualifications

BSc Zoology and Botany (University of South Africa)	2015
BHons Zoology (University of Johannesburg)	2017

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Free State
Namibia

SELECTED PROJECT EXAMPLES

Faunal Assessments

- Biodiversity Assessment for the proposed The Dual Colliery, Musina Area, Limpopo
- Ecological Scan for the proposed upgrade of the Rondebult Sewer, Gauteng;
- Ecological Scan for the proposed Zandspruite Secondary School, Zandspruite, Gauteng;
- Ecological Scan for the proposed Mixed Use Township Development, Randburg, Gauteng;
- Biodiversity assessment for the expansion of the Overlooked Colliery near Delmas, Mpumalanga
- Biodiversity assessment for the proposed R101 interchange, the on-ramp C fencing area and the D3519 additional reserve, Mokopane, Limpopo;
- Vegetation screening and baseline ecological assessment for rural road upgrades in Hluhluwe, Kwazulu-Natal;
- Desktop biodiversity assessment for a proposed desalination plant, Elysium, Kwazulu-Natal;
- Baseline Biodiversity Assessment for the upgrade of Retention Dams, Germiston, Gauteng;
- Baseline Biodiversity Assessment for a proposed 100 hectare photovoltaic power plant, Mariental, Namibia;
- Desktop Biodiversity Assessment for a Commercial Office Park, Lusaka, Zambia;
- Baseline Biodiversity Assessment for Polokwane Smelter, Polokwane, Limpopo;
- Baseline Biodiversity Assessment for Mortimer Smelter, Rustenburg, North-West; and
- Baseline Biodiversity Assessment for the Pecanwood Estates, Hartebeespoort, North-West.

Previous Work Experience

- Head of Aquatics – Environmental Assurance (October 2017- September 2018);
- Intern at The Biodiversity Company (January 2016 – July 2017);
- Demonstrator for first years at the University of Johannesburg (2015)
- Assessor/ Trainer at the South African Wildlife College (7 contracts during 2012-2014).

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTOPHER HOOTON

PERSONAL DETAILS

Position in Company	Senior Scientist, Member Biodiversity Specialist
Joined SAS Environmental Group of Companies	2013

EDUCATION

Qualifications

BTech Nature Conservation (Tshwane University of Technology)	2013
National Diploma Nature Conservation (Tshwane University of Technology)	2008

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape, Free State
Africa - Zimbabwe, Sierra Leone, Zambia

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Floral Assessments
- Faunal Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments

- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF NELANIE CLOETE

PERSONAL DETAILS

Position in Company	Senior Scientist, Member Botanical Science and Terrestrial Ecology
Joined SAS Environmental Group of Companies	2011

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 400503/14)
Member of the South African Association of Botanists (SAAB)
Member of the International Affiliation for Impact Assessments (IAIAsa) South Africa group
Member of the Grassland Society of South Africa (GSSA)
Member of the Botanical Society of South Africa (BotSoc)
Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2013
MSc Botany (University of Johannesburg)	2007
BSc (Hons) Botany (University of Johannesburg)	2005
BSc (Botany and Zoology) (Rand Afrikaans University)	2004

Short Courses

Certificate – Department of Environmental Science in Legal context of Environmental Management, Compliance and Enforcement (UNISA)	2009
Introduction to Project Management - Online course by the University of Adelaide	2016
Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Northern Cape, Eastern Cape, Free State
Africa - Democratic Republic of the Congo (DRC)

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Plant species and Landscape Plan

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	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
Member of the Gauteng Wetland Forum
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments
- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies
- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments
- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment
- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment
- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

SCIENTIFIC TERRESTRIAL SERVICES

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BIODIVERSITY ASSESSMENT AND IMPACT ASSESSMENTS AS PART OF THE ENVIRONMENTAL AUTHORISATION AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS FOR THE TGME THETA PROJECT TO INCLUDE THE THETA HILL, BROWNS HILL AND IOTA HILL NEAR PILGRIM'S REST, MPUMALANGA PROVINCE

Prepared for

Batho Earth
Social and Environmental Consultants

First submission: May 2019
Updated: July 2020

Section B: Floral Assessment

Prepared by:	**Scientific Terrestrial Services**
Report author	**C. Steyn**
Report Reviver	**S. van Staden (Pr. Sci. Nat)**
	N. Cloete (Pr. Sci. Nat)
Report Reference:	**STS 190006**

SAS Environmental Group of Companies

EXECUTIVE SUMMARY

Based on the results of the floral assessment, it is the opinion of the specialist that this project will have significant negative impacts on the floral ecology within the focus area and potentially on a local to regional scale. The rehabilitation phase, if well-planned and implemented, may restore some ecological function; however, the current floral communities, especially in terms of floral species of conservation concern (SCC), are unlikely to return to a pre-mining condition.

The vegetation associated with the three focus areas vary across a spatial scale but could broadly be grouped into four habitat units, namely the Mountain Outcrops, Montane Grassland, Riparian Habitat and Forest Remnants as well as the Degraded Habitat. Each habitat unit has been exposed to varying levels of disturbances and the resultant ecological sensitivity of the habitat units thus varied accordingly, fluctuating between High to Intermediate (Mountain Outcrops and Montane Grasslands), Moderately high to Moderately Low (Riparian Habitat and Forest Remnants) and Moderately low to Low (Degraded Habitat). Within all habitat units, floral SCC were recorded with the highest abundance and diversity associated with the Montane Grasslands and Mountain Outcrops. All habitat units, with the Degraded Habitat unit to a lesser degree, have habitat that can support floral SCC that were not recorded during the site assessment. The potential for floral SCC to be present was determined by considering the suitability of the habitat on site and took previously recorded localities of such species in the region into account - provided by the Mpumalanga Tourism and Parks Agency. The Theta Project is highly likely to result in the loss of floral SCC individuals as the success of rescue and relocation is uncertain for many species.

The focus area is considered sensitive and important for floral communities, thus from a biodiversity perspective the focus area is of high conservation value. The Mpumalanga Biodiversity Sector Plan (MTPA, 2014) also recognises this and have categorised the area to be an Optimal and Irreplaceable Critical Biodiversity Area (CBA). Thus, where the proposed Theta Project mine layout falls within Irreplaceable and Optimal CBAs, both opencast and underground mining is considered to be a land-use that will compromise the CBA's biodiversity objective and is deemed a conflicting land use to the management objective for the area. The entire focus area is located within the 5 km Ecological Support Area (ESA): Protected Area Buffer, in which opencast mining projects are land-uses that will compromise biodiversity objectives for protected areas and are not permissible. The Theta Project will further impact negatively on several threatened vegetation types and ecosystems. The proposed Theta Project is fatally flawed from a floral perspective. If the project is authorised, strict adherence to the management of impacts in line with the mitigation hierarchy is deemed essential to attempt no net loss of biodiversity.

If the project is to be approved for overriding socio-economic reasons, and the mitigation hierarchy has been exhausted, an appropriate biodiversity offset and compensation plan, as well as appropriate funding of this initiative is considered essential. Refer to the proposed offset plan for the Theta Project ().

Management Summary

Scientific Terrestrial Services (STS) was appointed to conduct a Faunal and Floral Ecological Assessment and Impact Assessments as part of the environmental assessment and Environmental Impact Assessment (EIA) process for the Transvaal Gold Mining Estate (TGME) Mine Development Project: Application for the amendment of the existing environmental authorisation to include the proposed Theta Open Pit Project comprising the Theta Hill, Browns Hill and Iota Hill projects near Pilgrim's Rest, Mpumalanga Province. The areas to be assessed will henceforth be referred to as the "focus area", except when specifically referring to the activities associated with Theta Hill, Browns Hill or Iota Hill.

The purpose of this report is to define the floral ecology of the focus area, to identify areas of increased Ecological Importance and Sensitivity (EIS), as well as the mapping of such areas in relation to the proposed project footprint, and to describe the Present Ecological State (PES) of the focus area. It is the objective of this study:

- To provide inventories of floral species as encountered within the focus area;
- To determine and describe habitat types, communities and the ecological state of the focus area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/ or any other special features;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including the potential for such species to occur within the focus area;
- To provide detailed information to guide the activities associated with the proposed development activities within the focus area; and
- To ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

SUMMARY RESULTS OF THE FLORAL ASSESSMENT

The focus area is floristically diverse, and a broad range of floral SCC are present, some occurring in abundance in certain areas of the focus area. The desktop assessment indicated that the focus area covers four vegetation types as per Mucina and Rutherford (2018 database, Section A – Figure 10), encompassing grassland and forest biomes. The focus area therefore falls within the ecotone of these four vegetation types, leading to the potential for a complex and diverse floral species composition associated with the focus area - this was confirmed for all remaining natural vegetation within the focus area during the field assessment. The vegetation communities distinguished during the field assessment are described under four broad habitat units, namely:

- **Mountain outcrops:**
  - Cliff faces with associated Forest-like Thickets; and
  - Dolomite/quartzite outcrops.
- **Montane Grassland,** encompassing rocky grasslands along mountain slopes with species represented by all three grassland vegetation types indicated for the focus area (Mucina and Rutherford 2018 database), i.e. Long Tom Pass Montane Grassland, Northern Escarpment Quartzite Sourveld and Northern Escarpment Dolomite Grassland;
- **Riparian Habitat & Forest Remnants:**
  - Riparian vegetation associated with drainage lines and the Blyde River (freshwater resources); and
  - Forest Remnants – including indigenous forest and degraded forest which typically occur adjacent to the Riparian Habitat.
- **Degraded Habitat,** including transformed/built-up areas and alien and invasive plant (AIP) dominated vegetation**.**

Although all habitat units have been affected by anthropogenic activities to some degree, the severity of the impacts differs significantly. Apart from the Degraded Habitat unit, all other habitat units remain largely intact and their habitat integrity is only slightly compromised due to existing roads (i.e. habitat fragmentation) and some AIPs encroaching into natural areas. The potential for the various habitat units to support floral SCC also differ with the Mountain Outcrops harbouring the highest abundance and diversity of floral SCC, followed by the Montane Grasslands.

<u>Floral SCC</u>

One tree species protected under the National Forest Act, 1998 (Act 84 of 1998, as amended in September 2011) (NFA) was recorded within the Forest Remnants during the field assessment, i.e. *Pittosporum viridiflorum.* Suitable habitat is available for several additional species within the forest-like thickets associated with Mountain outcrops, as well as within the woody drainage lines associated with Riparian Habitat and within the Indigenous Forest Remnants. Several floral SCC listed in the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998) (MNCA) were recorded within the focus area (coordinates provided in Section B: Appendix B - Table C1):

- Woody Species:
  - *Faurea galpinii;*
  - *Olea europaea* subsp*. africana;*
  - *Protea caffra* subsp*. caffra;*

  - *Protea gaguedi;* and
  - *Protea roupelliae* subsp*. roupelliae*.
- Forb Species:
  - *Boophone disticha;*
  - *Clivia caulescens (*NT, MNCA*);*
  - *Clivia* sp*.;*
  - *Cyrtanthus tuckii;*
  - *Disa patula* var*. transvaalensis;*
  - *Eulophia foliosa;*
  - *Eulophia streptopetala;*
  - *Gladiolus ecklonii;*
  - *Gloriosa modesta;*
  - *Graderia sp.;*
  - *Habenaria sp.;*
  - *Haemanthus humilis* subsp*. hirsutus;*
  - *Kniphofia linearifolia;*
  - *Kniphofia sp.;*
  - *Merwilla plumbea (*Near Threatened*);*
  - *Orthochilus aculeatus;*
  - *Satyrium cristatum;*
  - *Scadoxus multiflorus* subsp*. katharinae;*
  - *Scadoxus puniceus;*
  - *Stenoglottis fimbriata;* and
  - *Zantedeschia albomaculata.*
- Succulent Species:
  - *Aloe alooides;*
  - *Aloe arborescens;*
  - *Aloe barbertoniae;*
  - *Aloe* cf*. graciliflora;*
  - *Aloe cooperi;*
  - *Aloe dyeri;* and
  - *Aloe greatheadii* var*. davyana*.

The majority of SCC were found within the Mountain Outcrops, mostly concentrated on Theta Hill. The Montane Grasslands further harboured several floral SCC. The Degraded Habitat only supported a few SCC due to the disturbed conditions that are present within this habitat unit. Before any construction activities can take place, a detailed walk-down of the area is necessary, during which all SCC must be marked and either considered for rescue and relocation or, if planning to destroy or move these species, permits would be required from relevant authorities. As the MBSP Handbook (2014) and Ferrar and Lotter (2007) point out, the large number of rare and endangered species in grasslands is a particular problem for EIAs because these plants are mostly small, have a very localised distribution and are only visible for only a few weeks in the year when they flower – which means that they can easily be missed with once-off field assessments. It is expected that the floral SCC encountered on site is not a complete representation of the floral SCC associated with the focus area and many more are expected to occur, especially within the sensitive Mountain Outcrops, Montane Grasslands and Riparian Habitat and Forest Remnants (where still indigenous). To ensure saturation of data considering the floral SCC occurring within the focus area, marking of such species will need to take place during specific times of the year, across several seasons, under the guidance of an MTPA approved, suitably qualified and experienced specialist.

<u>Alien and Invasive Plant Species</u>
The focus area had several sections where AIPs have severely proliferated and this includes the riparian zone of the Blyde River and immediate surrounding habitat. The main sources of introduction, and cause of spread, identified for the focus area includes the commercial plantations and anthropogenic disturbances (primarily mine-related activities). It is evident that AIP management (if any) is currently not adequate and these species have been allowed to spread profusely. The presence of AIPs was highest within the Degraded Habitat, Riparian Habitat and Forest Remnants (where degraded), although the Mountain Outcrops and Montane Grasslands are not devoid of AIPs. If AIPs are not prevented from further encroaching into the Riparian Habitat, severe downstream impacts can

be expected – resulting in potential decreases in water yields and overall loss of niche habitat for floral species adapted to moisture-rich or inundated soil conditions.

Due to the extent of AIPs within the focus area (and beyond), it is of utmost importance that strict control of AIPs located on the mine's property, especially areas associated with increased disturbances, be undertaken on a regular basis as part of maintenance activities. For all species listed within the NEMBA: Alien and Invasive Species Regulations, GN R864 of 2016, their control, as stipulated within the regulations, should be implemented.

Solanum mauritianum **proliferating within a Pine plantation south of Browns Hill (left),** ***Eucalyptus grandis*** **encroaching into natural vegetation south of Theta Hill (centre) and** ***Acacia dealbata*** **encroaching into drainage lines and cliffs within the focus area.**

Floral Habitat Sensitivity

The ecological sensitivity of the identified floral habitat units varies between High to Intermediate (Mountain Outcrops and Montane Grasslands), Moderately high to Moderately Low (Riparian Habitat and Forest Remnants) and Moderately low to Low (Degraded Habitat). The table below indicates the sensitivity of the habitat units along with an associated conservation objective and implications for development – followed by a sensitivity map.

Table A: A summary of the sensitivity of each habitat unit and implications for development.

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
Mountain Outcrops	High	Iota Pit North-eastern portion of the Wishbone WRD Several stretches of the Haul Road and Linear Developments associated with Iota Hill and Theta Pit	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered Offsetting or compensation for residual loss to be considered **only as a last resort**	The Mountain Outcrops were determined to be the most sensitive of the habitat units encountered within the focus area, especially those associated with Theta Hill. The Theta Hill and Browns Hill Mountain Outcrops are highly sensitive from both an ecological and conservation perspective, owing to their high floral diversity, an abundance of floral SCC and the presence of intact vegetation and habitat integrity. The Mountain Outcrops associated with Iota Hill had lower species diversity and fewer SCC but is still considered highly important due to its presence within an Irreplaceable CBA. From a floral resource management and conservation perspective, these areas must be excluded from surface developments, as far as is feasibly possible. The EIA Phase layout has reduced its footprint considerably, especially within the northern and eastern portions of Theta Hill. The current highest risk to the Mountain Outcrops will thus be on Iota Hill,
	Moderately High	Iota Pit, Iota WRD North and Iota WRD South Theta Pit Northern Section of Browns Hill Several stretches of the Haul Road and Linear Developments associated with Iota Hill and Theta Pit	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered **only as a last resort**	

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
	Intermediate	Iota Pit and Browns Pit	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered only as a last resort	where the proposed layout will lead to the direct loss of favourable habitat for floral communities and floral SCC numbers **locally**. Several of the highly sensitive floral communities are located within Irreplaceable CBAs, ESAs and threatened ecosystems; there is thus a conflict between the intended land use and the conservation requirements for the region.
Montane Grasslands	High	Most of the Iota Pit and Iota WRD North, as well as central portion of Iota WRD South Northern portion of the Wishbone WRD	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered Offsetting or compensation for residual loss to be considered only as a last resort	The Montane Grasslands are characterised by a high floral diversity and several floral SCC were recorded in this habitat unit. However, in some sections, habitat integrity was lower for this habitat unit than for the Mountain Outcrops due to the presence of several anthropogenic-related disturbances, including roads excavated along the slopes of Iota Hill (habitat fragmentation) and AIPs encroaching into natural areas throughout. Thus, the Montane Grasslands range from intermediate to high importance from a floral ecological and conservation perspective. Along the south-eastern slopes of Iota Hill, where several roads have been excavated, the grasslands have been fragmented and it is evident that floral diversity is lower in these sections. Thus, considering the impact of habitat fragmentation, together with the conservation significance of South African montane grasslands, no further destruction of these grasslands should take place. The high probability of rare and endemic species occurring in this habitat unit further necessitates the conservation, rather than destruction, of this habitat unit. Several of the highly sensitive floral communities are located within Irreplaceable CBAs, ESAs and threatened ecosystems; there is thus a conflict between the intended land use and the conservation requirements for the region.
	Moderately High	Scattered sections within the Iota WRD North. Northern-most portion of the Iota WRD South Theta Pit 1, Theta Pit and much of the Wishbone WRD Haul Roads associated with Iota Hill and Theta Hill Several stretches of the Linear Developments	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance Offsetting or compensation for residual loss to be considered only as a last resort	
	Intermediate	Browns Pit Iota Pits and Iota WRDs Theta Pit 1	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered only as a last resort	
Riparian Habitat and Forest Remnants	Moderately High	Eastern arm of the Wishbone WRD	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance Offsetting or compensation for residual loss to be considered only as a last resort	The Riparian Habitat and Forest Remnants are of moderately low to moderately high ecological and conservation significance from a floral resource management and conservation perspective. The habitat integrity of the Riparian Habitat within the focus area has been greatly compromised by the proliferation of AIPs, e.g. *Acacia dealbata, Eucalyptus grandis, Jacaranda mimosifolia, Rubus cuneifolius* and *Solanum mauritianum* have encroached into most drainage lines and comprise the majority of vegetation along the Blyde River.

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
	Intermediate	Sections of the Wishbone WRD Linear developments, mainly Haul Roads and Linear Developments Browns PCD	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered only as a last resort	Floristically this habitat unit is significant due to the provision of water and the creation of niches for facultative or obligate wetland plants. However, in its current AIP-encroached condition, many native species have been displaced. With the potential for additional disturbances that would stem from the proposed mining-related activities, it is likely that the Riparian Habitat will suffer further loss of native species diversity and down-stream effects of possible siltation, water contamination and AIP proliferation could lead to additional impacts on floral communities within the larger region. The section of the Forest Remnants where indigenous forest species still form the dominant vegetation component is floristically more sensitive and provides unique habitat for forest species. The remnants of Northern Mistbelt Forest should be excluded from planned mining activities and as per the DEFF recommendations, no mining activities should occur within 30 m of this vegetation type. Activities that are planned within freshwater resources as delineated by the Freshwater Ecologist or within the zones of regulation, as identified in the Freshwater Report, will require authorisation from the Department of Water and Sanitation (DWS). Mining-related activities within this habitat unit will require cogent mitigation measures to ensure no additional, or cumulative, impacts on floral communities occur.
	Moderately Low	Iota Pit	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	
Degraded Habitat	Moderately Low	Sections of Iota Pit, Iota WRD North and Iota WRD South. Most of Browns Pit and southern sections of the Theta Pit 1, Theta Satellite Pit 1, 2 and 3, as well as sections of the Wishbone WRD Haul Roads and several stretches of the Linear Developments Stockpiles and Mine Contractors Site	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	This habitat unit is of moderately low to low sensitivity, from a floral ecological and conservation perspective. Development within this habitat unit should not pose significant threats to native floral communities within the central part of the focus area. However, edge effects will need to be carefully managed, especially the potential spread of AIPs. Development within this habitat unit on Theta and Iota Hills have a greater potential for edge effects to impact on the adjacent, more sensitive habitat units. Ecological functioning and habitat integrity are significantly compromised, and these areas can be optimised for development.
	Low	Powerline Balancing Dam Sections of the Topsoil Stockpiles and Haul Road Southern portion of the Theta Pit 1 and a small section of the Theta Pit 2	Optimise development potential.	

Floral Impact Assessment

The perceived impact significance of the proposed mining activities prior to mitigation affecting floral habitat, diversity and SCC are mostly high significance impacts, with some considered medium significance impacts. Even with effective mitigation taking place, most of the impacts will retain a high significance rating, with only a few reduced to a medium significance rating. Low significance ratings were only obtained for areas that are currently degraded and already have a loss of floral diversity and very few (if any) floral SCC present. Positive impacts are deemed likely for the decommissioning phase if current degraded habitat is rehabilitated to restore some ecological functioning that has been lost due to AIP proliferation and habitat transformation.

Placement of infrastructure and mining activities within areas of intact floral habitat of the Mountain Outcrops Habitat, Montane Grasslands Habitat, the Riparian Habitat and indigenous Forest Remnants will negatively impact on floral diversity and habitat within the focus area and potentially within the region if mitigation measures are not fully implemented. The proposed project, if authorised, will result in the loss of not only rare and/or protected plant life, but also primary grasslands with habitat suitable to sustain and support diverse ecosystems. The impacts will be especially significant associated with the Iota Pit, Iota WRDs, Wishbone WRD and Theta Pits. Below is a size estimation of fair to good habitat that will be directly impacted:

- **Pits**: approximately 23 ha of Irreplaceable CBA, 33 ha of Optimal CBA and 40 ha of Malmani Karstlands;
- **Waste Rock Dimps** (including the portion within the Iota Pit area): approximately 45 ha of Irreplaceable CBA, 37 ha of Optimal CBA and 80 ha of Malmani Karstlands;
- **Pollution Control Dams and Balancing Dam**: approximately 2 ha of Optimal CBA and 2 ha of Malmani Karstlands; and
- **Topsoil Stockpiles**: approximately 2 ha of Optimal CBA and 2 ha of Malmani Karstlands.

Assessing the No-go Alternative, or the scenario of a project not going ahead, requires that all possible scenarios be taken into account, including the implications of not authorising the project. For the Theta Project, four scenarios were identified, and their anticipated impacts on floral ecology for the focus area and larger region (where applicable), assessed below:

- No-go with no management from relevant stakeholders;
- No-go with management from relevant stakeholders;
- Authorised mining in an ideal scenario; and
- Authorised mining practically achievable.

If the No-go Alternative is pursued, there will be no immediate and/or direct impact on sensitive floral communities within the proposed mine footprint and will thus avoid the loss of CBAs, threatened ecosystems and floral SCC. The No-go Alternative therefore better aligns with the intended land use and the conservation requirements for the region (see MTPA, 2014). With the No-go Alternative, the existing threats to biodiversity however remain present. To prevent negative impacts on floral communities, there would need to be agreement from government authorities to manage the current risks posed by illegal mining and AIP proliferation. This scenario is not deemed likely as the required resources are unlikely to be made available.

The proposed project, if authorised, will result in the loss of not only rare and/or protected plant life, but also primary grasslands with habitat suitable to sustain and support diverse ecosystems. With authorisation comes the inclusion of mitigation measures that the mine would be obligated to implement, adhere to and be audited on. Control over existing impacts such as AIP proliferation and pollution from illegal mining activities will be better managed if the Theta Project is authorised. Large mining operations can have greater potential for impact than small-scale artisanal mining (illegal mining in this case), but they also have a greater capacity to minimise damage where artisanal mining practises rarely take responsibility for environmental damage.

The following tables represent a summary of the findings of the impact assessment pertaining to the proposed Theta Project:

Table B: Summary of the impact significance of the proposed mining activities.

Pre-construction Phase		
Proposed Activities	UNMANAGED	MANAGED
Iota Pit	High	High
Browns Pit	Medium	Medium
Theta Pits	High	High
Iota WRDs	High	High
Wishbone WRD	High	High
Stockpiles; Mine Contractors Site	Medium	Low
Iota PCD	Medium	Low
Wishbone PCD	High	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	Medium	Medium
Construction Phase		
Proposed Activities	UNMANAGED	MANAGED
Iota Pit	High	High
Browns Pit	High	Medium
Theta Pits	High	Medium
Iota WRDs	High	High
Wishbone WRD	High	High
Stockpiles; Mine Contractors Site	Medium	Low
Iota PCD	Medium	Low
Wishbone PCD	Medium	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	Medium	Medium
Operational Phase		
Proposed Activities	UNMANAGED	MANAGED
Iota Pit	High	Medium
Browns Pit	Medium	Low
Theta Pits	Medium	Medium
Iota WRDs	High	Medium
Wishbone WRD	High	Medium
Stockpiles; Mine Contractors Site	Medium	Low
Iota PCD	Medium	Low
Wishbone PCD	Medium	Low
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	Medium	Low
Decommissioning and closure Phase		
Proposed Activities	UNMANAGED	MANAGED
Iota Pit	High	Medium
Browns Pit	Medium	Low
Theta Pits	High	Medium
Iota WRDs	High	Medium
Wishbone WRD	High	Medium
Stockpiles; Mine Contractors Site	Medium	Low (+)
Iota PCD	Medium	Low (+)
Wishbone PCD	Medium	Low (+)
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	Medium	Low

NO GO ALTERNATIVE VS MINING	
Proposed Activities	Significance
No-go with no management from all stakeholders	High-
No-go with effective management from all stakeholders	High+
Authorised mining in an ideal scenario	Low-
Authorised mining practically achievable	High-

Concerns from a floral ecological perspective include:

1) Many rare or endemic species occur in mountain grasslands, mostly restricted to either quartzite or dolomite, and these grasslands must be considered a conservation priority (Schmidt et al., 2002). Where grasslands formerly spanned 61% of Mpumalanga, agriculture and other development (such as mining and afforestation) have led to approximately 44% to be irreversibly transformed (Ferrar and Lotter, 2007). The conservation of remaining untransformed grasslands with natural vegetation cover should be prioritised to conserve biodiversity.
2) The current assessment on floral SCC for the focus areas is likely not a full representation of conservation important species that occur on site. Additional summer assessments are deemed essential and must take place across all seasons. Summer, autumn and spring assessments have taken place and MTPA recommends additional surveys in winter and in the rainy season (November / December). This will allow for a fully saturated species lists to be developed as part of the study and to ensure the EMP is comprehensive in the management of floral SCC and robust to ensure appropriate execution.
3) Most of the focus area falls within poorly protected grassland ecosystems (National Biodiversity Assessment, 2011) and according to the MBSP Handbook (2014), only 2.3% of South African grasslands are protected, making them of high conservation value. Thus, further pressures on these grasslands from high impact land uses such as surface mining, will hamper the potential for biodiversity targets to be reached for the grassland biome.
4) The entire focus area is located within the 5 km ESA Protected Area Buffer (MBSP, 2014). These are zones around protected areas where changes in land-use may affect the ecological functioning or tourism potential of the adjacent protected area(s). The MBSP Handbook indicates that mining activities such as the activities associated with the proposed Theta Project are land-uses that will compromise biodiversity objectives and are not permissible within the allocated 5 km buffer around protected areas. According to Goal 3 of the Biodiversity Policy and Strategy for South Africa: Strategy on Buffer Zones for National Parks, published under Government Notice 106 in Government Gazette 35020, mining as a whole is described as a development which may have a negative impact or effect on a national park. Such developments are discouraged. However, it is worth mentioning that the current condition of the 5 km Buffer is already extensively transformed by plantations, various agricultural practices and some areas have seen urbanisation. Using the Mpumalanga Biodiversity Sector Plan database (2014), which likely does not have the full extent of transformed land, there is an estimated 60% already modified within this PA buffer (calculated for a 7km buffer around the Theta Project). On the one hand, this is strong motivation to prevent any further transformation within the buffer; however, the Theta Project will partially fall within the historically mined areas and partially within land transformed by AIPs or plantations, thus forming part of the existing transformed landscape where impact from mining will be limited. Iota Hill is within untransformed land and conflicts with Protected Areas outcomes.
5) Rehabilitation potential: Due to the presence of sensitive floral habitat of high conservation value, it is necessary that all affected areas should be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated. Due to the location of the focus area in Irreplaceable and Optimal CBAs (MBSP, 2014), rehabilitation must be to a pre-mined condition in order for biodiversity targets to be met. If this is not possible, which the findings of this report deem likely, offsetting must be considered for **Optimal CBAs**. Biodiversity offsetting, on the other hand, is not feasible for **Irreplaceable CBAs** (MBSP Handbook, 2014); however, if the proposed MR83-amendment application is approved after consideration of the principles of Integrated Environmental Management (IEM), it is recommended that it be on the bases that there will be compensation for lost habitat in accordance with National and Provincial Offset Guidelines (preferably as a like for like offset[1]). According to the DEA (2017) and the DEA&DP (2011), offsets need to be undertaken according to various ratios based on the ecological importance and sensitivity and vulnerability of the ecosystem:

[1] "*Like for like*" - Undertaking positive management interventions to restore an area or stop degradation: improving the conservation status of an area of land by restoring habitats or ecosystems and reintroducing native species. Where proven methods exist or there are no other options, reconstructing or creating ecosystems can be undertaken. Also, reducing or removing current threats or pressures by, for instance, introducing sustainable livelihoods or substitute materials. This can either be done on the development site (on-site offset) or a distance from the site (off-site offset) [Business and Biodiversity Offsets Programme (BBOP) Handbook (2009)].

- Large sections of the focus area are located within the **Malmani Karstlands Endangered ecosystem**. Basic offset ratio: Endangered ecosystems at least 10 but up to 20 times the impacted area.
- Large sections of the focus area, and particularly Iota Hill, are located within the **endangered Northern Escarpment Dolomite Grassland.** Basic offset ratio: Endangered ecosystems at least 10 but up to 20 times the impacted area.
- **Areas of composite biodiversity significance (Optimal CBAs)**: Offset ratio at minimum 20 times the impacted area.
- **Areas of irreplaceable biodiversity (Irreplaceable CBAs)**: Very little flexibility for these areas. Offset at 30:1 only where no alternatives to the development project are deemed feasible and where project is of overriding public importance.

6) South Africa is a signatory to the Convention on Biological Diversity and has committed to achieving the Aichi Targets. The proposed Theta Project could compromise these commitments in terms of the following Aichi Targets:
   - **Target 9 (Invasive Species):** The extent of AIPs currently within the focus area (and beyond) suggests that no formal AIP management has been implemented by the mine – or not sufficiently. This has already caused displacement of indigenous floral species and compromises habitat integrity of the area. Regardless of whether the proposed Theta Project proceeds, an AIP Management and Control Plan should be implemented.
   - **Target 11 (Protected Areas and identification of Key Biodiversity Areas)**: The focus area is located in CBAs and Endangered Ecosystems which will be lost or significantly impacted by the proposed Theta Project.
   - **Target 12 (conservation of species)**: The focus area is associated with floral SCC of which several individuals is likely to be directly impacted by the proposed Theta Project.

Based on the results of the floral assessment, it is the opinion of the specialist that this project will have negative impacts on the floral ecology within the focus area and potentially on a local to regional scale and the impacts are relatively irreversible. If the project is to be approved for overriding socio-economic reasons, an appropriate biodiversity offset and compensation plan as well as appropriate funding of this initiative is considered essential.

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LIST OF ACRONYMS

AIPs	Alien and invasive plants
BGIS	Biodiversity Geographic Information Systems
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CR	Critically Endangered
DEFF	Department of Environment, Forestry and Fisheries
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EN	Endangered
ESA	Ecological Support Area
GIS	Geographic Information System
GPS	Global Positioning System
IBA	Important Bird Area
IEM	Integrated Environmental Management
IUCN	International Union for the Conservation of Nature
MNCA	Mpumalanga Nature Conservation Act (1998)
MPRDA	Mineral and Petroleum Resource Development Act
MRA	Mining Right Area
NBA	National Biodiversity Assessment (2011)
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
NPAES	National Protected Areas Expansion Strategy
NT	Near Threatened
PES	Present Ecological State
POC	Probability of Occurrence
POSA	Plants of Southern Africa
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square (1:50,000 topographical mapping references)
RDL	Red Data Listed
SABAP 2	Southern African Bird Atlas 2
SACAD	South African Conservation Areas Database
SANBI	South African National Biodiversity Institute
SAPAD	South African Protected Areas Database
SAS	Scientific Aquatic Services
SCC	Species of Conservation Concern
STS	Scientific Terrestrial Services CC
TGME	Transvaal Gold Mining Estate
TOPS	Threatened or Protected Species
TSP	Threatened Species Programme
VU	Vulnerable
WRD	Waste Rock Dump

GLOSSARY OF TERMS

Alien and Invasive species	A species that is not an indigenous species; or an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.
Biodiversity offset (as per the MBSP Handbook, 2014)	An area legally set aside or acquired for conservation purposes, in exchange for the permitted destruction (by development) of a separate area of biodiversity of recognized value. If possible, the biodiversity value of the offset should be at least greater than that of the area destroyed and as similar as possible to it.
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.
CBA (Critical Biodiversity Area)	A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges.
Endangered	Organisms in danger of extinction if causal factors continue to operate.
Endemic species	Species that are only found within a pre-defined area. There can, therefore, be sub-continental (e.g. southern Africa), national (South Africa), provincial, regional or even within a particular mountain range.
ESA (Ecological Support Area)	An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation.
IBA (Important Bird and Biodiversity Area)	The IBA Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that: are globally threatened, have a restricted range, are restricted to specific biomes/vegetation types or sites that have significant populations.
Indigenous vegetation (as per the definition in (NEMA)	Vegetation occurring naturally within a defined area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
Integrity (ecological)	The integrity of an ecosystem refers to its functional completeness, including its components (species) its patterns (distribution) and its processes.
Invasive species (as per the MBSP Handbook, 2014)	Any plant or animal species that has been introduced into South Africa and which has become naturalised, i.e. capable of reproducing and spreading without human assistance. In the case of plants, such species may establish in natural vegetation to the point of replacing it and destroying biodiversity and ecological functioning. The worst invader plants are required by law to be controlled on both private and state land.
Least Threatened	Least threatened ecosystems are still largely intact.
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.
SCC (Species of Conservation Concern)	The term SCC in the context of this report refers to all RDL (Red Data) and IUCN (International Union for the Conservation of Nature) listed threatened species as well as protected species of relevance to the project.

DOCUMENT GUIDE

The Document Guide below is for reference to the procedural requirements for environmental authorisation applications in accordance to GN267 of 24 March 2017, as it pertains to National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA).

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Section A: Appendix E
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Section A: Appendix E
b)	A declaration that the specialist is independent	Section A: Appendix E
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section A: Section 1.1 – 1.3 Section B: Section 1.1 – 1.3
cA)	An indication of the quality and age of base data used for the specialist report	Section A: Section 2.1 and 3.1 Section B: Section 2
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section B: Section 5
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section B: Section 2
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section A: Appendix C Section B: Appendix A
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 B: Section 3 and 4
g)	An identification of any areas to be avoided, including buffers	Section B: Section 4
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 B: Section 4
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section B: Section 1.4
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 B: Section 5
k)	Any mitigation measures for inclusion in the EMPr	Section B: Section 5
l)	Any conditions for inclusion in the environmental authorisation	Section B: Section 5
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section B: Section 5
n)	A reasoned opinion -	Section B: Section 6
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section B: Section 6
(iA)	Regarding the acceptability of the proposed activity or activities	Section B: 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 B: Section 5
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	Section B: Appendix D
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section B: Appendix D
q)	Any other information requested by the competent authority	Section B: Appendix D

1 INTRODUCTION

1.1 Background

Scientific Terrestrial Services (STS) was appointed to conduct a Faunal and Floral Ecological Assessment and Impact Assessments as part of the environmental assessment and Environmental Impact Assessment (EIA) process for the Transvaal Gold Mining Estate (TGME) Mine Development Project: Application for the amendment of the existing environmental authorisation to include the proposed Theta Open Pit Project comprising the Theta Hill, Browns Hill and Iota Hill projects, near Pilgrim's Rest, Mpumalanga Province. The areas to be assessed will henceforth be referred to as the "focus area" (Section A: Figures 2 and 3), except when specifically referring to the activities associated with Theta Hill, Browns Hill or Iota Hill.

The focus area falls within the Thaba Chweu Local Municipality and is located on Portion (Ptn) 42 of the Farm Ponieskrans 543KT (owned by Public Works), which forms part of six farm portions making up the existing Mining Right Area (MRA, Section A: Figure 1). The focus area is situated immediately to the south and west of Pilgrim's Rest, a provincial heritage site, with the R533 running along the northern and eastern sides of the focus area. Apart from Mashishing (previously known as Lydenburg) (approximately 35 km southwest), no major towns are nearby; however, several tourist attractions are located close to the focus area, including the tourist town Graskop and the scenic tourist destination God's Window (approximately 8.2 km southeast). On a regional setting, the landscape consists of far-stretching hills with large portions still in a natural, undisturbed condition. The major contributor of disturbance of natural habitat within the region includes mining, forestry and cultivation.

The purpose of this report is to define the floral ecology of the focus area, to identify areas of increased Ecological Importance and Sensitivity (EIS), as well as the mapping of such areas in relation to the proposed project footprint, and to describe the Present Ecological State (PES) of the focus area. It is the objective of this study to:

- Provide inventories of floral species as encountered within the focus area;
- Determine and describe habitat types, communities and the ecological state of the focus area and to rank each habitat type based on conservation importance and ecological sensitivity;
- Identify and consider all sensitive landscapes including rocky ridges, wetlands and/ or any other special features;

- Conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including the potential for such species to occur within the focus area;
- Provide detailed information to guide the activities associated with the proposed development activities within the focus area; and
- Ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

1.2 Project Description

The Theta Project Mineral Resources traverse two mining right areas, namely 83MR for the portion within Ponieskrantz 543 KT, and 341MR for the portion within Grootfontein 562 KT. Only the portion within Ponieskrantz 543 KT, i.e. 83MR, is investigated in this study. The entire 83MR is situated on various portions of the farms Frankfort 509-KT, Krugers Hoop 527-KT, van der Merwes Reef 526-KT, Morgenzon 525-KT, Peach Tree 544-KT and Ponieskrans 543-KT, and encompasses an area of 9,413 hectares (ha). Extent of the area required for mining is 286 ha.

The existing and approved 83MR allows for the mining of gold ore, silver ore, copper ore and stone aggregate over the extensive 9,413 ha of land. It was granted, registered and executed and expires on 15 October 2023. An application for the amendment of the existing environmental authorisation has been submitted to include the proposed Theta Open Pit Project. In support of this, an Environmental Authorisation and IWULA amendment process is underway.

Historically the area on 83MR has operated in terms of open cut as well as underground gold mines. Theta Hill, Browns Hill and Iota Hill have historically been exploited as mainly underground mines with very limited open pitting. The Theta Hill, Browns Hill and Iota Hill surface projects, collectively referred to as the “Theta Project”, entails surface mining operations at the abovementioned three locations, with an anticipated Life of Mine (LoM) of five and a half years.

To effectively establish the open pit mining operation, a number of infrastructure items will be required. Extent of the area required for the proposed Theta mine is listed in the below table. A depiction of the proposed mine layout is provided in Figure 2. The existing TGME Plant falls within the MR341 mining licence area. Included in this area will be the newly proposed mining site (Offices, workshops, stores, etc.).

Table 1: Extent of the infrastructure associated with the Theta Project.

NAME	ENCLOSED AREA (Ha)	TOTAL LENGTH/ PERIMETER (Km)
Access Road		6,98
Balancing Dam	3,35	
Berms		10,44
Browns Pit	17,45	
Clean Water Channels		27,60
Culverts	0,24	
Dirty Water Channel		52,24
Haul Roads	9,54	9,60
Iota Pit	25,53	
Iota Pollution Control Dam	8,33	
Iota Waste Rock Dump North	45,88	
Iota Waste Rock Dump South	16,66	
Low Level River Crossing	0,49	
Mine Boundary		6,42
Mine Contractor Area	1,82	
Outlet Structures	0,19	
Pipelines		3,39
Powerline		2,35
Silt Trap	0,04	
Spillway	0,30	
Stilling Basin	0,22	
Theta Pit 1	12,74	
Theta Pit 2	6,29	
Theta Satellite Pit 1	0,03	
Theta Satellite Pit 2	0,38	
Theta Satellite Pit 3	0,62	
Topsoil Stockpile	12,82	
Water Treatment Plant	0,21	
Whishbone Waste Rock Dump	23,14	
Wishbone Pollution Control Dam	2,45	

1.3 *Progression of site layouts from Environmental Scoping Phase to EIA Phase*

The Theta Project progression from an initial layout to the most feasible site layout has been significantly influenced by engineering, economic, environmental and social considerations and is described in detail in **Section A**. Certain biophysical and social baseline studies, namely terrestrial ecology (fauna and flora), soils and land capability, air quality, noise and vibration, visual impact, socio-economic and health impact, water quality, heritage and the rehabilitation objectives, returned substantial environmental and social sensitivities and nuances. In the case of the Theta Project, the site layout plan was subsequently altered from that what was initially presented in the Scoping Report (Figure 1) to reflect revised pit layouts (with the Theta Pit being largely affected), new Waste Rock Dump (WRD) locations as well as optimisation of the overall project footprint to achieve the best Integrated Environmental Management (IEM) scenario considering the extent of baseline information available at the time (Figure 2).

The altered site layout plan was achieved through the implementation of the following mitigation hierarchy:

1. Avoid the potential impact altogether;
2. Minimise the area of the potential impact as far as possible;
3. Rehabilitate and restore the affected area; and
4. Secure a biodiversity offset area as compensation for the affected area.

In this instance, the pit shells were reduced in size and waste rock dump sites were relocated to avoid/minimise the impacts on the ground-truthed portions of highest biodiversity significance to minimize the extent of areas requiring detailed rehabilitation and to limit the requirements for offsets of residual impacts. Refer to Figure 2 for the revised site layout plan which will be incorporated into the EIA Report and EMP.

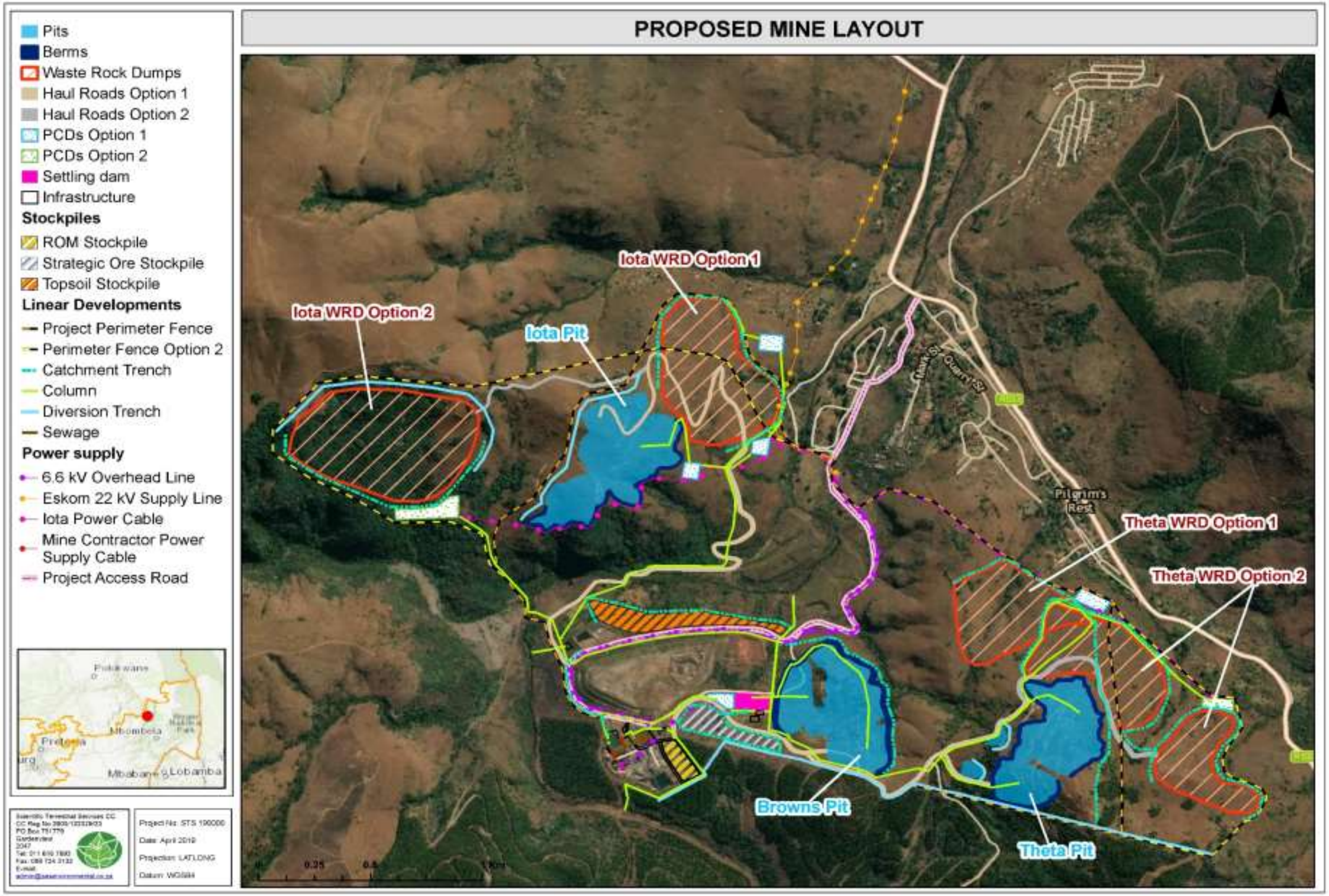


Figure 1: The initial proposed mine layout for the Theta Project as part of the Scoping Phase (Layout 1).

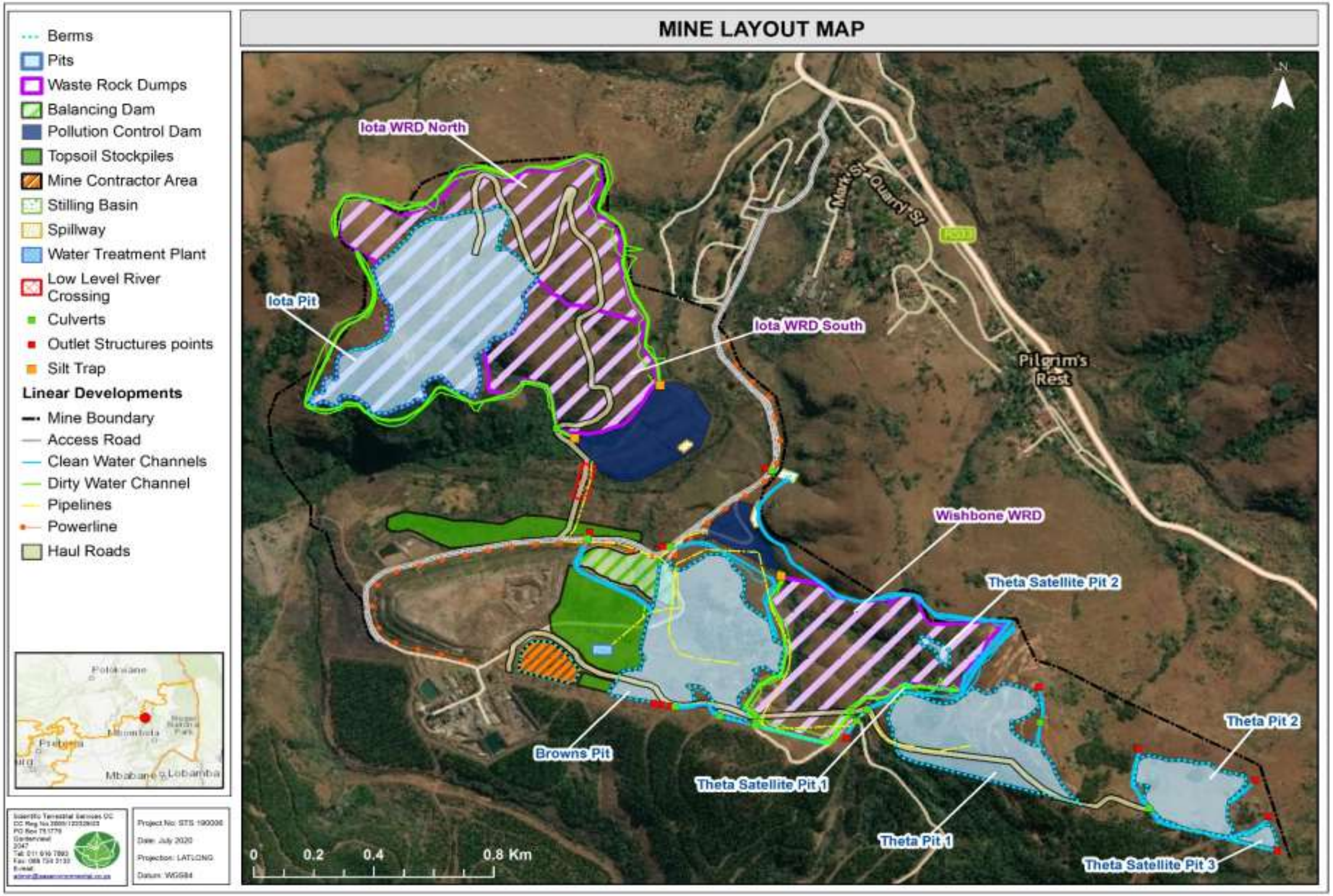


Figure 2: The proposed EIA Phase (Layout 3) mine layout for the focus area.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- Zone of influence around the proposed activities: The floral assessment is confined to the focus area and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment (Section A). In this instance the floral assessment focused on the proposed areas of activity, with the immediate areas surrounding the proposed activities (up to 100 m zone of influence) not meticulously assessed but also examined during the site visits;
- Season of assessment: With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. To account for seasonal turnover, several assessments took place, including assessments in autumn, spring and summer. These assessments also occurred following various successional changes in the landscape e.g. the summer assessment occurred after good rains and the spring assessment after veldfires, thus providing a chance to detect pioneer species during post-fire secondary succession as well as the more permanent species once the veld has recovered. This floral study thus assumes that the data gathered and supplemented with the additional, available background databases, adequately describes the various floral communities associated with the focus area to an acceptable level to allow for informed decision making;
- Sampling design: Sampling by its nature means that not all individuals are assessed and identified. Some species and taxa within the focus area may, therefore, have been missed during the assessment. Due to the extent of the focus area, detailed field assessments were restricted to the proposed infrastructure areas as provided by the applicant. Information for vegetation within the focus area where no infrastructure is planned, and which was thus not meticulously assessed during the site visit, were inferred from the results of the field assessment and mapped using desktop methods. If any changes are made to the proposed layout within areas that are still natural and undisturbed, more field assessments will be required for those areas. The sampling design was thus a targeted approach and is assumed to have resulted in a representative floral species list for the focus area; and
- Timing and frequency of botanical surveys: An initial field assessment was undertaken from the 26th to the 29th of March 2019 (autumn season), to determine the floral ecological status of the focus area, and to “ground-truth” the results of the desktop assessment (Section A). Several follow-up assessment took place thereafter to assess changes made to the proposed layout:

- A spring assessment was undertaken from the 2nd to the 4th of September 2019 to assess changes to the proposed mine layout, which followed planned veld fires. A suitable assessment of floral communities was thus not possible; however, species were observed during the spring assessment that were not recorded during the March assessment (typical pioneer species);
- Due to additional layout changes a follow-up summer assessment was required which took place from the 28th of January 2020 to the 31st of January 2020, thus allowing for a more saturated species list; and
- At the request of the Department of Environment, Forestry and Fisheries (DEFF), an assessment of the forest areas and drainage lines on Iota Hill and within the Wishbone WRD was undertaken from the 29th to the 30th of April 2020. During this assessment, areas were visited where smaller changes to the proposed layout was made. A more meticulous approach was further taken to mark all encountered protected floral species.

- A more accurate assessment would require that assessments take place in all seasons of the year – winter assessments can e.g. allow detection of *Aloe* species that only flower in the winter months and are otherwise difficult to detect or troublesome to adequately identify[2]. However, on-site data was significantly augmented with all available data from desktop sources, together with project experience in the area, and the findings of this assessment are considered to be an adequate reflection of the ecological characteristics of the focus area to allow for informed decision making.

2 ASSESSMENT APPROACH

Several field assessments were undertaken across spring, summer and autumn:

- The initial assessment took place from the 26th to the 29th of March 2019 (early autumn season) in order to determine the floral ecological status of the focus area;
- A spring assessment took place from the 2nd to the 4th of September 2019 due to small adjustments made to the initial layout;
- The summer assessment took place from the 28th to the 31st of January 2020 where the focus was to re-visit selected sites in the focus area to allow for a more saturated species list and to search for protected floral species; and

[2] All species belonging to the *Aloe* genus have flowering periods ranging from spring to winter. Although it is easy to detect the larger *Aloe* spp. regardless of season, the grass and bulbous *Aloe* species are not easily detected outside of their flowering period. For example, *Aloe chortolirioides* var. *woolliana* (peak flowering time from June to September) and *Aloe subspicata* (flowering from August to September) have flowering period that do not coincide with the timing of the site assessments. It is thus possible that these species were missed.

- A follow-up autumn assessment of selected forest patches took place from the 29th to the 30th of April 2020 where.

In order to accurately determine the ecological state of the focus area and to capture comprehensive data with respect to floral ecology, the methodology presented in the bullet points below was followed:

- Maps and digital satellite imagery were consulted prior to the field assessment to determine broad habitats, vegetation types and potentially sensitive sites. The results of these analyses were then used to guide the fieldwork component;
- Historical data and previous specialist studies were available for the surrounding area[3] and formed part of the background information assessed for this report;
- All relevant information as presented by SANBI's Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org), including the Mpumalanga Biodiversity Sector Plan (MBSP, 2014), were consulted to gain background information on the physical habitat and potential floral diversity associated with the focus area; and
- For the field assessments, a reconnaissance 'walkabout' was initially undertaken to determine the general habitat types found throughout the focus area. Following this, the specific infrastructure areas were investigated, with special emphasis being placed on areas representative of the habitats found within the area and that may potentially support floral SCC. The field assessments took place on foot in order to identify the occurrence of the dominant plant species and habitat diversities. A detailed explanation of the method of assessment is provided in **Appendix A** of this report.

2.1 Sensitivity Mapping

All the ecological features of the focus area were considered, and sensitive areas were assessed. In addition, identified locations of protected species were marked by means of a Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto satellite imagery and/or topographic maps. The sensitivity map should guide the final design and layout of the proposed development activities.

[3] STS 170056, 2017. Terrestrial Ecological Habitat Integrity Assessment as part of the environmental impact and authorisation process for the proposed TGME Pilgrim's Rest (10167) gold mining project, Pilgrim's Rest, Mpumalanga Province. Prepared for Globesight Environmental Consulting. October 2017.

3 RESULTS OF FLORAL ASSESSMENT

3.1 Existing impacts on floral communities within the focus area

Several areas within and around the focus area have historically been impacted by mining activities and are currently impacted by illegal (artisanal) mining and small-scale agricultural practices. These areas are typically left disturbed and as a result are extensively encroached by alien and invasive plant (AIP) species – although not all AIP proliferation is associated with mining activities. A brief description of the existing impacts / disturbances associated with the focus area is discussed below, with reference photos provided.

3.1.1 Indirect impacts (Figure 3 and 4)

The most significant indirect impacts relate to the extensive proliferation of AIPs within previously disturbed areas. Considerable woody AIP proliferation have occurred within forested kloofs and especially along the drainage lines which are not necessarily associated with historic disturbance. The presence of artisanal mining further impacts on the riparian habitat due to impacts on water quality, sediment loads to the stream and the subsequent impacts on aquatic life. Physical disturbance to the Blyde river has also resulted from illegal mining activities where a section of the river has been diverted (see SAS 219038, 2020).

Figure 3: Existing indirect impacts on floral habitat were noted during the field investigation and mainly consisted of the proliferation of AIP species within previously mined areas or in areas where soils have been left disturbed. The drainage lines on site, as well as many of the drainage lines in the area have, like several areas in Mpumalanga, been extensively encroached by Australian wattle species (most notably *Acacia dealbata*).


Figure 4: Artisanal mining activities within the Blyde River and the Peach Tree Stream have direct impacts on water quality and thus indirectly impacts on the associated riparian habitat.

3.1.2 Direct historic impacts (Figure 5)

Direct historic impacts are associated with historic mining activities, dating back to the late 1950s, as well as forestry practices. Within the focus area and immediate surroundings, this mostly relates to Browns Hill and sections of Theta Hill. As a result of ongoing disturbances at Browns Hill, the current landscape is unnaturally uneven, and several areas still comprise of waste rock and soil heaps. The topsoil layer has thus been disturbed for over a decade (referring to available digital satellite imagery) to the extent that indigenous plant species are struggling to recover within impacted areas. The forestry areas, mostly comprising pine plantations and gum and wattle stands, have resulted in the complete transformation of historic grassland vegetation.


Figure 5: Evidence of historic disturbances that directly impacted on floral habitat included unrehabilitated waste rock dumps (left) and AIP trees as part of the forestry industry, including pine plantations (right).

3.1.3 Direct current/recent impacts (Figure 6)

More recently, exploration activities have occurred within the focus area and resulted in prospecting roads with a significant footprint area (approximately 18m wide at some sections). Clearing activities related to the construction of these exploration roads have resulted in the isolated loss of habitat along the road footprints and the adjacent downslope areas due to the discarding of cleared material.

Figure 6: Recent activities that directly impacted on floral habitat within the focus area mainly included the construction of prospecting roads as part of exploration activities and dumping of soil discard and rock material.

3.2 *Description of floral communities as recorded during the 2019 and 2020 field assessments*

The desktop assessment indicated that the focus area falls within four vegetation types according to Mucina and Rutherford (2012 and 2018 databases, Section A: Figure 10), including both grassland and forest biomes. The focus area, therefore, falls within the ecotone of these four vegetation types, owing to the potential for a complex and diverse floral species composition to be associated with the focus area - this was evident within the remaining natural areas of the focus area. As stated above, the focus area is associated with both current and historic mining and forestry activities and, at the time of the assessments, large sections of the assessed vegetation had been transformed and/or degraded as a result.

The results presented below are based on four field investigations related directly to the Theta Project:

1) March 2019 assessment (Figure 7): The autumn assessment took place at the end of the wet season and a good representation of habitat conditions and species composition of the various habitat units could be observed. However, due to the sensitivity of the vegetation, additional floral surveys were required to better saturate the species list and to get a better representation of floral SCC within the focus area (or suitable habitat for such species).

Figure 7: Vegetation condition during the March 2019 assessment.

2) September 2019 assessment (Figure 8): The spring assessment took place before the onset of the rain season and after seasonal burning of the veld. These are not generally considered good conditions for a vegetation survey, but the assessment yielded the detection of several pioneer floral species that establish post-fires and that could otherwise be easily overlooked once the veld has fully recovered. Though the spring assessment resulted in a better understanding of the fuller compliment of species utilising the focus area, it was deemed necessary to conduct additional surveys in a more favourable season.

Figure 8: Vegetation condition during the September 2019 site visit.

3) January 2020 assessment (Figure 9): The summer assessment took place after adequate rains and yielded favourable results. Several assumptions regarding the veld conditions and potentially occurring species was confirmed with over 80 additional species recorded for the focus area (refer to full species list in Appendix C).

Figure 9: Vegetation condition during the January 2020 site visit.

4) April 2020 assessment: This assessment specifically focussed on the forest areas and drainage lines of Iota Hill, as well as forest patches within the proposed Wishbone WRD. Previous assessments were limited within these areas due to safety risks posed by artisanal mining activities within these sections.

Figure 10: Vegetation condition during the April 2020 site visit.

The vegetation communities distinguished during the field assessment are described in this section under four broad habitat units, namely:

- **Mountain outcrops**:
  - Cliff faces with associated Forest-like Thickets; and
  - Dolomite/quartzite outcrops.
- **Montane Grassland**, encompassing rocky grasslands along mountain slopes with species represented by all three grassland vegetation types indicated for the focus area (Mucina and Rutherford 2018 database), i.e. Long Tom Pass Montane Grassland, Northern Escarpment Quartzite Sourveld and Northern Escarpment Dolomite Grassland;
- **Riparian Habitat & Forest Remnants**:
  - Riparian vegetation associated with drainage lines and the Blyde River (freshwater resources); and
  - Forest Remnants – including indigenous forest and degraded forest which typically occur adjacent to the Riparian Habitat.
- **Degraded Habitat**, including transformed/built-up areas and AIP-dominated vegetation.

The ecological and conservation important aspects of the floral communities associated with the above-mentioned habitat units are described in detail in the below dashboards (sections 3.2.1 to 3.2.4). The below maps provide a depiction of the habitat units in relation to the focus area.

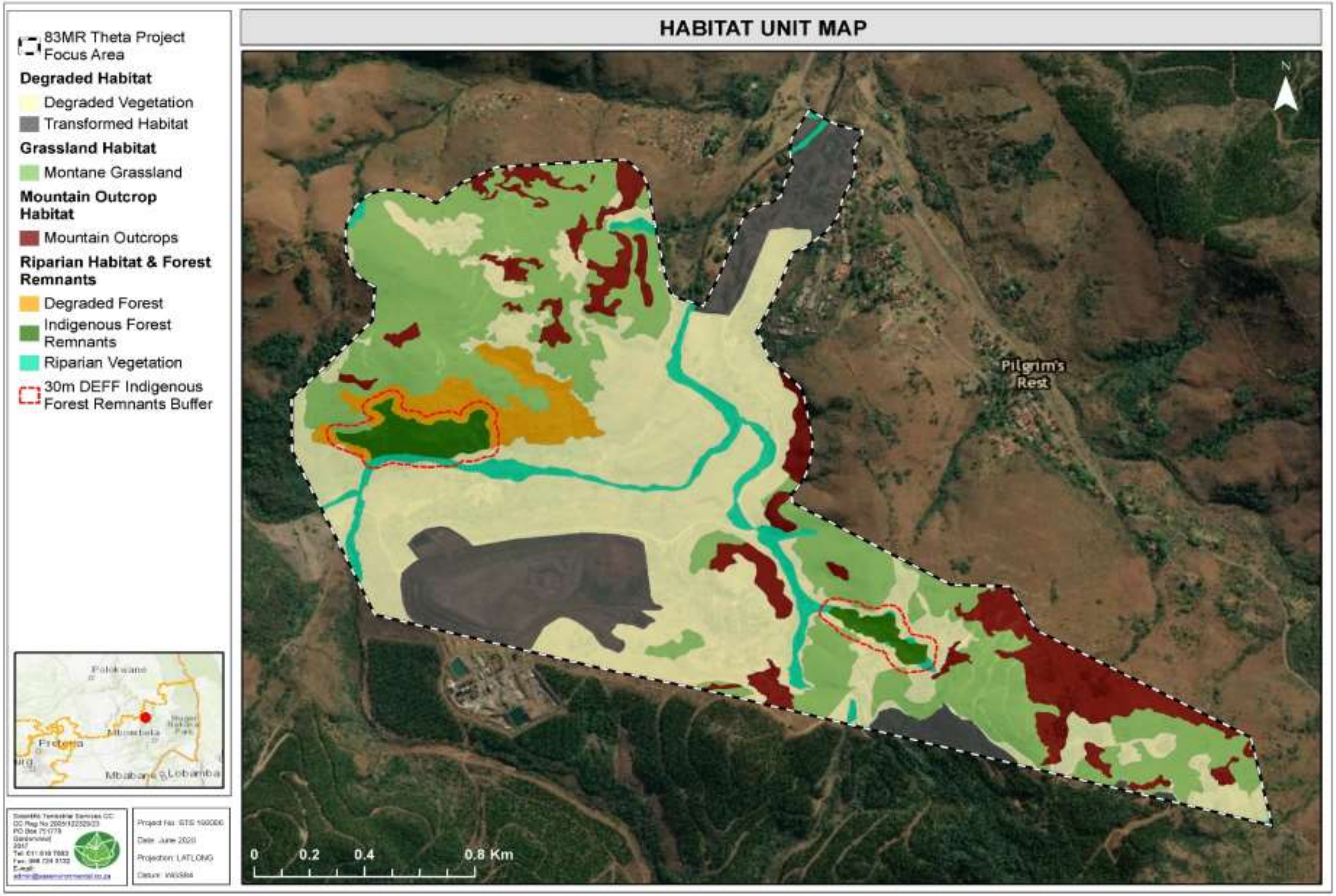


Figure 11: Conceptual illustration of the habitat units within the focus area.

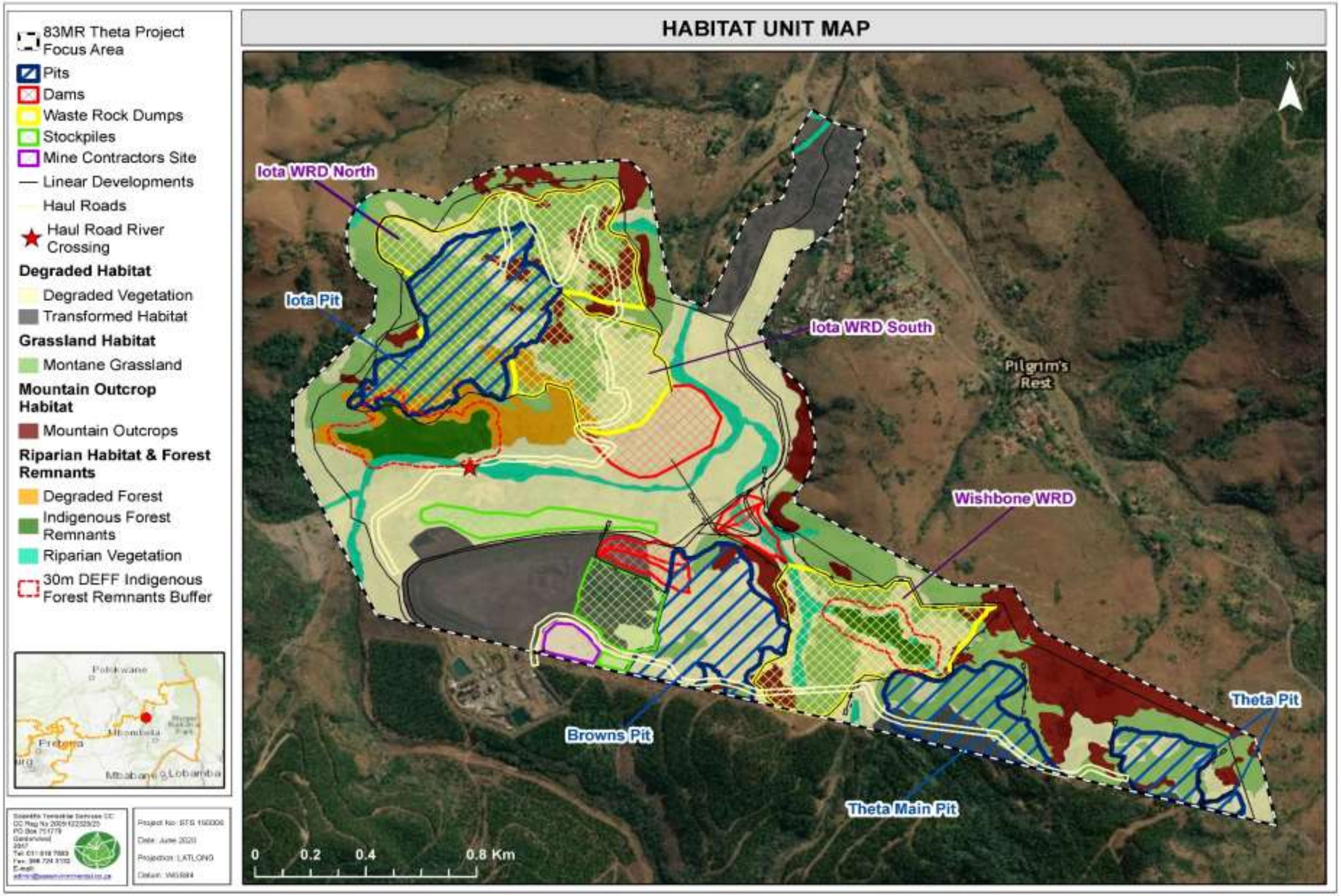
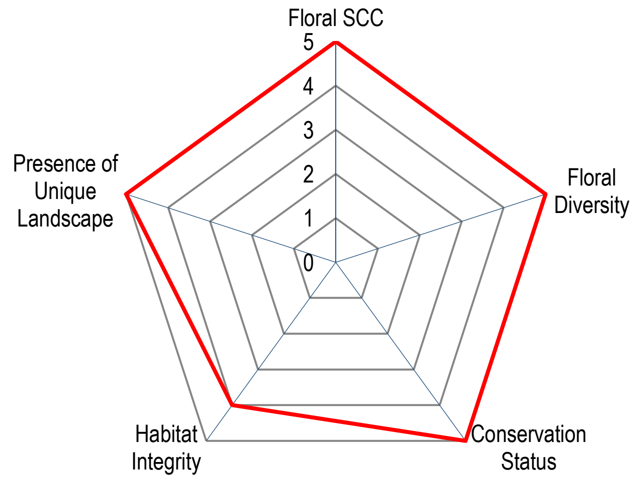


Figure 12: Conceptual illustration of the habitat units within the focus area in relation to the proposed mine layout.

3.2.1 Habitat Unit 1: Mountain Outcrops Habitat Unit

<table>
<tr><th>Mountain Outcrops Floral Sensitivity</th><th>Intermediate to High</th><th><u>Floral Habitat Sensitivity Graph</u></th></tr>
<tr><td colspan="2">
<u>Habitat Description:</u>
The Mountain Outcrops habitat unit is present throughout the focus area; however, only areas that fall within the direct footprint of the proposed Theta Project was meticulously assessed during the field assessments (based on the layouts provided at the time field assessments occurred). The Mountain Outcrop Habitat associated with the Theta Pit 1and Theta Pit 2 consists of vegetation and habitat representative of the Northern Escarpment Quartzite Sourveld, i.e. habitat that is “very rocky and occurs on weather-resistant quartzite”, with vegetation consisting of a “short, closed grassland rich in forb species with scattered trees and shrubs” (Mucina and Rutherford, 2006).
The main distinguishing characteristic that separates this habitat unit from the others is its prominent rock features which supports a high diversity of floral species through the creation of unique micro-habitat niches. Two floral communities can be distinguished within this habitat unit based on the type of rock formation, i.e. cliff face vegetation and rock outcrop vegetation.
Within the focus area, cliff faces refer to the vertical, or nearly vertical, exposed rock formations. The more prominent cliff faces occur at the higher elevations of Theta Hill. The vegetation occurring on the cliff faces ranges from numerous herbaceous and succulent species adapted to shallow, well-drained soil conditions, to forest-like thickets that have formed due to long-term protection from fires.
The rock outcrops are scattered throughout the focus area but are most abundant within the eastern sections, i.e. most prominent in Theta Hill but also present within Browns Hill and Iota Hill. Rock outcrops are the parts of a rock formation that appear above the surface of the surrounding land and can range from scattered smaller rocks to clumps of larger boulders. Within the focus area, these include both dolomite and quartzite outcrops. The rock outcrops are associated with a high graminoid, forb and succulent species diversity, with several shrub species also benefitting from the niche habitat provided by these outcrops.
</td><td>


</td></tr>
</table>

REPRESENTATIVE PHOTOS OF THE DIFFERENT FLORAL COMMUNITIES WITHIN THE MOUNTAIN OUTCROP HABITAT UNIT

Cliff faces associated with a well-developed woody layer



Rock outcrops where forbs and graminoids flourish



Floral Diversity

Floral diversity of this habitat unit was generally high, with woody species forming the dominant vegetation within the cliff faces and the herbaceous layer being better represented within the rock outcrops.

The woody layer associated with the **cliff faces** formed a forest-like thicket of tree and shrub species. The most abundant woody species included *Chionanthus foveolatus*, *Diospyros lyciodes* subsp. *guerkei*, *Ficus ingens*, *Heteromorpha arborescens* var. *abyssinica*, *Plectranthus fruticosus*, *Seemannaralia gerrardii*, *Senecio barbertonicus* and *Vangueria infausta*. The woody component of the **rock outcrops** was better represented by shrubs or small trees such as *Englerophytum magalismontanum*, *Fadogia homblei*, *Olinia emarginata*, *Rapanea melanophloeos* and *Searsia discolor*. The woody layer comprised species typically associated with rockier environments.

Herbaceous succulent species that are well-suited to the protected environments provided by **cliff faces**, were well represented. Species recorded during the field assessment included *Chlorophytum krookianum*, *Crassula setulosa* var. *setulosa*, species of *Delosperma*, *Haemanthus humilis* subsp. *hirsutus*, *Plectranthus rubropunctatus*, *Scadoxus puniceus*, *Schistostephium rotundifolium*, *Streptocarpus* sp., *Zantedeschia albomaculata* and several orchid species. The forb and succulent layer within the **rock outcrops** also consist of species that utilise the rocky habitat for protection but further include species that are not necessarily shade tolerant – this is in contrast to several of the forbs present in the understory of the forest-like thickets found along the cliff faces. Species more commonly encountered included several *Aloe* species (*Aloe alooides*, *Aloe arborescens*, *Aloe davyana*, *Aloe cooperi*, *Aloe dyeri*), *Crassula alba, Crassula sarcocaulis, Crassula vaginata, Kalanchoe luciae, Kalanchoe rotundifolia, Ledebouria revoluta, Senecio scitus, Xerophyta retinervis* and *Xerophyta schlechteri*.

Graminoids are not well represented within the **cliff faces** but those present are typical shade-tolerant species such as *Panicum maximum* or those associated with rockier environments such as *Oropetium capense.* The grass layer within the **rock outcrops** was well-developed and included species such as *Alloteropsis semialata, Andropogon chinensis, Bewsia biflora, Diheteropogon filifolius, Harpochloa falx, Loudetia simplex* and *Tristachya leucothrix.*

For a list of species recorded in this habitat unit, refer to Appendix C.

Aloe davyana **(left) and** ***Ficus ingens*** **(right)**

Crassula setulosa **var.** ***setulosa*** **(left) and** ***Delosperma*** **sp. (right)**

Ekebergia pterophylla **(left) and** ***Fadogia homblei*** **(right)**

<table>
<tr>
<td>Floral Species of Conservation Concern (SCC)</td>
<td colspan="2">Several floral SCC are associated with the Mountain Outcrops, mainly consisting of species protected under the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998) (MNCA). The MNCA lists not only flora at the species level but also includes whole genera and families, of which the following were recorded within this habitat unit during the field assessment:
• All species falling within the Proteaceae family, of which the species recorded within this habitat unit included: Protea gaguedi, Protea roupelliae subsp. roupelliae and Protea caffra subsp. caffra;
• All species falling within the Orchidaceae family, of which the species recorded within this habitat unit included: species recorded within this habitat unit: Eulophia streptopetala, Satyrium parviflorum, Stenoglottis fimbriata;
• All species of Arum lilies, of which the species recorded within this habitat unit included: Zantedeschia albomaculata;
• All species of Aloes, of which the species recorded within this habitat unit included: Aloe alooides (Northern Escarpment Dolomite Grassland endemic), Aloe arborescens, Aloe cooperi, Aloe davyana, Aloe dyeri and Aloe transvaalensis[4];
• All species of Paint brush lilies, of which the species recorded within this habitat unit included: Haemanthus humilis subsp. hirsutus and Scadoxus puniceus; and
• Boophone disticha.

The Mountain Outcrop habitat is suitable to support not only the above-mentioned floral SCC but it is expected that several additional species are present; making this habitat unit highly sensitive in terms of conserving floral SCC. The dolomite and quartzite outcrops provide suitable habitat for several SCC. Species worth mentioning that are of biogeographic importance (Mucina and Rutherford, 2006) recorded within this habitat unit include Heteromorpha pubescens (Northern sourveld endemic). Additional South African endemics recorded in this habitat unit, but which are all listed as least concern, include Searsia zeyheri, Seemannaralia gerrardii, Sporobolus pectinatus, Tetraselago wilmsii and Wahlenbergia magaliesbergensis. Refer to section 3.4 for a full discussion on the floral SCC encountered on site, including species expected to occur in this habitat unit based on suitable habitat and available conditions.</td>
</tr>
<tr>
<td rowspan="4">Conservation Status of Vegetation Type/Ecosystem</td>
<td rowspan="4">The Mountain Outcrops fall within two threatened vegetations types, i.e. the Northern Escarpment Dolomite Grassland (Endangered) and Northern Escarpment Quartzite Sourveld (Vulnerable). The on-site species composition is indicative of both these threatened vegetation types. Much of the focus area is located within the remaining extent of the Malmani Karstlands endangered ecosystem. This includes most of the Mountain Outcrops apart from the less disturbed outcrops that are present within the eastern portion of Theta Hill.

Most of the Mountain Outcrops fall within several areas of conservation importance, i.e. Irreplaceable and Optimal Critical Biodiversity Areas (CBAs) (MTPA, 2014), an Ecological Support Area (ESA) Protected Areas Buffer, as well as areas of Highest and High Biodiversity Importance according to the Mining and Biodiversity Guidelines (2013). Apart from the Mountain Outcrops within the southern section of Browns Hill, this habitat unit is largely in an undisturbed condition representative of the above-mentioned conservation significant areas.

The entire Theta Project focus area is located within the Kruger to Canyons Biosphere Reserve and is therefore recognised under the UNESCO (United Nations Educations, Scientific and Cultural Organisation) Man and the Biosphere Programme. Depending on the spatial zonation of a Biosphere Reserve (core area, buffer zone or transitional zone), these areas can be granted legal protection or can be used for sustainable developments. It is unclear what the spatial zonation is of this section of the Biosphere Reserve, however, it is not located in the core area.

The Mountain Outcrops fall within two areas of increased floral sensitivity, i.e. the Wolkberg Centre of Endemism and the Drakensberg Afromontane Region of Endemism (Mpumalanga BioBase Report, 2002).</td>
<td>Presence of Unique Landscapes</td>
</tr>
<tr>
<td>The rocky environment provides protection against fires, herbivory, strong high-altitude wind conditions and they create environments for shade-tolerant plant species in an otherwise sun-exposed grassland landscape. Thus, this habitat unit is unique and provides niche habitat for several floral species, including numerous floral SCC.</td>
</tr>
<tr>
<td>Habitat integrity/Alien and Invasive species</td>
</tr>
<tr>
<td>The Mountain Outcrops habitat unit was in a largely undisturbed condition within Theta Hill and Iota Hill; whereas Browns Hill was more influenced by activities associated with mining and forestry, owing to greater loss of habitat integrity.
Within areas of increased disturbance, alien and invasive plant (AIP) species have proliferated, with species such as Acacia dealbata, Eucalyptus diversicolor, Jacaranda mimosifolia, Lantana camara and Solanum mauritianum representing some of the more troublesome AIPs within this habitat unit.</td>
</tr>
</table>

[4] There is some dispute regarding the separation or merging of *Aloe transvaalensis* and *Aloe zebrina*. Based on more recent authors, *Aloe zebrina* and *Aloe transvaalensis* are seen as the same species and on the SANBI website *Aloe transvaalensis* is considered a synonym of *Aloe zebrina*.

Business Case, Conclusion and Mitigation Requirements
This habitat unit is mostly of moderately high to high floral ecological sensitivity and importance, with the more disturbed sections on Browns Hill and Iota Hill of intermediate sensitivity. The proposed mining activities are expected to have a significant negative impact on floral diversity within the focus area, including the loss of several SCC individuals. Due to the extent of habitat transformation within the region, caused by mining and largely by forestry, the impact on floral communities associated with the Mountain Outcrops habitat unit has the potential to impact on floral communities beyond the project footprint area through the loss of limited, favourable habitat. The more species-rich and more sensitive Mountain Outcrops are located on Theta Hill and sections of Browns Hill; however, the outcrops on Theta Hill largely fall outside of the direct proposed footprint of the Theta Project. The Mountain Outcrops on Iota Hill that will directly be impacted by the proposed mining activities consist of less diverse floral communities and impacts are anticipated to be restricted to the footprint area as less unique species were recorded in these sections. Most of the Mountain Outcrops are, however, still intact and forms part of conservation significant areas such as CBAs. The habitat on Iota Hill is connected with a largely untransformed grassland landscape to the north, and as such, in terms of habitat connectivity this is an important area. The most significant impact to floral ecology associated with the Mountain Outcrops Habitat unit will occur within Iota Hill due to the extent of Mountain Outcrops that fall within the proposed footprint area, with limited impacts for this habitat unit anticipated for Theta and Browns Hill due to the smaller extent within the proposed footprint area. As far as possible, this habitat unit should be excluded from development. <u>Potential development constraints associated with the Mountain Outcrop Habitat Unit:</u> The Mountain Outcrops that will be directly impacted by the proposed Theta Project fall within both Optimal and Irreplaceable CBAs (MTPA, 2014), most notably within the Iota Hill footprint area. Opencast mining is considered to be a land-use that will compromise the CBA's biodiversity objective and is in conflict with the conservation requirements for CBAs. The Mountain outcrops are located within an ESA: Protected Area Buffer, in which mining is deemed an unsuitable land use and is in conflict with the targets for the affected protected areas (MTPA, 2014). The proposed mining activities within the Mountain Outcrop habitat unit is thus not supported. The section of Mountain Outcrops that will be impacted by the proposed layout is located in an area of Highest Biodiversity Importance as per the Mining and Biodiversity Guidelines (2013), i.e. high risk for mining. The results of the field assessment confirmed the presence of significant biodiversity features such as several floral SCC and intact threatened vegetation. Most of the Mountain Outcrops located on Iota Hill fall within an endangered vegetation type and an endangered ecosystem. On a national level, this habitat unit has been awarded a threatened status to primarily reduce the rate of ecosystem and species extinction. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems. The proposed mining activities therefore threatens to contribute to a further loss of already vulnerable and endangered ecosystems. The floral SCC recorded for this habitat unit is likely not a complete representation and it is anticipated that several additional SCC occur within the Mountain Outcrop Habitat Unit, such as the fern . To avoid the loss of potentially occurring floral SCC, the presence of such species should be confirmed before vegetation clearing commences. A thorough walkdown of the footprint area should take place where all floral SCC are marked for rescue and relocation, or removal (where permit application would then be required). This walkdown will need to take place, ideally in late November and early February when species identification will be more accurate, and the species lists for these habitats can be fully saturated. Floral SCC surveys for the Mountain Outcrop Habitat Unit within Iota Hill is considered essential as this section will directly be impacted by the proposed Theta Project. Considering the above, it is recommended that mining activities be avoided within this habitat unit and that these areas are to be maintained in a natural state to prevent the loss of ecosystems, functionality or species. A biodiversity offset investigation process should be initiated to address all residual impacts which are likely to occur as a result of the proposed mining project. It should, however, be noted that Irreplaceable CBAs cannot be considered for offsetting.

3.2.2 Habitat Unit 2: Montane Grassland Habitat Unit

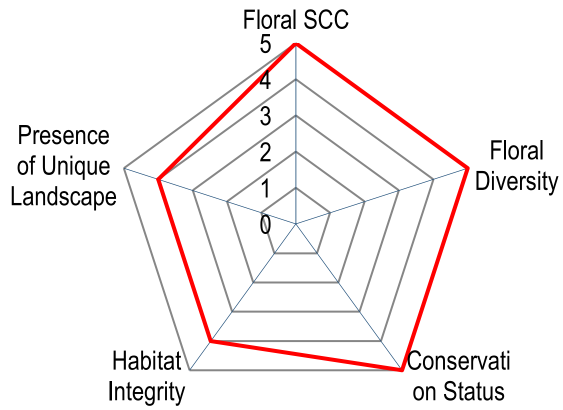
Montane Grassland Floral Sensitivity	Intermediate to High	Floral Habitat Sensitivity Graph

Habitat Description:

According to the updated Mucina and Rutherford 2018 database, the focus area is associated with three grassland vegetation types, or reference states, i.e. the Long Tom Pass Montane Grassland (far northern portion of the focus area), Northern Escarpment Quartzite Sourveld (small section of the south-eastern portion) and Northern Escarpment Dolomite Grassland (majority of the focus area). The field assessment revealed that the grasslands within the focus area had a large overlap in floral species and all grasslands are thus jointly discussed under one broad habitat unit, i.e. Montane Grassland. However, species characteristic of each of the reference states were recorded throughout the focus area with the Long Tom Pass Montane Grassland vegetation type **least represented** and the Northern Escarpment Dolomite Grassland **best represented**.

The Montane Grassland habitat unit is best described as rocky, high altitude grasslands interspersed with sporadically occurring shrubby patches. These shrubby patches either consisted of *Erica* species or *Protea* species. Elements of the Northern Escarpment Quartzite Sourveld, such as the rugged landscapes with steep east-facing cliffs, are mainly found within the vicinity of the proposed Theta Pit 1 and Theta Pit 2. In areas of higher disturbance, the common Bracken fern formed dense patches. AIP tree species have encroached into this habitat unit.

A large number of rare or endemic species occur in mountain grasslands, mostly restricted to either quartzite or dolomite, and these grasslands must be considered a conservation priority (Schmidt et al., 2002). Where grasslands formerly spanned 61% of Mpumalanga, agriculture and other development (such as mining and forestry) have resulted in the approximate irreversible transformation of 44% of grasslands (MBSP Handbook, 2014). This habitat unit is of high conservation importance.



TYPICAL VIEW OF THE MONTANE GRASSLANDS WITHIN THE NORTHERN (LEFT PHOTO) AND SOUTHERN (RIGHT PHOTO) SECTION OF THE FOCUS AREA.

Floral Species of Conservation Concern (SCC)	Many rare or endemic species occur in mountain grasslands, mostly restricted to either quartzite or dolomite, and these grasslands must be considered a conservation priority (Schmidt et al., 2002). Within the Theta Project Area, the Montane Grassland habitat unit had a variety of species protected under the MNCA: • All species falling within the Proteaceae family**,** of which the species recorded within this habitat unit included: *Protea gaguedi, Protea caffra* subsp*. caffra, Protea roupelliae* subsp*. roupelliae;* • All species falling within the Orchidaceae family, of which the species recorded within this habitat unit included: *Brachycorythis ovata* subsp*. ovata*, *Disa patula* var. *transvaalensis*, *Eulophia foliosa*, *Habenaria falcicornis*, *Orthochilus aculeatus*, *Satyrium cristatum*, *Satyrium* sp.; • All species of Pineapple flower, of which the species recorded within this habitat unit included: *Eucomis* sp.*;* • All species of Aloes, of which the species recorded within this habitat unit included: *Aloe barbertoniae Aloe* cf *cooperi* and *Aloe dyeri;* • All species of Gladioli, of which the species recorded within this habitat unit included: *Gladiolus ecklonii* and *Gladiolus longicollis*; and • *Boophone disticha.* Most of the Montane Grassland habitat unit remains relatively undisturbed, and ample habitat is available for floral SCC. Thus, the list provided above is not expected to be a full representation of the floral SCC within this habitat unit. Species worth mentioning that are of biogeographic importance (Mucina and Rutherford, 2006) recorded within this habitat unit include *Heteromorpha pubescens, Syncolostemon transvaalensis* (Northern sourveld endemic). Additional South African endemics recorded in this habitat unit, but which are all listed as least concern, include *Hermannia lancifolia*, *Hermannia montana*, *Searsia zeyheri*, *Sporobolus pectinatus*, *Syncolostemon parvifolius*, *Tetraselago wilmsii* and *Wahlenbergia magaliesbergensis*. Refer to section 3.4 for a full discussion on the floral SCC encountered on site, including species expected to occur in this habitat unit based on suitable and available conditions.
Floral Diversity	The overarching diversity of flora within this habitat unit is considered moderately high to high, with graminoids and herbaceous species best represented. The Montane Grasslands within the northern section of the focus area (associated with **Iota Hill**), occurring above the Blyde River, ranges from highly diverse to moderately diverse. At the higher elevations of Iota Hill corresponding to the northern and western sections of the proposed Iota Pit and Iota WRDs, the grasslands have been less impacted by anthropogenic pressures and retain a high floral diversity. However, edge effects have resulted in a decrease in floral species diversity within the eastern and southern portions of Iota Hill. The edge effects impacts stem from fragmentation resulting from the excavated roads along the south-eastern side of Iota Hill, as well as grazing pressures and the abundance of AIPs occurring at the lower elevations. Patches of undisturbed grasslands are still present at **Browns Hill**, most notably the northern and eastern slopes of Browns Hill, where floral diversity, therefore, remains moderately high. The remainder of the grasslands associated with Browns Hill has been impacted on, thus resulting in a moderate diversity of indigenous grassland flora. The Montane Grassland vegetation associated with **Theta Hill** has received the least disturbance, resulting in a high diversity of indigenous grassland species mostly representative of the Northern Escarpment Dolomite Grassland vegetation type. Within the far eastern sections, historic WRDs are associated with disturbed vegetation and indigenous species diversity is moderately low (described under the Degraded Vegetation Habitat Unit). **<u>Woody diversity</u>**: The woody layer mainly consisted of shrubs and small trees, with *Erica drakensbergensis*, *Parinari capensis* subsp. *capensis*, *Protea caffra* subsp. *caffra*, *Protea*  *Lopholaena disticha* (left) and *Inezia integrifolia* (right)  *Cycnium racemosum* (left) and *Cyphia elata var. elata* (right)

gaguedi, *Protea roupelliae* subsp. *roupelliae*, *Senecio microglossus*, *Tenrhynea phylicifolia* and *Tetraselago wilmsii* most abundant.

<u>Forb diversity:</u> The forb layer was very species rich and these grasslands were well-represented by species of the genera *Crassula, Dicoma, Helichrysum, Ledebouria, Plectranthus* and *Senecio*, to name a few. Species such as *Alectra sessiliflora*, *Alepidea peduncularis*, *Alepidea setifera*, *Berkheya echinacea*, *Euryops pedunculatus, Geigeria burkei Gladiolus ecklonii, Lopholaena disticha, Pearsonia sessilifolia* and *Plectranthus calycinus* were more common across the focus area.

<u>Graminoid diversity</u>: Graminoids included species representative of the various reference states with *Diheteropogon amplectens*, *Harpochloa falx*, *Hyparrhenia filipendula*, *Loudetia simplex*, *Monocymbium ceresiiforme*, *Panicum natalense, Themeda triandra* and *Tristachya leucothrix* most abundant.


Berkheya echinacea (left) and *Moraea elliotii* (right)

For a list of species recorded in this habitat unit, refer to Appendix C.

Conservation Status of Vegetation Type/Ecosystem

The Montane Grassland habitat unit is located within the Northern Escarpment Dolomite Grassland (Endangered) and Northern Escarpment Quartzite Sourveld (Vulnerable) vegetation types. Species characteristic of both these vegetation types were present within the habitat unit. Structurally, the vegetation largely represented the Northern Escarpment Dolomite Grassland, with smaller sections structurally representative if the Northern Escarpment Quartzite Sourveld.

Most of the focus area is located within the remaining extent of the Malmani Karstlands endangered ecosystem. This includes most of the Montane Grassland apart from the less disturbed areas within the north-eastern portion of Theta Hill.

The Montane Grassland habitat unit falls within Irreplaceable and Optimal CBAs (MTPA, 2014); however, the area associated with Browns Hill has been significantly disturbed due to mining activities, but also due to the proliferation of AIPs, and therefore is no longer regarded to be a true representation of an Optimal CBA. Moreover, the entire focus area falls within an Ecological Support Area (ESA) Protected Areas Buffer, in which activities and land-use changes that can compromise the objectives of the Protected Areas associated with the buffer, should be avoided.

The Montane Grassland habitat unit is located within areas of Highest and High Biodiversity Importance (Mining and Biodiversity Guidelines, 2013), which could pose restrictions on the types of mining activities allowed.

The entire Theta Project focus area is located within the Kruger to Canyons Biosphere Reserve; however, it is unclear what the spatial zonation is of the section of the Biosphere Reserve in which the focus area is located.

The Montane Grassland habitat unit falls within two areas of increased floral sensitivity, i.e. the Wolkberg Centre of Endemism and the Drakensberg Afromontane Region of Endemism (Mpumalanga BioBase Report, 2002).

Habitat integrity/Alien and Invasive species

Disturbance within the Montane Grassland is currently associated with excavated roads, AIPs encroaching into the habitat unit and mining activities such as prospecting.

Overall, the grasslands are intact and harbour a high diversity of floral species and several protected flora.

The habitat integrity is currently moderately high.

Presence of Unique Landscapes

Montane Grasslands are moderate to poorly protected, and the vast expanses of plantations and anthropogenic activities in the region threaten this habitat unit.

Montane Grasslands are important for maintaining high floral diversity and for the conservation of rare and endemic species.

Business Case, Conclusion and Mitigation Requirements
The Montane Grassland is of intermediate to high sensitivity and importance from a floral perspective. Biodiversity of the habitat unit should be preserved and enhanced, with development and disturbance limited as far as possible. Within Iota Hill and Theta Hill, the Montane Grassland is considered to be primary grassland[5] with patches of indigenous vegetation[6] still present. The proposed Theta Project will result in significant impacts on the floral communities and SCC of the Montane Grassland within the focus area, with the largest impact anticipated for Iota Hill and the Wishbone WRD. The restoration of species-rich grasslands is unlikely to be successful (see e.g. Zaloumis and Bond, 2011) and thus the impacts on the Montane Grassland Habitat Unit is likely to be significant on a local to regional scale. <u>Possible constraints for developments for the Montane Grassland floral communities</u>: As part of best-practices and minimum ecological requirements for managing grasslands for biodiversity (SANBI, 2013), wherever possible, primary grasslands should be kept in a natural or near-natural state and should be managed to avoid degradation. This includes very strict edge effect management from activities occurring within adjacent, less sensitive areas. Any residual loss of habitat will have to be compensated for through an offset initiative. The MBSP Handbook (MTPA, 2014) has specific land-use guidelines set out for terrestrial biodiversity areas which is likely to affect the proposed Theta Project. Where the Montane Grassland falls within Optimal and Irreplaceable CBAs, opencast mining is considered to be a land-use that will compromise the CBA's biodiversity objective and is deemed a conflicting land use to the management objective for the area. Similarly, the location of the Montane Grasslands within an ESA: Protected Area Buffer further limits the potential for mining as it is not deemed a suitable land use to achieve various biodiversity targets of the affected protected areas (MTPA, 2014). The proposed mining activities are likely to be deemed unsuitable and thus strict adherence to management of impacts in line with the mitigation hierarchy is essential to ensure no net loss of biodiversity. Irreplaceable CBAs cannot be offset and therefore if the Theta Project is approved, compensation for residual loss of primary grasslands will have to take place by conserving other important biodiversity aspects in acknowledgment of the loss of CBA habitat. Most of the Montane Grasslands are located within an endangered vegetation type and the remaining extent of the endangered Malmani Karstlands ecosystem (refer to section 3.3.1 of this report). On a national level the loss of threatened ecosystems should be avoided to prevent further loss. As the MBSP Handbook (2014) points out that the large number of rare and endangered species in grasslands is a particular problem for environmental impact assessments. These plants are mostly small, very localised and visible for only a few weeks in the year when they flower. Therefore, if any construction activities are approved in the Montane Grasslands, a thorough walkdown of the area should take place where floral SCC can be marked for either relocation or permit application. This walkdown will need to take place in early summer when species identification will be more accurate. Ideally a walkdown should take place in both late November and early February – a once off survey will not suffice. Given these requirements, strong consideration should be given to the proposed layout to exclude primary grasslands. Due to the moderately high sensitivity of this habitat unit, together with the already transformed surroundings, this habitat unit should not be further impacted on so that floral species diversity can be conserved in support of achieving both national and provincial biodiversity and conservation targets.

[5] SANBI (2013): Primary grasslands are those that have not been significantly modified from their original state; even though they may no longer have their full complement of naturally occurring species, they have not undergone significant or irreversible modification and still retain their essential ecological characteristics.

[6] The NEMA definition of indigenous vegetation: "Indigenous vegetation: refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding 10 years.

3.2.3 Habitat Unit 3: Riparian Habitat & Forest Remnants

<table>
<tr><th><u>Habitat Unit Description:</u></th><th>Intermediate to Moderately High</th><th>Moderately Low</th></tr>
<tr><td>

This habitat unit is predominantly associated with a woody component and will be presented below:

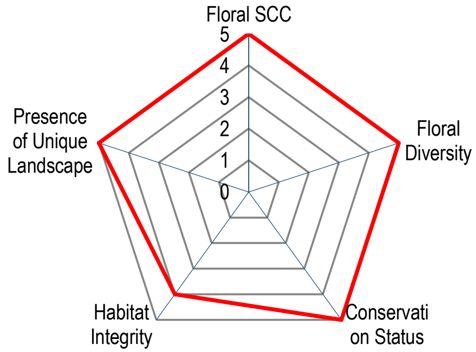
- Forest Remnants associated with Iota Hill, including Degraded Forest and Indigenous Forest Remnants;
- Indigenous Forest Remnants associated with the Wishbone WRD; and
- Riparian Vegetation – represented throughout the focus area.

The focus area is associated with **Forest Remnants**, which include a section of the wishbone drainage line (described further down), with **Northern Mistbelt Forest** (Mucina and Rutherford, 2006) occurring along the cliff face of southern Iota Hill (largely outside of the direct footprint). Several sections of the Forest Vegetation have been degraded; i.e. more than 70% of the vegetation consists of AIPs (mapped as **Degraded Forest**, Figure 11). Where forests are deemed natural and AIPs do not form the dominant vegetation cover, reference is made to **Indigenous Forest Remnants,** in alignment with the definition of natural forest[7] within the National Forest Act, 1998 (Act No. 84 of 1998, as amended in September 2011) (NFA).

Riparian Habitat[8] occurs throughout the footprint area and is mainly associated with the Blyde River (running through the centre of the focus area), the Peach Tree stream and with drainage lines along Theta Hill, Browns Hill and Iota Hill. The wishbone drainage line located between Browns Hill and Theta Hill will be directly impacted by the proposed Theta Project.

</td><td>

Floral Habitat Sensitivity Graph
Riparian habitat and Indigenous Forest



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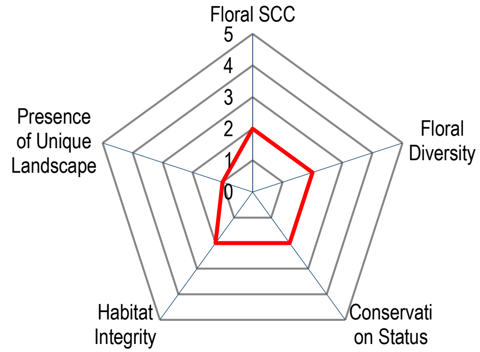
Floral Habitat Sensitivity Graph
Degraded Forests



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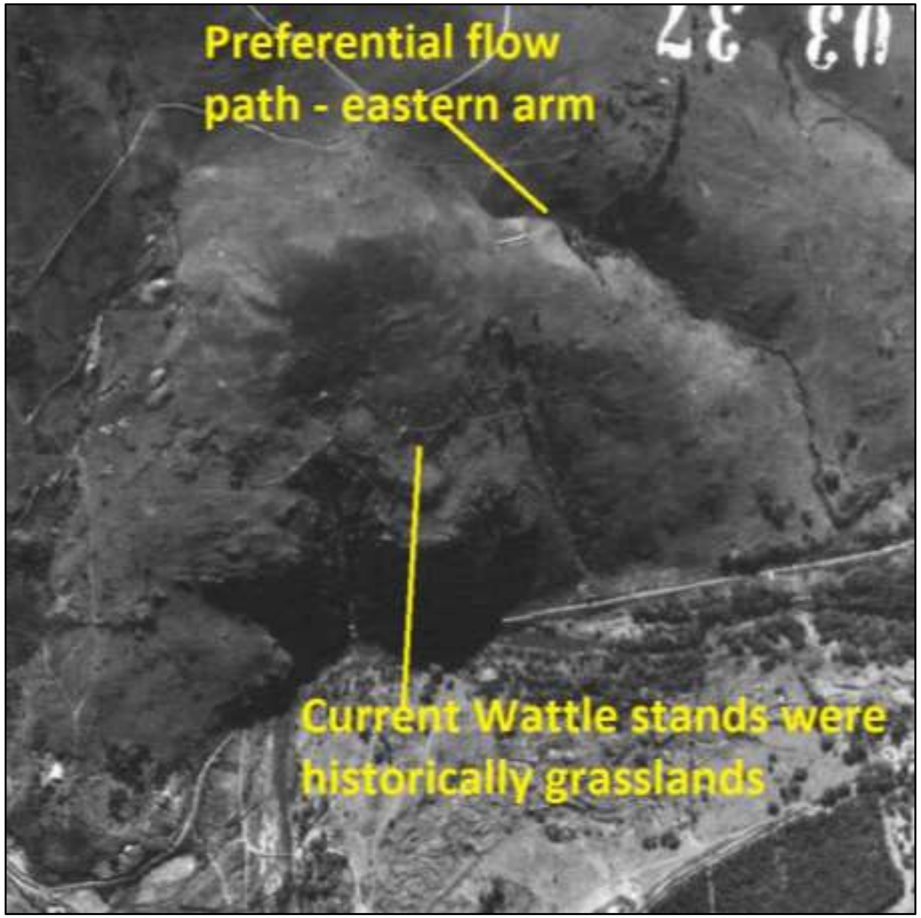
[7] The National Forest Act, 1998 (Act No 84 of 1998, as amended in September 2011) (NFA): "natural forest" means a group of indigenous trees- (a) whose crowns are largely contiguous; or (b) which have been declared by the Minister to be a natural forest under section 7(2).

[8] National Water Act, 1998 (Act 36 of 1998) (NWA): 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.

Iota Forest Remnants:

Most of the vegetation associated with the Forest Remnants within the proposed footprint of Iota Hill is considered **degraded** due to the dominance of alien woody species such as *Acacia dealbata, Eucalyptus diversicolor, Lantana camara* and *Solanum mauritianum***.** Historically, the Degraded Forest on Iota Hill was not part of Mucina and Rutherford's Northern Mistbelt Forest; instead, these areas were grasslands (Figure 13 below).



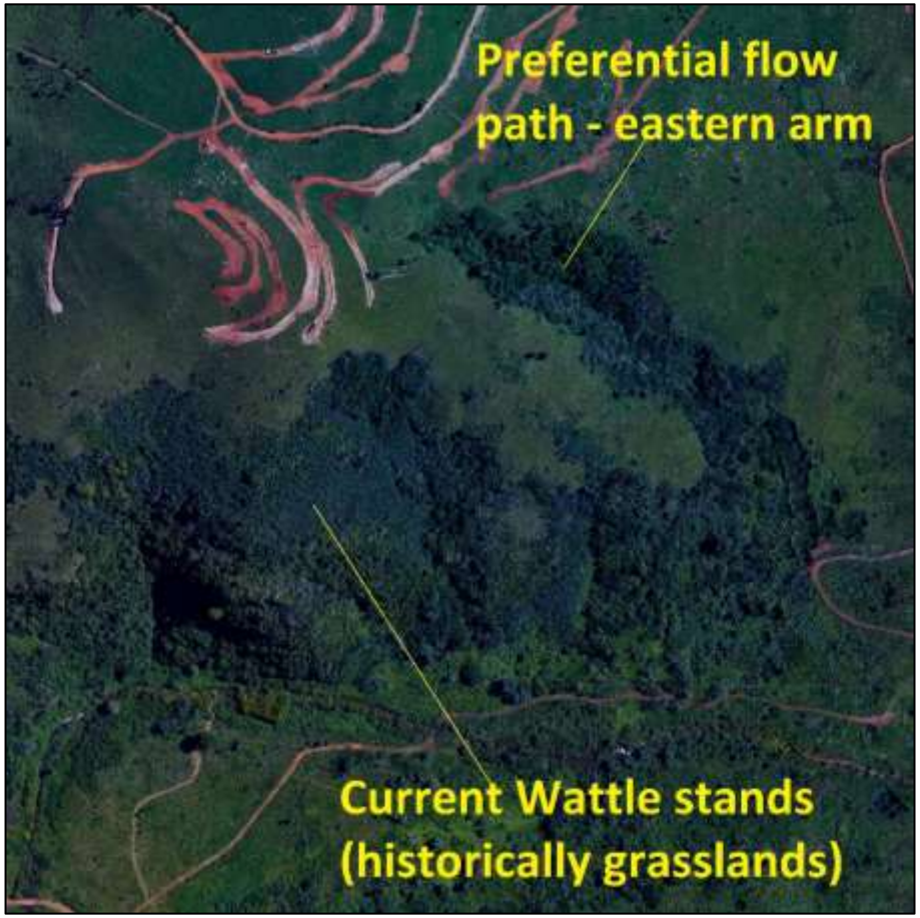


Figure 13: Historic (1935, left photo) and current (2020, right photo) imagery of the forest remnants within Iota Hill.

The eastern arm of the **Degraded Forest** is associated with a preferential flow path where the indigenous vegetation, particularly referring to the woody component, only make up about 30 – 40% of the species composition. Rockier areas still provide habitat for indigenous succulent and bulbous species such as *Aloe arborescens* and *Morea* species. The remaining sections are almost completely overgrown by *Eucalyptus diversicolor*. *Acacia dealbata* dominates the area north of the Indigenous Forest Remnants (Figure 13). Representative photos of the Degraded Forest within the proposed footprint on Iota Hill are shown below (Figure 14):

Figure 14: Representative photos of the Degraded Forest within Iota Hill. The eastern arm which is associated with a preferential flow path is dominated by *Eucalyptus versicolor* (left photo), with areas of increased rock outcropping still vegetated by indigenous species such as *Aloe arborescens* (middle photo). The wattle stands north of the Indigenous Forest Remnants of Iota Hill mainly comprise *Acacia dealbata* (right photo).

The **Indigenous Forest Remnants** associated with Iota Hill occur along a cliff (Figure 15 below). Mucina and Rutherford describe these forests as **Northern Mistbelt Forest** which largely falls outside of the proposed footprint (approximately 0.7 ha falling within the proposed footprint). Due to safety concerns and access constraints, the assessment of the Northern Mistbelt Forest was limited to ad hoc observations, the use of high-resolution Lidar imagery and drone footage. Although a comprehensive species list cannot be provided for this vegetation type, it was evident that the species composition comprised mainly of indigenous floral species, of which the woody component included species such as *Celtis africaca, Morella pilulifera, Seemannaralia gerrardii* and *Ficus* species.

The Northern Mistbelt Forest is listed in the Declaration of a list of National Forest types as Natural Forests in terms of section 7(3)(a) of the NFA. The effect of this declaration is that in terms of section 7(1) of the NFA, no person may cut, disturb, damage or destroy any indigenous tree in, or remove or receive any such tree from a natural forest except in terms of:

a) a license issued under subsection (4) or section 23; or
b) an exemption from the provisions of subsection (4) published by the Minister in the Gazette.

Figure 15: Representative photos of the Indigenous Forest Remnants of Iota Hill.

Wishbone Forest Remnants:

The drainage line within the proposed Wishbone WRD footprint has largely been degraded (discussed in the Riparian Vegetation section) with only the eastern arm still predominantly comprising indigenous vegetation (Figure 16). The Indigenous Forest Remnants within the Wishbone WRD occur within a rocky kloof associated with a drainage line. As such, the vegetation comprise woody floral species adapted to both moisture-rich and rocky habitat; with a clear distinction between canopy and understory (shade-tolerant) vegetation. This section is not mapped as forest in Mucina and Rutherford (2018 updated database) and likely formed due its location in a fire refugia.

The patchy distribution of indigenous forests within hilly and mountainous areas are due to their formation being so closely associated with fire patterns. Within the mountain kloofs, the forests are protected from fire, as is the case with the forest patches associated with Iota Hill and the proposed Wishbone WRD footprint. The sharp change in topography from mountain slopes to kloof or drainage lines prevents fire from reaching these areas and this is why there is such a rapid or sharp transition from grassland to forest. The Indigenous Forest Remnants within the Wishbone WRD footprint is represented by moderate diversity of woody species, all commonly occurring flora not necessarily associated with a specific forest type. Many of the recorded woody species, however, are described as being associated with either rocky ravines, forest margins or developing forests. The vegetation structure also conforms to the NFA's definition of natural forests that have not yet been declared as forest by the Minister, i.e. "…a group of indigenous trees - (a) whose crowns are largely contiguous;…".

Figure 16: Representative photos of the Indigenous Forest Remnants within the proposed wishbone WRD.

Riparian Vegetation

The vegetation associated with the Riparian Habitat within the focus area has largely been degraded from a floral perspective due to the proliferation of AIP species. The section of the Blyde River within the focus area is characterised by the presence of woody and herbaceous AIPs with indigenous vegetation only recovering (or becoming the dominant vegetation) again outside of the focus area. Several anthropogenic pressures have resulted in this degradation of riparian vegetation, including previously disturbed areas left unrehabilitated (mostly mine related) and the presence of artisanal miners. The various drainage lines within the focus area have been transformed by encroaching Wattles (mostly *Acacia dealbata*), Gum trees (mostly *Eucalyptus diversicolor*), *Lantana camara, Rubus niveus* (subgenous *Idaeobatus*) and *Solanum mauritianum*. Native vegetation still occurs within the drainage lines; however, AIP proliferation is extensive. Representative photos are provided below (Figure 17).

Figure 17: Representative photos of the Riparian vegetation within the focus area.

<table>
<tr>
<td>Floral Species of Conservation Concern (SCC)</td>
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Floral SCC were recorded within this habitat unit, most of which are species protected under the MNCA, i.e Aloe arborescens, Clivia species, Faurea galpinii and Scadoxus multiflorus subsp. katharinae. These species were more common in the rockier areas within the Indigenous Forest Remnants (wishbone WRD) and on the outskirts of the Degraded Forest and Riparian Vegetation.

One protected tree species (GN 809 of 2014) under the NFA was recorded in low abundances within the Forest Remnants, i.e. Pittosporum viridiflorum. South African endemics recorded in this habitat unit, but which are all listed as least concern, include Seemannaralia gerrardii.

The low SCC numbers within this habitat unit can be attributed to the extent of AIP proliferation – very little habitat for indigenous species remains. This habitat unit likely harbours SCC not recorded during the field assessments as it provides suitable habitat for several species protected under the NFA as well as for SANBI Red Listed plants.

Refer to section 3.4 for a full discussion on the floral SCC encountered on site, including species expected to occur in this habitat unit based on suitable and available conditions.
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Presence of Unique Landscapes

This habitat unit, despite being heavily encroached by AIPs in several sections, is considered to be unique within the landscape by providing habitat for water-reliant species and woody-dominated vegetation.

Habitat integrity/Alien and Invasive species

The overarching habitat integrity of habitat unit is intermediate. Despite the habitat unit being represented by several native species characteristic of riverine thickets and forest margins, the extent of AIP proliferation throughout this habitat unit has contributed towards a lowered habitat integrity. Only the Indigenous Forest Remnants are considered to have a moderately high habitat integrity.

Some of the more serious invaders include Acacia dealbata, Eucalyptus diversicolor, Eucalyptus grandis, Lantana camara, Rubus niveus, Senna septemtrionalis, Solanum mauritianum and Solanum pseudocapsicum.
</td>
</tr>
<tr>
<td>Floral Diversity</td>
<td>Riparian Vegetation</td>
<td>
The Riparian Vegetation is characterised by woody species and graminoids, with the forb layer less prominent. The woody layer associated with the drainage lines consisted of trees that are typically associated with riverine thickets or montane forest margins, including species like Apodytes dimidiata subsp.dimidiata, Celtis africana, Cephalanthus natalensis, Chionanthus foveolatus, Diospyros lyciodes subsp. guerkei, Rapanea melanophloeos, Schefflera umbellifera and Ziziphus mucronata. The woody layer associated with the Blyde River was dominated by AIPs such as Lantana camara and Rubus niveus. Indigenous tree species along the Blyde included Bowkeria cymosa, Gymnosporia rubra, Searsia chirindensis, Searsia pyroides var. gracilis and Salix mucronata.

The graminoid layer was not well-developed but included species such as Cymbopogon caesius, Cyperus albostriatus, Phragmites mauritianus, Setaria megaphylla and Setaria sphacelata var. sericea.

For a list of species recorded in this habitat unit, refer to Appendix C.

Left to Right: Elaphoglossum acrostichoides, Gloriosa modesta, Crocosmia paniculata, Hesperantha species
</td>
</tr>
</table>

Forest Remnants

As mentioned previously, the **Degraded Forest** was dominated by a woody AIP component, including the species *Acacia dealbata, Eucalyptus diversicolor, Eucalyptus grandis, Lantana camara, Rubus niveus, Senna septemtrionalis, Solanum mauritianum* and *Solanum pseudocapsicum.*

The **Indigenous Forest Remnants** (Wishbone WRD) had some wattle species that formed part of the outer canopy vegetation, but mostly included a well-developed indigenous woody canopy comprising tree species such as *Celtis africana, Combretum kraussii, Cussonia spicata, Dombeya pulchra, Faurea galpinii* (outskirts) and *Senegalia ataxacantha.* The understory vegetation mainly comprised forbs such as *Argyrolobium tomentosum, Begonia sutherlandii, Clivia* sp., *Hypoestes triflora, Plectranthus ciliatus, Scadoxus multiflorus subsp. katharinae* and *Streptocarpus* sp.; with graminoids such as *Carex spicatopaniculata* and *Cyperus albostriatus*.

For a list of species recorded in this habitat unit, refer to Appendix C.




Left to Right: ***Faurea galpinii, Schrebera alata, Kiggelaria africana, Combretum kraussii***




Left to Right: ***Argyrolobium tomentosum, Rhamnus prinoides, Senecio tamoides, Trimeria grandifolia***

Business Case, Conclusion and Mitigation Requirements
This habitat unit is of moderately low to moderately high sensitivity and importance from a floral perspective. Compared to the Indigenous Forest Remnants of the Wishbone drainage line and Iota Hill, the riparian vegetation is less species-rich, and species generally comprise a higher abundance of AIPs. Floral SCC are anticipated to occur within this habitat unit and despite the presence of disturbances, this habitat unit is ecologically functioning and serves as a biodiversity corridor. Direct impacts to the floral communities associated with the Blyde River is anticipated to be limited, given that stringent mitigation measures are implemented to prevent downslope sedimentation o the river. The proposed Wishbone WRD will directly impact on the drainage line and Indigenous Forest Remnants located between the Theta Hill and Browns Hill and, as such, will result in the loss of indigenous species – most notably indigenous tree species. A small section of the Indigenous Forest Remnants on Iota Hill will be impacted by the proposed Iota Pit (approximately 0.11 ha in direct footprint and 0.7 ha of the DEFF buffer within the direct footprint). <u>Important considerations</u> Several sections of this habitat unit fall within Optimal and Irreplaceable CBAs, including ESA: Protected Area Buffers – thus opencast mining is not deemed permissible as it will prevent biodiversity and conservation targets for the area to be achieved. Several sections of vegetation associated with the drainage lines and the Blyde River within the Theta Project area has been extensively encroached by AIPs and it is essential that degraded vegetation be restored to natural ecosystem functioning as far as possible. The drainage lines and the vegetation associated with the Blyde River within the Theta Project focus area is not representative of the threatened ecosystems listed for the area. However, there is potential for floral SCC to be present within the Riparian Habitat and Forest Remnants and a thorough walkdown of the areas is essential to avoid potential loss of species. Activities that are planned within the delineated Riparian Vegetation or the zones of regulation, as identified in the Freshwater Report, will require authorisation from the Department of Water and Sanitation (DWS). The Department of Agriculture, Forestry and Fisheries (DAFF), now renamed the Department of Environment, Forestry and Fisheries (DEFF), have commented on the scoping phase of the proposed Theta Mining Project and have recommended that natural forests, regardless of the extent of alien tree proliferation, should be excluded from the direct project footprint. A 30 m buffer around natural forests within the focus area was proposed by DEFF (Appendix D, comment 13). This buffer was applied to the Indigenous Forest Remnants and is depicted in Figure 11 and 12 Despite the existing edge effect impacts on the Riparian Habitat and Forest Remnants, ecological functionality remains intact. To limit impacts to floral ecology within the area, the mining footprint must be contained within the focus area, and edge effects on surrounding natural areas should be minimised: - Sedimentation of this habitat unit from adjacent mine activities should be prevented as this will result in direct and downstream degradation of this habitat unit, with potentially significant impacts on floral ecology; - It will be important to ensure that current alien species do not spread or that their rate of recruitment does not increase, and that new alien species are not introduced. It is very difficult and often too expensive to completely eradicate or control alien species if not managed from the onset of any development activity. An AIP Management and Control Plan is thus considered essential. It should be noted that within areas of extensive AIP proliferation, a phased clearance approach would be more beneficial; and - If natural forest will be affected, like the Indigenous Forest Remnants, then a licence application has to be made to the regional forestry office. When receiving an application that affects natural forest, Section 3(3)(a) of the NFA is applicable, i.e. “natural forests must not be destroyed save in exceptional circumstances where, in the opinion of the Minister, a proposed new land use is preferable in terms of its economic, social or environmental benefits”. If it is exceptional and there is no feasible alternative then a licence can be issued, but then conditions would apply and it might be determined that a biodiversity offset is necessary.

3.2.4 Habitat Unit 4: Degraded Habitat Unit

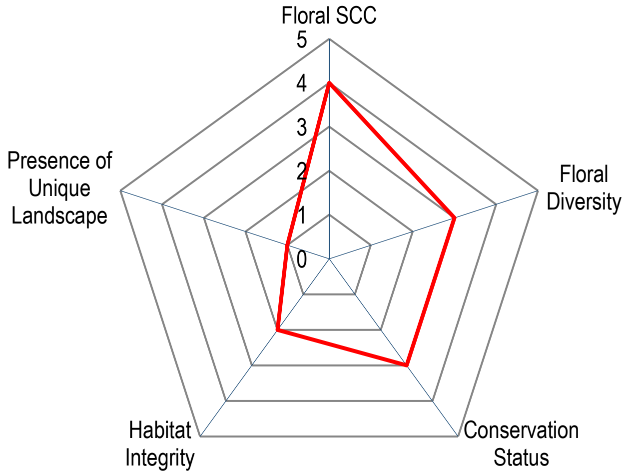
Degraded Habitat Floral Sensitivity	Moderately Low to Intermediate	Typical view of the Degraded habitat unit associated with the focus area.

Habitat Description:

Across the entire Theta project focus area there are sections where the natural vegetation has been heavily modified to the extent that native vegetation is poorly represented, or no vegetation remains at all. Within areas where historic or current anthropogenic disturbances have resulted in the proliferation of AIPs, native species have been displaced and the vegetation has largely lost its integrity.

This habitat unit includes areas where indigenous vegetation has been cleared for either mining or forestry purposes, which includes built-up areas, mined areas and plantations.

Floral Habitat Sensitivity Graph:



Transformed areas with low floral ecological functioning.

View of the TGME's existing transformed areas with a view of the plantations in the back.

Floral Species of Conservation Concern (SCC)	Despite the level of disturbance and transformation that has occurred within this habitat unit, several floral SCC were recorded that are protected under the MNCA: • All species falling within the Proteaceae family, of which the species recorded within this habitat unit included: *Protea gaguedi;* • All species falling within the Orchidaceae family, of which the species recorded within this habitat unit included: *Habenaria falcicornis*; • All species of Gladioli, of which the species recorded within this habitat unit included: *Gladiolus ecklonii*; • All species of Olive trees, of which the species recorded within this habitat unit included: *Olea europaea* subsp. *africana* • All species of Red hot pokers, of which the species recorded within this habitat unit included: *Kniphofia* sp. Species listed under the National Forest Act, 1998 (Act 84 of 1998, as amended in September 2011) (NFA), present within the built-up areas: • All South African species of *Podocarpus* – an **ornamental** within the built-up area and thus likely planted. It is likely that more floral SCC are present; however, their distribution is expected to be limited to areas where less disturbance has taken place. Refer to section 3.4 for a full discussion on the floral SCC encountered on site, including species expected to occur in this habitat unit based on suitable and available conditions.
Floral Diversity	Floral diversity ranges from low to high, depending on the extent and type of disturbance associated with the area; however, in several sections AIPs contribute most towards species diversity. A low species diversity is present within **plantations and built-up areas**, generally consisting of species such as *Pinus patula*, *Eucalyptus diversicolor*, *Lantana camara* and *Rubus niveus.* Weedy species within these areas mostly consisted of *Bidens pilosa, Tagetes minuta* and the grasses *Cymbopogon caesius* and *Sporobolus africanus* and *Sporobolus pyramidalis* – all of which are species that can readily colonise disturbed conditions. The largest area of the Degraded habitat unit consisted of AIP-dominated vegetation. Within the woody layer, the more prominent AIPs included *Flaveria bidentis*, *Jacaranda mimosifolia*, *Lantana camara*, *Melia azedarach*, *Phytolacca octandra*, *Ricinus communis*, *Rubus niveus*, *Solanum mauritianum* and *Solanum pseudocapsicum*. The herbaceous layer was dominated by *Agrimonia procera, Bidens pilosa, Cardiospermum grandiflorum, Conyza bonariensis, Datura stramonium, Galinsoga parviflora, Hypochaeris radicata, Ipomoea purpurea, Lilium formosanum, Malvastrum coromandelianum, Oenothera rosea, Oxalis corniculate, Plantago lanceolate, Plantago major, Schkuhria pinnata, Tagetes minuta, Verbena bonariensis, Verbena rigida* and *Zinnia peruviana.* Some indigenous flora remains within this habitat unit such as the woody species *Artemisia afra, Baccharoides adoensis* var. *kotschyana*, *Diospyros lyciodes* subsp. *guerkei*, *Gomphocarpus physocarpus*, *Leonotis intermedia*, *Lippia javanica*, *Senegalia ataxacatha*, *Sida cordifolia* subsp. *cordifolia* and *Solanum panduriforme*. The indigenous herbaceous layer included species such as *Clematis brachiata*, *Crotalaria pallida*, *Geigeria burkei*, *Helichrysum nudifolium* var. *pilosellum*, *Helichrysum oreophilum* and *Senecio microglossus*. **For a list of species recorded in this habitat unit, refer to Appendix C.**  *Crotalaria pallida* (left) and *Habenaria falcicornis* (right)  *Kniphofia* sp (left) and *Agrimonia procera* (right)

Presence of Unique Landscapes	No unique habitat remains that is considered important from a floral perspective within moderately low sensitivity areas.	**Habitat integrity/Alien and Invasive species**	Habitat integrity is almost completely lost within this habitat unit. Some indigenous floral species and SCC are present but are limited in their extent and abundance.
Business Case, Conclusion and Mitigation Requirements	This habitat unit is of moderately low ecological importance and sensitivity, from a floral biodiversity management perspective. Where habitat is of moderately low sensitivity, no features of biodiversity significance are present, and the proposed Theta Project is not anticipated to significantly impact on floral communities. Due to the proliferation of AIPs within this habitat unit, there is an increased risk that these species could be introduced to the surrounding, more sensitive habitat units during the construction and operational phases. It is therefore important that edge effects be mitigated, and an AIP management plan must be implemented. This will require the removal of AIPs before construction activities commence. The Grassland Biome in South Africa is rapidly declining, and it is therefore recommended that areas where no mining is planned, degraded grasslands should be rehabilitated to conserve the diversity of floral grassland species. Rehabilitation and re-vegetation should be prioritised where heavily modified areas occur close to land of high biodiversity value or where they are located in such a way that they could potentially contribute towards beneficial ecological connectivity (e.g. ecological corridors). For individual parcels of land identified as having specific actual or potential biodiversity values, incentives to restore lost biodiversity and connectivity should be developed.		

3.3 Discussion on Critical Biodiversity Areas and the Malmani Karstlands endangered ecosystem

Apart from the threatened Mucina and Rutherford vegetation types associated with the Theta Project Area (the Northern Escarpment Dolomite Grassland and the Northern Escarpment Quartzite Sourveld), discussed in more detail in section 3.2.1 and 3.2.2, the Theta Project Area is also associated with biodiversity significant features such as the Malmani Karstlands endangered ecosystem and Critical Biodiversity Areas. These are discussed in more detail in the below sections.

3.3.1 Malmani Karstlands endangered ecosystem

The extent of Malmani Karstlands that fall within the direct footprint of the Theta Project is approximately 118 ha, with several section of this already degraded.

The Malmani Karstlands endangered ecosystem (GN 1002 of the 9th of December 2011) is gazetted based on Criterion F, which identifies priority areas for meeting explicit biodiversity targets as defined by a systematic biodiversity plan. This ecosystem is associated with mountainous karstlands of the Malmanl subgroup, together with the presence of karstland endemic taxa and threatened species. Key biodiversity features associated with this ecosystem include five mammal species, namely the Rough-haired Golden Mole, Meester's Golden Mole, Short-eared Trident Bat, Natal Long-fingered Bat and Oribi; six bird species including Blue Crane, Blue Swallow, Grey Crowned Crane, Striped Flufftail, Southern Ground Hornbill and Wattled Crane; and three reptile species for example *Bradypodion transvaalense* and *Lamprophis swazicus.*

From a floral perspective, the Malmani Karstlands ecosystem includes seven vegetation types, namely the Northern Escarpment Dolomite Grassland, Poung Dolomite Mountain Bushveld, Ohrigstad Mountain Bushveld, Long Tom Pass Montane Grassland, Lydenburg Thornveld, Mpumalanga Afromontane Forest and Northern Escarpment Quartzite Sourveld. Three of these vegetation types are within the Theta Project Area. The ecosystem includes part of the Wolkberg Centre of Endemism, provides an escarpment corridor and contains important caves. It is considered important for both grassland and forest processes.

Important plant species associated with this ecosystem include, but are not limited to, the below list:

- ***Aloe fouriei***: Currently this species is considered taxonomically problematic. It is probably an edaphic specialist[9] limited to the Abel Erasmus Pass, where it is potentially threatened by habitat degradation. Taxonomic clarification is required before this species can be listed as threatened, as it would probably qualify under the criterion VU D2. Suitable habitat for this species is present within the Theta Project Area (refer to Table 1 of section 3.4.1 of this report).
- ***Gladiolus vernus***: This species is listed as least concern but is a South African endemic. The flowering period is during spring and since the spring assessment occurred after recent veld fires, it would have been impossible to detect this species.
- ***Gladiolus macneilii***: This species is Critically Endangered B1ab(iii)+2ab(iii) and confined to a small area on dolomites at the summit of Abel Erasmus Pass. Unlikely to be present in the Theta Project Area.
- ***Ocotea kenyensis***: This species is listed as Vulnerable D1. It is a naturally rare species in South Africa, with probably fewer than 1 000 mature plants. Suitable habitat for this species is present within the Northern Mistbelt Forest below Iota Hill.
- ***Warburgia salutaris***; An Endangered A2acd species. The Theta Project Area has suitable habitat and there is a chance that this species is present (refer to Table 1 and Table 2 of section 3.4.1 of this report).

Within the Theta Project Area, the Malmani Karstlands ecosystem is probably best represented in the Northern Escarpment Dolomite Grassland and the Northern Escarpment Quartzite Sourveld (i.e. the Mountain Outcrops and Montane Grassland Habitat Units).

3.3.2 Critical Biodiversity Areas

Within the Theta Project Area, both Irreplaceable and Optimal CBAs are present. The extent of CBA Irreplaceable that will directly be impacted by the proposed Theta Project is approximately 62 ha, with approximately 82 ha of CBA Optimal within the direct footprint. Much of the CBA within the direct footprint is degraded.

The CBA Irreplaceable category includes areas required to meet targets and with irreplaceability values of more than 80%, critical linkages or pinch-points in the landscape that must remain natural, and critically endangered ecosystems. The CBA Optimal Areas are the areas optimally located to meet both the various biodiversity targets and other criteria defined in the analysis. Although these areas are not ‘irreplaceable’ they are the most efficient land configuration to meet all biodiversity targets and design criteria.

[9] Only associated with certain soil types.

According to the MTPA, the below features are triggers for allocating the Irreplaceable and Optimal CBAs associated with the Theta Project Area (from a floral perspective):

- **Vegetation types**: Long Tom Pass Montane Grassland, Northern Escarpment Dolomite Grassland and the Long Tom Mistbelt Forest. The majority of the intact Montane Grassland and Mountain Outcrops are within the Northern Escarpment Dolomite Grassland and probably one of the main triggers of the CBAs within the Theta Project Area.
- **Important species**: *Alepidea amatymbica*, *Streptocarpus hilburtianus*. Neither of these species were recorded during the field investigations and *Streptocarpus hilburtianus* is unlikely to occur within the Theta Project Area as it only occurs at an altitude of 2000m and higher, whereas the Theta Project Area does not reach such elevations.
- Falls within the Wolkberg Centre of Phyto-Endemism.
- **Important corridor**: Macro-corridor, critical linkages, core corridor and supporting corridor. This is likely due to the presence of the Blyde River but also due to the stretches of intact montane grasslands.
- Intact grassland patches. As much of the grasslands in Mpumalanga have been transformed, the remaining intact grasslands are seen as priority areas.
- Climate change land facets and climate change refugia.

3.4 Floral Species of Conservation Concern Assessment

Threatened/protected species are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is a threatened species (referred to as SANBI Red Data Listed species). Furthermore, SCC are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare and Declining. A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7 of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA).

The SCC assessment not only considers floral SCC recorded on site during the field assessment but also includes a Potential of Occurrence (POC) assessment where the assessment takes suitable habitat to support any such species into consideration. Thus, for the POC assessment, a list of floral SCC recorded within the QDS 2430DC and QDS 2430DD was obtained from the MTPA, comprising SANBI Red Data Listed species. The data from

MTPA was provided for various farm portions and these were mapped, Figure 18, and categorised according to the diversity of SCC recorded. The occurrence of floral SCC was categorised in this manner to give an indication of SCC diversity within the region and, thus, further depicting the sensitivity of the area. The MTPA data is not necessarily complete and more SCC are likely present.

Also taken into consideration as part of the POC assessment was:

- The list of Schedule 11 Protected Plants [Section 69 (1)(a)] and Schedule 12 Specially Protected Plants [Section 69 (1)(b)] under the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998); and
- The List of Protected Tree Species (GN 809 of 2014) under the National Forest Act (Act 84 of 1998).

3.4.1 SANBI Red Data Listed species

One SANBI Red Data Listed species was encountered during the field assessment, i.e *Merwilla plumbea* (NT), which was abundant within the Mountain Outcrops associated with Browns Hill and Theta Hill. This species had a limited distribution within Iota Hill. However, following the POC calculations, it was determined that there are favourable growing conditions within the focus area for several Red Data Listed plants (Table 2). Montane grasslands typically support many rare or endemic species that are mostly restricted to either quartzite or dolomite (Schmidt et al., 2002). Thus, suitable habitat and growing conditions within the focus area are mostly available within the **Mountain Outcrops** and **Montane Grasslands** habitat units. The **forest-like thickets** associated with Mountain outcrops and the **smaller drainage lines with woody riparian zones** associated with Riparian Vegetation and Forest Remnants further provide suitable conditions for several floral SCC. Despite these species not found on site during the field investigation, it by no means suggests that they do not occur there and a thorough walk-down of any area to be impacted by construction activities will be necessary before any vegetation clearing takes place. A Rescue and Relocation Plan is recommended if any Red Data Listed species are encountered on site.

The POC of each of the species listed for the area was calculated, following the precautionary approach, and is presented in Appendix C. The below table includes species that obtained a POC of 60% or higher and that is considered likely to be present within the focus area.

Table 2: Floral SCC potentially occurring within the focus area. A full list of POC calculations is presented in Appendix C.

Scientific Name	Ecology & Habitat	National Red List Status	Mtpa Status	POC (%)	Suitable Habitat Within the Focus Area
SPECIES RECORDED ON THE FARM PONIESKRANS 543 KT (FOCUS AREA) OR WITHIN THE PILGRIMS REST AREA					
Aloe fouriei	Rocky areas in grasslands, either at the edges of large sheets of exposed dolomite, on cliff faces, or among large tumbled rocks on the summits of hills, generally on south to east facing slopes.	**DD**	**NT**	**80**	Mountain outcrops
Callilepis leptophylla	Grassland or open woodland, often on rocky outcrops or rocky hill slopes.	**LC**	**Declining**	**60**	Mountain outcrops
Crocosmia mathewsiana	Damp, shady places along streams and forest margins.	**VU**	**VU**	**67**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Curtisia dentata	Evergreen forest from coast to 1800 m.	**NT**	**NT**	**60**	Forest-like thickets associated with Mountain outcrops.
Erica atherstonei	Rocky areas (quartzite) in montane grassland at edge of escarpment or on steep slopes, occasionally in moist areas, 1500-2500 m.	**NT**	**NT**	**60**	Mountain Outcrops & Montane Grasslands
Hypodematium crenatum	Crevices on dolomite cliffs or in soil at the base of dolomite outcrops, from 1260-1600 m.	**VU**	**VU**	**80**	Mountain Outcrops
Kniphofia rigidifolia	Terrestrial	**LC**	**Rare**	**60**	Mountain Outcrops & Montane Grasslands
Kniphofia triangularis* subsp. *obtusiloba	Quartzitic rocky outcrops in montane grasslands, 1200-2200 m.	**Rare**	**Rare**	**73**	Mountain Outcrops
Monopsis kowynensis	Along forest margins in mistbelt grassland.	**VU**	**VU**	**67**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Pelargonium album	Grows on humus-rich soils, in shady rock crevices on dolomite hills.	**Rare**	**Rare**	**80**	Mountain Outcrops
Pentatrichia alata	Grassland or savanna, on rocky slopes and sandy ground.	**DDD**	**DDD**	**60**	Mountain Outcrops Montane Grasslands
Prunus africana	Evergreen forests near the coast, inland mistbelt forests and afromontane forests up to 2100 m.	**VU**	**VU**	**73**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Schizochilus crenulatus	Edges of flat Black Reef Quartzite rock flushes, in damp, to wet conditions, and often in moss, substrate rarely deeper than 10 mm.	**VU**	**VU**	**60**	Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Schizochilus lilacinus	Occurs among rocks or on narrow ledges on steep rocky slopes in damp areas. 1600-2300 m.	**Rare**	**Rare**	**60**	Forest-like thickets associated with Mountain outcrops.

Scientific Name	Ecology & Habitat	National Red List Status	Mtpa Status	POC (%)	Suitable Habitat Within the Focus Area
					Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Senecio latissimifolius	**Range**: Pilgrim's Rest. **Description**: Unknown.	**DDD**	**DDD**	**60**	-
Zantedeschia pentlandii	Rocky hillsides.	**VU**	**VU**	**80**	Mountain Outcrops
SPECIES RECORDED ON NEIGHBOURING FARM PORTIONS					
Curtisia dentata	Evergreen forest from coast to 1800 m.	**NT**	**NT**	**60**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Eucomis autumnalis	Damp, open grassland and sheltered places from the coast to 2450 m.	**Declining**	**Declining**	**87**	Montane Grasslands
Gladiolus saxatilis	Shady places on sandstone rocks and cliffs of black reef quartzite.	**Rare**	**Rare**	**60**	Mountain Outcrops
Ledebouria parvifolia	Dolomite of the Malmani Formation in the Chuniespoort Group.	**DDD**	**DDD**	**60**	Mountain Outcrops
Pentatrichia alata	Grassland or savanna, on rocky slopes and sandy ground.	**DDD**	**DDD**	**73**	Mountain Outcrops & Montane Grasslands
Tulbaghia coddii	Montane grassland, on damp, shallow soils over sheet rocks or in open grassland.	**Rare**	**Rare**	**60**	Mountain Outcrops & Montane Grasslands
SPECIES RECORDED ON FARM PORTION WITHIN 10 KM OF THE FOCUS AREA					
Adenia gummifera* var. *gummifera	Forested ravines, forest patches and forest margins, forest scrub, miombo woodland, savanna, dune forest, on stony slopes, termitaria and littoral bush, 0-1 800 m.	**LC**	**Declining**	**67**	Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Aloe albida	Mistbelt grassland.	**NT**	**NT**	**67**	Montane Grassland
Aloe modesta	Montane grassland, 1600-2000 m.	**VU**	**VU**	**67**	Montane Grassland
Argyrolobium muddii	Mistbelt Grassland.	**EN**	**EN**	**67**	Montane Grassland
Cymbopappus piliferus	Rocky quartzitic ridges in montane grassland.	**VU**	**VU**	**67**	Mountain Outcrops
Erica holtii	**Major system**: Terrestrial	**LC**	**Rare**	**60**	Mountain Outcrops & Montane Grasslands
Merwilla plumbea (=Scilla natalensis)	Montane mistbelt and Ngongoni grassland, rocky areas on steep, well drained slopes. 300-2500 m.	**NT**	**NT**	**100**	Mountain Outcrops
Protea parvula	Most prominent in Lydenburg montane grassland.	**NT**	**NT**	**60**	Montane Grassland
Senecio hederiformis (was Cineraria)	Cracks of quartzite rock faces in mistbelt.	**Rare**	**Rare**	**60**	Mountain Outcrops
Warburgia salutaris	Variable, including coastal, riverine, dune and montane forest as well as open woodland and thickets.	**EN**	**EN**	**67**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants
SPECIES RECORDED ON FARM PORTION WITHIN 20 KM OF THE FOCUS AREA					

Scientific Name	Ecology & Habitat	National Red List Status	Mtpa Status	POC (%)	Suitable Habitat Within the Focus Area
Brachystelma minor	Shallow pockets of dolomite, tolerating both open and shady conditions.	**VU**	**VU**	**67**	Mountain Outcrops
Clivia caulescens	Forest patches and forest margins.	**NT**	**NT**	**60**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Cyrtanthus huttonii	**Major system**: Terrestrial	**LC**	**Rare**	**73**	Mountain Outcrops & Montane Grasslands
Dioscorea sylvatica	Wooded and relatively mesic places, such as the moister bushveld areas, coastal bush and wooded mountain kloofs.	**VU**	**VU**	**60**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Disa maculomarronina	Swamps, montane grassland on the edges of Black Reef Quartzite, 1500-1700 m.	**NT**	**NT**	**60**	Mountain Outcrops
Eucomis montana	Rocky montane grassland.	**LC**	**Declining**	**73**	Montane Grassland
Eulophia zeyheriana	**Provincial distribution**: Eastern Cape, KwaZulu-Natal, Mpumalanga **Major system**: Terrestrial	**LC**	**Rare**	**60**	Mountain Outcrops & Montane Grasslands

CR= Critically Endangered, **DD= Data Deficient - Insufficient Information, EN=** Endangered, **EW =** Extinct in the Wild, **NT =** Near Threatened, **VU=** Vulnerable, **P=** Protected, POC = Probability of Occurrence

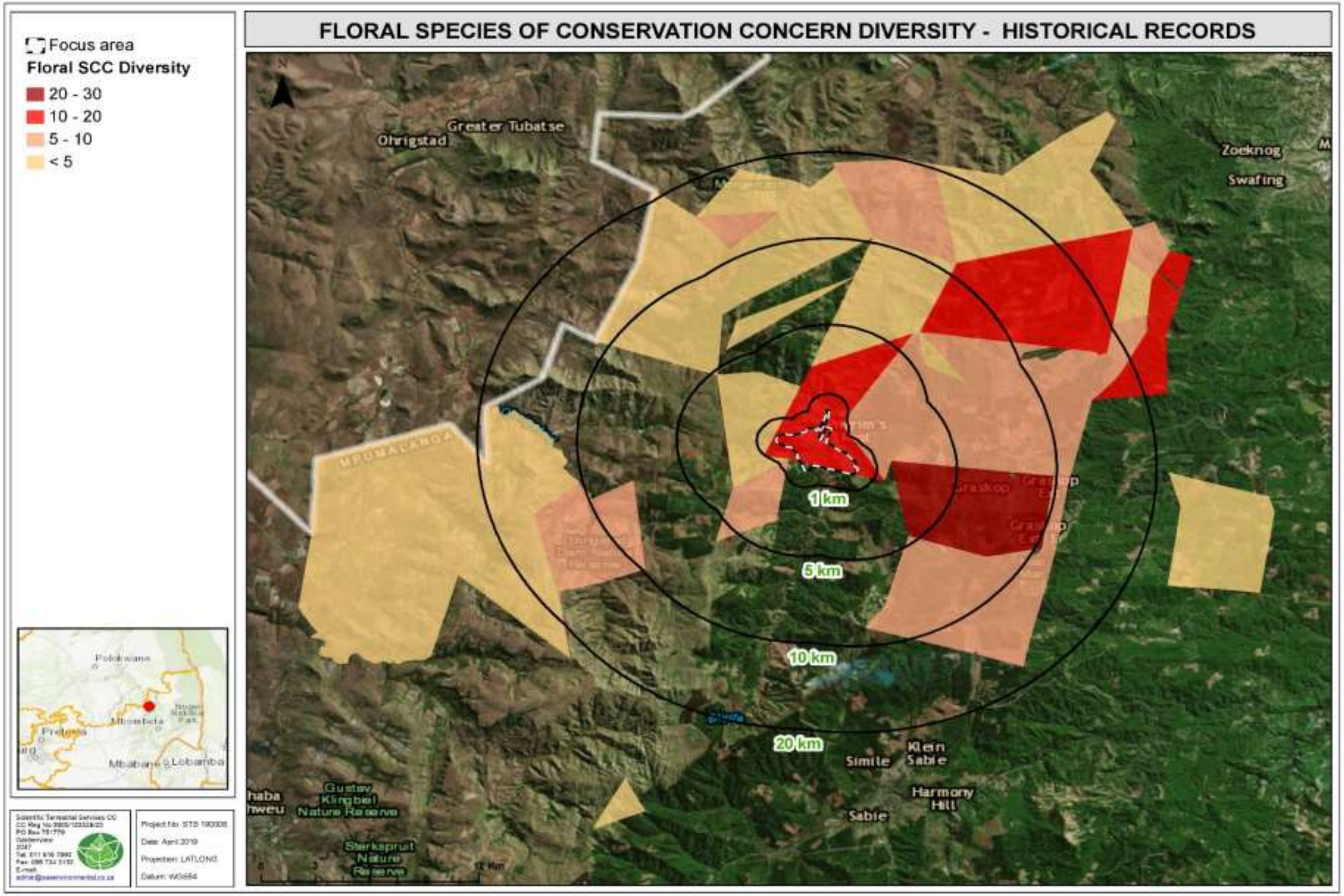


Figure 18: Historic records of floral SCC in relation to the focus area – information provided by the Mpumalanga Tourism and Parks Agency.

3.4.2 NFA Protected species

One tree species protected under the NFA was recorded within the Forest Remnants during the field assessment, i.e. *Pittosporum viridiflorum.* Suitable habitat is available for several additional species within the forest-like thickets associated with Mountain outcrops, as well as within the woody drainage lines associated with Riparian Habitat and within the Indigenous Forest Remnants. The Mountain Outcrops also provides suitable habitat for NFA protected trees. Species of *Podocarpus* was noted within the built-up areas – likely planted as an ornamental – not within the direct footprint.

NFA protected tree species may not be cut, disturbed, damaged or destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold - except under licence granted by the DEFF or a delegated authority. Applications for such activities should be made to the responsible official in each province. Each application is evaluated on merit (including field assessments) before a decision is taken whether or not to issue a licence (with or without conditions). Such decisions must be in line with national policy and guidelines.

The table below presents species that are likely occurring within the focus area due to obtaining high POC scores. A full list of assessed NFA species, along with calculated POCs, are presented in Appendix C of this report.

Table 3: NFA plant list for species with a known distribution range falling within the focus area[10].

Scientific Name	Ecology & Habitat [11 & 12]	National Red List Status	POC (%)	Suitable Habitat Within the Focus Area
Ilex mitis	Along rivers and streams in forest and thickets, sometimes in the open. Found from sea level to inland mountain slopes.	LC	**60**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Pittosporum viridiflorum	Found in deciduous woodland, open bushveld and riverine fringe thichet. Also grows on rocky outcrops.	LC	**100**	Recorded within the Forest Remnants
Prunus africana	Evergreen forests near the coast, inland mistbelt forests and afromontane forests up to 2100 m.	VU	**73**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants
Podocarpus falcatus	Found in Mistbelt forest, scarp forest, afrotemperate forest and coastal forest.	LC	**73**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants

[10] https://www.thetreeapp.co.za/team/
[11] http://pza.sanbi.org/
[12] http://redlist.sanbi.org/index.php

Scientific Name	Ecology & Habitat [11 & 12]	National Red List Status	POC (%)	Suitable Habitat Within the Focus Area
				Remnants of the Northern Mistbelt Forest
Podocarpus latifolius	Found in Mistbelt forest, scarp forest, riverine forest, afrotemperate forest and coastal forest. Also grows on exposed mountain sides and in bush clumps on rocky outcrops.	LC	**73**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants Remnants of the Northern Mistbelt Forest
Warburgia salutaris	Variable, including coastal, riverine, dune and montane forest as well as open woodland and thickets.	EN	**67**	Forest-like thickets associated with Mountain outcrops. Wooded drainage lines associated with Riparian Habitat and Forest Remnants

CR= Critically Endangered, EN= Endangered, EW = Extinct in the Wild, LC = Least concern; NT = Near Threatened, VU= Vulnerable, P= Protected, POC = Probability of Occurrence

3.4.3 MNCA species recorded within the focus area

Several floral SCC listed in the MNCA were recorded within the focus area (Table 4). Table 5 presents some representative photographs of the protected flora encountered on site.

The majority of SCC were found within the Mountain Outcrops, mostly on Theta Hill and within the less disturbed areas in Browns Hill. The Montane Grasslands further harboured several floral SCC. The Degraded Habitat only supported a few SCC due to the disturbed and/or transformed habitat that are associated with this habitat unit.

An indication of the abundance of floral SCC recorded within the proposed Theta Protect footprint is depicted in Figure 19. It should be noted that marking the occurrences of all SCC individuals within the focus area was not part of the scope of work and that the depicted floral SCC abundances are merely a guideline to indicate that the species were present. Before any construction activities can take place, a detailed walk-down of the area is necessary, during which all SCC are marked and either considered for rescue and relocation or, if planning to destroy or move these individuals, permits would be required from relevant authorities.

As the MBSP Handbook (2014) points out, the large number of rare and endangered species in grasslands is a problem for environmental impact assessments because these plants are mostly small, have a very localised distribution and are only visible for a few weeks in the year when they flower – which means that they can easily be missed with once-off field assessments. Thus, SCC marking will need to take place during specific times of the year with the guidance of an MTPA approved specialist.

Table 4: Protected MNCA flora within the focus area.

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
WOODY				
Faurea galpinii	X Wishbone			
Olea europaea subsp. africana				X
Protea caffra subsp. *caffra*		X	X	
Protea gaguedi			X	
Protea roupelliae subsp. *roupelliae*		X	X	
FORBS				
Boophone disticha			X	X
Clivia caulescens (NT, MNCA)	X			
Clivia sp.	X Wishbone			
Cyrtanthus tuckii			X	
Disa patula var. transvaalensis			X	
Eulophia foliosa			X Iota	
Eulophia streptopetala		X	X	
Gladiolus ecklonii			X	
Gloriosa modesta	X			
Graderia sp.		X	X	
Habenaria sp.				X
Haemanthus humilis subsp. *hirsutus*		X		
Kniphofia linearifolia				
Kniphofia sp				X
Merwilla plumbea (Near Threatened)		X	X	X
Orthochilus aculeatus			X Iota	
Satyrium cristatum			X	X
Scadoxus multiflorus subsp. katharinae	X Wishbone			
Scadoxus puniceus		X		
Stenoglottis fimbriata		X		
Zantedeschia albomaculata		X		
SUCCULENTS				
Aloe alooides		X	X	
Aloe arborescens	X Degraded Forest		X	
Aloe barbertoniae		X	X	
Aloe cf. graciliflora		X	X	
Aloe cooperi		X		X
Aloe dyeri			X	X
Aloe greatheadii var. davyana		X	X	

Table 5: Representative photos of most of the floral species protected under the MNCA encountered within the Theta Project Area.

Orchidaceae

Brachycorythis ovata subsp. *ovata*, *Disa patula* var. *transvaalensis*, *Eulophia foliosa, Eulophia streptopetala, Orthochilus aculeatus*

Habenaria falcicornis, *Satyrium parviflorum*, *Satyrium cristatum*, *Stenoglottis fimbriata*

Proteaceae

Protea gaguedi, *Protea caffra* subsp. *caffra*, *Protea roupelliae* subsp. *roupelliae*.

Aloes






Aloe alooides, *Aloe arborescens*, *Aloe transvaalensis*, *Aloe cooperi*, *Aloe greatheadii* var. *davyana*, *Aloe dyeri*

Arum lilies, Gladioli, Pineapple flower, Red hot pokers





Zantedeschia albomaculata; Gladiolus ecklonii and *Gladiolus longicollis, Eucomis* sp. and *Kniphofia* sp.

Paint brush lilies


Haemanthus humilis subsp. *hirsutus* and *Scadoxus puniceus*

Specific species


Boophone disticha; Merwilla plumbea (also NT)

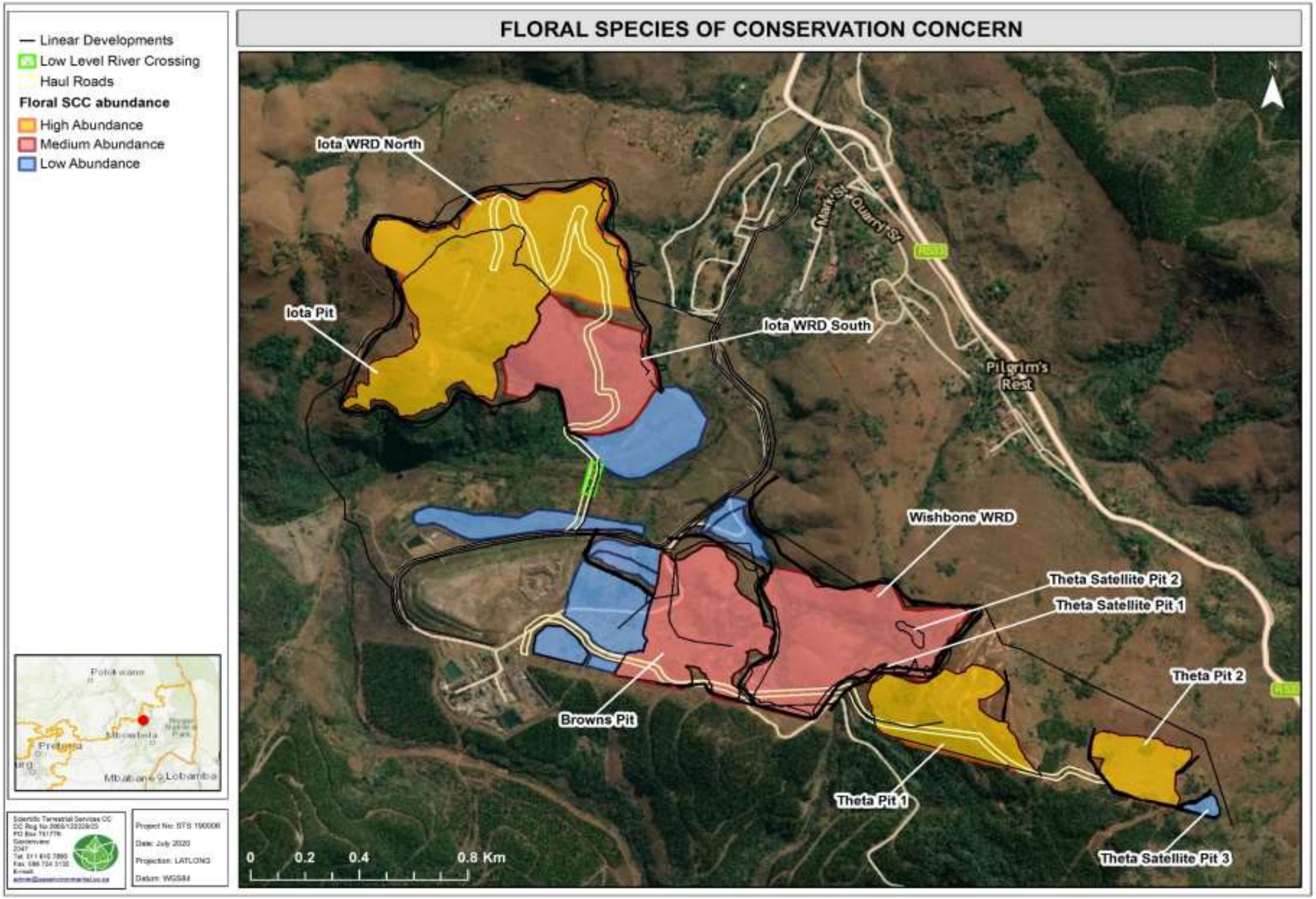


Figure 19: Floral SCC locality records in relation to infrastructure proposed for Theta Hill.

3.5 Medicinal Plant Species

The National Biodiversity Assessment (2011) (NBA) estimates that South Africa has over 2000 medicinal plant species. Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds.

Medicinal plants in Mpumalanga are known to be in high demand (MTPA, 2014) which is evidenced by the high volume (700 tons) of plants being consumed annually within the Province, and even more being transported for sale at markets in other urban centres. The high demand for medicinal plant use and trade within the province can place additional pressure on floral communities within the focus areas if the proposed Theta Project is authorised, as it will result in increased human activity in the area.

A moderately high diversity of medicinal species is present with most of the species being common and widespread and not confined to the focus area. Some of the medicinal species that could be negatively impacted by the proposed mining activities due to being protected species (MNCA) include *Aloe arborescens, Haemanthus humilis* subsp*. hirsutus, Merwilla plumbea* and *Scadoxus puniceus*. *M. plumbea* in particular is a highly sought-after species that has been exploited over most of its range for medicinal use (see http://redlist.sanbi.org/species.php?species=7485-2).

The table below presents a list of dominant plant species with traditional medicinal value and the plant parts traditionally used, which were identified during the field assessment.

Table 6: Dominant traditional medicinal floral species identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2009). Alien species are indicated with an asterisk (*). Protected species are indicated in Bold.

Species	Name	Plant parts used
**Agave sisalana*	Sisal	Leaves
**Agrimonia eupatoria*	Scented Agrimony	Herb
**Ailanthus altissima*	Tree of Heaven	Bark
***Aloe arborescens* (MNCA)**	Krantz aloe	Leaves, or leave gel
Artemisia afra	African wormwood	Roots, stems and leaves
Asparagus sp.	Wild Asparagus	Rhizomes and fleshy roots
Baccharoides adoensis var. *kotschyana*	-	Leaves and twigs
**Bidens pilosa*	Blackjack	Herb
Boophone disticha	Bushman Poison Bulb	Bulb scales
Cheilanthus hirta	Lip Fern	Leaves
**Datura stramonium*	Common Thorn-apple	Leaves, Seeds
Dicoma anomala	Fever Bush	Leaves and twigs, sometimes roots
Dombeya rotundifolia	Wild pear	Bark, sometimes wood and roots
Gomphocarpus physocarpus	Balloon Milkwees	Leaves, sometimes the roots
***Haemanthus humilis subsp. hirsutus* (MNC Act)**	Rabbit's ear	Bulbs and roots
Helichrysum nudifolium var. *pilosellum*	Everlasting	Leaves and twigs, sometimes roots

Species	Name	Plant parts used
Heteromorpha arborescens var. *abyssinica*	Parsley tree	Roots, sometimes stem bark and leaves
Lannea edulis var. *edulis*	Wild grape	Bark of the rootstock
Lippia javanica	Fever tea	Leaves and twigs
Merwilla plumbea **(MNC Act)**	Blouberglelie	Bulb
Rapanea melanophloeos	Cape Beech	Bark, sometimes roots
Pellaea calomelanos	Hard fern	Leaves and rhizomes
Plantago lanceolata	Ribwort Plantain	Leaves, Herb
**Plantago major*	Hoary Plantain	Leaves, Herb
**Plectranthus barbatus*	Indian coleus	Root & Herbs
Rhoicissus tridentata subsp. cuneifolia	Wild grape	Roots or tuberous rootstock
**Ricinus communis*	Castor oil Plant	Seed oil
Scabiosa columbaria	Wild Scabious	Leaves or fleshy roots
Scadoxus puniceus **(MNC Act)**	Red paintbrush	Bulbs and roots
Sida cordifolia	Flannel Weed	Root
Syzygium cordatum var. cordatum	Water berry	Bark, leaves and roots
Xerophyta retinervis	Monkey's tail	Whole plant
Ziziphus mucronata	Buffalo Thorn	Leaves, Root & Bark

3.6 *Alien and Invasive Plant (AIP) Species*

Alien and invasive floral species are floral species of exotic origin which are invading previously pristine areas or ecological niches (Bromilow, 2001). Not all weeds are exotic in origin but, as these exotic plant species have very limited natural “check” mechanisms within the natural environment, they are often the most opportunistic and aggressively growing species within the ecosystem. Therefore, they are often the most dominant and noticeable within an area. Disturbances of the ground through trampling, excavations or landscaping often leads to the dominance of exotic pioneer species that rapidly dominate the area. Under natural conditions, these pioneer species are overtaken by sub-climax and climax species through natural veld succession. This process, however, takes many years to occur, with the natural vegetation never reaching the balanced, pristine species composition prior to the disturbance. There are many species of indigenous pioneer plants, but very few indigenous species can out-compete their more aggressively growing exotic counterparts.

Alien vegetation invasion causes degradation of the ecological integrity of an area, causing (Bromilow, 2001):

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures; and
- Increased agricultural input costs.

AIPs are defined in terms of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA) and categories are assigned as per the NEMBA List of Alien and Invasive Species (2016) in accordance with Section 70(1)(a) of the NEMBA:

- Category 1a Listed Invasive Species are those species listed as species which must be combatted or eradicated:
- Category 1b Listed Invasive Species are those species listed as species which must be controlled;
- Category 2 Listed Invasive Species are those species listed as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be;
- Category 3 Listed Invasive Species are species that are listed as species which are subject to exemptions and prohibitions.

Alien species located within the focus area need to be removed regularly as part of maintenance activities - according to the NEMBA: Alien and Invasive Species Regulations, GN R864 of 2016. Duty of care related to listed invasive species are referred to in NEMBA Section 73:

- Section 73(2): A person who is the owner of land on which a listed invasive species occurs must-
  a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;
  b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and
  c) take all the required steps to prevent or minimise harm to biodiversity.

During the floral assessment, dominant AIPs species were identified and are listed in the below tables.

Table 7: Woody alien floral species identified during the field assessment with their invasive status as per NEMBA: Alien and Invasive Species Lists, GN R598 of 2016.

Species	English name	Country of Origin[13]	Category*	Habitat Unit
Acacia dealbata	Silver Wattle	Australia	**2**	Montane Grasslands Riparian Habitat and Forest Remnants Degraded Habitat
Acacia mearnsii	Black wattle	Australia	**2**	Montane Grasslands Degraded Habitat
Ailanthus altissima	Tree-of-hell	China	**1b**	Riparian Habitat and Forest Remnants Degraded Habitat
Ardisia crenata	Coralberry tree, Coral Bush	Asia	**1b**	Degraded Habitat
Citrus × limon	Lemon tree	South Asia	-	Riparian Habitat and Forest Remnants
Eucalyptus diversicolor	Karri	South-western Australia	2	Montane Grasslands
Eucalyptus grandis	Saligna gum	Australia	2	Montane Grasslands Degraded Habitat
Flaveria bidentis	Smelter's bush	Asia, Africa and Australia	**1b**	Montane Grasslands Degraded Habitat
Jacaranda mimosifolia	Jacaranda	South America (north-west Argentina)	1b	Mountain Outcrops Montane Grassland Riparian Habitat and Forest Remnants Degraded Habitat
Lantana camara	Lantana	Central and South America	**1b**	Mountain Outcrops Montane Grassland Riparian Habitat and Forest Remnants Degraded Habitat
Melia azedarach	Syringa	India	3	Montane Grassland Riparian Habitat and Forest Remnants Degraded Habitat
Phytolacca octandra	Forest inkberry	Tropical America	**1b**	Degraded Habitat
Pinus patula	Patula pine	Central America	**2**	Montane Grasslands Degraded Habitat
Plectranthus barbatus	Indian coleus	South America	-	Montane Grasslands Degraded Habitat
Quercus acutissima	Sawtooth oak	China, Korea, Japan, Himalayas	-	Degraded Habitat
Ricinus communis	Castor-oil plant	Tropical Africa	**2**	Montane Grasslands Degraded Habitat
Rubus niveus	Ceylon raspberry, Mysore raspberry	Southern Asia	**1b**	Riparian Habitat and Forest Remnants Degraded Habitat
Senna septemtrionalis	Arsenic bush	Mexico and Central America	**1b**	Riparian Habitat and Forest Remnants Degraded Habitat
Solanum mauritianum	Bugweed	South America	**1b**	Mountain Outcrops Montane Grassland Riparian Habitat and Forest Remnants Degraded Habitat
Solanum nigrum	European black nightshade	Europe	**-**	Riparian Habitat and Forest Remnants Degraded Habitat

1a: Category 1a – Invasive species that require compulsory control.
1b: Category 1b – Invasive species that require control by means of an invasive species management programme.
2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.
3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

[13] https://www.invasives.org.za/

Table 8: Herbaceous alien floral species identified during the field assessment with their invasive status as per NEMBA: Alien and Invasive Species Lists, GN R598 of 2016.

Species	English name	Country of Origin	Category*	Habitat Unit
Acanthospermum australe	Creeping starbur	Central and South America	-	Montane Grasslands Degraded Habitat
Agrimonia procera	Scented agrimony	Northern America	1b	Degraded Habitat
Bidens pilosa	Common blackjack	South America	-	Mountain Outcrops Montane Grassland Riparian Habitat and Forest Remnants Degraded Habitat
Cardiospermum grandiflorum	Balloon vine	Tropical South America (Brazil and eastern Argentina)	1b	Riparian Habitat and Forest Remnants Degraded Habitat
Datura stramonium	Downy thorn apple	Tropical America	1b	Montane Grassland Riparian Habitat and Forest Remnants Degraded Habitat
Erigeron bonariensis	Hairy fleabane	South America	-	Montane Grasslands Degraded Habitat
Galinsoga parviflora	Potato weed, gallant-soldiers, small flowered galinsoga	South America	-	Riparian Habitat and Forest Remnants Degraded Habitat
Hypochaeris radicata	Cat's ear, cat's ear dandelion	Native to northern Africa, most of Europe and western Asia.	-	Degraded Habitat
Ipomoea purpurea	Common morning glory	Tropical America	1b	Montane Grassland Degraded Habitat
Lilium formosanum	Formosa lily	Asia (Taiwan)	1b	Montane Grassland Degraded Habitat
Malvastrum coromandelianum	Prickly malvastrum	Tropical America	1b	Riparian Habitat and Forest Remnants Degraded Habitat
Melilotus albus	White sweet clover	Europe and Asia	-	Riparian Habitat and Forest Remnants Degraded Habitat
Melilotus indicus	Annual yellow sweet clover	Europe and Asia	-	Riparian Habitat and Forest Remnants Degraded Habitat
Oenothera rosea	Rose evening primrose	South America	-	Degraded Habitat
Oenothera tetraptera	White evening primrose	Americas	-	Riparian Habitat and Forest Remnants Degraded Habitat
Oxalis corniculata	Creeping woodsorrel	Cosmopolitan weed of tropical and temperature zones	-	Degraded Habitat
Plantago major	Broadleaf plantain, white man's foot, or greater plantain	Most of Europe and northern and central Asia	-	Degraded Habitat
Schkuhria pinnata	Dwarf marigold	South America	-	Montane Grassland Degraded Habitat
Solanum elaeagnifolium	Silver-leaf bitter apple	Americas	1b	Degraded Habitat
Tagetes minuta	Khaki bush	South America	-	Montane Grassland Riparian Habitat and Forest Remnants Degraded Habitat
Verbena bonariensis	Tall Verbena	South America	1b	Montane Grassland Riparian Habitat and Forest Remnants Degraded Habitat
Verbena officinalis	Common verbain	Europe	-	Degraded Habitat
Verbena rigida	Veined verbena	Brazil and Argentina	1b	Degraded Habitat
Zinnia peruviana	Redstar zinnia	Mexico to Brazil, Peru and Bolivia	-	Riparian Habitat and Forest Remnants Degraded Habitat

1a: Category 1a – Invasive species that require compulsory control.
1b: Category 1b – Invasive species that require control by means of an invasive species management programme.
2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.
3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

Table 9: Succulent alien floral species identified during the field assessment with their invasive status as per NEMBA: Alien and Invasive Species Lists, GN R598 of 2016.

Species	English name	Country of Origin	Category*	Habitat Unit
Agave sisalana	Sisal	Mexico	**2**	Degraded Habitat

1a: Category 1a – Invasive species that require compulsory control.
1b: Category 1b – Invasive species that require control by means of an invasive species management programme.
2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.
3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

Table 10: Graminoid alien floral species identified during the field assessment with their invasive status as per NEMBA: Alien and Invasive Species Lists, GN R598 of 2016.

Species	English name	Country of Origin	Category*	Habitat Unit
Bromus catharticus	Prairiegrass	South America	**-**	Riparian Habitat and Forest Remnants
Cortaderia jubata	Pampas grass	South America	**1b**	Degraded Habitat
Cortaderia selloana	Common pampas grass	South America (Brazil, Uruguay, Paraguay, Argentina and Chile	**1b**	Montane Grassland
Paspalum dilatatum	Common paspalum	Brazil, Argentina, Bolivia, Chile, Guyana, Paraguay and Uruguay	**-**	Degraded Habitat

1a: Category 1a – Invasive species that require compulsory control.
1b: Category 1b – Invasive species that require control by means of an invasive species management programme.
2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.
3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

The focus area had several areas where AIPs have severely proliferated, and this includes the riparian zone of the Blyde River and immediate surrounding habitat. The main sources of introduction and cause of spread identified for the focus area include commercial plantations and anthropogenic disturbances (primarily mining-related activities).

The region is host to extensive plantations, largely consisting of *Pinus patula* and *Eucalyptus grandis* species, forming part of afforestation that originated within the 1800's. Along the southern border of the focus area, Pine and Eucalyptus plantations occur. These plantations contribute to AIP proliferation within the focus area through (a) Pine and Eucalypt species escaping cultivation and encroaching into natural areas, and (b) through its association with typical forestry weeds such as *Solanum mauritianum* (Bugweed), *Rubus niveus* (Ceylon raspberry, Mysore raspberry), *Lantana camara* (Lantana) and *Acacia mearnsii* (Black Wattle). Thus, these plantations are both a direct and indirect source of AIPs. See photos below:

Figure 20: *Solanum mauritianum* proliferating within a Pine plantation south of Browns Hill (left) and *Eucalyptus grandis* encroaching into natural vegetation south of Theta Hill (right).

Areas associated with current and past mining activities have the highest abundance of AIPs, i.e. the Tailings Storage Facility (TSF), roads and areas surrounding built-up areas. Species such as *Flaveria bidentis, Lantana camara, Ricinus communis, Datura stramonium* and *Lilium formosanum* are of greatest concern and are spreading due to the presence of anthropogenic activities. Furthermore, the drainage lines and the riparian zones of the Blyde River are under pressure from species such as *Acacia dealbata, Eucalyptus diversicolor, Eucalyptus grandis, Jacaranda mimosifolia, Rubus niveus* and *Solanum mauritianum.* These, and other AIPs as listed in the above tables, are encroaching into areas where water is more readily available and, in many instances, have displaced native species. See example photos below:

Figure 21: *Solanum mauritianum, Lantana camara* and *Acacia dealbata* encroaching into drainage lines and cliffs within the focus area.

It is evident that AIP management (if any) is not currently adequate and these species have been allowed to spread profusely. The presence of AIPs was highest within the Degraded Habitat, Riparian Habitat and Forest Remnants (where degraded), although the Mountain Outcrops and Montane Grasslands are not devoid of AIPs. Due to the extent of AIPs within the focus area (and beyond), it is of utmost importance that strict control of AIPs located on the mine's property, especially areas associated with increased disturbances, be undertaken on a regular basis as part of maintenance activities.

4 SENSITIVITY MAPPING

Based on the March 2019 field assessment, the sensitivity of the habitat units for the larger focus area were determined according to their sensitivity in terms of the presence or potential for floral SCC, habitat integrity and levels of disturbance, threat status of the habitat type, the presence of unique landscapes and overall levels of diversity. The September 2019, January 2020 and April 2020 assessments were able to refine the sensitivities of the affected areas (Figures 22 and 23). The table below presents the sensitivity of each identified habitat unit along with an associated conservation objective and implications for development.

Table 11: A summary of the sensitivity of each habitat unit and implications for development.

<table>
<tr><th>HU</th><th>Sensitivity</th><th>Impacting Infrastructure</th><th>Conservation Objective</th><th>Development Implications</th></tr>
<tr><td rowspan="3">Mountain Outcrops</td><td>High</td><td>Iota Pit
North-eastern portion of the Wishbone WRD
Several stretches of the Haul Road and Linear Developments associated with Iota Hill and Theta Pit</td><td>Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered
Offsetting or compensation for residual loss to be considered only as a last resort</td><td rowspan="3">The Mountain Outcrops were determined to be the most sensitive of the habitat units encountered within the focus area, especially those associated with Theta Hill. The Theta Hill and Browns Hill Mountain Outcrops are highly sensitive from both an ecological and conservation perspective, owing to their high floral diversity, an abundance of floral SCC and the presence of intact vegetation and habitat integrity. The Mountain Outcrops associated with Iota Hill had lower species diversity and fewer SCC but is still considered highly important due to its presence within an Irreplaceable CBA.
From a floral resource management and conservation perspective, these areas must be excluded from surface developments, as far as is feasibly possible. The EIA Phase layout has reduced its footprint considerably, especially within the northern and eastern portions of Theta Hill. The current highest risk to the Mountain Outcrops will thus be on Iota Hill, where the proposed layout will lead to the direct loss of favourable habitat for floral communities and floral SCC numbers locally.
Several of the highly sensitive floral communities are located within Irreplaceable CBAs, ESAs and threatened ecosystems; there is thus a conflict between the intended land use and the conservation requirements for the region.</td></tr>
<tr><td>Moderately High</td><td>Iota Pit, Iota WRD North and Iota WRD South
Theta Pit
Northern Section of Browns Hill
Several stretches of the Haul Road and Linear Developments associated with Iota Hill and Theta Pit</td><td>Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential
Offsetting or compensation for residual loss to be considered only as a last resort</td></tr>
<tr><td>Intermediate</td><td>Iota Pit and Browns Pit</td><td>Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential
Offsetting or compensation for residual loss to be considered only as a last resort</td></tr>
</table>

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
Montane Grasslands	High	Most of the Iota Pit and Iota WRD North, as well as central portion of Iota WRD South Northern portion of the Wishbone WRD	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered Offsetting or compensation for residual loss to be considered only as a last resort	The Montane Grasslands are characterised by a high floral diversity and several floral SCC were recorded in this habitat unit. However, in some sections, habitat integrity was lower for this habitat unit than for the Mountain Outcrops due to the presence of several anthropogenic-related disturbances, including roads excavated along the slopes of Iota Hill (habitat fragmentation) and AIPs encroaching into natural areas throughout. Thus, the Montane Grasslands range from intermediate to high importance from a floral ecological and conservation perspective. Along the south-eastern slopes of Iota Hill, where several roads have been excavated, the grasslands have been fragmented and it is evident that floral diversity is lower in these sections. Thus, considering the impact of habitat fragmentation, together with the conservation significance of South African montane grasslands, no further destruction of these grasslands should take place. The high probability of rare and endemic species occurring in this habitat unit further necessitates the conservation, rather than destruction, of this habitat unit. Several of the highly sensitive floral communities are located within Irreplaceable CBAs, ESAs and threatened ecosystems; there is thus a conflict between the intended land use and the conservation requirements for the region.
	Moderately High	Scattered sections within the Iota WRD North. Northern-most portion of the Iota WRD South Theta Pit 1, Theta Pit and much of the Wishbone WRD Haul Roads associated with Iota Hill and Theta Hill Several stretches of the Linear Developments	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance Offsetting or compensation for residual loss to be considered only as a last resort	
	Intermediate	Browns Pit Iota Pits and Iota WRDs Theta Pit 1	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered only as a last resort	
Riparian Habitat and Forest Remnants	Moderately High	Eastern arm of the Wishbone WRD	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance Offsetting or compensation for residual loss to be considered only as a last resort	The Riparian Habitat and Forest Remnants are of moderately low to moderately high ecological and conservation significance from a floral resource management and conservation perspective. The habitat integrity of the Riparian Habitat within the focus area has been greatly compromised by the proliferation of AIPs, e.g. *Acacia dealbata, Eucalyptus grandis, Jacaranda mimosifolia, Rubus cuneifolius* and *Solanum mauritianum* have encroached into most drainage lines and comprise the majority of vegetation along the Blyde River. Floristically this habitat unit is significant due to the provision of water and the creation of niches for facultative or obligate wetland plants. However, in its current AIP-encroached condition, many native species have been displaced. With the potential for additional disturbances that would stem from the proposed mining-related activities, it is likely that the Riparian Habitat will suffer further loss of native species diversity and down-stream effects of possible siltation, water contamination and AIP proliferation could lead to additional impacts on floral communities within the larger region. The section of the Forest Remnants where indigenous forest species still form the dominant vegetation component is floristically more sensitive and provides unique habitat for forest species. The remnants of Northern Mistbelt Forest should be excluded from planned mining activities and as per the DEFF
	Intermediate	Sections of the Wishbone WRD Linear developments, mainly Haul Roads and Linear Developments Browns PCD	Preserve and enhance the biodiversity of the habitat unit and surrounds while optimising development potential Offsetting or compensation for residual loss to be considered only as a last resort	

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
	Moderately Low	Iota Pit	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	recommendations, no mining activities should occur within 30 m of this vegetation type. Activities that are planned within freshwater resources as delineated by the Freshwater Ecologist or within the zones of regulation, as identified in the Freshwater Report, will require authorisation from the Department of Water and Sanitation (DWS). Mining-related activities within this habitat unit will require cogent mitigation measures to ensure no additional, or cumulative, impacts on floral communities occur.
Degraded Habitat	Moderately Low	Sections of Iota Pit, Iota WRD North and Iota WRD South. Most of Browns Pit and southern sections of the Theta Pit 1, Theta Satellite Pit 1, 2 and 3, as well as sections of the Wishbone WRD Haul Roads and several stretches of the Linear Developments Stockpiles and Mine Contractors Site	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	This habitat unit is of moderately low to low sensitivity, from a floral ecological and conservation perspective. Development within this habitat unit should not pose significant threats to native floral communities within the central part of the focus area. However, edge effects will need to be carefully managed, especially the potential spread of AIPs. Development within this habitat unit on Theta and Iota Hills have a greater potential for edge effects to impact on the adjacent, more sensitive habitat units. Ecological functioning and habitat integrity are significantly compromised, and these areas can be optimised for development.
	Low	Powerline Balancing Dam Sections of the Topsoil Stockpiles and Haul Road Southern portion of the Theta Pit 1 and a small section of the Theta Pit 2	Optimise development potential.	

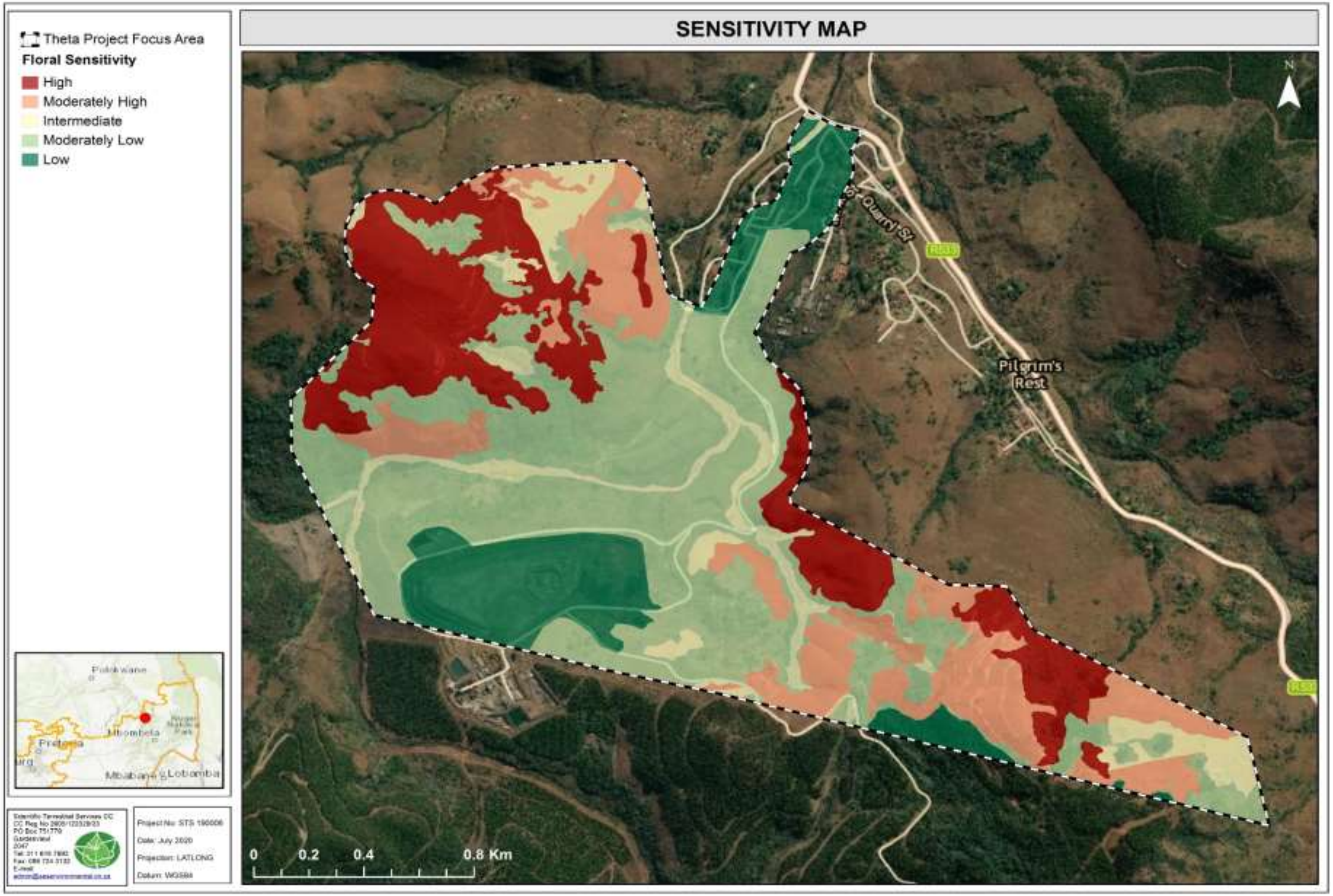


Figure 22: Sensitivity map based on updated results from the September 2019, January 2020 and April 2020 field assessments.

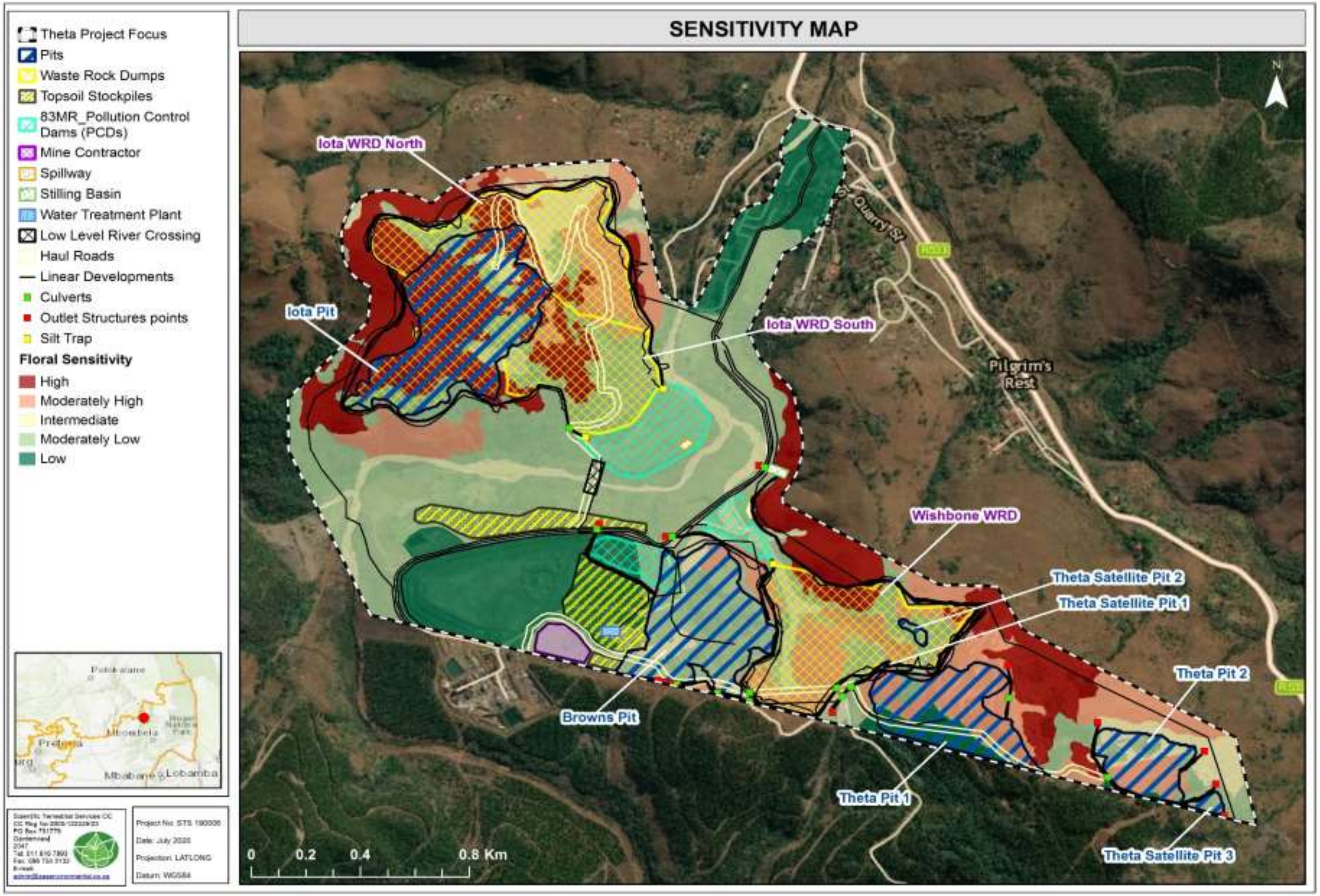


Figure 23: Sensitivity map for the focus area based on updated results from the September 2019 and January 2020 field assessments.

5 IMPACT ASSESSMENT

The table below serves to summarise the significance of the perceived impacts on the floral ecology of the proposed mining development. Individual impacts identified are presented in Section 5.1. A summary and impact discussion of all potential construction, operational and decommissioning phase impacts are provided in Section 5.2. All the required mitigatory measures needed to minimise the impact are presented in Section 5.1 (activity-specific) and 5.3 (general).

5.1 Impacts on the floral ecology of the focus area

The table below identifies potential activities that might take place during the various phases of the proposed mining development, which could impact on the floral ecology of the area. It should be noted that these activities listed in the table below were utilised during the impact assessment as pre-mitigated impacts to ascertain the significance of the perceived impacts prior to mitigation measures.

Table 12: Activities and aspects register

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potential poorly planned placement of the proposed infrastructure within natural areas and areas identified as increasingly sensitive during ecological studies. Contaminated soils could lead to a loss of viable growing conditions for plants and result in a decrease of floral habitat, diversity, SCC and medicinal species – rehabilitation effort will also be increased as a result	Site clearing and the removal of vegetation leading to a loss of sensitive floral habitat and floral SCC as well as fragmentation of SCC populations	Loss of floral SCC through ineffective monitoring of relocation success of rescued and relocated floral SCC, and/or due to the harvesting of protected floral species by mining and operational personnel	Loss of floral SCC encountered within the decommissioning footprint areas
Prospecting, **which has already occurred**, leading to the clearing of natural vegetation associated with the drilling of boreholes and construction of prospecting roads	Continuous stretches of vegetation cleared along proposed linear developments leading to fragmented habitat and the potential loss of floral SCC, floral diversity and of favourable floral habitat	Loss of floral habitat due to removal of material from pits, as well as vehicle access and other operational activities	Ineffective rehabilitation of exposed and impacted areas, particularly the large footprint of the pits and waste rock dumps, leading to permanent loss of floral habitat **Only partial backfilling planned for Browns Hill*

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potential failure to implement the required mitigation measures before and at the commencement of construction activities: *Failure to implement an Erosion Control Plan, to have a Rehabilitation Plan developed, and implemented, before commencement of mining activities; and failure to implement an Alien and Invasive Plant (AIP) Management/Control Plan before construction activities commence Resulting in long-term or permanent degradation and modification of the receiving environment	Loss of favourable floral habitat, floral diversity and SCC through construction-related activities: *Proliferation of alien and invasive plant species resulting from increased disturbances; *Movement of construction vehicles and access road construction through sensitive floral habitat; *Waste from construction material, e.g. bricks, concrete and/or wood damaged or unused for various reasons during construction, leading to disturbance of natural vegetation; *Destruction of vegetation due to unplanned construction-related fires	Further loss of floral habitat beyond the project footprint as a result of: *vegetation clearing related to operational-phase disturbances and expansion of stockpiles and waste rock dumps; *on-going disturbance of soils due to operational activities; *edge effects associated with mining activities	On-going risk of discharge from mining facilities beyond closure leading to a permanent impact on floral habitat and downstream impacts on Riparian Habitat and Forest Remnants Potential failure to initiate a biodiversity offset investigation process to address all residual impacts – leading to permanent loss of SCC and cumulative loss of floral diversity for the region
Potential failure to implement an Erosion Control Plan for sloped areas leading to sedimentation of watercourses, the loss of a nutrient-rich topsoil layer and degradation of soil structure. Resulting in the loss of favourable floral habitat and consequent declines in floral diversity with rare species (or niche species) likely to disappear.	Removal or collection of medicinal/ protected floral SCC beyond the project footprint area	Increased introduction and proliferation of alien and invasive plant species and further transformation of natural habitat beyond the project footprint	Failure to implement and manage biodiversity action plan, rehabilitation plan, alien and invasive control plan during the decommissioning and closure phase leading to long-term (or permanent) transformation of the landscape and loss of favourable floral habitat, diversity and SCC
Potential failure to have a Rehabilitation Plan developed and ready for implementation before the commencement of mining activities. Concurrent backfilling is planned and without a Rehabilitation plan in place prior to the construction phase, there could be potential delays in the implementation of the rehabilitation plan at later stages, thus leading to the loss of viable soils for optimal plant growth.	Soil compaction and erosion as a result of development activities and storm water runoff, reducing the efficiency of floral re-establishment and leading to a loss of favourable floral habitat and consequently a further loss of diversity	Risk of discharge and contamination from all operational facilities may pollute receiving environment leading to altered floral habitat	Ongoing mining development and ineffective rehabilitation leading to a cumulative loss of natural vegetation in the region

Pre-Construction	Construction	Operational	Decommissioning & Closure
Potential failure to implement an Alien and Invasive Plant (AIP) Management/Control Plan before construction activities commence which is required to allow for non-contaminated topsoil stockpiles and will subsequently aid with improved AIP management and rehabilitation as the project progresses. Could result in the potential loss of viable, non-contaminated soils for rehabilitation purposes and displacement of indigenous species by AIPs.	Increased personnel on site leading to loss of floral habitat through the potential for increased fire frequency and intensity, as well as indiscriminate driving through natural veld	Seepage affecting soils and the groundwater regime leading to altered floral habitat	Failure to monitor rehabilitation efforts, leading to: * Reintroduction and proliferation of alien and invasive plant species; * Compacted soils limiting the re-establishment of natural vegetation; * Increased risk of erosion in areas left disturbed and inadequately vegetated; * Improper rehabilitation of disturbed areas leading to permanent floral habitat loss Ultimately leading to a permanent loss of floral habitat, diversity and SCC, and a higher likelihood of edge effect impacts on adjacent and nearby natural vegetation of increased sensitivity
Inadequate design of infrastructure leading to pollution of soils and ground water which may lead to a loss of floral habitat, diversity, SCC and medicinal species	Die-off of floral species due to dust	On-going disturbance may lead to erosion and sedimentation resulting the further loss of favourable floral habitat beyond the project footprint	Rehabilitation of currently degraded habitat and AIP clearance of already proliferated areas. Some ecological functioning will be restored that has been lost due to AIP proliferation and habitat transformation.
Failure to apply for permits to relocate/ destroy floral SCC within the project focus area, potentially leading to the loss of SCC	Potential failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the construction phase, potentially leading to a permanent transformation of floral habitat	Additional pressure on floral habitat by increased human populations associated with the proposed mine leading to a loss of floral habitat and increased harvesting of medicinal species and floral SCC	
		Dust generation during operational activities leading to a loss of floral habitat	
		Increased fire frequency and intensity, as well as uncontrolled fires during operational activities due to increased human activity impacting on floral communities	

Pre-Construction	Construction	Operational	Decommissioning & Closure
		Potential failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the operational phase, potentially leading to a permanent transformation of floral habitat due to long-term degradation	
		Ongoing mining development leading to a cumulative loss of natural vegetation in the region	

5.1.1 Results of the Impact Assessment

The tables below indicate the significance of the perceived impacts prior to the implementation of mitigation measures (see above activities and aspects register) and following the implementation of mitigation measures (presented within the below tables).

The mitigated results of the impact assessment have been calculated on the premise that all mitigation measures as stipulated in this report are adhered to and implemented, and that all regulated zones as per the Freshwater Report (SAS 219038, 2020) are excluded from the proposed Theta Project. Should such actions not be adhered to, it is highly likely that post mitigation impact scores will increase.

The current EIA Phase layout is the applicant's go forward option and it is recognised that any further reductions to the proposed layout will potentially not be economically viable. The mitigation measures presented within this report are deemed to be implementable and financially practical or are considered absolutely essential to reduce impacts on the receiving environment. However, even with the presented mitigation measures fully implemented, several of the perceived impacts may only be lowered to a medium significance level with most impacts deemed unavoidable.

Table 13: Impact on floral habitat, species diversity and SCC for the focus area associated with pre-construction phase activities.

Pre-Construction Phase

UNMANAGED

Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
Iota Pit	-1	4	3	5	-5	-17	High
Browns Pit	-1	2	2	3	-3	-10	Medium
Theta Pits	-1	4	3	5	-5	-17	High
Iota WRDs	-1	4	3	5	-5	-17	High
Wishbone WRD	-1	4	3	5	-5	-17	High
Stockpiles; Mine Contractors Site	-1	2	1	3	-2	-8	Medium
Iota PCD	-1	3	1	4	-2	-10	Medium
Wishbone PCDs	-1	3	2	4	-3	-12	High
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	3	2	3	-3	-11	Medium

PROPOSED MITIGATION MEASURES

Floral Habitat and Diversity

- Minimise loss of indigenous vegetation where possible through planning and suitable layouts. Limit placement of infrastructure within habitat of intermediate to high sensitivity. The following changes to the current layouts are recommended:
  - Changes to the design of the proposed Iota Pit and Iota WRDs should be considered to ensure that the footprint area falls outside of the 30 m buffer around natural forests as recommended by the Department of Agriculture, Forestry and Fisheries (DAFF) (now the Department of Environment, Forestry and Fisheries (DEFF));
- Based on the findings of the Freshwater Assessment (SAS 219038), it is considered imperative that during the planning phase, very careful consideration be given to the locality and layouts of surface infrastructure, to ensure that watercourses and their associated zones of regulation (in terms of both GN704 and GN509 as they relate to the National Water Act 1998 (Act No. 36 of 1998)) are avoided as much as possible;
- All Stockpiles and WRDs must be designed in such a manner that runoff is contained, especially where slopes are steep so that sedimentation of the Blyde River is prevented;
- Prior to the commencement of construction activities, an AIP Management/Control Plan should be compiled for implementation:
  - Removal of alien invasive species should preferably commence during the pre-construction phase and continue throughout the construction, operational, decommissioning, and post-closure phase. AIPs should be cleared within areas where infrastructure is planned before any construction activities commence, thereby ensuring that no AIPs are spread, or soils contaminated with AIP seeds, during construction phases. Alternatively, stringent measures should be implemented to prevent or limit alien propagules from remaining in stockpiled topsoil. An AIP Management/Control Plan should be designed and implemented by a qualified professional. No chemical control of AIPs to occur without a certified professional.
- Prior to the commencement of construction activities on site, a rehabilitation plan should be developed for implementation throughout the development phases. Use of a plant nursery to cultivate indigenous floral species for rehabilitation should be used only where necessary. Communications with Mpumalanga Tourism and Parks Agency (MTPA) has revealed concerns for the introductions of pathogens and exotic earthworms into the natural environment. Success or failures of the rehabilitation approach must be documented;
- Due to the potential for residual impacts on sensitive habitat, a biodiversity offset investigation process should be initiated as part of the planning phase and before any construction commences; and
- Where the excavated prospecting roads fall outside of the proposed mine layout (i.e. Theta Hill), rehabilitation of the roads must commence as soon as possible. The aim should be to re-slope the areas (without damaging unaffected areas) and to revegetate with indigenous grassland species. Reducing fragmentation of the areas is crucial.

Pre-Construction Phase								
MANAGED								PROPOSED MITIGATION MEASURES
Proposed Activities	**Status of Impact**	**Extent**	**Duration**	**Probability**	**Intensity**	**Magnitude**	**Significance**	
Iota Pit	-1	3	3	4	-4	**-14**	**High**	
Browns Pit	-1	1	1	2	-2	**-6**	**Medium**	
Theta Pits	-1	3	2	4	-4	**-13**	**High**	
Iota WRDs	-1	3	3	4	-4	**-14**	**High**	
Wishbone WRD	-1	3	3	3	-4	**-13**	**High**	
Stockpiles; Mine Contractors Site	-1	1	1	1	-1	**-4**	**Low**	
Iota PCD	-1	1	1	1	-1	**-4**	**Low**	
Wishbone PCDs	-1	2	1	2	-2	**-7**	**Medium**	
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	1	1	2	-2	**-6**	**Medium**	

Proposed mitigation measures:

Floral SCC

- Before any construction activities can occur a detailed walk down of the area must take place, during which all floral SCC should be identified and marked by a suitably qualified specialist approved by the MTPA. Surveys to be overseen by MTPA and would need to be conducted within the correct flowering season for all potentially occurring SCC – throughout the year and over various seasons. A once-off walk-down will not suffice. MTPA recommends that surveys for SCC must occur during winter, and twice in the rainy season (November / December and February/March);
- Prior to construction activities, floral SCC that will be directly impacted upon need to be removed, if feasible. This will include species belonging to groups that have underground rhizomes or bulbs, as well as most of the succulent species. Ideally species should be moved to suitable similar habitat outside of the direct footprint, but without causing harm to undisturbed areas. MTPA recommends that all protected flora that can successfully be relocated should be used as part of rehabilitation – intact vegetation outside of the mine footprint should not be disturbed by the planting of rescued SCC. The use of a nursery to aid in the rescue and relocation of floral SCC should only be used if necessary, and only for a short time, so that potential risk of introducing pathogens and exotic earthworms into a natural area is avoided.
- Successes and/or failures of the relocation of SCC must be documented;
- The removal and/or rescue and relocation should be planned before construction activities commence and must be set up by a suitably qualified and experienced specialist in association with a suitably qualified horticulturist;
- Permits from the relevant authorities, i.e. MTPA and DEFF, should be obtained before removal, cutting or destruction of protected species or floral SCC before any proposed mining activities may take place; and
- Marking and/or rescue and relocation activities must take place over several seasons to coincide with the flowering period of all potentially occurring SCC.

Table 14: Impact on floral habitat, species diversity and SCC for the focus area associated with construction phase activities.

Construction Phase

UNMANAGED

Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
Iota Pit	-1	4	3	5	-5	**-17**	High
Browns Pit	-1	2	3	4	-3	**-12**	High
Theta Pits	-1	3	3	5	-4	**-15**	High
Iota WRDs	-1	4	3	5	-5	**-17**	High
Wishbone WRD	-1	3	3	4	-5	**-15**	High
Stockpiles; Mine Contractors Site	-1	1	2	2	-1	**-6**	Medium
Iota PCD	-1	2	2	2	-2	**-8**	Medium
Wishbone PCDs	-1	2	2	3	-2	**-9**	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	2	2	2	-3	**-9**	Medium

PROPOSED MITIGATION MEASURES

<u>**Floral Habitat and Diversity**</u>

- All areas of increased ecological sensitivity falling outside of the direct mine footprint must be designated as No-Go areas and must be off limits to all unauthorised construction vehicles and personnel. This includes the Mountain Outcrops, Montane Grasslands and the Riparian Habitat and Forest Remnants;
- The construction process must be phased to limit the extent of exposed areas at any one time and ensure that the time between initial disturbance and completion of construction is as short as possible;
- Site clearance must be limited to the project footprint areas only, with disturbance limited as far as possible;
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the construction activities. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept minimal;
- Edge effects of all construction activities, which may affect floral habitat within surrounding areas, are to be strictly managed. For example, implement an AIP Management and Control Plan from the get-go, mitigate soil erosion by reducing soil compaction caused by movement of construction personnel and vehicles, suppress dust in order to mitigate the impact of dust on flora within a close proximity of construction activities and reduce sediment loads to the Riparian Habitat and Forest Remnants (Blyde River and its tributaries);
- An AIP Management and Control Plan should be implemented, and an AIP monitoring programme followed during the construction phase in order to prevent the re-establishment of AIPs:
  - Ongoing alien and invasive plant monitoring and clearing/control should take place throughout all phases of the development. The project perimeters should be regularly checked for AIP establishment and proliferation and to prevent spread into surrounding natural areas; and
  - AIP management for construction-phase activities should be focused on limiting their spread, e.g. roadsides should be monitored, as they serve as common corridors along which AIP species are introduced and dispersed, and disturbed areas should regularly be monitored for AIP recruitment until successfully rehabilitated;
- All soils compacted as a result of construction activities falling outside of development footprint areas must be ripped and profiled. Special attention should be paid to alien and invasive control within these areas; and
- A rehabilitation plan must be in place and concurrently implemented within disturbed areas where work has been completed. As far as possible, grass seeds must be harvested, or seeds of any other plants, seedlings, young plants, and bulbs, and these must be used to rehabilitate disturbed areas. A plant nursery can be used if needed but only for a short time and measures must be implemented to prevent pathogens etc. to be introduced to natural areas. All plant species that can be saved should be used for rehabilitation. Relocation of floral species to nearby ''healthy' habitat is not recommended – this can be limited to a select few species so that 'healthy' sites to not unnecessarily get disturbed.

Construction Phase

MANAGED								PROPOSED MITIGATION MEASURES
Proposed Activities	**Status of Impact**	**Extent**	**Duration**	**Probability**	**Intensity**	**Magnitude**	**Significance**	
Iota Pit	-1	2	3	5	-4	**-14**	**High**	
Browns Pit	-1	1	2	3	-2	**-8**	**Medium**	
Theta Pits	-1	2	2	4	-3	**-11**	**Medium**	
Iota WRDs	-1	2	3	5	-4	**-14**	**High**	
Wishbone WRD	-1	2	2	5	-5	**-14**	**High**	
Stockpiles; Mine Contractors Site	-1	1	1	1	-1	**-4**	**Low**	
Iota PCD	-1	1	1	1	-1	**-4**	**Low**	
Wishbone PCDs	-1	1	1	2	-2	**-6**	**Medium**	
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	1	1	2	-2	**-6**	**Medium**	

Proposed mitigation measures:

Floral SCC

- All floral SCC within the construction footprint should have been rescued and relocated, or removed/destroyed, before construction commences. Permits must be obtained before construction commences;
- Ongoing monitoring of SCC that have been relocated to either nearby natural areas or that has been transplanted to a plant nursery should take place during the construction phase. All successes and failures must be documented; and
- Any unauthorised collection or harvesting of floral material, especially floral SCC and species of medicinal value, by construction personnel must be strictly prohibited.

Disposal of construction related material

- All construction related waste and material must be disposed of at a registered waste facility; and
- No waste of construction rubble to be dumped in the surrounding natural habitats.

Increased personnel on site

- No illicit fires must be allowed during any phases of the proposed mining development. A Fire Management Plan (FMP) should be set in place to ensure that any fires that do originate can be managed and / or stopped before significant damage to the environment occurs; and
- No indiscriminate driving through the veld is allowed. As far as possible vehicles are to utilise the existing roads. Where this is not feasible, new roads are to be in areas of existing high disturbance, and not encroach upon sensitive habitats.

Table 15: Impact on floral habitat, species diversity and SCC for the focus area associated with operational phase activities.

Operational Phase								
UNMANAGED								PROPOSED MITIGATION MEASURES
Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance	**Floral Habitat and Diversity** - All areas of increased ecological sensitivity (i.e. Mountain Outcrops, Montane Grasslands and Riparian Habitat and indigenous Forest Remnants) should be designated as No-Go areas and be off limits to all unauthorised vehicles and personnel. Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed mining activities; - No additional habitat is to be disturbed during the operational phase of the proposed mine activities. Stockpiles, WRDs and PCDs, and their expansion as the material is deposited, should be restricted to the footprint area that is authorised. Weekly monitoring and recording of the footprint areas must be done; - Manage all edge effects stemming from mining operations and infrastructure areas: • Implement erosion control measures where necessary to ensure that further habitat loss does not occur. Erosion must be monitored on a continual basis throughout the operational phase, particularly in the vicinity of disturbed areas and where increased human activities will take place; • All soils compacted as a result of operational activities falling outside of the proposed infrastructure areas should be ripped and profiled. Special attention should be paid to alien and invasive plant control within these areas; • An effective dust management plan must be designed and implemented to mitigate the impact of dust on floral species throughout the operational phase; and • AIP control (see below for more details). - No uncontrolled or unsanctioned fires must be allowed. A Fire Management Plan should be in place; and - Concurrent rehabilitation of the disturbed areas must be conducted during the operational phase to re–introduce indigenous vegetation where areas become available. Mature plants, seeds, seedlings, and all plant material collected during the construction phase that have not yet been used for rehabilitation should be planted in disturbed areas where no additional mining activities will take place. - Successes and/or failures of the rehabilitation approach must be documented.
Iota Pit	-1	3	3	4	-4	**-14**	**High**	
Browns Pit	-1	2	1	2	-2	**-7**	**Medium**	
Theta Pits	-1	2	3	3	-3	**-11**	**Medium**	
Iota WRDs	-1	3	3	4	-4	**-14**	**High**	
Wishbone WRD	-1	3	3	3	-5	**-14**	**High**	
Stockpiles; Mine Contractors Site	-1	1	1	2	-2	**-6**	**Medium**	
Iota PCD	-1	1	1	2	-2	**-6**	**Medium**	
Wishbone PCDs	-1	1	2	3	-3	**-9**	**Medium**	
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	2	2	3	-3	**-10**	**Medium**	

Operational Phase

MANAGED							
Proposed Activities	**Status of Impact**	**Extent**	**Duration**	**Probability**	**Intensity**	**Magnitude**	**Significance**
Iota Pit	-1	2	2	3	-3	**-10**	**Medium**
Browns Pit	-1	1	1	1	-1	**-4**	**Low**
Theta Pits	-1	2	2	2	-3	**-9**	**Medium**
Iota WRDs	-1	2	2	3	-3	**-10**	**Medium**
Wishbone WRD	-1	2	2	2	-5	**-11**	**Medium**
Stockpiles; Mine Contractors Site	-1	1	1	1	-1	**-4**	**Low**
Iota PCD	-1	1	1	1	-1	**-4**	**Low**
Wishbone PCDs	-1	1	1	1	-1	**-4**	**Low**
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	1	1	1	-1	**-4**	**Low**

PROPOSED MITIGATION MEASURES

Floral SCC

- Monitoring of relocation success of rescued and relocated floral SCC must take place during the operational phase;
- Harvesting of protected floral species by mining and operational personnel must be strictly prohibited; and
- As part of a Biodiversity Action Plan (BAP), floral monitoring should be done annually during operational activities, including the monitoring of the mine nursery. Please also refer to the monitoring guidelines in section 5.4.

Ongoing AIP Management

- AIPs must be monitored and must be removed throughout the operational phase of the project to prevent their spread beyond the development footprint areas;
- Alien plant seed dispersal within the top layers of the topsoil within footprint areas, that will have an impact on future rehabilitation, must be controlled; and
- Clearing of the AIPs, with specific emphasis on NEMBA Category 1b and Category 2 alien species, encountered within the footprint area (preferably within the entire project perimeter), including the immediate surrounds, must take place in order to comply with existing legislation (NEMBA: Alien and Invasive Species Regulations (Notice number 864 of 29 July 2016 in Government Gazette 40166)).

Waste, discharge and pollution

- No operational-related waste material is to enter natural habitats;
- It must be ensured that the mine process water system is managed in such a way as to prevent discharge to the receiving environment;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- Any waste or toxic spills from vehicles or mining infrastructure must be dealt with immediately in accordance with the waste management plan.

Table 16: Impact on floral habitat, species diversity and SCC for the focus area associated with decommissioning and closure phase activities.

UNMANAGED							
Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
Iota Pit	-1	4	3	5	-5	**-17**	High
Browns Pit	-1	2	2	2	-2	**-8**	Medium
Theta Pits	-1	4	3	4	-4	**-15**	High
Iota WRDs	-1	4	3	5	-5	**-17**	High
Wishbone WRD	-1	4	3	4	-4	**-15**	High
Stockpiles; Mine Contractors Site	-1	2	1	2	-2	**-7**	Medium
Iota PCD	-1	2	2	2	-2	**-8**	Medium
Wishbone PCDs	-1	3	2	2	-3	**-10**	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	3	2	2	-2	**-9**	Medium

MANAGED							
Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
Iota Pit	-1	2	2	4	-3	**-11**	Medium
Browns Pit	-1	1	1	1	-1	**-4**	Low
Theta Pits	-1	2	2	3	-3	**-10**	Medium
Iota WRDs	-1	2	2	4	-3	**-11**	Medium
Wishbone WRD	-1	2	2	3	-3	**-10**	Medium
Stockpiles; Mine Contractors Site	1	1	1	1	2	**5**	Low (+)
Iota PCD	1	1	1	1	2	**5**	Low (+)
Wishbone PCDs	1	1	1	1	2	**5**	Low (+)
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	1	1	1	-2	**-5**	Low

PROPOSED MITIGATION MEASURES

Floral Habitat and Diversity

- Implement all recommendations as per the mine closure plan;
- All surface infrastructure should be removed, and waste material disposed of at a registered dump site. Waste and remnant mine related material should not be dumped or left within the focus area;
- Where soils have been compacted, they are to be ripped and where necessary reprofiled in accordance with the approved rehabilitation plan;
- Indigenous grass species and all plant material (seeds, seedlings, bulbs etc.) collected during the construction and operational phases are to be used for revegetation of disturbed areas. Due to the proposed layouts falling within CBAs, the end-goal of rehabilitation would need to aim to achieve the pre-mined condition as far as possible; and
- Continue monitoring of rehabilitation activities for a minimum period of 5 years following the mine closure or until an acceptable level of habitat and biodiversity reinstatement has occurred, in such a way as to ensure that natural processes and veld succession will lead to the re-establishment of the natural wilderness conditions which are analogous to the pre-mining conditions of the area.

Floral SCC

- Floral SCC, if encountered within the decommissioning footprint areas, are to be handled with care and the relocation of sensitive plant species to suitable similar habitat is to be overseen by a suitably qualified botanist/horticulturist in association with a MTPA recommended ecologist; and
- Monitoring of relocation success of rescued and relocated floral SCC should continue for a minimum of 2 years after closure or until a suitably qualified botanist/horticulturist determines the relocation activities to be successful.

Ongoing AIP Management

- A bi-annual alien vegetation clearance programme should be implemented for a minimum of 5 years after closure. Where areas are disturbed during decommissioning activities, proliferation of alien invasive species within these areas must be continually monitored and controlled.; and
- Follow-up with alien and invasive plant control measures for a period of at least 5 years post-closure.

5.2 Impact Discussion

The data gathered during the baseline floral ecological assessment indicate that, in terms of ecological functioning and floral habitat integrity, the Mountain Outcrops and the Montane Grasslands are of intermediate to high sensitivity, the Riparian Habitat and Forest Remnants of moderately low to moderately high sensitivity and the Degraded Habitat of moderately low to low sensitivity. Placement of infrastructure and mining activities within areas of intact floral habitat of the Mountain Outcrops Habitat, Montane Grasslands Habitat, the Riparian Habitat and indigenous Forest Remnants will negatively impact on floral diversity and habitat within the focus area and potentially within the region if mitigation measures are not fully implemented.

The pre-construction phase is essential in ensuring that activities associated with all phases of the project have the lowest possible impact on the receiving environment. As part of the pre-construction phase, of utmost importance will be to prepare a Rehabilitation Plan, Biodiversity Action Plan, an Alien and Invasive Plant Management and Control Plan, Erosion Control Plan, as well as initiating an investigation into the applicability of a biodiversity offset.

The construction phase will have the largest direct impact on floral ecology due to extensive vegetation clearing. However, long-term, and potentially permanent, high significance impacts are more likely to result from the decommissioning phase of the project if all mitigation measures are not adequately implemented, or if rehabilitation is not carried out long enough. Where impacted environments within currently degraded habitat are rehabilitated with indigenous species and AIPs controlled, there is potential for the decommissioning phase to result in positive impacts to the environment by allowing ecological functions to return where they have been lost as a result of historic mining and forestry activities. Rehabilitation of the Theta Pit and, more importantly the Iota Pit, as well as all WRDs, is not expected to be able to allow for pre-mined conditions to return and the decommissioning phase, even with mitigation measures implemented, will have high impacts on sensitive floral habitat. For the entire footprint of the proposed mine, without sufficiently implemented mitigation measures, the decommissioning phase could result in a transformed landscape with permanent loss of floral habitat, diversity and SCC.

The impacts associated with the proposed Open Pits and WRDs will have high significance impacts on the floral ecology if no mitigation measures are implemented – with a high probability of permanent loss of habitat and floral SCC individuals for the region.

Threatened vegetation types and ecosystems will be directly impacted by the proposed Theta Project. The focus area is located within Optimal and Irreplaceable CBAs as well as an ESA:

Protected Area Buffer (MBSP, 2019). The Mining and Biodiversity Guidelines (2013) consider the area of High to Highest Biodiversity Importance. Thus, no mining-related activities are deemed suitable to allow biodiversity targets to be met and the floral habitat is therefore of high conservation importance.

Activities which are likely to negatively affect the floral habitat integrity of the focus area includes, but are not limited to, the following:

- Placement of mining infrastructure within sensitive floral habitat;
- Destruction of floral habitat during construction and operational activities;
- Dust generated by mining activities;
- Alien and Invasive Plant proliferation and erosion in disturbed areas;
- Dewatering and pollution of watercourses leading to altered riparian and freshwater floral habitat; and
- Increased human populations in the surrounding area leading to greater pressure on natural floral habitat.

5.2.1 Impacts pertaining to the proposed Iota, Browns and Theta Pits

Based on the Scoping Phase layout, the initial placement of the Iota Pit, Browns Pit and Theta Pit were all proposed to fall either fully or partially within highly sensitive vegetation – especially pertaining to the Theta Hill Mountain Outcrops and the Iota Hill Montane Grasslands. The revised EIA Layout have reduced the footprint area within the Theta Hill considerably; however, the construction phase associated with the pits will negatively impact on the floral ecology within the focus area, albeit to a lesser extent than with the Scoping Phase layouts. There remains potential for regional-scale impacts on floral communities to occur based on the EIA Phase layout if all risks to floral species are not considered and mitigation measures are not aptly implemented.

Based on the EIA Phase layout, the **Iota Pit** will have the most significant impact on floral ecology when compared to the Browns and Theta Pits as it will impact on intact, sensitive and floristically diverse vegetation types (Mountain Outcrops and primary Montane Grasslands within CBAs).The southern portion of the Iota Pit traverses a steep cliff which increases the erosion potential; impact on lower slope vegetation and sedimentation of the Blyde River is thus a risk. Floral SCC were recorded within the Iota Pit footprint and based on the results of the SCC assessment it is anticipated that additional floral SCC are present. The Iota Pit footprint will not merely result in the loss of favourable floral habitat and subsequent declines in floral diversity within the focus area, but a potential local loss of floral SCC is likely. The regional-scale impact on floral SCC is uncertain and will require surveying of the area over several seasons to ensure all SCC are identified. Rescue and relocation for floral SCC within the Iota Pit footprint is recommended; however, the feasibility of such initiatives would need to be determined as it is likely that several SCC cannot be successfully relocated, e.g. *Protea* species, and it is possible that SCC could be overlooked and thus destroyed during the construction activities.

If the Theta Project were to receive authorisation, the rehabilitation options for the Iota Pit include the following:

- Ideal rehabilitation goal: Restoration to pre-mined conditions.
- Realistic rehabilitation goal: Revegetation with indigenous species to the point where floral ecological functions or processes can continue without human intervention, albeit in a modified, marginally functional way (when compared to pre-mined conditions).

Based on the revised layouts, the proposed **Theta Pits** mostly fall within fragmented Montane Grassland (where forb and graminoid diversity was still high) and the Degraded Habitat unit (mostly consisting of plantations or AIP stands). As emphasised previously in this report, rare and endemic species of the montane grasslands are not easily detected if not in flower and tend to have limited, localised distributions. The footprint of the Theta Pits will result in the loss of favourable floral habitat and diversity within the focus area, but the impact will be smaller than what was anticipated with the Scoping Phase layouts as the sensitive Mountain Outcrops are mostly avoided. The footprint of the Theta Pits is expected to be smaller, and thus of lower impact significance, than the Iota Pit footprint. Floral SCC were recorded within the Theta Pits in high abundances (mostly *Protea* species and several species of forbs) and the proposed mining activities will result in the loss of SCC individuals within the focus area. The regional-scale impact on floral SCC is uncertain and will require surveying of the area over several seasons to ensure all SCC are identified. The revised layout of the Theta Pits (EIA Phase) was designed to avoid the highly sensitive Mountain Outcrops of the Theta Hill, where the highest diversity of floral SCC was recorded, and this area will require strict access control and measures must be implemented to prevent the harvesting of SCC.

If the Theta Project were to receive authorisation, the rehabilitation options for the Theta Pits include the following:

- Ideal rehabilitation goal: Restoration to pre-mined conditions with areas currently degraded rehabilitated to improve the ecological function for the area.
- Realistic rehabilitation goal: Revegetation with indigenous species, AIP control and improved habitat connectivity can allow floral ecological functions or processes to continue without human intervention, albeit in a modified, functional way.

Historically, **Browns Pit** has received the most disturbance from mine-related activities. The habitat integrity is therefore compromised, which is evidenced by the irregular landscape profile and proliferation of AIPs. Nevertheless, the proposed Browns Pit will impact on floral ecology within its northern and southern portions where Montane Grassland and Mountain Outcrops are still present, fairly intact and harbours several floral SCC. Backfilling of Browns pit is planned, with only the most westerly section of Browns pit to remain open for future tailings deposition. Some impacts on flora will thus be permanent.

If the Theta Project were to receive authorisation, the rehabilitation options for the areas surrounding the Browns Pit include the following:

- Ideal rehabilitation goal: Revegetation with indigenous species to the point where floral ecological functions or processes can continue without human intervention, albeit in a modified, functional way.
- Realistic rehabilitation goal: Browns will be partially backfilled; thus, revegetation will mostly be for the benefit of preventing soil erosion and to stabilise soils. Floral ecological functions or processes will, over time, be able to continue in a modified state. There is some benefit to floral ecology anticipated. However, edge effect management and rehabilitation of the surrounding vegetation should be prioritised so to allow biodiversity to return over time.

5.2.2 Impacts pertaining to the proposed Waste Rock Dumps

The **Iota WRDs** will impact on sensitive habitat – most significantly the primary Montane Grasslands and Mountain Outcrops. The Montane Grassland within the Iota WRD has lost some habitat integrity due to the construction of prospecting roads and encroaching AIPs. It can also be assumed that several floral SCC are present within the WRD footprint based on suitable habitat and field assessment results. Design of the WRD footprint should be reconsidered seeing that small sections fall within the recommended DAFF 30 m buffer around natural forests; development within the buffer should be avoided as much as possible. Erosion control will be essential for Iota WRD 2, especially given that the Blyde River is located downslope of this WRD.

If the Theta Project were to receive authorisation, the rehabilitation options for the Iota WRDs include the following:

- Ideal rehabilitation goal: Restoration to pre-mined conditions.
- Realistic rehabilitation goal: Revegetation with indigenous species to the point where floral ecological functions or processes can continue without human intervention, albeit in a modified, marginally functional way (when compared to pre-mined conditions).

The **Wishbone WRD** will have a significant impact on floral habitat associated with the Riparian Habitat, indigenous Forest Remnants and intact Montane Grassland. The Wishbone WRD was designed to reduce the impact on sensitive floral habitat and SCC that associated with the Scoping Phase layout for WRDs. From a purely floral perspective, the Wishbone WRD will have a smaller impact than the initial Scoping Phase WRDs.

If the Theta Project were to receive authorisation, the rehabilitation options for the Iota WRDs include the following:

- Ideal rehabilitation goal: Restoration to pre-mined conditions.
- Realistic rehabilitation goal: Revegetation with indigenous species to the point where floral ecological functions or processes can continue without human intervention, albeit in a modified, marginally functional way (when compared to pre-mined conditions).

5.2.3 Impacts pertaining to the proposed Mine Contractors Site, Stockpiles and PCDs

The current proposed placement of the Mine Contractors Site, Topsoil Stockpiles and PCDs are located in vegetation that has been degraded, either as a result of previous mine activities or the proliferation of AIPs. The proposed Topsoil Stockpiles and the Iota PCD are not anticipated to contribute to significant impacts on floral ecology, if mitigation measures are adhered to. The Wishbone PCD, although also considered to be within degraded vegetation, is located within the Riparian Habitat (i.e. a freshwater resource) and will require authorisation from the DWS.

No floral SCC were recorded within the footprint of the Topsoil Stockpiles and the PCDs. The high abundance of AIPs within these areas are of concern as the proposed activities could result in the spread of these species if an AIP Management and Control Plan is not implemented.

If the Theta Project were to receive authorisation, the rehabilitation options for the Project Infrastructure, Stockpiles and Dams include the following:

- Ideal rehabilitation goal: Revegetation with indigenous species to the point where floral ecological functions or processes can continue without human intervention, resulting in the maximum possible and permanent benefit.
- Realistic rehabilitation goal: AIP control and revegetation with indigenous species to the point where floral ecological functions or processes can continue without human intervention, resulting in the maximum possible and permanent benefit.

5.2.4 Impacts pertaining to the proposed Linear Developments

The linear developments, particularly the construction of Haul Roads, will lead to continuous strips of vegetation being cleared regardless of placement on existing roads and, within Iota Hill, this will likely result in the clearing/removal of SCC. Habitat fragmentation should be minimised when it comes to linear developments as diversity is lost when habitat becomes fragmented. This is already evident on both Iota and Theta Hills where floral diversity is lower, and AIP proliferation higher, where construction of prospecting roads has resulted in fragmented habitat. All linear developments will require erosion monitoring and the control of AIPs (typical corridors of spread).

The majority of the proposed linear development (powerlines, haul roads, diversion trenches etc.), has been designed to mostly fall within the Degraded Habitat or follows existing roads and will have the least significant impact on floral communities within the focus area. However, due to the proliferation of AIPs within the Degraded Habitat unit, an AIP Management and Control Plan will be essential to prevent and/or limit AIPs from further encroaching into adjacent, natural vegetation.

If the Theta Project were to receive authorisation, the rehabilitation options for the Linear Developments include the following:

- Ideal rehabilitation goal: Revegetation with indigenous species to the point where floral ecological functions or processes can continue without human intervention, resulting in the maximum possible and permanent benefit.
- Realistic rehabilitation goal: Revegetation with indigenous species to the point where habitat fragmentation is reduced, AIP control is implemented and floral ecological functions or processes can continue without human intervention, resulting in the maximum possible and permanent benefit.

5.2.5 Probable Latent Impacts

Even with mitigation, significant latent impacts on the receiving floral ecological environment are deemed highly likely. The following points highlight the key latent impacts that have been identified:

- Further destruction of floral habitat of increased sensitivity, particularly the freshwater and rocky outcrop/ grassland habitat units;
- Permanent loss of niche floral habitat;
- Permanent loss of and altered floral species diversity;
- Continued AIP invasion and proliferation;
- Permanent loss of floral SCC and favourable habitat; and

- Disturbed areas are highly unlikely to be rehabilitated to pre-development conditions of ecological functioning, and significant loss of floral habitat, species diversity and floral SCC will most likely be permanent.

5.2.6 Cumulative Impacts

The Mpumalanga grasslands, particularly relevant to the Pilgrim's Rest region, is already under severe pressure from mining activities and afforestation, which has significantly altered and transformed natural habitat. The proposed Theta Project will further impact on the floral habitat and diversity as well as floral SCC through fragmentation of habitat of increased importance and sensitivity – this is relevant to all untransformed land with natural vegetation cover within the focus area, i.e. the Mountain Outcrops, the poorly protected Montane Grasslands and Riparian Habitat (with downstream impacts likely). It is therefore imperative that all mining infrastructure and related activities be kept to the habitat units considered to be of low ecological importance and sensitivity, which is not an economically feasible option for the entire proposed Theta Project. For some areas the mine plan has been amended to avoid and minimise the impacts on sensitive habitat, while maintaining an economically feasible project. Biodiversity offsets would need to be investigated to compensate for the residual impacts that will result (see Botha et al., 2020). An important consideration will be the potential non-feasibility of offsets for Irreplaceable CBAs, which covers the large section of Iota Hill.

Fragmentation of sensitive floral habitat as a result of mining activities, and limited rehabilitation opportunities, can result in the cumulative loss of floral diversity within the region. Fragmented habitat will lead to the ongoing loss of species diversity over time due to the limitations to dispersal abilities and pollination opportunities, including the loss of gene flows between floral communities. A decrease in floral diversity will result in communities that are less resilient against encroaching AIPs which can thus result in further displacement of floral communities over time. Fragmented habitat not only impacts on floral communities but also limits the migration potential of faunal species. If adequate erosion measures are not in place, ongoing erosion can further impact on floral habitat and hamper the potential recovery of floral communities in the long run as topsoil continues to diminish. The loss of favourable habitat and ongoing declines in species diversity, along with the potential for AIP proliferation, could result in the loss of the remaining extent of threatened vegetation types, namely the Northern Escarpment Dolomite Grassland (Endangered) and the Northern Escarpment Quartzite Sourveld (Vulnerable) vegetation types. The Theta Project is located within Optimal CBAs that and Irreplaceable CBAs, of which the fragmentation thereof can reduce the CBA's potential to achieve biodiversity and conservation targets.

With three pits planned (along with associated WRDs and surface infrastructure), each on a different hill within the focus area, there will be mine-related disturbances originating from three sources, thus creating three potential sources from which AIPs can spread. With the current abundance of AIPs present in existing disturbed areas within the focus area, it is clear that the sites are susceptible to AIP proliferation. If AIPs are not cleared prior to new mining operations commencing, and an AIP Management and Control Plan not implemented throughout all phases of the proposed Theta Project, it is possible that the focus area will end up being dominated by AIPs that will continue to outcompete and displace indigenous floral species. If AIPs are not prevented from further encroaching into the Riparian Habitat, severe downstream impacts can be expected – resulting in potential loss of water yields and overall loss of niche habitat for floral species adapted to moisture-rich or inundated conditions.

The proposed Theta Project has the potential to act as a catalyst for continued or additional further mining in this ecologically sensitive area (likely that Browns Pit will form part of future expansions) including increased human populations associated with the proposed mining activities. This will place additional pressure on floral habitat as a result of potential increases in the collection of plant material for medicinal purposes, the introduction of AIP species, increases in fire frequency risks and ultimately, without effective rehabilitation, could lead to a cumulative loss of natural vegetation in the region. The potential for a shift in the region's vegetation structure and composition from natural, intact habitat to mined land, is not ideal for areas of increased EIS as mining within this area is contradictory to the Mining and Biodiversity Guidelines, as well as the MBSP, National Threatened Ecosystems Assessment and the NPAES.

To assist with managing potential cumulative impacts of multiple projects/activities, it will be important to exchange experiences from past projects or to ensure that cumulative impacts are fully understood and so can be strategically managed. Where it is evident that cumulative impacts will result in significant negative, long-term environmental changes, new projects should be reconsidered.

The above-mentioned cumulative impacts are associated with the Theta Project only and has not taken additional proposed applications in the region into account.

5.3 Integrated Impact Mitigation

The table below highlights the key, general integrated mitigation measures that are applicable to the proposed mining development in order to suitably manage and mitigate the ecological impacts that are associated with all phases of the proposed development activities. Section 5.1.1 provide activity specific mitigation measures to be utilised in conjunction with the below-listed mitigation measures.

Provided that all management and mitigation measures are implemented, as stipulated in this report, the overall risk to floral diversity, habitat and SCC can be moderately mitigated and minimised.

Table 17: A summary of the mitigatory requirements for floral resources.

Project phase	*Pre-construction Phase*
Impact Summary	*Loss of floral habitat, species and floral SCC*
Management Measures	***Proposed mitigation and management measures:*** - Prior to the commencement of construction activities, the entire construction servitude, including lay down areas and stockpile areas etc., must be clearly demarcated to prevent disturbance creep; - Where possible, and feasible, access roads should be kept to existing roads so to reduce fragmentation of natural habitat; - Prior to the commencement of construction activities an alien vegetation management plan shall be compiled for implementation throughout all development phases; - Prior to the commencement of construction activities, a rehabilitation plan shall be developed for implementation throughout all development phases; - As part of the planning and preparation phase, a Fire Management Plan shall be developed and be in place before construction activities can commence; - Design of infrastructure shall be environmentally sound, and all possible precautions taken to prevent potential spills and /or leaks – i.e. best practice and compliance to e.g. SABS standards, non-negotiable; and - At all times, ensure that sound environmental management is in place during the planning phase.
Project phase	*Construction Phase*
Impact Summary	*Loss of floral habitat, species and floral SCC*
Management Measures	***Proposed mitigation and management measures:*** **Development footprint** - Any mining surface infrastructure, including stockpiles, offices and workshops to be placed within transformed areas, i.e. degraded habitat, as far as possible; - The footprint areas of all surface infrastructure shall be minimised to what is absolutely essential; - No dumping of waste on site shall take place. As such it is advised that waste disposal containers and bins be provided during the construction phase for all construction rubble and general waste; - If any spills occur, they must be cleaned up immediately. Spill kits shall be kept on site within workshops. In the event of a breakdown, maintenance of vehicles must take place with care, and the recollection of spillage shall be practised preventing the ingress of hydrocarbons into the topsoil. It must be ensured that no spills leak into the Blyde River or associated drainage lines within and beyond the focus area; - Any disturbance of sensitive floral habitat and floral SCC must be actively prevented. - Sensitive habitat outside of the direct mining footprint areas must be designated as No-Go areas, and no construction vehicles, personnel, or any other construction related activities are to encroach upon these areas; - As much vegetation growth (indigenous species) as possible must be promoted within the proposed mine area in order to protect soils and limit AIP establishment within these areas and subsequent spread to surrounding natural habitat;

	Alien Vegetation - Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect adjacent grassland, outcrops and riparian habitat, must be strictly managed adjacent to the project footprint areas. Specific mention in this regard is made of Category 1b and 2 species, in line with the NEMBA Alien and Invasive Species Regulations (2014), as identified within the focus area; - An Alien and Invasive Plant Management and Control Plan must be designed and implemented in order to monitor and control alien floral recruitment; and - Where areas are disturbed during construction activities, propagation of alien invasive species within these areas must be continually monitored and controlled throughout the construction phase. **Floral SCC** - No collection of firewood, floral SCC or medicinal floral species shall be allowed by construction personnel; - During the surveying and site-pegging phase of surface infrastructure, all floral SCC that will be affected by surface infrastructure shall be marked and, where possible, relocated to suitable habitat surrounding the disturbance footprint. The relevant permits must be applied for from the MTPA prior to the commencement of the construction phase; - The number of floral SCC removed for the construction of mining infrastructure shall be kept to a minimum, and no plants shall needlessly be destroyed; - Floral SCC must be handled with care and the relocation of these plant species to nearby suitable similar habitat must be overseen by a suitably qualified horticulturist in conjunction with a MTPA recommended ecologist; - Should any other floral species protected under NEMBA (Act 10 of 2004), the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998), and the National Forest Act (Act 84 of 1998) be encountered within the proposed development footprint areas, authorisation to relocate such species shall be obtained from the MTPA or the Department of Environmental Affairs (DEA); and - Edge effect control needs to be implemented to ensure no further degradation and potential loss of floral SCC outside of the proposed project footprint area. **Dust** - An effective dust management plan must be designed and implemented in order to mitigate the impact of dust on flora throughout the operational phase. There is evidence of dust pollution leading to a reduction in chlorophyll, including chlorophyll degradation and reduced photosynthetic activity[14;15], resulting from dust deposition on leaf surfaces. Dust deposition also result in stomata clogging[16], which causes a decreased rate of carbon dioxide exchange, carbon assimilation, transpiration, and therefore decreased net photosynthesis **Fire** - No illicit fires must be allowed during the construction phases of the proposed mining development. **Rehabilitation** - Rehabilitation of natural vegetation shall proceed in accordance with a rehabilitation plan compiled by a suitably qualified and experienced specialist. This rehabilitation plan must consider all phases of the mining project indicating rehabilitation actions to be undertaken during and once construction has been completed, ongoing rehabilitation during the operational phase of the project as well as rehabilitation actions to be undertaken during mine closure; - As part of a Biodiversity Action Plan (BAP), floral monitoring shall be done annually and must include all sensitive habitat identified during the field investigation; - Any natural areas beyond the development footprint, that are affected by the construction activities, must be rehabilitated using indigenous species. All

[14] Gunamani T, Gurusamy R, Swamynathan K. Effect of dust pollution on the dermal appendages and anatomy of leaves in some herbaceous plants. J Swamy Boli Club. 1991;8(3–4):79–85.
[15] Naik DP, Ushamani, Somasekhar RK. Reduction in protein and chlorophyll contents in some plant species due to some stone quarrying activity. Environ Polln Cont J. 2005;8:42–44.
[16] Vijaywargiya A, Pandey GP. Effect of cement dust on soybean, Glycine max (L) merr. And Maize, Zea mays Linn. Inflorescence study. Geobios. 2003;30:209–212.

<table>
<tr><td></td><td>rehabilitated areas should aim to be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated. Already degraded areas should aim to improve ecological function and processes;
- All soils compacted as a result of construction activities falling outside of the project footprint shall be ripped and profiled. Special attention shall be paid to ongoing alien and invasive control within these areas; and
- Development of a nursery may be considered where indigenous/endemic plant species must be propagated with focus on rehabilitation in conjunction with a suitably qualified specialist.</td></tr>
<tr><td>Project phase</td><td>Operational Phase</td></tr>
<tr><td>Impact Summary</td><td>Loss of floral habitat, species and Floral SCC</td></tr>
<tr><td rowspan="2">Management Measures</td><td>Proposed mitigation and management measures:</td></tr>
<tr><td>Development footprint
- The footprint and daily operation of all mining surface infrastructure areas, including opencast pits, WRDs and stockpiles shall be strictly monitored to ensure that edge effects from the operational facilities do not affect the surrounding floral habitat;
- Any disturbance of sensitive floral habitat and SCC shall be actively avoided during the operational phase of the development;
- Sensitive habitat shall be designated as No-Go areas, and no mining vehicles, personnel, or any other mining-related activities are to encroach upon these areas;
- As much indigenous vegetation growth as possible shall be promoted within the proposed mining focus areas in order to protect soils; and
- All potentially affected freshwater resource systems shall be monitored for moisture stress and for changes in vegetation structure.
Dust
- An effective dust management plan must be designed and implemented in order to mitigate the impact of dust on flora throughout the operational phase.
Stormwater
- Adequate stormwater management shall be incorporated into the design of the proposed development in order to prevent erosion of topsoil and the loss of floral habitat. In this regard, special mention is made of:
• Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed;
• Runoff from paved surfaces should be slowed down by the strategic placement of berms; and
• All stockpiles and WRDs must have berms and/catchment paddocks at their toe to contain runoff of the facilities.
Alien Vegetation
- Edge effects of all operational activities, such as erosion and alien plant species proliferation, which may affect adjacent natural habitat within surrounding areas, shall be strictly managed adjacent to the project footprint areas. Specific mention in this regard is made to Category 1b and 2 species identified in section 3.7 of this report;
- Ongoing alien and invasive vegetation monitoring and eradication shall take place throughout the operational phase of the development, and the project perimeters should be regularly checked during the operational phase for alien vegetation proliferation to prevent spread into surrounding natural areas; and
- An alien floral control plan must be designed and implemented in order to monitor and control alien floral recruitment in disturbed areas.
Floral SCC
- No collection of firewood, floral SCC or medicinal floral species must be allowed by mining personnel;
- Care should be taken not to remove or destroy any floral SCC during the operational phase of the mine. Should removal of species become imperative during the mining operation, a permit for the removal of any species should be obtained from the MTPA prior to any species removed;
- Edge effect control needs to be implemented to ensure no further degradation and potential loss of floral SCC outside of the proposed project focus area take place; and</td></tr>
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	- It must be ensured that related operational activities are kept strictly within the development footprint. **Fire** - No illicit fires must be allowed during any the operational phase of the proposed mining development. **Rehabilitation** - Rehabilitation of natural vegetation shall proceed in accordance with a rehabilitation plan compiled by a suitable specialist. This rehabilitation plan shall consider all development phases of the project indicating rehabilitation actions to be undertaken during and once construction has been completed, ongoing rehabilitation during the operational phase of the project as well as rehabilitation actions to be undertaken during mine closure; - As part of a Biodiversity Action Plan (BAP), floral monitoring shall be done annually and should include all sensitive habitat units identified during the field investigation; - Any landscaping exercise should use locally indigenous species as far as possible; and - Rehabilitation must be implemented at all times, and disturbed areas must be rehabilitated as soon as such areas become available. This will not only reduce the total disturbance footprint but will also reduce the overall rehabilitation effort and cost.
Project phase	*Decommissioning and Closure Phase*
Impact Summary	*Loss of floral habitat, species and SCC*
	Rehabilitation - All infrastructure and mining operation footprints shall be rehabilitated in accordance with a rehabilitation plan compiled by a suitable specialist; - Any natural areas, including freshwater resource areas, beyond the development footprint that has been affected by the mining operation, must be rehabilitated using indigenous species. All rehabilitated areas shall be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated. Due to the location of the focus area in Irreplaceable and Optimal CBAs (MBSP, 2019), rehabilitation must be to the pre-mined condition. If this is not possible, the feasibility of offsetting for Optimal CBAs should be investigated. Offsetting is not feasible for Irreplaceable CBAs (MBSP Handbook, 2014); however, were the proposed mine approved, it is recommended that it be on the bases that there will be compensation for lost habitat in accordance with applicable National and Provincial Offset Guidelines; and - Rehabilitation efforts must be implemented for a period of at least five years after decommissioning and closure. **Alien Vegetation** - Edge effects of decommissioning and closure activities, such as erosion and alien plant species proliferation, which may affect adjacent sensitive habitat, need to be strictly managed adjacent to the project footprint areas. Specific mention in this regard is made to Category 1b and 2 species identified within section 3.7.; - Ongoing alien and invasive vegetation monitoring and eradication should take place throughout the closure/ decommissioning phase of the development, and the project focus areas and immediate surrounding area (30m from the perimeters) should be regularly checked during the decommissioning phase for alien vegetation proliferation to prevent spread into the surrounding natural area; and - An Alien and Invasive Plant Management and Control Plan must be designed and implemented in order to monitor and control alien floral recruitment in disturbed areas. The alien floral control plan must be implemented for a period of at least 5 years after decommissioning and closure. **Floral SCC** - It must be ensured that decommissioning related activities are kept strictly within the development footprint, and care should be taken not to damage/ harm floral SCC during the closure phase of the mine.

5.4 Floral Monitoring

A floral monitoring plan must be designed and implemented throughout all phases of the mining development, should it be approved. The following points aim to guide the design of the monitoring plan, and it must be noted that the monitoring plan must be continually updated and refined for site-specific requirements:

- Permanent monitoring plots must be established in areas surrounding the surface infrastructure and rehabilitated areas. These plots must be designed to accurately monitor the following parameters:
  - Measurements of the crown and basal cover as applicable in the various habitat units;
  - Species diversity and species abundance;
  - Impact of dust on flora;
  - Recruitment of indigenous species and of alien and invasive species;
  - Alien vs Indigenous plant ratio;
  - Erosion levels and the efficacy of erosion control measures;
  - Vegetation community structure including species composition and diversity which should be compared to pre-development conditions;
  - Presence, abundance and condition of floral SCC communities, and
  - Monitoring of relocation success of rescued and relocated floral SCC.
- Monitoring of rehabilitation trials in light of the above parameters must also take place throughout all phases of the proposed mining development and for a period of five years after decommissioning and closure;
- The rehabilitation plan must be continuously updated in accordance with the monitoring results in order to ensure that optimal rehabilitation measures are employed;
- Monitoring and inspection of the mine nursery to take place throughout the mining phase to ensure floral species for rehabilitation and/or rescue and relocation purposes will be successful;
- Results of the monitoring activities must be taken into account during all phases of the proposed mining development and action must be taken to mitigate impacts as soon as negative effects from mining-related activities become apparent; and
- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.

5.5 Impact Statement on the No-go Alternative vs Authorised Mining

The following section presents the outcome and discussion of anticipated impacts on floral ecology, based on several scenarios surrounding the No-go alternative vs if the Theta Project is authorised. Assessing the No-go Alternative, or the scenario of a project not going ahead, requires that all possible scenarios be taken into account, including the implications of not authorising the project. For the Theta Project, four scenarios were identified, and their anticipated impacts on floral ecology for the focus area and larger region (where applicable), assessed below:

- No-go with no management from relevant stakeholders;
- No-go with management from relevant stakeholders;
- Authorised mining in an ideal scenario; and
- Authorised mining practically achievable.

No-go Alternative

If the No-go Alternative is pursued, there will be no immediate and/or direct impact on sensitive floral communities within the proposed mine footprint and will thus avoid the loss of CBAs, threatened ecosystems and floral SCC. The No-go Alternative therefore better aligns with the intended land use and the conservation requirements for the region (see MTPA, 2014).

With the No-go Alternative, the existing threats to biodiversity however remain present. To prevent negative impacts on floral communities, there would need to be agreement from all relevant stakeholders to manage the current risks posed by artisanal mining and AIP proliferation. For example, controlling artisanal mining activities will allow for recovery of water quality of the Blyde River and ensure the long-term health of riparian habitat within the focus area and downstream. Clearing of AIPs will allow current degraded habitat to be reinstated into the sensitive natural areas with long-term, sustained biodiversity improvement within the region. This scenario is not deemed likely as the required resources are unlikely to be made available.

Pursuing the no-go alternative will most likely allow indirect impacts on floral communities to continue if the current trend continues (i.e. no management from government):

- **Ongoing artisanal mining**. If the Theta Project is not approved, the necessary funding and resources required to control illegal miners will not be available, resulting in the ongoing pollution and sedimentation of the Blyde River and tributaries. Immediate impacts will include habitat being directly destroyed or fragmented by modifying riverbanks, channelising and diverting flows, creating ponds, and through increased erosion, turbidity and sediment composition. The anticipated long-term impacts include the ongoing degradation and die-back of riparian habitat with significant impacts on downstream riparian habitat also anticipated.

- **AIP proliferation**. The current state of AIPs within the focus area and beyond already poses a significant risk to the local biodiversity and many indigenous species have been displaced by AIPs. Of increased concern is the presence of wattle and gum species along the freshwater resources. For example, wattle spreads quickly and invades both grasslands and stream banks where it clogs rivers and causes soil erosion. Without adequate resources, managing the existing, vast population of AIPs associated with the focus area will not yield positive results. The most likely long-term outcome will be loss of sensitive habitat, including CBAs and floral SCC, due to displacement by AIPs.

Authorised mining

The proposed project, if authorised, will result in the loss of not only rare and/or protected plant life, but also primary grasslands with habitat suitable to sustain and support diverse ecosystems. The impacts will be especially significant associated with the Iota Pit, Iota WRDs, Wishbone WRD and Theta Pits. Below is a size estimation of fair to good habitat that will be directly impacted:

- **Pits**: approximately 23 ha of Irreplaceable CBA, 33 ha of Optimal CBA and 40 ha of Malmani Karstlands;
- **Waste Rock Dimps** (including the portion within the Iota Pit area): approximately 45 ha of Irreplaceable CBA, 37 ha of Optimal CBA and 80 ha of Malmani Karstlands;
- **Pollution Control Dams and Balancing Dam**: approximately 2 ha of Optimal CBA and 2 ha of Malmani Karstlands; and
- **Topsoil Stockpiles**: approximately 2 ha of Optimal CBA and 2 ha of Malmani Karstlands.

Several studies have shown that diverse grasslands such as those associated with the Theta Project are impossible to completely restore following activities such as terrace mining. The proposed rehabilitation plan for the Theta Project is good and will undoubtably allow some ecological functions to return over time, even allowing for thriving ecosystems to return in the future – if implemented and managed adequately. Obtaining the pre-mined condition, however, is not possible.

The current greatest non-mining threat to floral communities in the region is the ongoing spread of AIPs and the displacement of indigenous vegetation. Duty of care (NEMBA Section 73(2)) states that landowners are responsible for clearing listed invasive plants on their property. The financial requirements to control and manage the existing, vast population of AIPs associated with the focus area is undoubtably high and will realistically only be adequately managed once the mine is in operation.

With authorisation comes the inclusion of mitigation measures that the mine would be obligated to implement, adhere to and be audited on. Strict control of mining activities, along with sound engineering designs, where no mine-related activities result in pollution or sedimentation of the Blyde River and downstream habitat, should be the goal. However, accidental discharge or spills are always a possibility, and this emphasises the necessity for strict adherence to cogent, well-conceived and ecologically sensitive mitigation measures along with readily available emergency action plans (discharge, fires, spillages etc.). Once in operation, and as resources become available, the mine will be able to implement the necessary security measures to control illegal mining activities. This will have an immediate positive impact on the water quality of the Blyde with the subsequent long-term improvement of riparian habitat.

Large mining operations can have greater potential for impact than small-scale artisanal mining, but they also have a greater capacity to minimise damage where artisanal mining practises rarely take responsibility for environmental damage.

The table below presents a summary of the assessment of each future land use alternative.

Table 18: Results of the impacts assessed associated with the various mining scenarios.

NO GO ALTERNATIVE VS MINING								
Proposed Activities	**Status of Impact**	**Extent**	**Duration**	**Probability**	**Intensity**	**Magnitude**	**Significance**	**IMPACT DESCRIPTION**
No-go with no management from relevant stakeholders	N	3	3	3	-4	**-13**	**High-**	Anticipated impacts on floral ecology include: - No direct large-scale loss of threatened ecosystems, CBAs or floral SCC; - Ongoing AIP proliferation along the Blyde River and its tributaries, as well as into Montane Grasslands; - Displacement of sensitive and/or rare indigenous flora by encroaching AIPs; and - Ongoing pressure on Blyde River (and tributaries) from illegal mining activities, resulting in local and downstream impacts on Riparian Habitat and general biodiversity.
No-go with management from relevant stakeholders	P	3	2	2	5	**12**	**High+**	Anticipated impacts on floral ecology include: - No direct loss of threatened ecosystems, CBAs or floral SCC; - AIP controlled; - AIP cleared areas rehabilitated and sensitive habitat no longer fragmented; - Return of biodiversity to previously invaded areas; - Long-term benefit to local and regional biodiversity targets; and - Riparian habitat improved with control of illegal mining activities.
Authorised mining in an ideal scenario	-	1	2	3	-3	**-3**	**Low-**	Anticipated impacts on floral ecology include: - Loss of threatened ecosystems, CBAs and floral SCC; - Rehabilitation of receiving environment to allow floral ecological functions or processes to continue without human intervention, resulting in the maximum possible and permanent benefit; - Ongoing, adequate control of AIPs and the subsequent return of indigenous floral to areas cleared of alien vegetation; and - Ongoing, adequate control of illegal mining with subsequent recovery of Riparian Habitat impacted by illegal mining activities.
Authorised mining practically achievable	N	2	3	4	-4	**-13**	**High-**	Anticipated impacts on floral ecology include: - Loss of threatened ecosystems, CBAs and floral SCC; - Rehabilitation of receiving environment to include revegetation with indigenous species, AIP control and improved habitat connectivity, however, floral ecological functions or processes to continue in a modified, functional way; - Downslope and downstream habitat to be impacted by accidental spills, discharges, sedimentation and erosion – though these will be managed by readily available emergency action plans; - Ongoing AIP clearing and management unlikely to proceed fast enough to prevent loss of some indigenous flora; and - Illegal mining to continue, to a lesser extent, with some impacts on the Blyde and Riparian Habitat still possible.

6 REASONED OPINION

Scientific Terrestrial Services (STS) was appointed to conduct a Faunal and Floral Ecological Assessment and Impact Assessments as part of the environmental assessment and Environmental Impact Assessment (EIA) process for the TGME Mine Development Project: Application for the amendment of the existing environmental authorisation to include the proposed Theta Open Pit Project to include the Theta Hill, Browns Hill and Iota Hill projects near Pilgrim's Rest, Mpumalanga Province.

The results of the floral report indicate that the focus area is of increased sensitivity due to the proposed mine layout encroaching onto areas of intact, and largely undisturbed, vegetation that is representative of the vegetation types for the area; these include endangered vegetation types and an endangered ecosystem. Moreover, the focus area is floristically diverse, and a broad range of floral SCC are present, including some threatened species but mostly consisting of provincially protected flora. Based on these results the mine has made changes to their proposed layout to minimise, as far as is economically feasible, the impact on the sensitive floral communities and habitat within the Theta Hill site. Although the revised EIA Phase Layout has managed to reduce the overall perceived impact on floral ecology on Theta Hill, there will still be a loss of favourable floral habitat that will impact on floral communities and SCC not only within the direct footprint but on adjacent habitat as well. This will result mainly from edge effects associated with habitat fragmentation, ongoing AIP proliferation and an increased risk of SCC harvesting.

The findings of the field assessment indicate that the focus area is characterised by four broad habitat units, i.e. Mountain Outcrops, Montane Grasslands, Riparian Habitat and Forest Remnants as well as Degraded Habitat. Although all habitat units have been affected by anthropogenic activities to some degree, the severity of the impacts differ. Apart from the Degraded Habitat unit, all other habitat units remain largely intact and their habitat integrity is only slightly compromised due to existing roads (i.e. habitat fragmentation) and some AIPs encroaching into natural areas. The potential for the various habitat units to support floral SCC also differ with the Mountain Outcrops harbouring the highest abundance and diversity of floral SCC, followed by the Montane Grasslands. Consequently, the ecological sensitivity of the identified habitat units varies between high to moderately high (Mountain Outcrops and Montane Grasslands), moderately high to intermediate (Riparian Habitat and Forest Remnants) and moderately low (Degraded Habitat).

The perceived impact significance of the proposed mining activities prior to mitigation affecting floral habitat, diversity and SCC are mostly high significance impacts, with some considered to be medium significance impacts. Even with effective mitigation taking place, most of the impacts will retain a high significance rating, with only a few reduced to a medium significance rating. Low significance ratings were only obtained for areas that are currently degraded and already suffered a loss of floral diversity with few (if any) floral SCC present. Positive impacts are deemed possible for the decommissioning phase if current degraded habitat is rehabilitated to restore some ecological functioning and habitat connectivity that have been lost due to AIP proliferation and habitat transformation. Thus, for several proposed development activities, particularly activities associated with Iota Hill (Iota Pit, and all WRDs) and to a somewhat lesser extent activities associated with Theta Hill (Theta Pits, and Theta Wishbone WRD), impact mitigation is expected to be limited in its ability to minimise the impacts on the receiving floral environment. If the proposed Theta Project is to proceed, it is deemed essential that a cogently developed, documented and managed biodiversity management plan be implemented and maintained throughout the life of the proposed mine. The feasibility of biodiversity offsets and/or compensation options should be investigated (see point 4 in the below section).

Concerns from a floral ecological perspective include:

1) Many rare or endemic species occur in mountain grasslands, mostly restricted to either quartzite or dolomite, and these grasslands must be considered a conservation priority (Schmidt et al., 2002). Where grasslands formerly spanned 61% of Mpumalanga, agriculture and other development (such as mining and afforestation) have led to approximately 44% to be irreversibly transformed (Ferrar and Lotter, 2007). The conservation of remaining untransformed grasslands with natural vegetation cover should be prioritised to conserve biodiversity.
2) The current assessment on floral SCC for the focus areas is likely not a full representation of conservation important species that occur on site. Additional summer assessments are deemed essential and must take place across all seasons. Summer, autumn and spring assessments have taken place and MTPA recommends additional surveys in winter and in the rainy season (November / December). This will allow for a fully saturated species lists to be developed as part of the study and to ensure the EMP is comprehensive in the management of floral SCC and robust to ensure appropriate execution.
3) Most of the focus area falls within poorly protected grassland ecosystems (National Biodiversity Assessment, 2011) and according to the MBSP Handbook (2014), only 2.3% of South African grasslands are protected, making them of high conservation value. Thus, further pressures on these grasslands from high impact land uses such

as surface mining, will hamper the potential for biodiversity targets to be reached for the grassland biome.

4) The entire focus area is located within the 5km ESA Protected Area Buffer (MBSP, 2014). These are zones around protected areas where changes in land-use may affect the ecological functioning or tourism potential of the adjacent protected area(s). The MBSP Handbook indicates that mining activities such as the activities associated with the proposed Theta Project are land-uses that will compromise biodiversity objectives and are not permissible within the allocated 5km buffer around protected areas. According to Goal 3 of the Biodiversity Policy and Strategy for South Africa: Strategy on Buffer Zones for National Parks, published under Government Notice 106 in Government Gazette 35020, mining as a whole is described as a development which may have a negative impact or effect on a national park. Such developments are discouraged. However, it is worth mentioning that the current condition of the 5 km Buffer is already extensively transformed by plantations, various farm practices and many areas are built-up. Using the Mpumalanga Biodiversity Sector Plan database (2014), which likely does not have the full extent of transformed land, there is an estimated 60% already modified within this PA buffer (calculated for a 7km buffer around the Theta Project). On the one hand, this is strong motivation to prevent any further transformation within the buffer; however, the Theta Project will partially fall within the historically mined areas and partially within land transformed by AIPs or plantations, thus forming part of the existing transformed landscape where impact from mining will be limited. Iota Hill is within untransformed land and conflicts with Protected Areas outcomes.

5) Rehabilitation potential: Due to the presence of sensitive floral habitat of high conservation value, it is necessary that all affected areas should be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated. Due to the location of the focus area in Irreplaceable and Optimal CBAs (MBSP, 2014), rehabilitation must be to a pre-mined condition in order for biodiversity targets to be met. If this is not possible, which the findings of this report deem likely, offsetting must be considered for **Optimal CBAs**. Biodiversity offsetting, on the other hand, is not feasible for **Irreplaceable CBAs** (MBSP Handbook, 2014); however, were the proposed MR83-amendment application approved after consideration of the principles of Integrated Environmental Management (IEM), it is recommended that it be on the bases that there will be compensation for lost habitat in accordance with National and Provincial Offset

Guidelines (preferably as a like for like offset[17]). According to the DEA (2017) and the DEA&DP (2011), offsets need to be undertaken according to various ratios based on the ecological importance and sensitivity and vulnerability of the ecosystem:

- Large sections of the focus area are located within the **Malmani Karstlands Endangered ecosystem**. Basic offset ratio: Endangered ecosystems at least 10 but up to 20 times the impacted area.
- Large sections of the focus area, and particularly Iota Hill, are located within the **endangered Northern Escarpment Dolomite Grassland.** Basic offset ratio: Endangered ecosystems at least 10 but up to 20 times the impacted area.
- **Areas of composite biodiversity significance (Optimal CBAs)**: Offset ratio at minimum 20 times the impacted area.
- **Areas of irreplaceable biodiversity (Irreplaceable CBAs)**: Very little flexibility for these areas. Offset at 30:1 only where no alternatives to the development project are deemed feasible and where project is of overriding public importance.

6) South Africa is a signatory to the Convention on Biological Diversity and has committed to achieving the Aichi Targets. The proposed Theta Project could compromise these commitments in terms of the following Aichi Targets:

- **Target 9 (Invasive Species):** The extent of AIPs currently within the focus area (and beyond) suggests that no formal AIP management has been implemented by the mine – or not sufficiently. This has already caused displacement of indigenous floral species and compromises habitat integrity of the area. Regardless of whether the proposed Theta Project proceeds, an AIP Management and Control Plan should be implemented.
- **Target 11 (Protected Areas and identification of Key Biodiversity Areas)**: The focus area is located in CBAs and Endangered Ecosystems which will be lost or significantly impacted by the proposed Theta Project.
- **Target 12 (conservation of species)**: The focus area is associated with floral SCC of which several individuals is likely to be directly impacted by the proposed Theta Project.

[17] "*Like for like*" - Undertaking positive management interventions to restore an area or stop degradation: improving the conservation status of an area of land by restoring habitats or ecosystems and reintroducing native species. Where proven methods exist or there are no other options, reconstructing or creating ecosystems can be undertaken. Also, reducing or removing current threats or pressures by, for instance, introducing sustainable livelihoods or substitute materials. This can either be done on the development site (on-site offset) or a distance from the site (off-site offset) [Business and Biodiversity Offsets Programme (BBOP) Handbook (2009)].

The initial Scoping Phase layout was associated with higher significance impacts on floral diversity, habitat and SCC due to the overall extent being much bigger than the current EIA Phase Layout, as well as the placement of the previous layouts within more sensitive and diverse floral habitat. Despite the footprint of the EIA Phase layout being smaller and more considerate of sensitive floral communities and habitat, it is the opinion of the specialist that this project will still have negative impacts on the floral ecology within the focus area and potentially on a local to regional scale. The impacts are perceived to be relatively irreversible. If the project is to be approved for overriding socio-economic reasons, Irreplaceable CBAs will be impacted, hence mitigation must comprise both offset (for non-irreplaceable biodiversity) and compensation (for irreplaceable components), including appropriate funding of this initiative.

The objective of this study was to provide sufficient information on the floral ecology of the area, together with other studies on the physical and socio-cultural environment, in order for the Environmental Assessment Practitioner (EAP) and the relevant authorities to apply the principles of IEM and the concept of sustainable development. The needs for conservation as well as the risks to other spheres of the physical and socio-cultural environment need to be compared and considered along with the need to ensure economic development of the country.

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APPENDIX A: Floral Method of Assessment

Floral Species of Conservational Concern Assessment

Prior to the field visit, a record of floral SCC and their habitat requirements was acquired from MTPA for the Quarter Degree Square in which the focus area is situated, as well as relevant regional, provincial and national lists. Throughout the floral assessment, special attention was paid to the identification of any of these SCC as well as the identification of suitable habitat that could potentially support these species.

The Probability of Occurrence (POC) for each floral SCC was determined using the following calculations wherein the distribution range for the species, specific habitat requirements and level of habitat disturbance were considered. The accuracy of the calculation is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Each factor contributes an equal value to the calculation.

Distribution						
	Outside of known distribution range					**Inside known distribution range**
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat availability						
	No habitat available					**Habitat available**
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat disturbance						
	0	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score						
EVC 1 score	5	4	3	2	1	0

POC% = [Distribution + Habitat availability + Habitat disturbance] / 15 x 100

Floral Habitat Sensitivity

The floral habitat sensitivity of each habitat unit was determined by calculating the mean of five different parameters which influence floral communities and provide an indication of the overall floristic ecological integrity, importance and sensitivity of the habitat unit. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Floral SCC:** The confirmed presence or potential for floral SCC or any other significant species, such as endemics, to occur within the habitat unit;
- **Unique Landscapes:** The presence of unique landscapes or the presence of an ecologically intact habitat unit in a transformed region;
- **Conservation Status:** The conservation status of the ecosystem or vegetation type in which the habitat unit is situated based on local, regional and national databases;
- **Floral Diversity:** The recorded floral diversity compared to a suitable reference condition such as surrounding natural areas or available floristic databases; and
- **Habitat Integrity:** The degree to which the habitat unit is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the floral habitat sensitivity class in which each habitat unit falls. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the habitat unit in question. In order to present the results use is made of spider diagrams to depict the significance of each aspect of floral ecology for each vegetation type. The different classes and land-use objectives are presented in the table below:

Table A1: Floral habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1 < 1.5	Low	Optimise development potential.
≥1.5 <2.5	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
≥2.5 <3.5	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
≥3.5<4.5	Moderately high	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance.
≥4.5 ≤5.0	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.

APPENDIX B: Floral SCC

POC Assessment Results for SANBI Red Data Listed Plants

South Africa uses the internationally endorsed **IUCN Red List Categories and Criteria** in the Red List of South African plants. This scientific system is designed to measure species' risk of extinction. The purpose of this system is to highlight those species that are most urgently in need of conservation action. Due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction but may nonetheless be of high conservation importance. Because the Red List of South African plants is used widely in South African conservation practices such as systematic conservation planning or protected area expansion, we use an amended system of categories designed to highlight those species that are at low risk of extinction but of conservation concern.

Definitions of the national Red List categories

Categories marked with **N** are non-IUCN, national Red List categories for species not in danger of extinction but considered of conservation concern. The IUCN equivalent of these categories is Least Concern (LC).

- **Extinct (EX)** A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
- **Extinct in the Wild (EW)** A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
- **Regionally Extinct (RE)** A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
- **Critically Endangered, Possibly Extinct (CR PE)** Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
- **Critically Endangered (CR)** A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
- **Endangered (EN)** A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
- **Vulnerable (VU)** A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
- **Near Threatened (NT)** A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable and is therefore likely to become at risk of extinction in the near future.
- [N]**Critically Rare** A species is Critically Rare when it is known to occur at a single site but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
- [N]**Rare** A species is Rare when it meets at least one of four South African criteria for rarity but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria. The four criteria are as follows:
  - Restricted range: Extent of Occurrence (EOO) <500 km^2, OR
  - Habitat specialist: Species is restricted to a specialized microhabitat so that it has a very small Area of Occupancy (AOO), typically smaller than 20 km^2, OR
  - Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area, OR
  - Small global population: Less than 10 000 mature individuals.

- **Least Concern** A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
- **Data Deficient - Insufficient Information (DDD)** A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required, and that future research could show that a threatened classification is appropriate.
- **Data Deficient - Taxonomically Problematic (DDT)** A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.
- **Not Evaluated (NE)** A species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in **Plants of southern Africa: an online checklist** are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

Floral Species of Conservation Concern (SCC) that were assessed for the focus area, as provided by MTPA, are listed within the tables below:

Table B1: Red Listed plant species for the focus area and surrounding areas, including the QDS 2430DC and 2430DD. Species data obtained from Mpumalanga Tourism and Parks Agency (MTPA) with information on species ecology and distribution obtained from the Red List of South African Plants (http://redlist.sanbi.org/index.php).

SCIENTIFIC NAME	ECOLOGY & DISTRIBUTION / RANGE	NATIONAL RED LIST STATUS	MTPA STATUS	ENDEMIC	POC (%)
SPECIES RECORDED ON THE FARM PONIESKRANS 543 KT (FOCUS AREA) OR WITHIN THE PILGRIMS REST AREA					
Aloe fouriei	**Range**: Abel Erasmus Pass, Dwars River Pass, Highlands Mountains near Polokwane and Strydpoort Mountains. **Description**: Rocky areas in grasslands, either at the edges of large sheets of exposed dolomite, on cliff faces, or among large tumbled rocks on the summits of hills, generally on south to east facing slopes.	**DD**	**NT**	**SA**	**80**
Callilepis leptophylla	**Range**: Widespread in eastern half of South Africa. Also in Swaziland. **Description**: Grassland or open woodland, often on rocky outcrops or rocky hill slopes.	**LC**	**Declining**	**FSA**	**60**
Crocosmia mathewsiana	**Range**:Mpumalanga Drakensberg Escarpment, Mariepskop to Mac **Description**: Damp, shady places along streams and forest margins.	**VU**	**VU**	**SA**	**67**
Cryptocarya transvaalensis	**Range**: Occurs along the eastern Escarpment, from Swaziland to the Wolkberg Mountains and also the Soutpansberg Mountains, and northwards to tropical Africa. **Description**: Limited to Afromontane forests up to 1700 m.	LC	Declining	NOT	53
Curtisia dentata	**Range**: Cape Peninsula to the Zimbabwe-Mozambique highlands. **Description**: Evergreen forest from coast to 1800 m.	**NT**	**NT**	**NOT**	**60**
Erica atherstonei	**Range**: Pilgrim's Rest to Buffelskloof. **Description**: Rocky areas (quartzite) in montane grassland at edge of escarpment or on steep slopes, occasionally in moist areas, 1500-2500 m.	**NT**	**NT**	**SA**	**60**
Hypodematium crenatum	**Range**: Wolkberg, and Bourke's Luck Potholes to Sodwala in South Africa. Widespread but very rare in Africa, Madagascar and Asia. **Description**: Crevices on dolomite cliffs or in soil at the base of dolomite outcrops, from 1260-1600 m.	**VU**	**VU**	**NOT**	**80**
Kniphofia rigidifolia	**Provincial distribution**: Mpumalanga **Major system**: Terrestrial	**LC**	**Rare**	**SA**	**60**
Kniphofia triangularis* subsp. *obtusiloba	**Range**: Mpumalanga Drakensberg Mountains and Ngome in KwaZulu-Natal. **Description**: Quartzitic rocky outcrops in montane grasslands, 1200-2200 m.	**Rare**	**Rare**	**SA**	**73**

SCIENTIFIC NAME	ECOLOGY & DISTRIBUTION / RANGE	NATIONAL RED LIST STATUS	MTPA STATUS	ENDEMIC	POC (%)
Monopsis kowynensis	**Range**: Mariepskop to Graskop and the Long Tom Pass. **Description**: Along forest margins in mistbelt grassland.	**VU**	**VU**	**SA**	**67**
Ocotea bullata	**Range**: Widespread in South Africa from the Cape Peninsula to the Wolkberg Mountains in Limpopo. **Description**: High, cool, evergreen Afromontane forests.	EN	EN	FSA	53
Pelargonium album	**Range:** Pilgrim's Rest. **Description**: Grows on humus-rich soils, in shady rock crevices on dolomite hills.	**Rare**	**Rare**	**SA**	**80**
Pentatrichia alata	**Range**: Pilgrim's Rest, Abel Erasmus Pass and Wolkberg Mountains. **Description**: Grassland or savanna, on rocky slopes and sandy ground.	**DDD**	**DDD**	**SA**	**60**
Prunus africana	**Range**: Widespread in Africa from the southern Cape, through KwaZulu-Natal, Swaziland and northwards into Zimbabwe and central Africa and the islands of Madagascar and Comoros. **Description**: Evergreen forests near the coast, inland mistbelt forests and afromontane forests up to 2100 m.	**VU**	**VU**	**NOT**	**73**
Schizochilus crenulatus	**Range:** Mariepskop to Graskop. **Description:** Edges of flat Black Reef Quartzite rock flushes, in damp to wet conditions, and often in moss, substrate rarely deeper than 10 mm.	**VU**	**VU**	**SA**	**60**
Schizochilus lilacinus	**Range:** Between Lydenburg and Graskop. **Description**: Occurs among rocks or on narrow ledges on steep rocky slopes in damp areas. 1600-2300 m.	**Rare**	**Rare**	**SA**	**60**
Senecio latissimifolius	**Range**: Pilgrim's Rest. **Description**: Unknown.	**DD**	**DD**	**SA**	**60**
Thesium subsimile	**Range**: Dullstroom. **Description**: Inundated grassland, 1600-200o m.	DD	DD	SA	47
Zantedeschia pentlandii	**Range**: Roossenekal to Dullstroom. **Description**: Rocky hillsides.	**VU**	**VU**	**SA**	**80**
SPECIES RECORDED ON NEIGHBOURING FARM PORTIONS					
Alepidea amatymbica	**Range**: Amathole Mountains in the Eastern Cape, extending north-eastwards to southern KwaZulu-Natal and along the eastern border of Lesotho (Hutchinson 2016). **Description**: West to south facing slopes along drainage lines, often associated with rocks, and along streams (Hutchinson 2016).	VU	VU	NOT	20
Curtisia dentata	**Range**: Cape Peninsula to the Zimbabwe-Mozambique highlands. **Description**: Evergreen forest from coast to 1800 m.	**NT**	**NT**	**NOT**	**60**
Disa extinctoria	**Range**: Swaziland to Tzaneen. **Description**: Crest of the escarpment in damp grassland and swamps, 1000-1300 m.	NT	NT	FSA	20
Eucomis autumnalis	**Range**: South Africa, Swaziland, Lesotho, Botswana, Zimbabwe and Malawi. **Description**: Damp, open grassland and sheltered places from the coast to 2450 m.	**Declining**	**Declining**	**FSA**	**87**
Eucomis pallidiflora subsp. *pole-evansii*	**Range**: Pilgrim's Rest and Lydenburg to Swaziland to southern Mpumalanga. **Description**: Wetlands in grassland, often in standing water up to 300 mm deep.	NT	NT	FSA	33
Faurea macnaughtonii	**Range**: Knysna to Tanzania. **Description**: Mature forest.	Rare	Rare	NOT	47
Gladiolus saxatilis	**Range**: Mariepskop to Graskop. **Description**: Shady places on sandstone rocks and cliffs of black reef quartzite.	**Rare**	**Rare**	**SA**	**60**
Gnidia variabilis	**Range**: Lydenburg. **Descriptin:** Well-drained grassland, 900-1800 m.	VU	VU	SA	13
Hesperantha bulbifera	**Provincial distribution**: Eastern Cape, Limpopo, Mpumalanga, North West **Description:** Terrestrial	LC	Rare	SA	53
Ledebouria parvifolia	**Range**: Graskop district. **Description**: Dolomite of the Malmani Formation in the Chuniespoort Group.	**DDD**	**DDD**	**SA**	**60**
Pentatrichia alata	**Range**: Pilgrim's Rest, Abel Erasmus Pass and Wolkberg Mountains. **Description**: Grassland or savanna, on rocky slopes and sandy ground.	**DDD**	**DDD**	**SA**	**73**
Streptocarpus decipiens	**Range:** Mariepskop to Graskop.	Rare	Rare	SA	53

SCIENTIFIC NAME	ECOLOGY & DISTRIBUTION / RANGE	NATIONAL RED LIST STATUS	MTPA STATUS	ENDEMIC	POC (%)
	Description: Grows under shallow overhangs of sandstone outcrops on grass slopes, more rarely it grows in horizontal cracks towards the base of larger cliffs.				
Tulbaghia coddii	**Range**: Mariepskop to Mount Sheba and Graskop. **Description**: Montane grassland, on damp, shallow soils over sheet rocks or in open grassland.	**Rare**	**Rare**	**SA**	**60**
SPECIES RECORDED ON FARM PORTION WITHIN 10 KM OF THE FOCUS AREA					
Adenia gummifera* var. *gummifera	**Range**: Widespread in eastern Africa, from Somalia to Kei River mouth in the Eastern Cape, South Africa. **Description**: Forested ravines, forest patches and forest margins, forest scrub, miombo woodland, savanna, dune forest, on stony slopes, termitaria and littoral bush, 0-1 800 m.	**LC**	**Declining**	**NOT**	**67**
Aloe albida	**Range**: Barberton to border of north-eastern Swaziland. **Description**: Mistbelt grassland.	**NT**	**NT**	**FSA**	**67**
Aloe integra	**Range**: Mpumalanga, from Vaalhoek north of Pilgrim's Rest southwards to Amsterdam. Also at Mankayane in Swaziland. **Description**: Dry highveld grassland, on exposed, rocky sites with short grass on north- and northwest-facing slopes.	VU	VU	FSA	20
Aloe modesta	**Range**: Dullstroom and Wakkerstroom districts in Mpumalanga and also possibly occurs near Vryheid in KwaZulu-Natal. **Description**: Montane grassland, 1600-2000 m.	**VU**	**VU**	**SA**	**67**
Argyrolobium muddii	**Range**: Haenertsburg and Graskop. **Description**: Mistbelt Grassland.	**EN**	**EN**	**SA**	**67**
Cymbopappus piliferus	**Range**: Ohrigstad to Belfast. **Description**: Rocky quartzitic ridges in montane grassland.	**VU**	**VU**	**-**	**67**
Disa extinctoria	**Range**: Swaziland to Tzaneen. **Description**: Crest of the escarpment in damp grassland and swamps, 1000-1300 m.	NT	NT	FSA	20
Drimia robusta (NOW Drimia elata)	**Provincial distribution**: Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West. **Major system**: Terrestrial	Muthi	-	-	33
Erica holtii	**Provincial distribution**: KwaZulu-Natal, Limpopo, Mpumalanga **Major system**: Terrestrial	**LC**	**Rare**	**SA**	**60**
Erica rivularis	**Range**: Blyde River Canyon and Graskop. **Description**: Margins of clear, high altitude perennial streams over quartzitic rocks.	EN	EN	SA	20
Erica subverticillaris	**Range**: Long Tom Pass. **Description**: High altitude, short grassland, among rocky outcrops on mountain summits, 1900-2200 m.	VU	VU	SA	0
Eucomis autumnalis sp nova - dwarf	See above?	Declining	Declining	FSA	
Gladiolus calcaratus	**Range**: Mpumalanga Highveld, between Dullstroom, Pilgrim's Rest and Lydenburg. **Description**: Grassy mountain slopes, in deeper soils in wet sites or around the edges of damp depressions. 2100-2400m.	LC	VU	SA	47
Gladiolus rufomarginatus	**Range**: Lydenburg to Ohrigstad. **Description**: Grasslands, either in the open or in light shade on stony shale ground, sometimes in crevices in bare shale outcrops.	Rare	Rare	SA	47
Habenaria mossii sp. nov. aff. mossii	**Range**: Johannesburg, Pretoria and Krugersdorp. Also Graskop (MTPA). **Description**: Open grassland on dolomite or in black, sandy soil.	EN	Mpum	-	53
Hesperantha rupestris	**Range**: Waterval Boven. **Description**: Uncertain, either rocky grassland or marshy vleis.	DD	DD	SA	0
Huperzia ophioglossoides (=Lycopodium ophioglossoides Lam)	**Range**: Limpopo and Mpumalanga Drakensberg Escarpment, extending to central and tropical Africa, the Mascarene islands and Madagascar. **Description**: Epiphyte in mid- to high altitude mistbelt forests.	LC	Rare	NOT	33
Jamesbrittenia macrantha	**Range**: Sekhukhuneland. **Description**: Grassy slopes with other scattered shrubs, restricted to norite.	NT	NT	SA	0
Ledebouria davidsoniae (=Drimiopsis davidsoniae)	**Range**: Blyde River Canyon Nature Reserve. **Description**: Rocky slopes.	VU	VU	SA	0

SCIENTIFIC NAME	ECOLOGY & DISTRIBUTION / RANGE	NATIONAL RED LIST STATUS	MTPA STATUS	ENDEMIC	POC (%)
Lobelia trullifolia subsp. *delicatula*	**Range**: Swaziland and Graskop. **Description**: Damp, sheltered areas among rocks.	Rare	Rare	FSA	53
Melinis drakensbergensis	**Provincial distribution**: Mpumalanga **Major system**: Terrestrial	DD	DD	SA	-
Merwilla plumbea (=Scilla natalensis)	**Range**: Widespread in eastern half of South Africa. Also in Swaziland and Lesotho. **Description**: Montane mistbelt and Ngongoni grassland, rocky areas on steep, well drained slopes. 300-2500 m.	**NT**	**NT**	**FSA**	**100**
Ocotea kenyensis	**Range**: Eastern Cape through KwaZulu-Natal, Mpumalanga and Limpopo Provinces and into Swaziland, Zimbabwe, Mozambique, Tanzania and Kenya. **Description**: Scarp and mistbelt forest.	VU	VU	NOT	53
Protea parvula	**Range**: Drakensberg Escarpment in Swaziland, Mpumalanga and KwaZulu-Natal from Mariepskop to Vryheid. **Description**: Most prominent in Lydenburg montane grassland.	**NT**	**NT**	**FSA**	**60**
Senecio hederiformis (was Cineraria)	**Range**: Blouberg and Graskop. **Description**: Cracks of quartzite rock faces in mistbelt.	**Rare**	**Rare**	**SA**	**60**
Warburgia salutaris	**Range**: North-eastern KwaZulu-Natal, Mpumalanga and Limpopo Province. Also occurs in Swaziland, Mozambique and Zimbabwe and Malawi. **Description:** Variable, including coastal, riverine, dune and montane forest as well as open woodland and thickets.	**EN**	**EN**	**NOT**	**67**
SPECIES RECORDED ON FARM PORTION WITHIN 20 KM OF THE FOCUS AREA					
Aloe nubigena	**Range**: Mpumalanga Escarpment, from Mariepskop to Graskop. **Description**: Mistbelt grassland, upper steep south to east facing cliffs above forested gorges.	VU	NT	SA	40
Argyrolobium megarrhizum	**Range**: Pretoria to Bronkhorstspruit.	NT	NT	SA	13
Brachystelma minor	**Range**: Wolkberg to Graskop. **Description**: Shallow pockets of dolomite, tolerating both open and shady conditions.	**VU**	**VU**	**SA**	**67**
Brachystelma stellatum	**Range**: Steenkampsberg, Ohrigstad Dam Nature Reserve and Long Tom Pass. **Description**: Montane grassland.	Rare	Rare	SA	33
Clivia caulescens	**Range**: Limpopo Province to Swaziland. **Description**: Forest patches and forest margins.	**NT**	**NT**	**FSA**	**60**
Cyrtanthus huttonii	**Provincial distribution**: Eastern Cape, Mpumalanga **Major system**: Terrestrial	**LC**	**Rare**	**SA**	**73**
Dioscorea sylvatica	**Range**: Western Cape, Eastern Cape, KwaZulu-Natal, Free State, Gauteng, Mpumalanga, Limpopo Province, Swaziland, Zimbabwe and Zambia. **Description**: Wooded and relatively mesic places, such as the moister bushveld areas, coastal bush and wooded mountain kloofs.	**VU**	**VU**	**NOT**	**60**
Disa maculomarronina	**Range**: Wakkerstroom and the Mpumalanga Escarpment around Graskop. **Description**: Swamps, montane grassland on the edges of Black Reef Quartzite, 1500-1700 m.	**NT**	**NT**	**SA**	**60**
Disa rungweensis (zimbabweensis)	**Provincial distribution**: Mpumalanga **Description:** Grows in very shallow quartzitic soil on rock sheets in wet exposed rocky grassland. Southwestern slopes.	LC	Rare	NOT	47
Drimia altissima (=Urginea altissima)	**Range**: Western Cape to Limpopo Province and Swaziland, and through southern Africa up to Angola and the Congo. **Description**: Hot, dry bushveld and thicket.	LC	Declining	-	47
Erica subverticillaris	**Range**: Long Tom Pass. **Description**: High altitude, short grassland, among rocky outcrops on mountain summits, 1900-2200 m.	VU	VU	SA	13
Eucomis montana	**Range**: Mpumalanga and Swaziland. **Description**: Rocky montane grassland.	**LC**	**Declining**	**FSA**	**73**
Eulophia zeyheriana	**Provincial distribution**: Eastern Cape, KwaZulu-Natal, Mpumalanga **Major system**: Terrestrial	**LC**	**Rare**	**FSA**	**60**
Gunnera perpensa	**Range**: Western Cape to Ethiopia. **Description**: Damp marshy area and vleis from coast to 2400 m.	Declining	Declining	NOT	40

SCIENTIFIC NAME	ECOLOGY & DISTRIBUTION / RANGE	NATIONAL RED LIST STATUS	MTPA STATUS	ENDEMIC	POC (%)
Kalanchoe alticola	**Range**: Barberton to north-eastern Swaziland. **Description**: Shallow peaty soils on granite rock, or in rock crevices, 900-1800 m.	DDD	DDD	FSA	13
Kniphofia typhoides	**Range**: Parys to Lydenburg to Paulpietersburg to Newcastle. **Description**: Low lying wetlands and seasonally wet areas in climax *Themeda triandra* grasslands on heavy black clay soils, tends to disappear from degraded grasslands.	NT	NT	SA	33
Ledebouria remifolia (was L. petiolata)	**Range**: Mpumalanga Escarpment, Blyde River Canyon to Kaapsehoop. **Description**: Shallow, grey sandy soils in Black Reef Quartzite grasslands.	VU	VU	SA	53
Streptocarpus actinoflorus (= S.dolomiticus in ed.)	**Range**: Mariepskop to Blyde. **Description**: Ecotone between grassland and dry mistbelt forest and in south-facing grassland areas.	EN	EN	SA	53
Streptocarpus fenestra-dei	**Range**: God's Window to Bourke's Luck mine. **Description**: Shallow soils in rocky areas in forested gullies.	VU	VU	SA	33

CR= Critically Endangered, **DD= Data Deficient - Insufficient Information, EN=** Endangered**, EW =** Extinct in the Wild**, NT =** Near Threatened**,**
VU= Vulnerable**, P=** Protected, POC = Probability of Occurrence

POC Assessment Results for Protected Tree Species – NFA

Table B2: NFA plant list for species with a known distribution range falling within the focus area[18].

SCIENTIFIC NAME	HABITAT & DISTRIBUTION[19] & [20]	NATIONAL RED LIST STATUS	POC (%)
Afzelia quanzensis	**Provincial distribution**: KwaZulu-Natal, Limpopo, Mpumalanga. **Major system**: Terrestrial	LC	0
Catha edulis	Found in bushveld and along margins of and in medium- to high altitude evergreen and riverine forest. Often in rocky places.	LC	53
Curtisia dentata	**Range**: Cape Peninsula to the Zimbabwe-Mozambique highlands. **Description**: Evergreen forest from coast to 1800 m.	NT	47
Elaeodendron transvaalense	**Range**: Widespread in Southern Africa, including Angola, Namibia, Botswana, Zambia, Zimbabwe, Swaziland and Mozambique. In South Africa it is restricted to eastern, summer rainfall areas from the KwaZulu-Natal coast northwards through eastern Mpumalanga into Limpopo and North West provinces. **Description**: Savanna or bushveld, from open woodland to thickets, often on termite mounds.	NT	47
Ilex mitis	**Range**: Widespread from Table Mountain in the Western Cape to Ethiopia and also Madagascar. **Description**: Along rivers and streams in forest and thickets, sometimes in the open. Found from sea level to inland mountain slopes.	LC	60
Ocotea bullata	**Range**: Widespread in South Africa from the Cape Peninsula to the Wolkberg Mountains in Limpopo. **Description**: High, cool, evergreen Afromontane forests.	EN	53
Pittosporum viridiflorum	**Provincial distribution:** Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, North West, Western Cape Found in deciduous woodland, open bushveld and riverine fringe thichet. Also grows on rocky outcrops.	LC	**100**
Prunus africana	**Range**: Widespread in Africa from the southern Cape, through KwaZulu-Natal, Swaziland and northwards into Zimbabwe and central Africa and the islands of Madagascar and Comoros. **Description**: Evergreen forests near the coast, inland mistbelt forests and afromontane forests up to 2100 m.	VU	**73**
Podocarpus falcatus	**Provincial distribution**: Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga, Western Cape Found in Mistbelt forest, scarp forest, afrotemperate forest and coastal forest.	LC	**60**
Podocarpus latifolius	**Provincial distribution**: Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga, Western Cape Found in Mistbelt forest, scarp forest, riverine forest, afrotemperate forest and coastal forest. Also grows on exposed mountain sides and in bush clumps on rocky outcrops.	LC	**60**
Pterocarpus angolensis	**Provincial distribution**: KwaZulu-Natal, Limpopo, Mpumalanga. **Major system**: Terrestrial	LC	33
Warburgia salutaris	**Range**: North-eastern KwaZulu-Natal, Mpumalanga and Limpopo Province. Also occurs in Swaziland, Mozambique and Zimbabwe and Malawi. **Description:** Variable, including coastal, riverine, dune and montane forest as well as open woodland and thickets.	EN	**67**

CR= Critically Endangered**, EN=** Endangered**, EW =** Extinct in the Wild**, NT =** Near Threatened**, VU=** Vulnerable**, P=** Protected, POC = Probability of Occurrence

[18] https://www.thetreeapp.co.za/team/
[19] http://pza.sanbi.org/
[20] http://redlist.sanbi.org/index.php

APPENDIX C: Floral Species List

Table C1: Woody species encountered in the focus area during the winter assessment. Alien species are indicated with an asterisk (*). Protected species are indicated in Bold. Protected species are indicated in Bold. Endemic species presented in blue.

WOODY SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
Acacia dealbata	X Dominant in Iota Hill Forest		X	X
Ailanthus altissima	X Riparian			X
Ardisia crenata				X
Citrus × limon	X Riparian			
Eucalyptus diversicolor	X Dominant in Iota Hill Forest		X	X
Eucalyptus grandis	X Riparian		X	X
Flaveria bidentis				X
Jacaranda mimosifolia	X Riparian	X	X	X
Lantana camara	X Dominant in Iota Hill Forest	X	X only small clumps	X
Melia azedarach	X Riparian			X
Phytolacca octandra				X
Pinus patula			X	X
Plectranthus barbatus			X	X
Quercus acutissima				X
Ricinus communis				X
Rubus niveus	X		X	X
Senna septemtrionalis	X			
Solanum mauritianum	X Dominant in Iota Hill Forest	X	X small clumps	X
Solanum nigrum	X			X
Aeschynomene rehmannii var. leptobotrya		X		
Apodytes dimidiata subsp.dimidiata	X	X	X	
Artemisia afra				X dominant
Asparagus sp.		X		
Athrixia sp	X			
Baccharoides adoensis var. kotschyana			X	X
Bowkeria cymosa	X Common in Wishbone and Iota Hill Forest		X Iota	X
Brachylaena transvaalensis	X Iota Hill Forest			
Buddleja auriculata	X Wishbone			
Canthium armatum	X Wishbone			
Canthium ciliatum	X	X		
Carissa bispinosa	X Wishbone			
Carissa edulis		X		
Cassinopsis ilicifolia	X Wishbone			

WOODY SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
Celtis africana	X Wishbone and Iota Hill Forest		X	X
Cephalanthus natalensis	X Wishbone and Iota Hill Forest	X	X	
Clausena anisata	X Wishbone			
Clematis brachiata	X	X		
Combretum erythrophyllum	X Riparian			
Combretum kraussii	X Abundant within Wishbone			
Cryptolepis oblongifolia			X	
Cussonia paniculata	X		X	
Cussonia spicata	X Wishbone			
Desmodium repandum	X			
Diospyros lyciodes subsp. guerkei	X	X	X	X
Dombeya pulchra	X Wishbone			
Dombeya rotundifolia		X	X	
Ekebergia pterophylla	X	X	X	
Elephantorrhiza elephantina		X	X	
Englerophytum magalismontanum		X	X	X
Englerophytum natalense	X Iota Hill Forest			
Erica caffrorum			X	
Erica drakenbergensis			X	X
Erica woodii			X	
Eriosema psoraleoides				X
Erythrina lysistemon	X (recorded outside of the focus area)			
Fadogia homblei		X	X	
Faurea galpinii (MNCA)	X Wishbone		X	
Ficus abutilifolia	X Iota Hill Forest (outside footprint)	X		
Ficus burkei		X		
Ficus ingens		X	X	
Gomphocarpus physocarpus			X	X
Gymnosporia rubra	X			
Halleria lucida	X Riparian			
Helichrysum kraussii		X	X	X
Heteromorpha arborescens var. abyssinica		X		
Heteromorpha pubescens		X	X	
Indigofera arrecta	X			
Indigofera hedyantha		X	X	
Indigofera sanguinea		X	X	
Inulanthera calva			X	
Kiggelaria africana	X Wishbone and Iota Hill Forest			
Lannea edulis var. edulis		X		
Leonotis intermedia		X	X	X
Lippia javanica		X	X	X

WOODY SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
Mackaya bella	X			
Maerua rosmarinoides	X Wishbone			
Morella pilulifera	X Iota Hill Forest		X	
Myrsine africana	X Iota Hill Forest			
Ochna confusa		X	X	
Olea europaea subsp. africana (MNCA)				X
Olinia emarginata	X Iota Hill Forest	X		X
Osteospermum moniliferum			X Iota	
Ozoroa sphaerocarpa		X	X	
Pachystigma (Vangueria) venosa			X	
Pappea capensis		X		
Parinari capensis subsp. capensis		X	X	
Phymaspermum acerosum			X	X
Piper capense	X Wishbone			
Pittosporum viridiflorum (NFA)	X Iota Hill Forest			
Plectranthus fruticosus		X		X
Plectroniella armata	X			
Pluchea dioscoridis	X Riparian			
Podocarpus sp.* (ornamental, NFA*)				X
***Protea caffra* subsp. *caffra* (MNCA)**		X	X	
***Protea gaguedi* (MNCA)**			X	
***Protea roupelliae* subsp. *roupelliae* (MNCA)**		X	X	
Rapanea melanophloeos	X	X	X	
Rhamnus prinoides	X Iota Hill Forest			
Salix mucronata	X			
Schefflera umbellifera	X Wishbone and Iota Hill Forest		X	
Schrebera alata	X Wishbone			
Sclerochiton harveyanus	X Wishbone			
Searsia chirindensis	X Iota Hill Forest			
Searsia dentata	X Iota Hill Forest	X	X	X
Searsia discolor		X	X	X
Searsia pyroides var. gracilis	X			
Searsia rigida var dentata			X	
Searsia rogersii		X		
Searsia tumulicola var. tumulicola		X	X	
Searsia zeyheri		X	X	
Seemannaralia gerrardii	X Iota Hill Forest (outside footprint)	X	X	
Senecio barbertonicus		X		
Senecio microglossus				X
Senegalia ataxacantha	X Wishbone and Iota Hill Forest		X	X
Sida cordifolia subsp. cordifolia				X

WOODY SPECIES				
Scientific name	**Riparian & Forest Remnants**	**Mountain Outcrops**	**Montane Grassland**	**Degraded Habitat**
Solanum panduriforme				X
Sphenostylis angustifolia			X	
Syncolostemon parvifolius			X	
Syzygium cordatum var. cordatum			X	
Tarchonanthus trilobus var. galpinii	X Wishbone	X	X	
Tenrhynea phylicifolia	X Iota Hill Forest			
Tetraselago wilmsii		X	X	
Trimeria grandifolia	X Iota Hill Forest			
Triumfetta sp.			X	
Vangueria infausta		X	X	
Widdringtonia cf. *nodiflora*	X Iota Hill Forest (outside footprint)			
Ziziphus mucronata	X Wishbone and Iota Hill Forest	X	X	X

Table C2: Forb species encountered within the focus area during the field assessment. Alien species are indicated with an asterisk (*). Protected species are indicated in Bold. Endemic species presented in blue.

FORB SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
Acanthospermum australe			X	X
Agrimonia procera				X
Bidens pilosa	X	X		X
Cardiospermum grandiflorum	X			X
Datura stramonium	X		X	X
Erigeron bonariensis	X		X	X
Galinsoga parviflora	X			X
Hypochaeris radicata				X
Ipomoea purpurea				X
Lilium formosanum				X
Malvastrum coromandelianum	X			X
Melilotus albus				X
Melilotus indicus				X
Oenothera rosea	X			X
Oenothera tetraptera				X
Oxalis corniculata				X
Plantago major			X	X
Schkuhria pinnata				X
Solanum elaeagnifolium				X
Tagetes minuta	X			X
Verbena bonariensis	X			X
Verbena officinalis				X
Verbena rigida				X
Zinnia peruviana				
Acalypha peduncularis		X	X	
Achyranthes aspera var. aspera	X			
Afroaster serrulatus			X	
Agapanthus sp.		X		
Albuca setosa		X	X	
Albuca shawii		X		X
Alectra sessiliflora				X
Alectra sp.			X	
***Alepidea peduncularis* (DDT)**			X	
Alepidea setifera				
Anemia nudiuscula		X	X	
Anemia vestita		X	X	
Argyrolobium tomentosum	X Wishbone and Iota Hill Forest			
Asclepias aurea			X	
Asclepias sp.			X Iota	
Asplenium aethiopicum	X	X		
Barleria ovata			X	
Basananthe sandersonii			X	
Begonia sonderiana	X			
Begonia sutherlandii	X Wishbone			
Berkheya echinacea			X	
Berkheya radula			X	
***Boophone disticha* (MNCA)**			X	X
Carex multispiculata	X			
Ceratotheca triloba		X	X	
Chamaecrista sp.			X	
Cheilanthes sp.	X	X		X
Cheilanthus hirta		X	X	
Chlorophytum comosum	X			

FORB SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
Chlorophytum krookianum		X		
Clematis brachiata				X
Clivia caulescens (NT, MNCA)	X			
Clivia sp. (MNCA)	X Wishbone			
Clutia monticola			X	
Coccinia rehmannii	X		X	
Commelina africana			X	
Commelina eckloniana		X		
Conostomium natalense			X	
Crabbea hirsuta		X	X	
***Crinum* sp. (MNCA)**	X			
Crocosmia aurea	X			
Crocosmia paniculata				X PCD
Crotalaria pallida				X
Cucumis zeyheri			X	X
Cyanotis speciosa			X	
Cycnium racemosum			X Iota	
Cynoglossum lanceolatum				X
Cyphia elata var. elata		X	X	
Cyphia sp.				
Cyphostemma humile		X	X	
Cyrtanthus tuckii (MNCA)			X	
Delosperma sp.		X		
Dicoma anomala			X	
Dietes iridioides	X			
Dioscorea sylvatica (VU)	X			
Disa patula var. transvaalensis (MNCA)			X	
Dyschoriste setigera		X	X	
Elaphoglossum acrostichoides	X	X		
Eriosema kraussianum			X	
Eriosema salignum			X	
Eriospermum cooperi		X	X	
Eucomis sp.			X Iota	
Eulophia foliosa (MNCA)			X Iota	
Eulophia streptopetala (MNCA)		X	X	
Euryops pedunculatus		X	X	
Felicia filifolia		X	X	
Geigeria burkei		X	X	X
Gerbera ambigua			X	
Gerbera piloselloides			X	
Gerbera viridifolia			X	
***Gladiolus ecklonii* (MNCA)**			X	
Gloriosa modesta	X			
Graderia sp.		X	X	
***Habenaria sp.* (MNCA)**				X
***Haemanthus humilis* subsp. *hirsutus* (MNCA)**		X		
Haplocarpha scaposa			X	
Helichrysum acutatum			X	X
Helichrysum aureonitens			X	
Helichrysum auriceps		X	X	
Helichrysum herbaceum			X	
Helichrysum kraussii				X
Helichrysum nudifolium var. pilosellum			X	X
Helichrysum oreophilum		X	X	X
Helichrysum rugulosum			X	

FORB SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
Helichrysum spiralepis			X	
Helichrysum umbraculigerum			X	
Hermannia lancifolia			X	X
Hermannia montana			X	
Hesperantha baurii			X	
Hibiscus trionum		X		
Hilliardiella aristata		X	X	
Hilliardiella hirsuta			X	
Hilliardiella oligocephala			X Iota	
Hirpicium armerioides			X	X
Hypericum aethiopicum			X	
Hypoestes triflora	X Wishbone			
Hypoxis angustifolia			X	
Hypoxis colchicifolia		X	X Iota	
Hypoxis filiformis		X	X	
Hypoxis rigidula			X	
Impatiens hochstetteri	X			
Indigofera comosa		X	X	
Indigofera sanguinea			X	
Inezia integrifolia			X	
Ipomoea crassipes		X		
Ipomoea ommanneyi			X	
Justicia anagalloides			X	
Kniphofia linearifolia (MNCA)				
Kniphofia sp (MNCA)				X
Kohautia amatymbica		X	X	X
Lasiosiphon caffer (previously Gnidia)		X	X	
Ledebouria cooperi		X	X	
Ledebouria marginata			X	
Ledebouria ovatifolia		X	X	
Ledebouria revoluta		X	X	
Ledebouria sandersonii		X	X	
Lopholaena disticha	X	X	X	
Macledium zeyheri subsp. zeyheri		X	X	
Merwilla plumbea (NT, MNCA)		X	X	X
Moraea elliotii			X Iota	
Moraea stricta			X	
Morella pilulifera			X	
Nidorella auriculata				X
Ophioglossum sp.				X
Orthochilus aculeatus (MNCA)			X Iota	
Oxalis obliquifolia			X	X
Pachycarpus appendiculatus			X Iota	
Pearsonia sessilifolia	X	X	X	X
Pelargonium luridum				X
Pellaea calomelanos		X	X	
Pentanisia prunelloides			X	
Plantago lanceolata				X
Plectranthus calycinus			X	
Plectranthus calycinus	X Iota Hill Forest			
Plectranthus ciliatus	X Wishbone			
Plectranthus grallatus	X Iota Hill Forest			

FORB SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
Plectranthus rubropunctatus		X		
Plectranthus sp. (large)		X	X	
Polydora poskeana (vernonia)			X	X
Pseudarthria hookeri				X
Pseudopegolettia (vernonia) tenella			X Iota	
Pteridium aquilinum (common bracken fern)	X	X	X	X
Rapanea melanophloeos			X	
Raphionacme galpinii			X	
Raphionacme hirsuta		X	X	
Rhoicissus tomentosa		X		
Rhoicissus tridentata subsp. *cuneifolia*			X	
Rhynchosia caribaea		X	X	
Rhynchosia monophylla		X	X	
Rotheca hirsuta		X		
***Satyrium cristatum* (MNCA)**			X	X
Scabiosa columbaria			X	
Scadoxus multiflorus subsp. katharinae (MNCA)	X Wishbone			
***Scadoxus puniceus* (MNCA)**		X		
Schistostephium rotundifolium		X	X	
Sebaea grandis			X	X
Sebaea natalensis			X	
Selago densiflora			X	
Senecio glaberrimus			X	
Senecio isatidioides		X		
Senecio microglossus		X	X	X
Senecio oxyriifolius			X	
Senecio polyanthemoides				X
Senecio scitus		X	X	
Senecio tamoides	X Iota Hill Forest			
Sida dregei				X
Sopubia cana			X	
Sphenostylis angustifolia				X
***Stenoglottis fimbriata* (MNCA)**		X		
Streptocarpus spp.	X Wishbone	X		
Striga bilabiata			X	
Syncolostemon transvaalensis			X	
Thesium pallidum			X	
Thunbergia atriplicifolia			X	
Todea sp	X			
Trachyandra asperata		X	X	
Vernonia fastigiata			X	
Vernonia natalensis			X	X
Vigna unguiculata		X		
Wahlenbergia huttonii			X	
Wahlenbergia magaliesbergensis		X	X	
Wahlenbergia undulata			X	X
Xerophyta retinervis		X	X	
Xerophyta schlechteri		X	X	
***Zantedeschia albomaculata* (MNCA)**		X		
Zornia capensis			X	

Table C3: Succulent species encountered within the focus area during the field assessment. Alien species are indicated with an asterisk (*). Protected species are indicated in Bold.

SUCCULENT SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
**Agave sisalana*				X
***Aloe alooides* (MNCA)**		X	X	
***Aloe arborescens* (MNCA)**	X Iota Hill Forest		X	
***Aloe barbertoniae* (MNCA)**		X	X	
Aloe cf. graciliflora (MNCA)		X	X	
Aloe cf. minima (MNCA)			X	
***Aloe cooperi* (MNCA)**		X		X
***Aloe dyeri* (MNCA)**			X	X
***Aloe transvaalensis* (MNCA)**		X	X	
Crassula alba			X	
Crassula capitella subsp. nodulosa		X	X	
Crassula sarcocaulis		X	X	
Crassula setulosa var. setulosa		X	X	
Crassula vaginata		X	X	
Kalanchoe luciae		X		
Kalanchoe rotundifolia	X Wishbone	X	X	
Kalanchoe thyrsiflora		X	X	

Table C4: Graminoid species encountered within the focus area during the field assessment. Alien species are indicated with an asterisk (*). Protected species are indicated in Bold. Protected species are indicated in Bold. Endemic species presented in blue.

GRAMINOID SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
#Eragrostis (tall and bendy)	X		X	X
**Bromus catharticus*	X			
**Cortaderia jubata*				X
**Cortaderia selloana*				X
**Paspalum dilatatum*				X
Alloteropsis semialata		X	X	
Andropogon chinensis		X	X	
Andropogon eucomis	X		X	X
Aristida junciformis			X	
Bewsia biflora		X	X	
Brachiaria serrata			X	
Carex spicatopaniculata	X Iota Hill Forest			
Chloris gayana				X
Ctenium concinnum			X	
Cymbopogon caesius	X	X	X	X
Cymbopogon nardus		X		
Cynodon dactylon				X
Cynodon nlemfuensis				X
Cyperus albostriatus	X			
Cyperus albostriatus	X Wishbone and Iota Hill Forest			
Cyperus cyperoides	X		X	X
Cyperus esculentus (thought to be exotic)	X		X	X
Cyperus sphaerocephalus			X	
Digitaria eriantha				X

GRAMINOID SPECIES

Scientific name	Riparian & Forest Remnants	Mountain Outcrops	Montane Grassland	Degraded Habitat
Diheteropogon amplectens		X	X	X
Diheteropogon filifolius		X		
Eragrostis capensis			X	X
Eragrostis chloromelas				X
Eragrostis gummiflua	X			
Eragrostis lehmanniana			X	
Eragrostis plana				X
Eragrostis racemosa			X	
Eragrostis rigidior			X	
Harpochloa falx		X	X	
Heteropogon contortus		X	X	
Heteropogon contortus			X	
Hyparrhenia filipendula		X	X	X
Hyparrhenia hirta			X	
Hyparrhenia tamba			X	
Hyperthelia dissoluta		X	X	X
Imperata cylindrica				X PCD dominant
Kyllinga alba			X	
Loudetia simplex		X	X	
Melinis nerviglumis			X	
Melinis repens		X	X	X
Microchloa altera			X	
Monocymbium ceresiiforme			X	
Oropetium capense		X		
Panicum ecklonii			X	
Panicum maximum		X		
Panicum natalense			X	
Paspalum dilatatum				X
Phragmites mauritianus	X Blyde			
Setaria megaphylla	X			X
Setaria sphacelata	X		X	X
Setaria sphacelata var sericea	X	X	X	X
Sporobolus africanus	X			X
Sporobolus pectinatus		X	X	
Sporobolus pyramidalis				X
Themeda triandra			X	X not abundant
Tristachya leucothrix		X	X	X
Urochloa mosabicensis				X

APPENDIX D: Responses to Issues and Risks highlighted by I&APs

Comments regarding the floral ecology associated with the project were received and are outlined in the below table, including the responses to each.

Table D1: Responses to issues and risks highlighted by Interested and Affected Parties from a floral perspective.

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FLORAL ECOLOGIST
			FLORA
1	The proposed mining is very close to a protected nature area on the farms Desire and Grootfonteinberg. The buffer zone is 5 km. One should also take cognisance of national protected areas (MTPA) development also falls adjacent to the Mount Sheba Nature Reserve, Morgenzon Nature Reserve and a the new proposed Morgenzon South Nature Reserve (K2C / AWARD)	Distance of protected areas to mining activity Buffer zone	The protected nature reserves that the comment refers to are the Mount Sheba Private Nature Reserve, located approximately 0.84km south-southwest of the proposed layout, and the Motlatse Canyon Provincial Nature Reserve, approximately 1.6 km southeast of the focus area (the latter is not in the latest SAPAD database). According to the Mpumalanga Biodiversity Sector Plan Handbook (2014), Quarrying/Opencast Mining is deemed a **conflicting land use** to the management objective for Protected Areas – thus not permissible if the ecological and tourism functionality of the protected area is to be maintained or improved. Other planned mine activities, mainly construction and operations of roads, powerlines, canals etc. are also considered to be a land use that may compromise biodiversity objectives of the protected areas and can only be permitted under certain circumstances. The floral assessment emphasis the concern of the placement of infrastructure and the proposed pits and WRDs within this protected area buffer, especially due to the significance of protected areas for the conservation of floral biodiversity. Please refer to more detailed discussion within the below outlined sections: - Conservation Status of Vegetation Type/Ecosystem (section 3.1 – 3.4) - Business Case, Conclusion and Mitigation Requirements (section 3.1 - 3.3) - A Reasoned opinion (section 6) - Section A (Background Information Report) explicitly states and maps protected and conservation areas in close proximity (within 10 km) of the focus area (SAPAD, 2018; SACAD, 2018; NPAES, 2009), including a brief discussion of the significance and consequence thereof for the proposed Theta mine activities. The Buffer zones are also mapped.
2	Impact on Critical Biodiversity Areas (CBA). Open-cast mining is a land use that will compromise the biodiversity objective and is not supported within CBA areas (MTPA) – ALSO: proposed development sites indicate fragmentation of the CBA areas with high exotic tree	CBA	The focus area is located within Critical Biodiversity Areas (CBA Irreplaceable and Optimal) (Mpumalanga Biodiversity Sector Plan, 2014). The extent of the CBAs within the focus area is mapped in Section A and their significance/ importance explained from a desktop perspective. Along with the ESA: Protected Area Buffer discussed in the previous comment, the Mpumalanga Biodiversity Sector Plan Handbook (2014) describes Quarrying/Opencast Mining as a **conflicting land use** to the biodiversity objective for province. As part of the Floral assessment, the remaining extent of the CBAs within the footprint of the proposed mine activities were ground-truthed during the 2019 field assessments. Upon completion of the field assessments,

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FLORAL ECOLOGIST
	infestations (also AWARD / K2C / SANPARKS)		the presence of representative CBAs was confirmed in several areas but denied in others e.g. where extensive habitat transformation has occurred due to the planting of plantations. The remaining extent of CBAs in each habitat unit within the focus area is discussed within the report. The floral report acknowledges the emphasizes the significant impact on the CBAs a biodiversity compensation is recommended in the event that destruction of the CBA cannot be avoided in the event that the project is authorised due to overriding socio-economic reasons. Please refer to more detailed discussion within the below outlined sections: - Conservation Status of Vegetation Type/Ecosystem (section 3.1 – 3.4) - Business Case, Conclusion and Mitigation Requirements (section 3.1 - 3.3) - A Reasoned opinion (section 6) - Mapping of CBAs within Section A: Background Information Report
3	MTPA would insist on on-site verification of the studies. Site visits must be undertaken in the growing seasons.	Timing of site visits and phased approach of specialist studies	An initial field assessment was undertaken from the 26th to the 29th of March 2019 (early authum season), to determine the floral ecological status of the focus area, and to "ground-truth" the results of the desktop assessment (please refer to Section A). A second assessment took place within early spring (2nd to the 4th of September 2019) to investigate changes made to the footprint areas. During the spring assessment the veld was recently burned, and a suitable assessment of floral communities was not possible; however, species were found during the spring assessment that were not recorded during the March assessment, thus allowing for a more saturated species list. It is acknowledged that a more accurate assessment would require that assessments take place in all seasons of the year. However, on-site data was significantly augmented with all available desktop data, together with project experience in the area, and the findings of this assessment are considered to be an adequate reflection of the ecological characteristics of the focus area that can allow for informed decision making. The floral report (Section B) specifically states that additional ground-thruthing is required, especially for the identification of floral species of conservation concern. Please refer to more detailed discussion within the below outlined sections: - Assumptions and limitations *section 1.4) - Results of the Floral Assessment (sections 3.1 – 3.7) - Business Case, Conclusion and Mitigation Requirements (section 3.1 - 3.4) - A Reasoned opinion (section 6)
4	It should be emphasised that permits would be needed for the removal of specific plants (MTPA) Although this property is not state forest land, the protected trees and natural forest trees on that property may not be cut or damaged without a licence (DAFF)	Permits Section 3.5	As part of the floral assessment (Section B), a full species of conservation concern (SCC) assessment was undertaken that not only considers floral SCC recorded on site during the field assessment but also includes a Potential of Occurrence (POC) assessment where the assessment takes suitable habitat to support any such species into consideration. Thus, for the POC assessment, a list of floral SCC recorded within the QDS 2430DC and QDS 2430DD was obtained from the MTPA, comprising SANBI Red Data Listed species recorded within the area. The report acknowledges that the MTPA data is not necessarily complete and more SCC are likely present.

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FLORAL ECOLOGIST
			Add.,itional datasets and sources that were also taken into consideration as part of the POC assessment included: - The list of Schedule 11 Protected Plants [Section 69 (1)(a)] and Schedule 12 Specially Protected Plants [Section 69 (1)(b)] under the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998); and - The List of Protected Tree Species (GN 809 of 2014) under the National Forest Act (Act 84 of 1998). Please refer to more detailed discussion within the below outlined sections: - Results of the Floral Species of Conservation Concern Assessment (section 3.5), including additional information in Appendix B - Business Case, Conclusion and Mitigation Requirements (section 3.1 - 3.4) - Integrated Impact Mitigation (section 5.3) also stating that permits from the relevant authorities, i.e. MTPA and Department of Agriculture, Forestry and Fisheries (DAFF), should be obtained before removal, cutting or destruction of protected species or floral SCC before any proposed mining activities may take place. - A Reasoned opinion (section 6)
5	Due to it being a CBA area, the corridors linking different areas and the effects on the areas outside that specific site area should be taken into account (MTPA)	Corridors linking CBA	The proposed mine activities have already and will continue to result in the fragmentation of the CBAs. The result of such fragmentation is emphasised within the floral report in sections 5.2.6 , section 5.3 and section 6. The resultant fragmented CBA will evidently lead to habitat loss as floral communities to become less diverse and displaced by both AIPs and plants that are better adapted to increasingly disturbed areas. Fragmented habitat not only impacts on floral communities but also limits the migration potential of faunal species. Overall, it is anticipated that the fragmentation of CBAs will result in lowered biodiversity for the area.
6	The biodiversity values of the buffer zones must be highlighted	Biodiversity Values Buffer Zones	The floral assessment emphasis the concern of the placement of infrastructure and the proposed pits and WRDs within this protected area buffer, especially due to the significance of protected areas for the conservation of floral biodiversity. Please refer to more detailed discussion within the below outlined sections: - Conservation Status of Vegetation Type/Ecosystem (section 3.1 – 3.4) - Business Case, Conclusion and Mitigation Requirements (section 3.1 - 3.3) - A Reasoned opinion (section 6) Section A (Background Information Report) explicitly states and maps protected and conservation areas in close proximity (within 10 km) of the focus area (SAPAD, 2018; SACAD, 2018; NPAES, 2009), including a brief discussion of the significance and consequence thereof for the proposed Theta mine activities. The Buffer zones are also mapped.
7	Request MTPA: A detailed botanical survey is required to assess the sensitivity of the mining footprint area - in addition, specialist studies should also be conducted looking at birds, reptiles, fish, Odonata (responsible	Botanical survey details	A floral assessment was conducted following two field assessments; the results of which are outlined in this report. Please refer to more detailed discussion within the below outlined sections: - Results of the Floral Assessment (sections 3.1 – 3.7), including additional species lists in Appendix B and C - Sensitivity Mapping (section 4) - Impact Assessment (section 5)

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FLORAL ECOLOGIST
	for the CBA Aquatic species in the MBSP freshwater map), and small mammals		- A Reasoned opinion (section 6) Please refer to the separate reports dealing with the faunal and freshwater aspects: Section C: Faunal Assessment and the Freshwater Assessment.
8	Request MTPA: extent and control of exotic tree species in the whole mining footprint area, particularly within the drainage areas	Exotic Tree Species	Compiling an Alien and Invasive Plant (AIP) Control and Management Plan did not form part of the scope of work for the floral assessment. A short discussion on AIPs within the mining footprint area is provided in section 3.7 with mitigation measures in section 5.3 stating the necessity for an AIP control plan.
9	The proposed sites also overlap with two nationally listed Threatened Ecosystems (Malmani Karstlands & Northern Escarpment Dolomite Grassland) in need of protection under the National Environmental Management Biodiversity Act (NEMBA, 2004). The proposed sites also overlap with Priority Areas under Mpumalanga Tourism & Parks Agency's (MTPA) Protected Area (PA) Expansion Strategy. (AWARD)	Threatened Ecosystems	The mining footprint area falls within several biodiversity and conservation important areas, all of which are mapped and briefly discussed within Section A: Background Information. Within the floral report (Section B), the results of the floral assessment confirm that the floral communities on site were representative of the two threatened vegetation's types, i.e. the Northern Escarpment Dolomite Grassland (**Endangered**) and, to a lesser degree, the Northern Escarpment Quartzite Sourveld (**Vulnerable**). Similarly, the remaining extent of the Malmani Karstlands **endangered ecosystem** (National Threatened Ecosystems, 2011), falls within the direct footprint. According to the Mpumalanga Biodiversity Sector Plan (2014), the focus area falls within several areas of conservation and biodiversity importance, i.e. Irreplaceable and Optimal Critical Biodiversity Areas (CBAs) (MTPA, 2014), an Ecological Support Area (ESA) Protected Areas Buffer. The report states that these are protected, and recommends that the remaining, intact vegetation be left in a natural state. Where this is not feasible, or if the proposed project is to be approved for overriding socio-economic reasons, an appropriate biodiversity offset and compensation plan as well as appropriate funding of this initiative is considered essential. Please refer to more detailed discussion within the below outlined sections: - Conservation Status of Vegetation Type/Ecosystem (section 3.1 – 3.4) - Business Case, Conclusion and Mitigation Requirements (section 3.1 - 3.3) - Sensitivity Mapping (section 4) - A Reasoned opinion (section 6) - Mapping of CBAs, ESAs and threatened ecosystems within Section A: Background Information Report
10	The mining application falls within the Kruger to Canyons Biosphere Region (K2C)	K2C Biosphere status regarding development	Within Section A: Background Information (section 3.1), as well as within Section B: Floral Assessment (sections 3.1 – 3.4), it is acknowledged that according to the South African Conservation Areas Database (SACAD, 2018), the entire proposed layout falls within the Kruger to Canyons Biosphere Reserve and, therefore is recognised under the UNESCO (United Nations Educations, Scientific and Cultural Organisation) Man and the Biosphere Programme. Depending on the spatial zonation of a Biosphere Reserve (core area, buffer zone or transitional zone), these areas can be granted legal protection or can be used for sustainable developments. It is unclear what the spatial zonation is of the section of the Biosphere Reserve in which the focus area is located.

<table>
<tr><th>No.</th><th>COMMENT</th><th>ISSUE / RISK</th><th>RESPONSE FROM THE FLORAL ECOLOGIST</th></tr>
<tr><td>11</td><td>Large number of rare and endangered species in grasslands is a particular problem for environmental impact assessment. They are mostly small, very localised and visible for only a few weeks in the year when they flower. Most surveys will not pick them up and special skills are required to locate and identify them reliably. Seasonal assessments should therefore be conducted during the EIA process. (K2C)</td><td>Endangered species in grassland Seasonal Assessments</td><td>This is acknowledged and taken into consideration within the floral assessment.

Section 3.5 in the floral report (Section B), undertook a full species of conservation concern (SCC) assessment that not only considers floral SCC recorded on site during the field assessment but also includes a Potential of Occurrence (POC) assessment where the assessment takes suitable habitat to support any such species into consideration. Thus, for the POC assessment, a list of floral SCC recorded within the QDS 2430DC and QDS 2430DD was obtained from the MTPA, comprising SANBI Red Data Listed species. The report acknowledges that the data provided by MTPA is not necessarily complete and more SCC are likely present.

Additional datasets and sources that were also taken into consideration as part of the POC assessment included:
- The list of Schedule 11 Protected Plants [Section 69 (1)(a)] and Schedule 12 Specially Protected Plants [Section 69 (1)(b)] under the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998); and
- The List of Protected Tree Species (GN 809 of 2014) under the National Forest Act (Act 84 of 1998).

The floral report emphasizes the need for additional seasonal assessments in several sections of the report.

Please refer to more detailed discussion within the below outlined sections:
- Assumptions and Limitations (section 1.4)
- Results of the Floral Assessment (section 3.1 – 3.4)
- Results of the Floral SCC Assessment (section 3.5 – 3.6)
- Impact Assessment (section 5)
- Integrated Impact Mitigation (section 5.3)
- A Reasoned opinion (section 6)</td></tr>
<tr><td>12</td><td>The amount of time spent in the field to establish the species composition was scant at best, and cannot be considered sufficient to establish the potential presence of threatened species (EWT)</td><td>Timing of studies vs. threatened species</td><td>We acknowledge that more time on site was necessary to compile a more saturated species list to ensure the EMP is comprehensive in the management of floral SCC and robust to ensure appropriate execution.

Although it is acknowledged that relying on historic background data, data provided by MTPA, species lists obtained for the relevant QDS from online datasets (e.g. the Virtual Museum and Botanical Database of Southern Africa) and experience in the area will not allow the provision of a complete representation of the area's floral and faunal diversity, we believe that the information provided in the biodiversity assessments are sufficient to allow for informed decision making to take place.

Additional surveys are recommended as part of the mitigation measures (section 5.3): "Before any construction activities can occur a detailed walk down of the area must take place, during which all floral SCC should be identified and marked by a suitably qualified specialist approved by the MTPA. Surveys to be overseen by MTPA and would need to be conducted within the correct flowering season for all potentially occurring SCC – thus throughout the year over various seasons. A once-off walk-down will not suffice"</td></tr>
<tr><td>13</td><td>Affecting trees can also be considered a transgression, and therefore the creation of a buffer area of at least 30 m wide around natural</td><td>Buffer area for natural forest areas</td><td>This comment has been taken into consideration and a 30 m buffer around natural forest areas are depicted on the habitat sensitivity maps (Section 4). This was also incorporated into the mitigation measures (section 5.3).</td></tr>
</table>

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FLORAL ECOLOGIST
	forest patches is important (DAFF)		

14	Protected tree species such as Protea comptonii and Protea curvata were also identified at the Iota WRD pit site. Such trees may not be removed, destroyed or disturbed without a licence in terms of section 15 of the National Forests Act, 1998 (DAFF)	Protected tree species	Both the mentioned species, *Protea comptoni* and *Protea curvata*, have very limited distributions that do not correspond to the focus area.
			
			Known distribution of *Protea comptoni* (Barberton Mountain Sugarbush):
			- Most prominent in Barberton montane grassland. In KwaZulu-Natal it occurs in open woodland on steep, cool, south-facing slopes from 850-1000 m. Also on quartzites of the Mozaan group.
			  • Red List of South African Plants (http://redlist.sanbi.org/species.php?species=799-25)
			- Found along the escarpment from northern KwaZulu-Natal (Vryheid), through Swaziland and into Mpumalanga (Barberton). This species has a very limited distribution range and is considered rare.
			  • Schmidt, E., Lotter, M., & McCleland, W. (2002). Trees and shrubs of Mpumalanga and Kruger national park. Jacana Media.
			- Limited distribution on steep, rocky south-facing mountain slopes – immediately north and south of Swaziland.
			  • Coates Palgrave, K., Drummond, R.B., Moll, E.J. and Palgrave, M.C., 2002. Trees of southern Africa. Cape Town.
			- Within Mpumalanga only recorded near Barberton.
			  • Boon, R. and Pooley, E., 2010. Pooley's trees of eastern South Africa. Flora and Fauna Publications Trust.
			
			Known distribution of *Protea curvata* (Barberton Lowveld Sugarbush):
			- Range: Barberton..
			  • Red List of South African Plants (http://redlist.sanbi.org/species.php?species=799-30)
			- Very limited in its distribution, known only from one area just north of Barberton. This species is occasionally confused with *Protea caffra,* particularly subsp. *fulcata*.
			  • Schmidt, E., Lotter, M., & McCleland, W. (2002). Trees and shrubs of Mpumalanga and Kruger national park. Jacana Media.
			- Occurring only on one 1 small hill of serpentine-derived soils in the lowveld near Barberton.
			  • Coates Palgrave, K., Drummond, R.B., Moll, E.J. and Palgrave, M.C., 2002. Trees of southern Africa. Cape Town.
			
			It is deemed highly unlikely that these species would have been recorded on Iota Hill, and thus it is not anticipated that permits from DAFF would be required to remove these species. However, an abundance of *Protea* species is present, all of which are listed Schedule 11 Protected Plants [Section 69 (1)(a)] under the Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998). These species will require permits from the MTPA.

	OFFSET		
15	In the event that there is conflict between sensitivities then one should consider the hierarchy of mitigation. If at the end of	Hierarchy of mitigation Biodiversity offset	Due to the location of the focus area in Irreplaceable and Optimal CBAs (MBSP, 2014), as well as threatened ecosystems, there is potential for significant residual impacts. The ideal would be for rehabilitation to be to a pre-mined condition. If this is not possible, which the findings of this

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FLORAL ECOLOGIST
	the process, it is found that one cannot mine anywhere else, the biodiversity offset options should be investigated.		report deem likely, offsetting must be considered for Optimal CBAs and threatened ecosystems. Biodiversity offsetting, on the other hand, is not feasible for Irreplaceable CBAs (MBSP Handbook, 2014); however, were the proposed Theta Project approved after consideration of the principles of Integrated Environmental Management (IEM), it is recommended that it be on the bases that there will be compensation for lost habitat in accordance with National and Provincial Offset Guidelines (preferably as a like for like offset).
	VISUAL / DUST		
16	Dust from the mining operation will affect the transpiration rates of plants. These are potential indirect impacts on the natural forest area (DAFF)	Dust impacts on natural forest areas	Several impacts from dust on floral species are anticipated and within the mitigation measures an effective dust management plan must be designed and implemented in order to mitigate the impact of dust on floral species throughout the operational phase (section 5.3).
	SEIA		
17	The consultants must make references to these other applications and the cumulative assessments in this regard should be based on this aspect. Illegal mining is also an issue. (AWARD)	Illegal mining	Cumulative impacts are discussed in the floral report under section 5.2.6.
	EIA PROCESS / GENERAL ENVIRONMENTAL		
18	Cumulative impacts – (DAFF)	Cumulative impacts	Cumulative impacts are discussed in the floral report under section 5.2.6.
	QUESTION NOT DIRECTLY RELATED TO 83 MR APPLICATION		
19	Exploration activities already caused damage. The process is done incorrectly (Pilgrim's Rest Museum)	Exploration impacts	The floral report acknowledges these impacts. Exploration impacts are touched on in the floral results section (section 3). It is also discussed within the cumulative impacts section (5.2.6). Clearing activities related to the development of the current exploration roads has led to the isolated loss of habitat along the road footprints and the adjacent downslope areas due to the discarding of cleared material – this includes fragmentation of primary grassland and clearance of areas where patches of indigenous vegetation were still present. Although the clearing of the roads will have led to the loss of floral SCC within the road footprint, several floral SCC were still observed throughout the surrounding areas, and it is further likely that several faunal SCC will still occur within and utilise the habitat.

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BIODIVERSITY ASSESSMENT AND IMPACT ASSESSMENTS AS PART OF THE ENVIRONMENTAL AUTHORISATION AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS FOR THE TGME THETA PROJECT TO INCLUDE THE THETA HILL, BROWNS HILL AND IOTA HILL NEAR PILGRIM'S REST, MPUMALANGA PROVINCE

Prepared for

Batho Earth
Social and Environmental Consultants

First submission: May 2019
Updated: July 2020

Section C: Faunal Assessment

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Report Reference:	**STS 190006**
Date:	**July 2020**

EXECUTIVE SUMMARY

The faunal assessment revealed a three faunal Species of Conservation Concern (SCC) present in the focus area namely *Pelea capreolus* (Grey Rhebok, NT), *Rhinolophus smithersi* (Smithers Horseshoe Bat, NT) and *Rhinolophus blasii* (Blasius's Horseshoe Bat, NT). Based on information gathered from databases as well as data obtained during the field assessments, there is an increased likelihood that other faunal SCC may also occur, either permanently or temporarily within the focus area. The habitat units within the focus area have all been exposed to varying levels of disturbances, with the net result being that the ecological sensitivity of the habitat units varied accordingly, fluctuating between High (Blyde River) to Moderately high (Mountain Outcrops, Montane Grasslands, Drainage Lines and Forest Remnants), Intermediate (Portions of the Degraded Forest and Drainage Lines) and Moderately low (Degraded Habitat and portions of the Degraded Forest).

The Theta Project will lead to significant habitat and species diversity loss, in addition to potential faunal SCC. The loss of habitat will lead to the displacement of species from the focus leading to increased competition for space and resources in the surrounding areas. The rehabilitation phase, if well-planned and implemented, may restore some ecological function; however, it is unlikely that the faunal biodiversity will ever return to pre-mining conditions as even the best rehabilitation activities will not be able to replicate the pre-mining micro habitats currently observed within the focus area.

The focus area is considered sensitivity and important for faunal communities, thus from a faunal biodiversity perspective the focus area is of high conservation value. Based on the results of the faunal assessment, it is the opinion of the specialist that this project will have negative impacts on the faunal ecology within the focus area and potentially on a local to regional scale. Of further importance it is expected that the impacts stemming from this project will be relatively irreversible. The impact of the proposed project must however be contrasted with the risk that uncontrolled artisanal mining poses. If the project is to be approved for overriding socio-economic reasons, an appropriate biodiversity offset and compensation plan as well as appropriate funding of this initiative is considered essential.

Management Summary

Scientific Terrestrial Services (STS) was appointed to conduct a Faunal and Floral Ecological Assessment and Impact Assessments as part of the environmental assessment and Environmental Impact Assessment (EIA) process for the Transvaal Gold Mining Estate (TGME) Mine Development Project: Application for the amendment of the existing environmental authorisation to include the proposed Theta Open Pit Project comprising the Theta Hill, Browns Hill and Iota Hill projects near Pilgrim's Rest, Mpumalanga Province. The areas to be assessed will henceforth be referred to as the "focus area", except when specifically referring to the activities associated with Theta Hill, Browns Hill or Iota Hill.
be referred to as the "focus area", except when specifically referring to the activities associated with Theta Hill, Browns Hill or Iota Hill.

The purpose of this report is to define the faunal ecology of the footprint area as well as mapping and defining areas of increased Ecological Importance and Sensitivity (EIS) and to define the Present Ecological State (PES) of the footprint area. The objective of this study:

- To provide inventories of faunal species as encountered within the footprint area;
- To determine and describe habitat types, communities and the ecological state of the footprint area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To identify and consider all sensitive landscapes including rocky ridges, primary grasslands, wetlands and/ or any other special features that may be affected by the proposed development and in turn affect faunal assemblages of the region;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including potential for such species to occur within the footprint area;

- To provide detailed information to guide the activities associated with the proposed development activities associated within the footprint area; and
- To ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

SUMMARY RESULTS OF THE FAUNAL ASSESSMENT

The Five habitat units were defined within the Focus Area from a faunal perspective included the Mountain Outcrops, Montane Grassland, Forest Remnants (Divided into Degraded Forest and Indigenous Forest Remnants), Riparian Habitat and Degraded Habitat Unit.

- Three faunal SCC were recorded within the focus area, namely *Pelea capreolus* (Grey Rhebok, NT), *Rhinolophus smithersi* (Smithers Horseshoe Bat, NT) and *Rhinolophus blasii* (Blasius's Horseshoe Bat, NT);
- Montane Grassland habitat unit offers potential habitat for foraging and breeding for a diversity of faunal species including mammals, reptiles and avifaunal SCC such as *Eupodotis senegalensis* (White-bellied Korhaan, VU), *Falco peregrinus* (Peregrine Falcon, VU), *Geronticus calvus* (Southern Bald Ibis, VU);
- The Mountain Outcrops habitat unit extends throughout the focus area. The distinguishing characteristic of this habitat unit is the composition of prominent rock features that support a diversity of faunal and floral species. The Mountain Outcrops habitat unit offers ideal habitat for numerous reptile SCC and arachnid species which will take advantage of the crevices for shelter such as *Amblyodipsas concolor* (Natal Purple-glossed Snake, VU), *Bradypodion transvaalensis* (Northern Dwarf Chameleon, VU). There is also an increased likelihood that *Panthera pardus* (Leopard, VU) would use the rocky outcrops as cover whilst hunting;
- The Forest Remnants have been split into 2 sub-habitats, namely Degraded Forest (AIP dominated) located within portions of the Iota footprint area and Indigenous Forest located south of the Iota footprint as well as in the Theta Wishbone WRD. These areas provide increased habitat for avifaunal species whilst also serving as areas of refuge for several other faunal species;
- The Blyde River and associated riparian habitat runs through the centre of the focus area and is considered of increased sensitivity and ecological importance. Several smaller drainage lines were also observed, all feeding into the Blyde, providing habitat for a diversity of faunal species. The Riparian Habitat, notably the Blyde River, has an increased potential of providing habitat to several SCC, including avifauna and amphibians. In addition, this habitat provides a permanent and important source of water to specie sin the region;
- The Transformed habitat unit comprises of areas where indigenous vegetation has been cleared for mining, housing and forestry purposes leaving limited habitat available for faunal species; and
- Degraded Habitat is characterised by been historically disturbed areas which are notably dominated by Alien Invasive Plants (AIP). This habitat unit supports several common and widely occurring faunal species but is unsuitable for SCC due to the levels of habitat degradation.

Faunal Habitat Sensitivity

The faunal ecological sensitivity of the habitat units varied between High (Blyde River), Moderately high (Mountain Outcrops, Montane Grasslands, Drainage Lines and Forest Remnants), Intermediate (Portions of the Degraded Forest and Drainage Lines) and Moderately low (Degraded Habitat and portions of the Degraded Forest), the sensitivities are discussed in the table below:

Table A: **A summary of the sensitivity of each habitat unit and implications for development.**

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
Montane Grasslands	Moderately High	Iota Pit, Iota WRD north and south Section of Browns Hill Several stretches if the Haul Road Portions of the Wishbone WRD Portions of the Theta Pits	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential in an ecologically sensitive manner. Offsetting or compensation for residual loss to be considered only as a last resort	This habitat unit offers ideal habitat for wide variety of species including mammals, reptiles and avifaunal species. Mining activities should be kept to a minimum within this habitat unit. In this regard, maintaining migratory corridors and connectivity is deemed essential in the remaining areas and as such footprint creep and edge effects must be strictly managed. Where mining is planned within habitat unit, care must be taken to prevent any negative impacts on vegetation and as such edge effects on the surrounding habitats, should be limited. All mitigation measure as set out in this report are to be correctly implemented.
Mountain Outcrops				The Mountain Outcrops habitat unit offers ideal habitat for numerous reptile SCC and arachnid species which will take advantage of the crevices for shelter. Any disturbance of sensitive faunal habitat must be actively avoided. In this regard, maintaining migratory corridors and connectivity along the Mountain Outcrops and with the Montane Grassland is deemed essential. If development will take place within a close proximity of this habitat unit, care must be taken to prevent any negative impacts on vegetation and as such edge effects on this, and surrounding habitats, should be limited. All mitigation measure as set out in this report are to be correctly implemented.
Forest Remnants	Moderately High	Wishbone WRD Downslope of and close proximity to Iota Pit	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential in an ecologically sensitive manner. Offsetting or compensation for residual loss to be considered only as a last resort	This habitat unit provides good habitat for arboreal mammal and reptile species, avifauna and invertebrates. In addition, there is a high likelihood that large raptors will also take advantage of the area for nesting purposes. Any disturbance of sensitive faunal habitat must be actively avoided. Portions of this habitat unit within the Wishbone WRD will be completely lost if current plans are approved, impacting notably on avifaunal species who roost and next in this area. Where development will take place within close proximity of this habitat unit (Iota Pit), care must be taken to prevent any negative impacts on vegetation and as such edge effects on this, and surrounding habitats, should be limited. All mitigation measures as set out in this report are to be correctly implemented.
Blyde River	High	Linear developments, mainly Haul Roads, Pump Column Iota PCD Downslope risk from Iota Pits and WRD's	Mining activities should be actively avoided in this habitat unit Offsetting or compensation for residual loss to be considered only as a last resort	This habitat unit provides ideal refuge for amphibians, small mammals, reptiles and waterfowl. Mining activities and infrastructure should be minimised in this habitat unit as far as possible due to the possible presence of several faunal SCC. Additionally, the Blyde River plays a pivotal and important function in terms of species support, notably as a corridor of movement and as a permanent source of drinking water. The proposed mining may pose a significant risk to the downstream habitat should activities not be suitably managed.

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
Riparian Habitat -Drainage Lines	**Moderately High**	Small portion of Iota WRD and linear infrastructure	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential in an ecologically sensitive manner. Offsetting or compensation for residual loss to be considered only as a last resort	The habitat integrity of the drainage lines (tributaries of the Blyde) have been compromised as a result of the proliferation of AIPs. Although AIP species are present, there are still indigenous plant species present. This habitat unit still provides habitat for several faunal species, and whilst AIP species are present, these species still provide seasonal food resources (berries, seeds and flowers) for fauna. The increased vegetation density further provides areas of refuge for fauna.
	Intermediate	Wishbone WRD Linear developments Wishbone Dam	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	The habitat integrity of the drainage line have been compromised as a result of the proliferation of AIPs, outcompeting much of the indigenous plant species leading to notable habitat loss. Common faunal species do still utilise these areas, although to a lesser degree than the more intact habitats. In addition, these drainage lines are often used as access points by illegal miners, resulting in increased anthropogenic impacts and disturbances.
Degraded Habitat and Degraded Forest	**Moderately Low**	Sections of Iota Pit, Iota WRD North and Iota WRD South. Most of Browns Pit and southern sections of the Theta Pits, as well as sections of the Wishbone WRD Haul Roads and several stretches of the Linear Developments Stockpiles and Mine Contractors Site	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	This habitat is of moderately low importance for faunal species in the region. The degraded state of the habitat and proliferation of AIPs limit faunal habitation opportunities. Although faunal species do traverse, and in some instance common species inhabit this unit, the continued mismanagement of the areas will further result in habitat loss and degradation through AIP proliferation. Development within this habitat unit is not expected to lead to high impacts to the faunal community of the region.
Transformed Habitat	**Low**	Stockpiles, Dams, Potions of Theta Pit and areas of the Haul Road	Optimise development potential.	Development in this area is unlikely to have any impact on faunal species given the already large extent of habitat loss that has occurred. In order to ensure that no further species and habitat loss occurs, it is imperative that edge effects are managed and that no footprint creep occurs into the surrounding areas.

Faunal Impact Assessment

The proposed Iota, Browns and Theta pits, Wishbone Waste Rock Dump and Iota Waste Rock Dumps are expected to have high impacts regardless of mitigation implementation; however, it must be noted that the extent and manageability of these impacts will decrease with mitigation measures. The remaining impacts associated with the project can be mitigated to medium levels of impact, provides mitigation measures are implemented.

The proposed mining activities will in addition to the loss of faunal habitat and diversity, lead to the following approximate area loss for the associated CBA's:

- Iota WRD (including the Iota Pit area): 34 ha of CBA Irreplaceable with 8 ha of Optimal CBA and 42 ha of Malmani Karstlands;
- Wishbone WRD: 0.001 ha of CBA Irreplaceable, 16 ha of Optimal CBA and 15ha of Malmani Karstlands;
- Iota Pit: 14 ha of Irreplaceable CBA with 5 ha of Optimal CBA and 19 ha of Malmani Karstlands;
- Theta Pits: 5 ha of CBA Irreplaceable with 8 ha of CBA Optimal and 6 ha of Malmani Karstlands;
- Browns Pit: 6 ha of CBA Optimal with 5 ha of Malnani Karstlands; and
- Pollution Control Dams: approximately 1 ha of Malmani Karstlands and 1 ha of CBA Optimal.

Assessing the No-go Alternative, or the scenario of a project not going ahead, requires that all possible scenarios be taken into account, including the implications of not authorising the project. For the Theta Project, four scenarios were identified, and their anticipated impacts on floral ecology for the focus area and larger region (where applicable), assessed below:

- No-go with no management relevant stakeholders;
- No-go with management from relevant stakeholders;
- Authorised mining in an ideal scenario; and
- Authorised mining practically achievable.

Should the mining application not be successful, and the No-go route be taken, there will be no immediate and/or direct impact to the faunal habitat or faunal species within the proposed mine footprint. In addition, this will avoid the loss of CBAs and threatened ecosystems within the footprint, and as such not compromise the current land use and conservation goals for the area (see MTPA, 2014). With the No-go Alternative, the existing threats to biodiversity remain present. To prevent negative impacts to faunal habitat and biodiversity, there would need to be agreement from government authorities to manage the current risks posed by illegal mining and AIP proliferation. Unfortunately, given the realities of the situation and the limited resources available to authorities and stakeholders, this scenario is unlikely to happen.

Should the mine receive authorisation, they will be obligated to implementing a list of mitigation measures to ensure sound and best practice environmental management in a mining scenario, to which they will be audited on. Strict control of mining activities, along with sound engineering designs, where AIPs are controlled and areas rehabilitated and no mine-related activities result in pollution or sedimentation of the Blyde River and downstream habitat, should be the goal. Large mining operations can have a greater impact potential when compared to small-scale artisanal mining, but they also have a greater capacity to minimise damage where artisanal mining practises rarely take responsibility for environmental damage. In addition, the artisanal mining, whilst small scale now, will likely ramp up over time to levels that are beyond any control of government, leading to widescale damage of ecosystems, significant degradation of the Blyde River and significantly increased levels of poaching.

The following tables represent a summary of the findings of the impact assessment pertaining to the proposed Theta Project:

Table B: Summary of the impact significance of the proposed mining activities.

Pre-construction Phase		
Proposed Activities	**Unmanaged**	**Mitigated**
Iota Pit	High	High
Browns Pit	High	High
Theta Pit	High	High
Iota WRD	High	High
Theta Wishbone WRD	High	High
Stockpiles and Project Infrastructure	High	Medium
Iota Dam	High	Medium
Browns Dam	High	Medium
Linear Development (Powerlines, Haul Roads, Access Roads and Diversion Trenches)	High	Medium
Construction Phase		
Proposed Activities	**Unmanaged**	**Mitigated**
Iota Pit	High	High
Browns Pit	High	High
Theta Pit	High	High
Iota WRD	High	High
Theta Wishbone WRD	High	High
Stockpiles and Project Infrastructure	High	Medium
Iota Dam	High	Medium

Browns Dam	High	Medium
Linear Development (Powerlines, Haul Roads, Access Roads and Diversion Trenches)	High	Medium
Operational Phase		
Proposed Activities	**Unmanaged**	**Mitigated**
Iota Pit	High	Medium
Browns Pit	High	Medium
Theta Pit	High	Medium
Iota WRD	High	Medium
Theta Wishbone WRD	High	Medium
Stockpiles and Project Infrastructure	High	Medium
Iota Dam	High	Medium
Browns Dam	High	Medium
Linear Development (Powerlines, Haul Roads, Access Roads and Diversion Trenches)	High	Medium
Decommissioning and closure Phase		
Proposed Activities	**Unmanaged**	**Mitigated**
Iota Pit	High	Medium
Browns Pit	High	Medium
Theta Pit	High	Medium
Iota WRD	High	High
Theta Wishbone WRD	High	Medium
Stockpiles and Project Infrastructure	High	Medium
Iota Dam	High	Medium
Browns Dam	High	Medium
Linear Development (Powerlines, Haul Roads, Access Roads and Diversion Trenches)	High	Medium

NO GO ALTERNATIVE VS MINING	
Proposed Activities	**Significance**
No-go with no management from all stakeholders	High-
No-go with effective management from all stakeholders	Low+
Authorised mining in an ideal scenario	Low-
Authorised mining practically achievable	Medium-

Concluding Remarks

The Riparian Habitat, Intact Forest Remnants and Rocky Outcrops are considered to be niche areas of habitat that support unique diversities of species often not found in other areas. The Montane Grassland and Mountain Outcrops habitat units are deemed to be sensitive due to the capacity of providing habitat and support a diversity of faunal species as well as several faunal SCC. It is of the highly recommended that if approval is granted, the proposed mining footprints and infrastructure locations be inspected by a suitably qualified and experienced ecologist to conduct thorough walkdowns prior to ground/vegetation clearing of the proposed areas to minimize the possible impact to SCC, as far as possible.

With proposed mitigations employed, most impacts may be reduced to medium, however impacts associated with the construction phase of Iota, Browns and Theta pits and Wishbone and Iota Waste Rock Dump are expected to remain high regardless of mitigation measures. It must be noted however that the extent and manageability of these impacts will decrease with mitigation measures. The proposed haul roads are anticipated to impact upon the Blyde River itself as well as the riparian habitat due to the upgrading of the river crossing and road network. Clearing activities of the riparian areas associated with the haul roads are likely to result in the displacement of amphibian and avifaunal species which inhabit and utilise these areas, whilst potentially providing an opportunity for AIPs to establish in the disturbed areas. Additional surface water runoff and sedimentation if not managed may result in amphibian habitat degradation.

Based on the results of the faunal assessment, it is the opinion of the specialist that this project will have negative impacts on the faunal ecology within the focus area and potentially on a local to regional scale. Of further importance it is expected that the impacts stemming from this project will be relatively irreversible. The impact of the proposed project must however be contrasted with the risk that uncontrolled artisanal mining poses. If the project is to be approved for overriding socio-economic reasons, an appropriate biodiversity offset and compensation plan as well as appropriate funding of this initiative is considered essential.

DOCUMENT GUIDE

The Document Guide below is for reference to the procedural requirements for environmental authorisation applications in accordance to GN267 of 24 March 2017, as it pertains to NEMA.

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Section A: Appendix E
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Section A: Appendix E
b)	A declaration that the specialist is independent	Section A: Appendix E
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section A: Section 1.1 – 1.3 Section C: Section 1.1 – 1.3
cA)	An indication of the quality and age of base data used for the specialist report	Section A: Section 2.1 and 3.1 Section C: Section 2
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section C: Section 5
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section C: 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	Section A: Appendix C Section C: Appendix A
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 C: Section 3 and 4
g)	An identification of any areas to be avoided, including buffers	Section C: Section 4
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 C: Section 4
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section C: Section 1.2
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 C: Section 5
k)	Any mitigation measures for inclusion in the EMPr	Section C: Section 5
l)	Any conditions for inclusion in the environmental authorisation	Section C: Section 5
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section C: Section 5
n)	A reasoned opinion -	Section C: Section 6
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section C: Section 6
(iA)	Regarding the acceptability of the proposed activity or activities	Section C: 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 C: Section 6
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	Section C: Appendix D
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section C: Appendix D
q)	Any other information requested by the competent authority	Section C: Appendix D

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ACRONYMS

Ad mon	Additional Monitoring
EIS	Ecological Importance and Sensitivity
EN	Endangered
GIS	Geographic Information System
GPS	Global Positioning System
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
LC	Least Concern
NT	Near Threatened
NYBA	Not yet been assessed
PES	Present Ecological State
POC	Probability of Occurrence
QDS	Quarter Degree Squares
SABAP	Southern African Bird Atlas
SCC	Species of Conservation Concern
STS	Scientific Terrestrial Services
VU	Vulnerable

1 INTRODUCTION

1.1 Background

Scientific Terrestrial Services (STS) was appointed to conduct a Faunal and Floral Ecological Assessment and Impact Assessments as part of the environmental assessment and Environmental Impact Assessment (EIA) process for the Transvaal Gold Mining Estate (TGME) Mine Development Project: Environmental Impact Assessment (EIA) process for the Transvaal Gold Mining Estate (TGME) Mine Development Project: Application for the amendment of the existing environmental authorisation to include the proposed Theta Open Pit Project to include the Theta Hill, Browns Hill and Iota Hill projects near Pilgrim's Rest, Mpumalanga Province. The areas to be assessed will henceforth be referred to as the "focus area" (Section A: Figure 2 – 3), except when specifically referring to the activities associated with Theta Hill, Browns Hill or Iota Hill.

The focus area falls within the Thaba Chweu Local Municipality and is located on Portion (Ptn) 42 of the Farm Ponieskrans 543KT (owned by Public Works), which forms part of five farm portions making up the existing Mining Right Area. The focus area is situated immediately to the south and west of Pilgrimsrest, a provincial heritage site, with the R533 running along the northern and eastern sides of the focus area. Apart from Mashishing (previously known as Lydenburg) (approximately 35 km southwest), no major towns are nearby; however, several tourist attractions are located close to the focus area, including the tourist town Graskop and the scenic tourist destination God's Window (approximately 8.2 km southeast). On a regional setting, the landscape consists of far-stretching hills with large portions still in a natural, undisturbed state. The major contributor of disturbance of natural habitat within the region includes mining, forestry and cultivation.

The proposed project entails surface mining operations at three locations, referred to as Theta Hill, Browns Hill and Iota Hill, with an anticipated Life of Mine (LoM) of five years. The mining footprint (Figure 2) includes three proposed Open Pits with berms and trenches, several WRDs as part of the operational activities, three proposed stockpiles, Pollution Control Dams (PCDs), Settling Dam, Low level river crossing and Linear developments such as power lines and haul roads (full description on Section A).

The purpose of this report is to define the faunal ecology of the footprint area as well as mapping and defining areas of increased Ecological Importance and Sensitivity (EIS) and to define the Present Ecological State (PES) of the footprint area. The objective of this study:

- To provide inventories of faunal species as encountered within the footprint area;

- To determine and describe habitat types, communities and the ecological state of the footprint area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To identify and consider all sensitive landscapes including rocky ridges, primary grasslands, wetlands and/ or any other special features that may be affected by the proposed development and in turn affect faunal assemblages of the region;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other Species of Conservation Concern (SCC), including potential for such species to occur within the footprint area;
- To provide detailed information to guide the activities associated with the proposed development activities associated within the footprint area; and
- To ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

1.2 Project Description

The Theta Project Mineral Resources traverse two mining right areas, namely 83MR for the portion within Ponieskrantz 543 KT, and 341MR for the portion within Grootfontein 562 KT. Only the portion within Ponieskrantz 543 KT, i.e. 83MR, is investigated in this study. The entire 83MR is situated on various portions of the farms Frankfort 509-KT, Krugers Hoop 527-KT, van der Merwes Reef 526-KT, Morgenzon 525-KT, Peach Tree 544-KT and Ponieskrans 543-KT, and encompasses an area of 9,413 hectares (ha). Extent of the area required for mining is 286 ha.

The existing and approved 83MR allows for the mining of gold ore, silver ore, copper ore and stone aggregate over the extensive 9,413 ha of land. It was granted, registered and executed and expires on 15 October 2023. An application for the amendment of the existing environmental authorisation has been submitted to include the proposed Theta Open Pit Project. In support of this, an Environmental Authorisation and IWULA amendment process is underway.

Historically the area on 83MR has operated in terms of open cut as well as underground gold mines. Theta Hill, Browns Hill and Iota Hill have historically been exploited as mainly underground mines with very limited open pitting. The Theta Hill, Browns Hill and Iota Hill surface projects, collectively referred to as the “Theta Project”, entails surface mining operations at the abovementioned three locations, with an anticipated Life of Mine (LoM) of five and half years.

To effectively establish the open pit mining operation, a number of infrastructure items will be required. Extent of the area required for the proposed Theta mine is listed in the below table. A depiction of the proposed mine layout is provided in Figure 2. The existing TGME Plant falls within the MR341 mining licence area. Included in this area will be the newly proposed mining site (Offices, workshops, stores, etc.).

Table 1: Extent of the infrastructure associated with the Theta Project.

NAME	ENCLOSED AREA (Ha)	TOTAL LENGTH/ PERIMETER (Km)
Access Road		6,98
Balancing Dam	3,35	
Berms		10,44
Browns Pit	17,45	
Clean Water Channels		27,60
Culverts	0,24	
Dirty Water Channel		52,24
Haul Roads	9,54	9,60
Iota Pit	25,53	
Iota Pollution Control Dam	8,33	
Iota Waste Rock Dump North	45,88	
Iota Waste Rock Dump South	16,66	
Low Level River Crossing	0,49	
Mine Boundary		6,42
Mine Contractor Area	1,82	
Outlet Structures	0,19	
Pipelines		3,39
Powerline		2,35
Silt Trap	0,04	
Spillway	0,30	
Stilling Basin	0,22	
Theta Pit 1	12,74	
Theta Pit 2	6,29	
Theta Satellite Pit 1	0,03	
Theta Satellite Pit 2	0,38	
Theta Satellite Pit 3	0,62	
Topsoil Stockpile	12,82	
Water Treatment Plant	0,21	
Wishbone Waste Rock Dump	23,14	
Wishbone Pollution Control Dam	2,45	

1.3 Progression of site layouts from Environmental Scoping Phase to EIA Phase

The Theta Project progression from an initial layout to the most feasible site layout has been significantly influenced by engineering, economic, environmental and social considerations and is described in detail in **Section A**. Certain biophysical and social baseline studies, namely terrestrial ecology (fauna and flora), soils and land capability, air quality, noise and vibration, visual impact, socio-economic and health impact, water quality, heritage and the rehabilitation objectives, returned substantial environmental and social sensitivities and nuances. In the case of the Theta Project, the site layout plan was subsequently altered from that what was initially presented in the Scoping Report (Figure 1) to reflect revised pit layouts (with the Theta Pit being largely affected), new Waste Rock Dump (WRD) locations as well as optimisation of the overall project footprint to achieve the best Integrated Environmental Management (IEM) scenario considering the extent of baseline information available at the time (Figure 2).

The altered site layout plan was achieved through the implementation of the following mitigation hierarchy:

1. Avoid the potential impact altogether;
2. Minimise the area of the potential impact as far as possible;
3. Rehabilitate and restore the affected area; and
4. Secure a biodiversity offset area as compensation for the affected area.

In this instance, the pit shells were reduced in size on Theta Hill and waste rock dump sites were relocated to avoid/minimise the impacts on the ground-truthed portions of highest biodiversity significance to minimize the extent of areas requiring detailed rehabilitation and to limit the requirements for offsets of residual impacts. Refer to Figure 2 for the revised site layout plan which will be incorporated into the EIA Report and EMP.

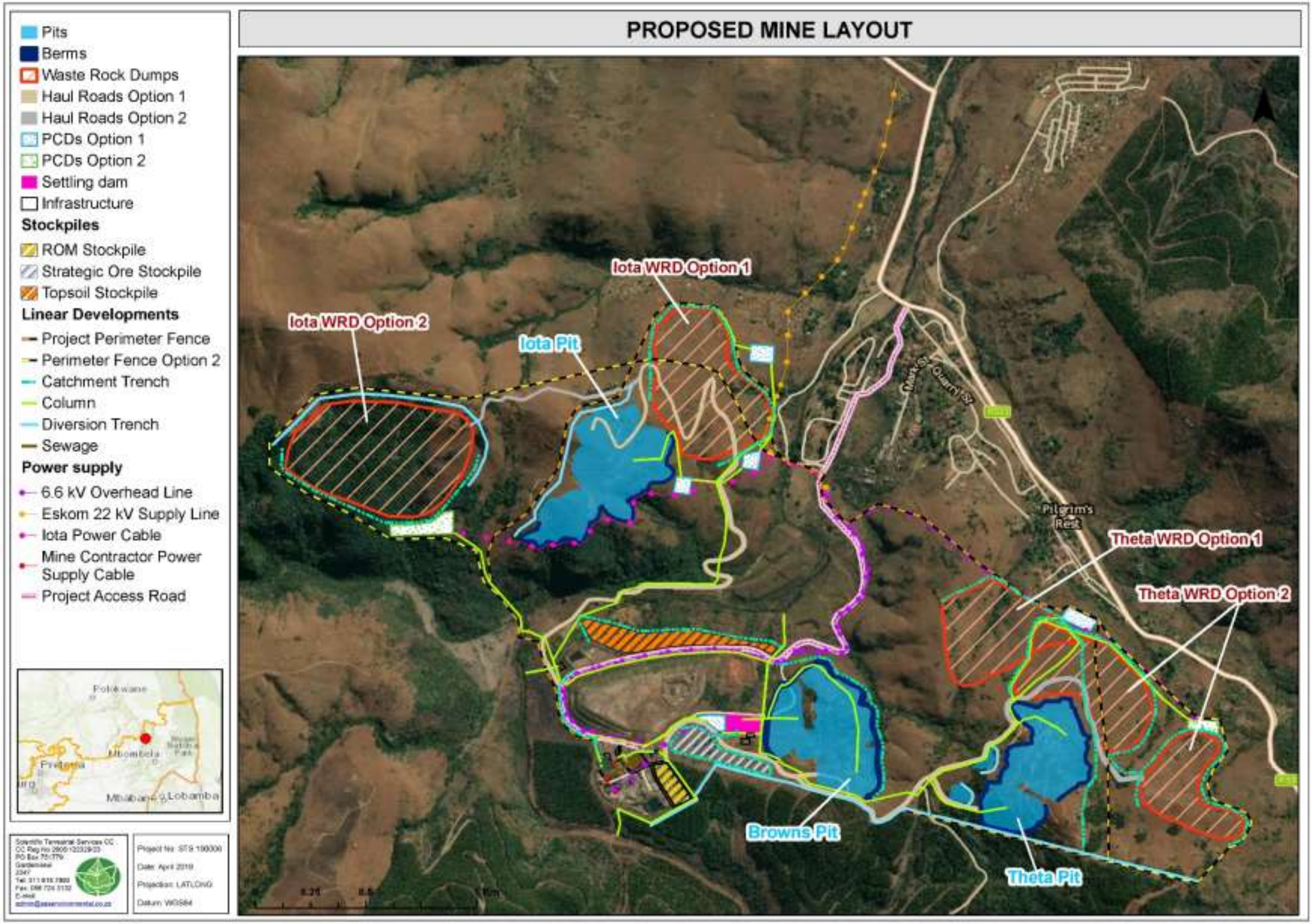


Figure 1: The initial proposed mine layout for the Theta Project as part of the Scoping Phase.

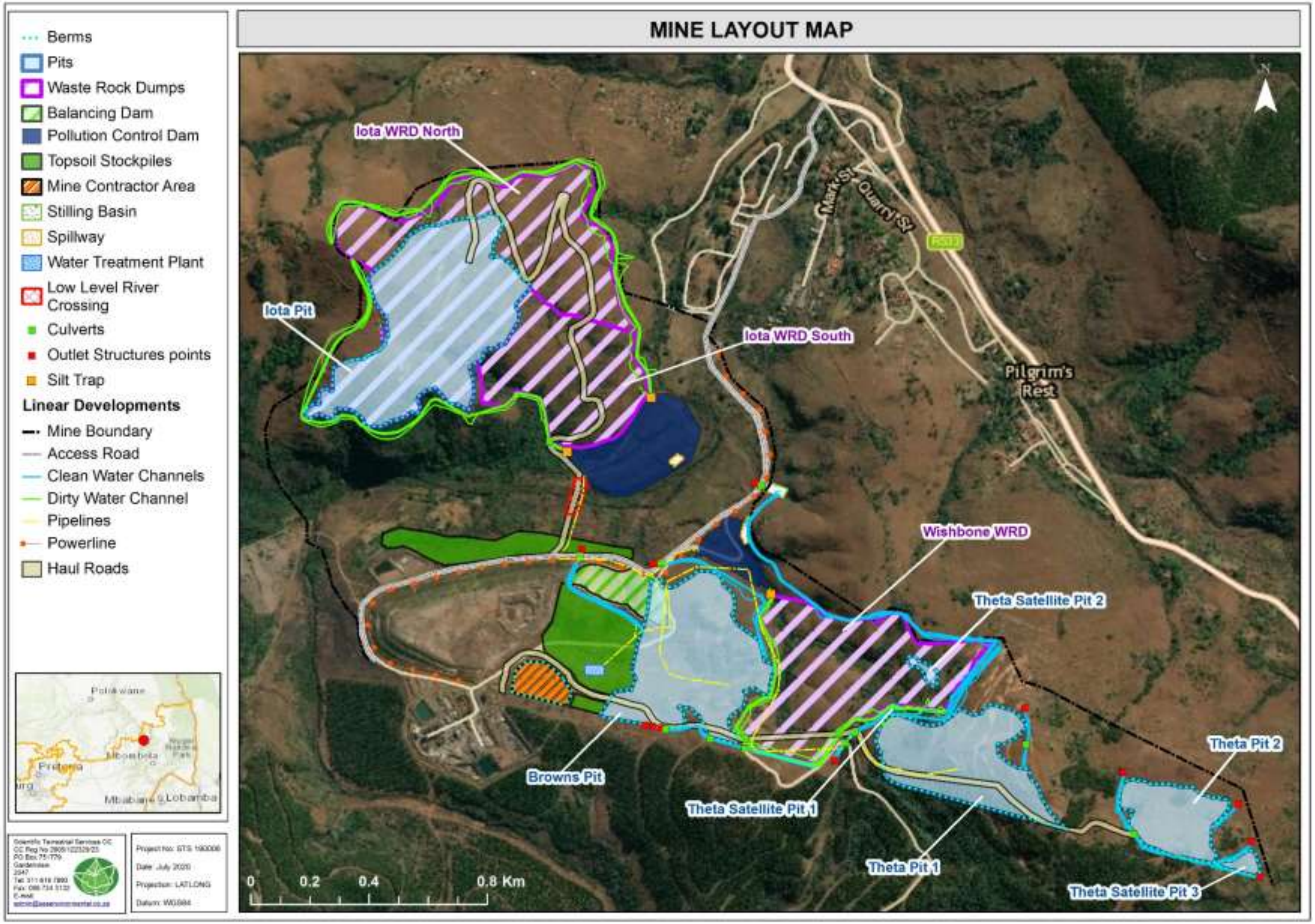


Figure 2: The proposed EIA Phase mine layout (Layout 3) for the focus area.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- Unfavourable weather conditions were encountered during the March 2019 survey (overcast, mist and strong winds), limiting faunal species observations;
- Due to additional layout changes a follow-up summer assessment was required which took place from the 28th of January 2020 to the 31st of January 2020, thus allowing for a more saturated species list;
- At the request of the Department of Environment, Forestry and Fisheries (DEFF), an assessment of the forest areas and drainage lines on Iota Hill and within the Wishbone WRD was undertaken from the 29th to the 30th of April 2020. During this assessment, areas were visited where smaller changes to the proposed layout was made;
- The faunal assessment is confined to the footprint area and does not include the neighboring and adjacent properties; these were however considered as part of the desktop assessment (Section A);
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most faunal communities have been accurately assessed and considered and the information provided is considered sufficient to allow informed decision making to take place and facilitate integrated environmental management;
- Due to the nature and habits of most faunal taxa, the high level of surrounding anthropogenic activities, it is unlikely that all species would have been observed during a field assessment of limited duration. Therefore, site observations were compared with literature studies where necessary;
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa within the footprint area may therefore have been missed during the assessment; and
- Three field assessments were undertaken, the first from the 26th - 29th of March 2019, the second from the 28th – 31st January 2020 and the third from 29th to the 30th of April 2020, to determine the ecological status of the footprint area, and to “ground-truth” the results of the desktop assessment. A more accurate assessment would require that assessments take place in all seasons of the year. However, on-site data was significantly augmented with all available desktop data, previous work done in the area and specialist experience in the area. The findings of this assessment are considered to be an acceptably accurate reflection of the ecological characteristics associated with the footprint area.

2 ASSESSMENT APPROACH

Several field assessments were undertaken across summer and autumn:

- The initial assessment took place from the 26th to the 29th of March 2019 (early autumn season) in order to determine the floral ecological status of the focus area;
- The summer assessment took place from the 28th to the 31st of January 2020 where the focus was to re-visit selected sites in the focus area to allow for a more saturated species list and to search for protected floral species; and
- A follow-up autumn assessment of selected forest patches and other areas where small layout changes had been made took place from the 29th to the 30th of April 2020 where.

During the field assessments a reconnaissance 'walkabout' was initially undertaken to determine the general habitat types found throughout the footprint area, following this, specific study sites were selected that were considered representative of the habitats found within the area, with special emphasis being placed on areas that may potentially support faunal Species of Conservation Concern (SCC). Sites were investigated on foot to identify and define the faunal assemblage within the footprint area. Sherman traps, camera traps, pitfall traps and bat recording devices were used to increase the likelihood of capturing and observing small mammal species, notably nocturnally active species.

A detailed explanation of the method of assessment is provided in Appendix A of this report. The faunal categories covered in this assessment include mammals, avifauna, reptiles, amphibians, general invertebrates and arachnids.

2.1 General Approach

In order to accurately determine faunal ecostatus of the footprint area and capture comprehensive data with respect to faunal taxa, the following methodology was used:

- Maps and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. An initial visual on-site assessment of the footprint area was made in order to confirm the assumptions made during consultation of the maps;
- Literature review with respect to habitats, vegetation types and species distribution was conducted;
- Relevant databases considered during the assessment of the footprint area included the South African National Biodiversity Institute (SANBI) Threatened species

programme (TSP), Threatened or Protected Species (TOPS) of NEMBA, Pretoria Computer Information Systems (PRECIS), South African Bird Atlas Project 2 (SABAP2), International Union for Conservation of Nature (IUCN), South Africa Protected Area Database (SAPAD), and National Biodiversity Assessment (NBA);

- Specific methodologies for the assessment, in terms of field work and data analysis of faunal ecological assemblages are presented in Appendix A of this report; and
- For the methodologies relating to the impact assessment and development of the mitigation measures, please refer to Section A within this report.

2.2 Sensitivity Mapping

All the ecological features associated with the footprint area were considered, and sensitive areas were assessed. In addition, identified locations of protected species were marked by means of Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto digital satellite imagery and/or topographic maps. The sensitivity map should guide the final design and layout of the proposed development activities.

3 FAUNAL ASSESSMENT RESULTS

3.1 Faunal Habitat

The Footprint Area comprised of three faunal habitat units. These habitat units are discussed briefly in terms of faunal utilisation and importance below. For a more detailed description and discussion of these habitat units from a vegetation standpoint see Section B (Floral Report).

Montane Grassland

This habitat unit according to Mucina and Rutherford (2018) is associated with three grassland vegetation types including the Long Tom Pass Montane Grassland situated in the northern portion of the focus area, the Northern Escarpment Quartzite Sourveld comprising of a small section in the southern portion and the Northern Escarpment Dolomite Grassland which encompasses the majority of the focus area. Which offers ideal habitat for wide variety of species including mammals, reptiles and avifaunal species.

Figure 3: Visual representation of the Montane Grassland Habitat Unit

Mountain Outcrops

The mountain outcrops habitat unit expands throughout the focus area. The distinguishing characteristic of this habitat unit is the composition of prominent rock features that support a diversity of faunal and floral species. Two floral communities are associated with this habitat unit namely cliff face vegetation and rock outcrop vegetation. The Mountain Outcrop habitat unit offers ideal habitat for numerous reptile SCC and arachnid species which will take advantage of the crevices for shelter.

Figure 4: Visual representation of the cliff face and rocky outcrops associated with the Mountain Outcrop habitat unit

Forest Remnants

This habitat unit can be further divided into two different vegetated areas, namely:

- Degraded Forest; and
- Indigenous Forest Remnants.

The eastern portion of Indigenous Forest is located within the Wishbone WRD footprint area, and as such will be lost as waste rock is deposited in this area. The portion of Indigenous Forest located in the western portion of the focus area falls outside of the proposed mining footprint and as such will not be subjected to clearing activities, provided footprint creep does not occur. The outer boundaries of the Indigenous Forest will however be impacted by the linear infrastructure which will lead to the removal of some vegetation in this habitat. Portions of the Degraded Forest will be subjected to clearing as they fall within the Iota pit and WRD footprints. Although this habitat is dominated by alien and invasive woody species the habitat unit still provides a semblance of habitat for faunal species, whilst there is an increased likelihood that raptors and other avifauna may also take advantage of the area for nesting purposes.

Figure 5: Visual representation of the Indigenous Forest areas.

Riparian Habitat

The Blyde River and smaller drainage lines have all been grouped and discussed under this vegetation type, unless where necessary each specific area is discussed separately. The dominant and most important freshwater resource in the region is the Blyde River which runs through the centre of the focus area. In addition to the Blyde River there are several smaller drainage lines, all tributaries of the Blyde River. The most notable of these is the Peach Tree Stream. This habitat unit could not be assessed in great detail due to dense Alien Invasive Plant proliferation and risk posed due to the close proximity to illegal miners in the area. This habitat unit provides ideal habitat for amphibians, small mammals, reptiles and waterfowl. In addition, the Blyde River serves as a permanent water resource for species in the region.

Figure 6: Visual representation of the Riparian Habitat along the Blyde River.

Degraded and Transformed Habitat

The Transformed Habitat comprise of areas where indigenous vegetation has been cleared for mining, housing and forestry purposes whilst the Degraded Habitat is characterised by been historically disturbed areas which are notably dominated by Alien Invasive Plants (AIP). The Degraded Habitat unit is likely to support common avifaunal species, whereas the canopies of the eucalyptus plantations may provide nesting and/or roosting for larger raptor species. A visual representation of the observed faunal habitat units are displayed in Figure 7 below.

Figure 7: Visual representation of the Degraded Habitat Unit

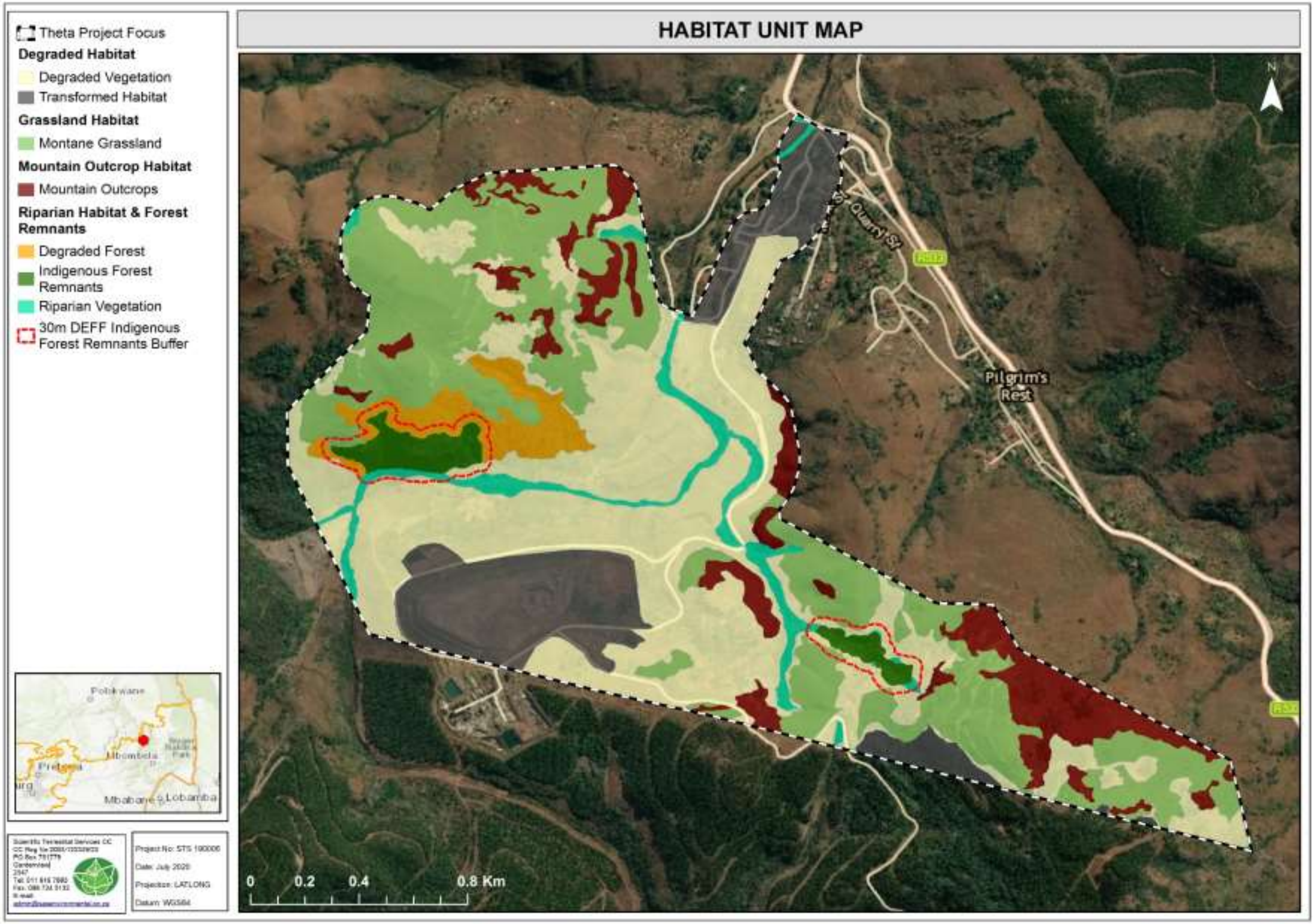


Figure 8: Habitat units observed within the focus area.

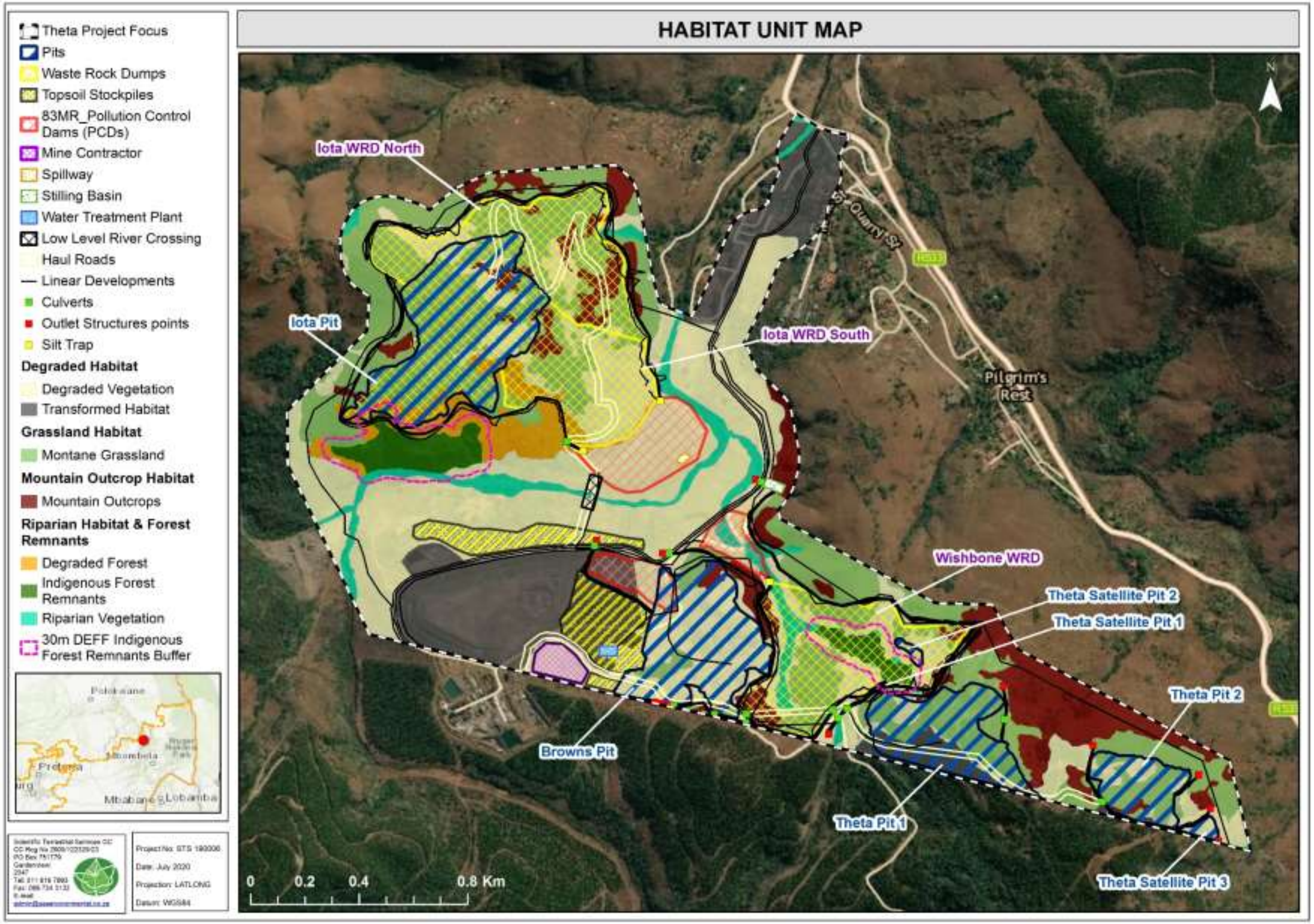


Figure 9: Habitat units with the proposed mining activities within the focus area.

3.2 Mammals

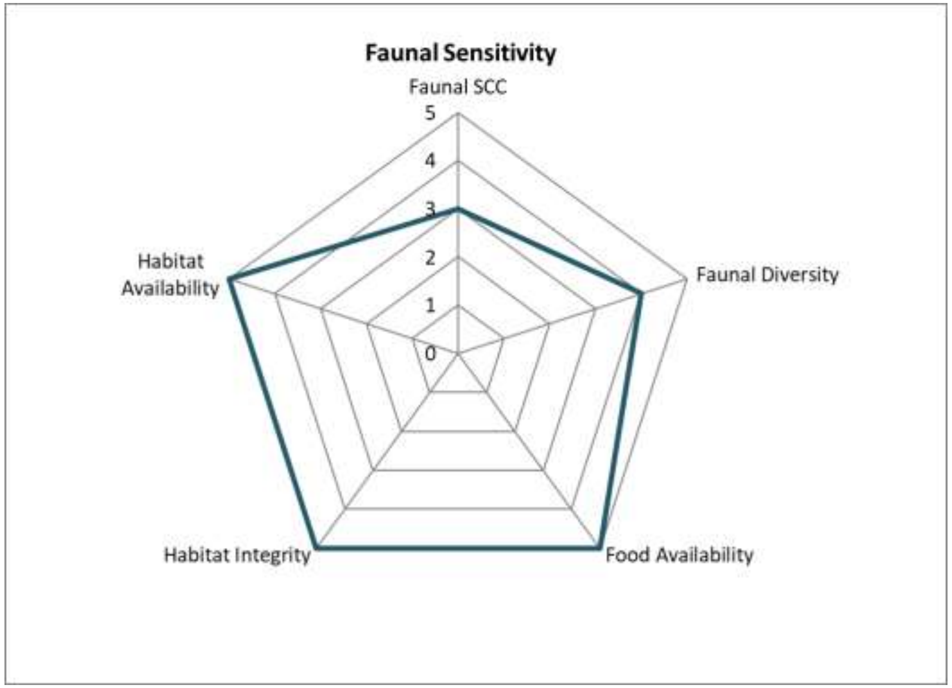
Table 2: Field assessment results pertaining to mammal species within the Focus Area

Faunal Class: Mammals	Faunal Habitat Sensitivity	Moderately High

Notes on the photographs:

Top: *Elephantulus myurus* (Eastern Rock Sengi) and *Aethomys namaquensis* (Namaqua Rock Mouse);
Middle 1st row: *Redunca fulvorufula* (Mountain Reedbuck) and *Chlorocebus pygerythrus* (Vervet Monkey);
Middle 2nd row: *Sylvicapra grimmia* (Common Duiker) and *Oreotragus oreotragus* (Klipspringer); and
Bottom: *Tragelaphus strepsiceros* (Greater Kudu) herd.

Faunal Sensitivity Graph:



<table>
<tr>
<td>Faunal SCC/Endemics/ TOPS/</td>
<td>Three mammal SCC were recorded during the survey namely Pelea capreolus (Grey Rhebok, NT), Rhinolophus blasii (Blasius's Horseshoe Bat, NT) and Rhinolophus smithersi (Smithers Horseshoe Bat, NT). The footprint area is capable of supporting various mammal SCC which have previously been recorded in the Quarter Degree Squares (QDS) including: Amblysomus hottentotus meesteri (Meester's golden mole, NE), Chrysospalax villosus (Rough-haired golden mole, VU), Leptailurus serval (Serval, NT), Mellivora capensis (Honey badger, NT), Otomys laminatus (Laminate Vlei Rat, NT), Panthera pardus (Leopard, NT), Rhinolophus cohenae (Cohen's Horseshoe Bat, VU), Rhinolophus hildebrandtii (Hildebrandt's Horseshoe Bat, NT) and Rhinolophus swinnyi (Swinny's Horseshoe Bat, VU).</td>
<td rowspan="2">Business Case, Conclusion and Mitigation Requirements:
The overall mammal habitat sensitivity is considered moderately high with a number of SCC likely to occur within the proposed mining areas. The proposed mining activities will result in the displacement of faunal species due to the increase in human activity, either temporarily or permanently from some areas.

Panthera pardus (Leopard) has a high likelihood of occurring within the mountainous areas, with home ranges that likely extend beyond that of the footprint area of the mine. Generally exhibiting both nocturnal and crepuscular behaviour patterns, leopards are normally solitary except during breeding season or when a female is with cubs. Threats to this species are mainly due to habitat destruction and the subsequent decline in viable food resources, conflict with humans and loss of home range.

Several old mine shafts and caves are located within the focus area which may be utilised by bat species, however the constant movement of illegal miners through these adits is likely to limit the use of these more active adits by bats. Consideration needs to be given that the construction of additional surface infrastructure and operational lights will have an increased probability of altering movement patterns and bat foraging areas due to the attraction of insects to these areas.

Issues of concern in terms of the mining activities for mammal species:
➢ Disturbance and loss of habitat within the montane grassland habitat unit;
➢ Loss of foraging grounds for both herbivorous and carnivorous species. Displacement of these species will lead to increased pressure on the surrounding natural areas and resources. In addition, predatory species will be forced to adjust the home ranges in order to supplement the loss of foraging grounds. The adjustment of home ranges and displacement of species will likely lead to increased intra and interspecific competition, which will cumulatively lead to the loss of species abundance and possibly diversity;
➢ Vehicle movement and mining activities within sensitive faunal habitat will result in species disturbance, displacement as well as increased mortalities due to vehicle collision.

In order to minimise the impact to mammal species, the following mitigatory actions are recommended:
➢ Opencast footprint in highly sensitive habitat areas should be either avoided, or where this is not feasible, minimised in order to keep disturbance levels to a minimum;
➢ Mining footprint areas are to remain as small as possible and no vegetation clearance outside of these areas is to occur;
➢ Downlighting and as few external lights as needed are to be used for all lighting requirements at night. Additionally, red lights of lower frequencies are to be used in order to limit insect attraction and subsequently the attraction of bats; and
➢ Prior to any vehicle movement along routes during the construction phase or on the mining site, mammal species should be flushed from the area to avoid collision with mining vehicles.</td>
</tr>
<tr>
<td>General Mammal Discussion</td>
<td>During the field assessments sherman traps were used to establish the presence of small mammals, whilst motion sensitive camera traps were used within the focus are to record larger cryptic mammal species which may otherwise not be seen during whilst moving through the area. Faunal diversity was rated Moderately High, the common mammalian species observed during the survey included Elephantulus myurus (Eastern Rock Sengi), Rattus norvegicus (Brown Rat), Sylvicapra grimmia (Common Duiker), Canis mesomelas (Black-backed Jackal) and Pelea capreolus (Grey Rhebok).

The food and habitat availability within the focus area is rated High with good browsing and grazing potential, the high abundances of invertebrates, avifauna and amphibian life, promote the occurrence of predaceous small mammals. The diversity of the habitat units in themselves provides a myriad of macro and micro habitats for mammal species, including areas of refuge and secluded areas for the raising of young. The variation amongst the habitat units further provides a variety of food resources for mammal species which is a contributing factor to the moderately high diversity of species. The small and medium sized herbivores which occur within the focus area are in turn utilised by predatory species as a food resource. In addition, is likely that the focus area will form part of the larger home ranges of predators, notably Canis mesomelas and Panthera pardus and as such the loss of the habitat within the focus area will impact upon these species as well as others.

The habitat integrity of the focus area is classed High for the focus area, although large areas of the degraded habitat unit are present within the focus area, the remaining habitat units are intact enough to support a diverse assemblage of mammal species.</td>
</tr>
</table>

3.3 Avifauna

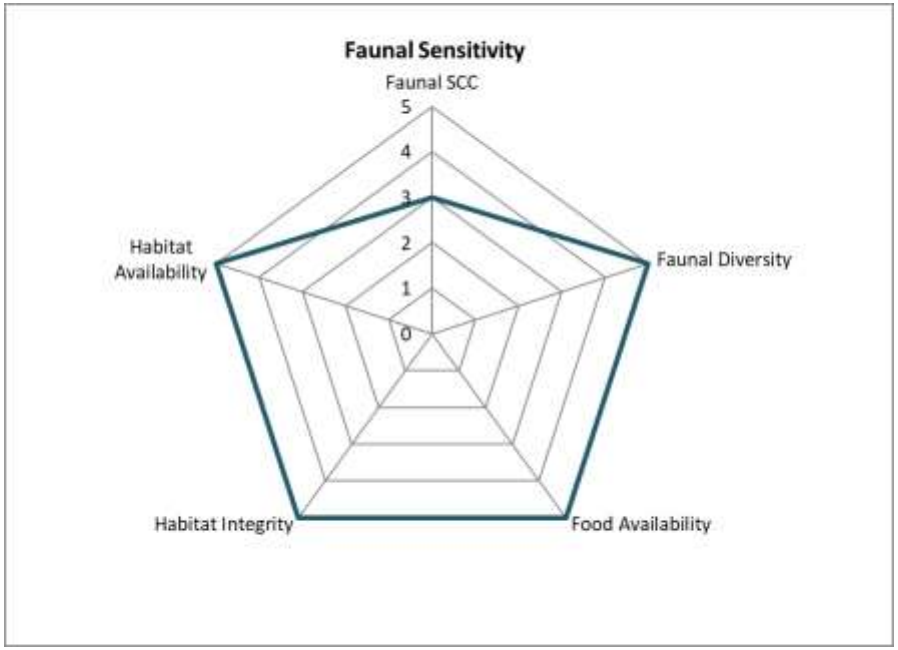
Table 3: Field assessment results pertaining to avifaunal species within the Focus Area

Faunal Class: Avifauna	Faunal Habitat Sensitivity	Moderately High

Notes on the photographs:

Top: *Saxicola torquatus* (African Stonechat) (left) and *Batis capensis* (Cape Batis) (right); **Middle:** *Prinia subflava* (Tawny-flanked Prinia) (left) and *Monticola rupestris* (Cape Rock Thrush) (right) **Bottom:** *Onychognathus morio* (Red-winged Starling) (left) and *Oenanthe bifasciata* (Buff-streaked Chat).

Faunal Sensitivity Graph:








<table>
<tr>
<td>Faunal SCC/Endemics/ TOPS/</td>
<td>No avifaunal SCC were observed during the survey, this is mainly due to the season the survey took place, with migrant species already having started their migrations. Several avifaunal SCC have been recorded historically in the QDS associated with the focus area including: Scotopelia peli (Pel's Fishing Owl, EN), Eupodotis senegalensis (White-bellied Korhaan, VU), Falco peregrinus (Peregrine Falcon, VU), Geronticus calvus (Southern Bald Ibis, VU), Gyps coprotheres (Cape Vulture, EN), Hirundo atrocaerulea (Blue Swallow, CR), Neotis denhami (Denhams Bustard, VU), Sagittarius serpentarius (Secretarybird, VU), Sarothrura affinis (Striped Flufftail, VU), Stephanoaetus coronatus (African Crowned Eagle, VU) and Zoothera gurneyi (Orange Ground-thrush, NT)</td>
<td rowspan="2">Business Case, Conclusion and Mitigation Requirements:

The overall avifaunal habitat sensitivity is considered moderately high. The proposed mining activities will likely result in the displacement of avifaunal species, either temporarily or permanently from the active mining areas.

Issues of concern in terms of the mining activities in terms of Avifauna:
➢ Loss of habitat and food resources;
➢ Increased noise may disturb large raptors and potential SCC frequenting the area causing them to disperse to surrounding areas ;
➢ Driving of vehicles to the opencast and overburden sites will place ground and other low-level nesting species at increased levels of risk. Nestlings may be driven over/trampled leading to a loss of species abundance and diversity during the construction phase;
➢ Sarothrura affinis (Striped Flufftail, VU) has been recoded historically in the 2450_3040 pentad on the 1st of March 2010, this species would generally be restricted to the riparian areas, it is imperative that a qualified ecologist inspect the areas where the intended haul roads and bridge crossings are to be constructed prior to construction;
➢ Disturbance of nests notably of the ground-nesting SCC Eupodotis senegalensis (White Bellied Korhaan); and
➢ Hirundo atrocaerulea (Blue Swallow, CR), have been recorded historically within the 2455_3045 pentad on the 3rd of December 2015. This species generally nest in underground cavities and old aardvark burrows.

In order to minimise the impact to avifaunal species, the following mitigatory actions are recommended:
➢ Bird flappers/diverters on all suspended high voltage lines, especially those along hillslopes and near water courses;
➢ Mining activities in highly sensitive habitat areas such as the Montane Grassland and Riparian habitat unit should be avoided so as to lessen the potential impact to species; and
➢ Prior to the movement of the mining vehicles to the various sites, a walkdown should be undertaken to assess the areas for the presence of nests, notably of ground breeding species that will place nests under vegetation. Should any nests be observed, the access route and/or mining site should be adjusted in order to avoid disturbance of the nesting sites.</td>
</tr>
<tr>
<td>General Avifaunal Discussion</td>
<td>During the various field assessments several avifaunal species were recorded. The initial field assessment yielded limited results as a result of the inclement weather patterns experienced, however subsequent follow up assessments produced better observations.

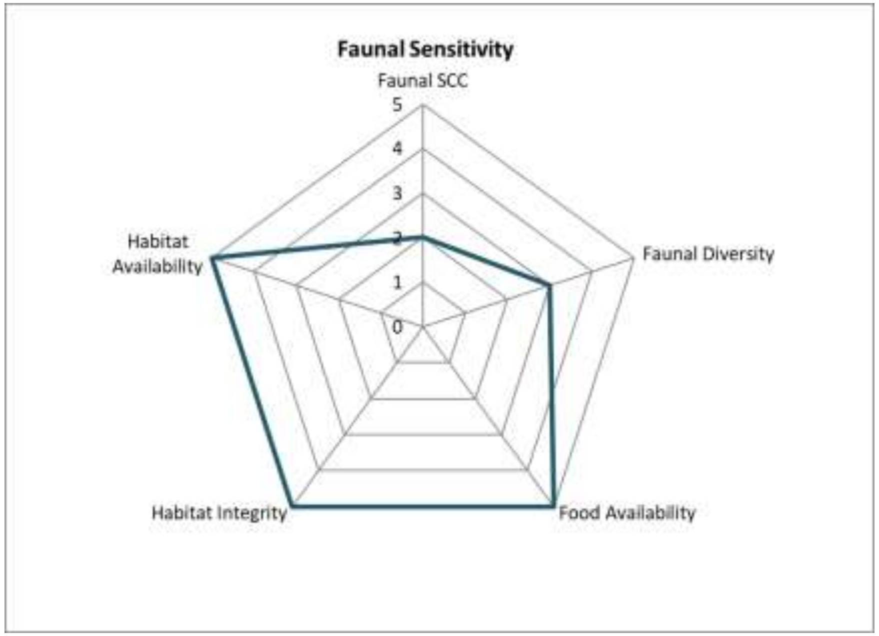
Common species observed included: Saxicola torquatus (African Stonechat), Cossypha dichroa (Chorister Robin Chat), Cossypha caffra (Cape Robin-chat), Buteo rufofuscus (Jackal Buzzard), Falco rupicolus (Rock Kestrel), Halcyon albiventris (Brown-hooded Kingfisher) and Plocepasser mahali (White-browed Sparrow Weaver). For the full list of observed birds see Appendix C.

The food availability within the focus area is expected to be high for avifaunal species. The varying habitat units offer a wide range of food resources for avifaunal species that will forage throughout the focus area. The Mountain Outcrops, Montane Grassland habitat and to a degree the Degraded habitats provide good resources for graminoid and nectar feeding avifauna. The Riparian Habitat unit in turn provides habitat for avifauna associated with watercourses whereas the plantations and forested areas provide good nesting and roosting habitat for raptors. The likelihood that large raptors frequent the area is deemed high due to the available food resources and potential nesting sites.

The habitat integrity of the Mountain outcrops, Montane Grassland and Riparian Habitat unit appears to be in good condition with limited alien invasive plant proliferation present.</td>
</tr>
</table>

3.4 Amphibians

Table 4: Field assessment results pertaining to amphibian species within the Focus Area

Faunal Class:	**Faunal Habitat Sensitivity**	**Moderately High**	
Amphibians	**Notes on Photograph:** **Top:** *Amietophrynus rangeri* (Raucous Toad) (left) and *Amietophrynus gutturalis* (Guttural Toad) (right); **Middle:** *Afrana angolensis* (Angola River Frog); **Bottom:** Tadpole, likely that of *Afrana angolensis* (Angola River Frog).		
Faunal Sensitivity Graph: 			

<table>
<tr>
<td>Faunal SCC/Endemics/ TOPS/</td>
<td>No amphibian SCC were observed during the survey although there is a high likelihood that some SCC may occur within the Blyde River. Amphibian SCC which have been recorded historically in the QDS which are protected by the MTPA included: Hadromophryne natalensis (Natal Ghost Frog, NT). Other protected species outlined by the Mpumalanga province that may occur within the focus area includes Hyperolius semidiscus (Yellow Striped Reed Frog, VU) which has an increased probability of occurrence.</td>
<td rowspan="2">Business Case, Conclusion and Mitigation Requirements:

The overall amphibian habitat sensitivity is considered Moderately-High. No amphibian SCC were observed during the field assessment, while historical observations do indicate the presence of Hadromophryne natalensis (Natal Ghost Frog), this species is generally associated with clean highly oxygenated perennial rivers and kloofs/gorges. The proposed activities associated with the Blyde River (haul roads/ power lines) located within and in close proximity to the freshwater areas may pose a threat to amphibian species.

Issue of concern in terms of the mining activities in terms of amphibian species:
➢ Disturbance and loss of habitat within the Blyde River as a result of the establishment of the proposed haul roads.
➢ Possible sedimentation as result of the proposed bridge construction, will likely cause the deposition of amphibian species; and
➢ Alien Invasive Plant proliferation of the Blyde River associated with the Haul Road and Powerline activities, is likely to cause serious habitat transformation which may cause the migration of amphibian SCC if not managed appropriately.

In order to minimise the impact to amphibian species, the following mitigatory actions are recommended:
➢ It must be ensured that the delineated freshwater systems including the applicable buffer zones continue to be excluded from mining activities, and that all edge effects are appropriately managed to ensure that the Blyde River system is not impacted upon.</td>
</tr>
<tr>
<td>General Amphibian Discussion</td>
<td>Three amphibian species were observed during the survey namely: Afrana angolensis (Angola River Frog); Amietophrynus gutturalis (Guttural Toad) and Amietophrynus rangeri (Raucous Toad).

The amphibian diversity of the focus area was classed Intermediate, with good food availability within the Blyde River system. The food availability and habitat integrity of the riparian habitat were classed high, primarily due to the high invertebrate communities observed in the surrounding areas which serve as a suitable food resource to amphibian species. The Blyde River reach associated with the focus area also offers good habitat for leaf folding frogs with extensive reed banks established downstream.

The habitat integrity of the riparian habitats associated with the focus area was classed High, although several low bridge crossings are established downstream which have slightly altered the flow dynamics of the reach, adequate habitat still remains available for amphibian species.</td>
</tr>
</table>

3.5 Reptiles

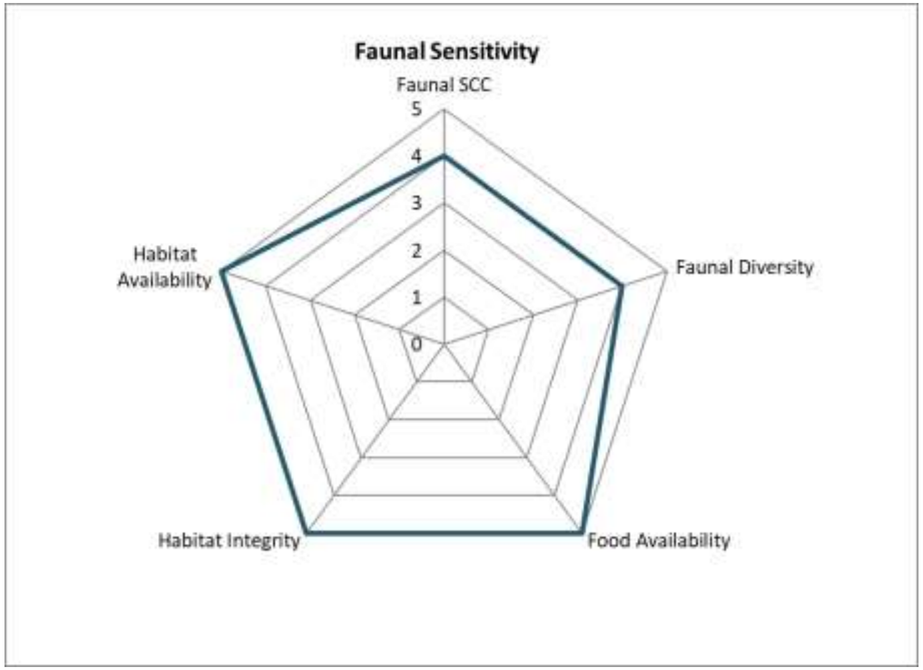
Table 5: Field assessment results pertaining to reptile species within the Focus Area

Faunal Class: Reptiles	Faunal Habitat Sensitivity	Moderately High

Notes on the photographs:

Top: *Chamaeleo dilepis* (Common Flap-necked Chameleon, LC) (right) and *Agama aculeata distanti* (Eastern Ground Agama) (right); **2nd Row:** *Pseudocordylus melanotus* (Drakensburg Crag Lizard) (left) and *Lygodactylus capensis capensis* (Common House Gecko) (left); **3rd Row:** *Trachylepis varia* (Variable Skink) (left) and *Panaspis wahlbergi* (Wahlberg's Snake-eyed Skink) (right); **Bottom:** *Philothamnus natalensis occidentalis* (Western Natal Green Snake).

Faunal Sensitivity Graph:









Faunal SCC/Endemics/ TOPS/	No Reptile SCC were observed during the site assessments. Several SCC have been recorded in the QDS associated with the focus area which includes: *Amblyodipsas concolor* (Natal Purple-glossed Snake, VU), *Amplorhinus multimaculatus* (Many-spotted Reed Snake, NT) *Bradypodion transvaalensis* (Northern Dwarf Chameleon, VU), *Chamaesaura aenea* (Coppery Grass Lizard, NT), *Chamaesaura macrolepis* (Large-scale Grass Lizard, NT) and *Tetradactylus breyeri* (Breyer's Long-tailed Seps, VU).
General Reptile Discussion	Several species of reptiles were observed during the assessment including *Chamaeleo dilepis* (Common Flap-necked Chameleon, LC), *Pseudocordylus melanotus* (Drakensburg Crag Lizard, LC), *Psammophylax tritaeniatus* (Striped Grass Snake), *Philothamnus natalensis occidentalis* (Western Natal Green Snake) and *Agama aculeata distanti* (Eastern Ground Agama) amongst others.   The initial faunal assessment (March 2019) yielded low reptile observations primarily due to the cooler and less favourable weather conditions encountered, however the subsequent survey (January 2020) yielded greater results, with increased reptile activity and abundance being noted. The focus area is capable of supporting a diversity of reptiles due to the high level of food availability. The habitat and food availability of the footprint area was defined as high during the assessment with high abundances of invertebrate and small mammal species observed during the assessment. The Montane Grassland habitat unit provides good habitat for most of the expected SCC with high abundances of insects and small mammals present. The Mountain outcrops offer ideal shelter for theses SCC with scattered crevices observed during the assessment. The habitat integrity of the focus area remains largely intact for reptile species although moderate transformation has occurred.
Business Case, Conclusion and Mitigation Requirements:	The overall reptile sensitivity is considered moderately high. No reptile SCC were observed during the assessment however this does not exclude the possibility that they will occur within the focus area. The proposed mining activities are likely to result in the displacement of reptile species either temporarily or permanently from the targeted mining areas. Issues of concern in terms of the mining activities in terms of reptile species: ➢ *Amblyodipsas concolor* (Natal Purple-glossed Snake, VU) and *Amplorhinus multimaculatus* (Many-spotted Reed Snake, NT) are burrowing species which reproduce mainly by laying eggs, although records of live young reproduction have been made for *Amblyodipsas concolor*. Prior to excavation of the opencast pits, a qualified ecologist should inspect the area for these species during the appropriate season; ➢ *Bradypodion transvaalensis* (Northern Dwarf Chameleon, VU) can occur in high densities in favourable habitat and are generally arboreal. Special attention should be paid in riparian habitat unit and densely vegetated areas of the montane grassland habitat unit, prior to construction if found specimens should be relocated; ➢ Many of the small skinks and lizards live in burrows in the sand and under rocks and dead logs. Vehicles moving through the natural vegetation are likely to drive over these burrows, possibly killing the inhabitants therein during construction and operational phases; and ➢ Disturbance and loss of habitat will result in the displacement of reptile species as well as the impact on their required food resources in the mining areas; To minimise the impact to reptile species, the following mitigatory actions are recommended: ➢ Mining sites in highly sensitive habitat areas such as the mountain outcrops, montane grassland and Riparian habitat unit should be avoided or minimised as far as possible so as to reduce the potential impact to species; ➢ Personnel working at the mine are to be educated and made aware about snakes in the area and instructed that they are not to be harmed. Nominated personnel working at the mine should be trained on how to catch, handle and relocate snakes that are found within the mine premises; and ➢ Workspace areas and buildings are to be kept clean, avoiding the unnecessary collection of rubbish and food waste, as this will attract rodents leading to an influx of predatory snakes.

3.6 Invertebrates

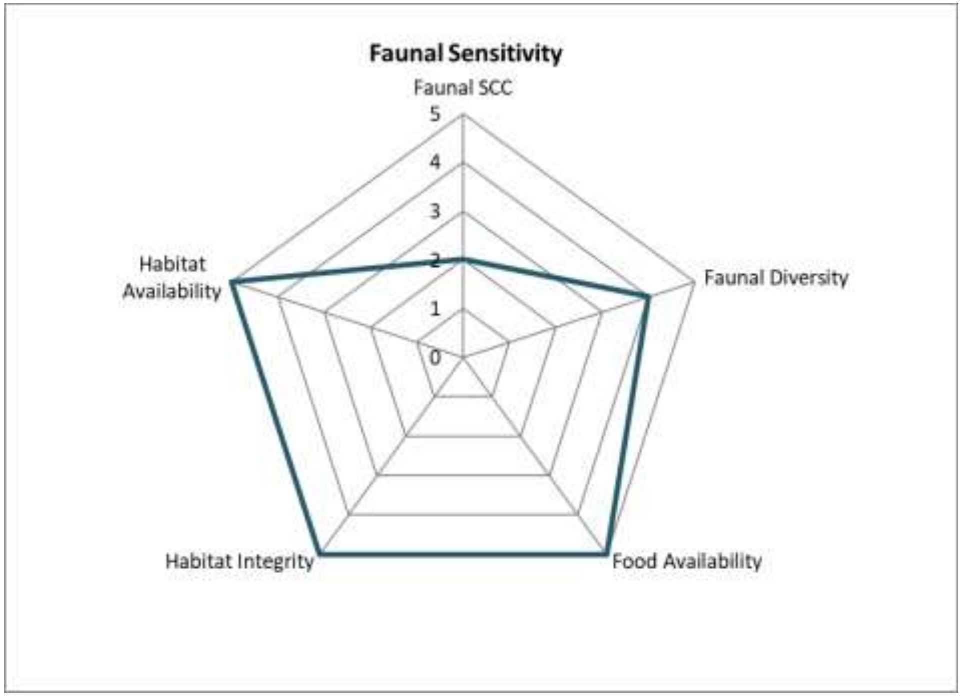
Table 6: Field assessment results pertaining to invertebrate species within the Focus Area

Faunal Class: Invertebrates	Faunal Habitat Sensitivity	Moderately High

Notes on the photograph:

Top: *Xeloma tomentosa* (Gold-haired Fruit Chafer) (left), *Acraea natalica* (Natal Acraea) (middle) and *Platypleura hirta* (Cicada) (right); **Middle:** *Bicyclus anynana* (Squinting Bush Brown) (left) and *Gastrimargus* sp; **Bottom left:** *Platycypha caligata* (Dancing Jewel) (above) and *Pseudagrion spernatum* (Upland Sprite) and **Bottom right:** *Orthetrum Julia* (Julia Skimmer).

Faunal Sensitivity Graph:



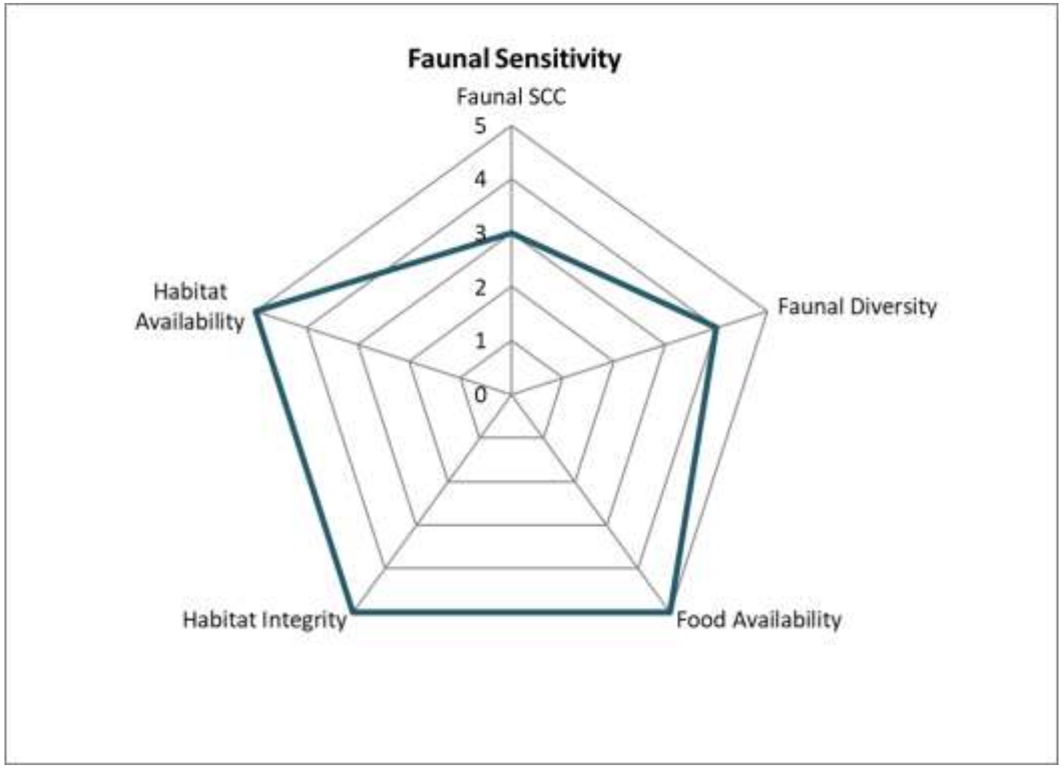
Faunal SCC/Endemics/ TOPS/	No invertebrate SCC were observed during the survey, although several species have been recorded historically within the associated QDS and may occur within the focus area, namely *Orachrysops violescens* (VU), *Proischnura rotundipennis* (Round Winged Bluet, VU), *Pseudagrion newtoni* (Harlequin Sprite, VU), *Aloeides nubilus* (Cloud Copper, EN) and *Lepidochrysops irvingi* (Irving's Blue, EN). The majority of these species rely on intact montane grasslands and freshwater systems in order to survive. The proposed mining activities may place additional pressure on the remaining populations of these species as habitat is lost and / or degraded.
General Invertebrate Discussion	 *Catacroptera cloanthe cloanthe*  Family Bacillidae  *Dischista rufa*  *Anisorrhina umbonata*  *Papilio nireus lyaeus* The insect diversity of the focus area was classed moderately high with the following common invertebrates observed: *Xeloma tomentosa* (Gold-haired Fruit Chafer), *Acraea natalica* (Natal Acraea), *Danaus chrysippus* (African Monarch), *Papilio demodocus* (Citrus Swallowtail) and *Mylothris agathina* (Common Dotted Border). For the full list of insects observed see Appendix C An abundance of habitat and food resources are associated with the focus area which in turn supports a high abundance of insect species from nectar feeding insects to herbaceous and burrowing species. In addition, insects are important to the ecosystem as they fulfil numerous ecological roles, such as removal and breakdown of detritus material, helping with nutrient cycling, whilst also acting as important pollinators for numerous plants. The increased abundance of insects plays a pivotal role in the food chain as insect species provide an important and staple food source for many small mammals, reptiles, amphibians and avifauna. The habitat integrity of the focus area is largely intact in most of the habitat units with areas of alien proliferation being noted within the riparian habitat unit. The pine plantations within the Degraded Habitat unit still provide sufficient habitat for insects living in leaf litter on the forest/woodland floors.
Business Case, Conclusion and Mitigation Requirements:	The overall sensitivity of the area in term of insect ecology is considered moderately high with three insect SCC having an increased probability of occurring within the study area. Issues of concern in terms of the mining activities with regards to invertebrates: ➢ Vegetation disturbance and trampling as a result of vehicle and personnel movement will result in disturbance and possible decreased food resources for many invertebrate species, while also possibly destroying eggs and pupae that are located both on the vegetation as well as in the soil; and ➢ Ground-dwelling insect's species may be trodden on or driven over during mining activities. Although the immediate effect of such may not be apparent, widespread impacts such as associated impacts on breeding individuals through habitat destruction and disturbance may lead to a decreased abundance in the following season. To minimise the impact to insect species, the following mitigatory actions are recommended: ➢ Vehicles should utilise existing roads as far as possible. Where roads do not exist vehicles should avoid larger shrubs and large clusters of vegetation, as these are likely to be inhabited and utilised by numerous insect species; ➢ Disturbance of freshwater resources of the Riparian Habitat should be avoided, as these areas provide important breeding grounds for species of the genus Odonata (Dragonflies and Damselflies); and ➢ Downlighting and as few external lights as needed are to be used for all lighting requirements at night. Additionally, yellow lights of lower frequencies are to be used in order to limit insect attraction.

3.7 Arachnids

Table 7: Field assessment results pertaining to arachnid species within the Focus Area

Faunal Class:	Faunal Habitat Sensitivity	Moderately High
Arachnids	**Notes on Photograph:** **Top:** *Harpactira hamiltoni* (Highveld Baboon Spider); **Middle:** *Argiope trifasciata* (Banded Argiope) (left) and *Gasteracantha versicolor* (Medium-wing Kite Spider) (right); **Bottom:** *Cheloctonus jonesii* (Jone's Creeper).	

Faunal Sensitivity Graph:



Faunal SCC/Endemics/ TOPS/	No arachnid SCC have been recorded at the current time in the relevant databases in the associated QDS. During the field assessment an exuvial of *Harpactira hamiltoni* (Highveld Baboon Spider) was observed within the rocky areas of the pine plantations of the Degraded Habitat unit. Although not protected in the Mpumalanga province care should be taken not to impact upon this species.
General Arachnids Discussion	Arachnids are normally crepuscular or nocturnal which makes observation of this faunal group limited, the rocky outcrops offer ideal refuge for arachnids during the hottest periods of the day The arachnid diversity of the focus area was rated Moderately- High with the following common arachnid species observed: *Harpactira hamiltoni* (Highveld Baboon Spider), *Argiope trifasciata* (Banded Argiope) and *Cheloctonus jonessi* (Jone's Creeper) amongst others. For the full list of observed arachnids refer to Appendix C. The habitat and food availability within the focus area was rated high due to the high abundances on invertebrate species observed during the survey which form the primary food source of arachnids. The habitat integrity of the focus area remains largely intact for arachnid species. The Rocky Outcrops provide ideal areas of refuge for many arachnid species during the daylight hours, with many such species becoming more active following dusk. Such activity cycles are also applicable to species inhabiting the grassland areas, notably burrowing arachnids and those which construct intricate funnel webs between grass tufts and between rocks. Such behavioural activities as well as the general secretive nature of many arachnid species makes detection of arachnids more difficult. Although at the time of assessment only a limited number of arachnids were observed, suitable habitat and food resources are available within the focus area and as such it is expected that the focus area will, overall, support an increased diversity and abundance of arachnids.     
Business Case, Conclusion and Mitigation Requirements:	The overall sensitivity of the project area in terms of arachnid ecology is considered moderately high, with the footprint area providing an abundance of habitat and food resources necessary for supporting a arachnid community. Issues of concern in terms of the mining activities with regards to arachnids: ➢ Vegetation clearance and ground levelling will result in the loss of resources for arachnids which have constructed webs within the vegetation, as well as those arachnids which have constructed burrows underneath and between the vegetation. To minimise the impact to reptile species, the following mitigatory actions are recommended: ➢ Proposed access routes and mining sites should be thoroughly inspected for burrows of *Harpactira hamiltoni* (Highveld Baboon Spider) prior to any mining activities or vehicle movement. These species should then be rescued and relocated with the process overseen by a qualified ecologist; ➢ Personnel working at the mine are to be educated and made aware about the larger scorpions and spiders in the area, and instructed that they are not to be harmed; ➢ Mine workers are to be educated on how to safely and carefully capture and relocate such species should they be found within mine buildings / offices; and ➢ Vehicles should utilise existing roads as far as possible. Where roads do not exist vehicles should avoid larger shrubs and large clusters of vegetation, as these are likely to be inhabited by numerous arachnid species, thereby decreasing the chance of vehicle related mortalities.

3.8 Faunal Species of Conservation Concern Assessment

During field assessment, it is not always feasible to identify or observe all species within an area, largely due to the secretive nature of many faunal species, possible low population numbers or varying habits of species. As such, and to specifically assess an area for faunal SCC, a Probability of Occurrence (POC) matrix is used, utilising a number of factors to determine the probability of faunal SCC occurrence within the focus area species listed in Appendix C with known distribution ranges and habitat preferences include the focus area were taken into consideration. Several faunal SCC are considered to have an increased probability of occurring within the focus area namely (Table 7):

Table 8: Faunal SCC recorded historically in the associated Quarter Degree Squares (QDS)

Scientific name	Common Name	MTPA	IUCN Status	POC
Chrysospalax villosus	Rough-haired Golden Mole	VU	VU	70
Amblysomus septentrionalis	Highveld Golden Mole	VU	VU	70
Pelea capreolus	Grey Rhebok	NT	NT	100
Leptailurus serval	Serval	NT	LC	75
Mellivora capensis	Honey Badger	NT	LC	75
Otomys laminatus	Laminate Vlei Rat	NT	NT	70
Panthera pardus	Leopard	NT	VU	75
Hydrictis maculicollis	Spotted-Necked Otter	-	NT	70
Rhinolophus blasii	Blasius’s Horseshoe Bat	NT	LC	100
Rhinolophus cohenae	Cohen's Horseshoe Bat	VU	VU	75
Rhinolophus hildebrandtii	Hildebrandt's Horseshoe Bat	NT	LC	75
Rhinolophus swinnyi	Swinny's Horseshoe Bat	VU	LC	75
Rhinolophus smithersi	Smithers Horseshoe Bat	-	NT	100
Scotopelia peli	Pel’s Fishing Owl	EN	LC	70
Podica senegalensis	African Finfoot	VU	LC	70
Eupodotis senegalensis	White-bellied Korhaan	VU	LC	70
Falco peregrinus	Peregrine Falcon	VU	LC	70
Geronticus calvus	Southern Bald Ibis	VU	VU	70
Necrosyrtes monachus	Hooded Vulture	CR	CR	60
Gyps africanus	White-Backed Vulture	CR	CR	60
Gyps coprotheres	Cape Vulture	EN	EN	70
Hirundo atrocaerulea	Blue Swallow	CR	VU	75
Neotis denhami	Denhams Bustard	VU	NT	70
Sagittarius serpentarius	Secretarybird	VU	VU	70
Sarothrura affinis	Striped Flufftail	VU	LC	75
Stephanoaetus coronatus	African Crowned Eagle	VU	NT	70
Zoothera gurneyi	Orange Ground-thrush	NT	LC	70
Hadromophryne natalensis	Natal Ghost Frog	NT	LC	75
Hyperolius semidiscus	Yellow Striped Reed Frog	VU	LC	70

Scientific name	Common Name	MTPA	IUCN Status	POC
Amblyodipsas concolor	Natal Purple-Glossed Snake	VU	LC	70
Amplorhinus multimaculatus	Many-spotted Reed Snake	NT	LC	70
Bradypodion transvaalensis	Northern Dwarf Chameleon	VU	NE	70
Chamaesaura aenea	Coppery Grass Lizard	NT	LC	70
Chamaesaura macrolepis	Large-scale Grass Lizard	NT	LC	70
Tetradactylus breyeri	Breyer’s Long-Tailed Seps	VU	LC	70
Orachrysops violescens	Violescent Blue	VU	NE	70
Proischnura rotundipennis	Round Winged Bluet	VU	LC	70
Aloeides nubilus	Cloud Copper	EN	EN	70
Lepidochrysops irvingi	Irving's Blue	EN	EN	70
Pseudagrion newtoni	Harlequin Sprite	VU	VU	70

Many of the above listed species have been highlighted as being of conservation concern as a result of habitat loss and degradation stemming from the expansion of human populations, loss of habitat to agricultural and forestry as well as other anthropogenic activities such as mining and hunting. Many of the above listed species occur in niche habitats and are sensitive to habitat changes. The region in which the focus area is poised has already been subjected to several of the afore-mentioned impacts, and as such the remaining natural habitat units found in the focus area can be considered to be of increased importance for faunal SCC.

It is deemed likely that the proposed mining activities will have a negative and long-term impact on faunal SCC within the focus area and possibly in the region. Niche habitat loss, decrease in food resources and impacts from mining activities (dust, noise, vibrations etc) pose a cumulative threat to the continued conservation and long-term survivability of these species.

Should the proposed mining activities be allowed, it is recommended that if any of the abovementioned species are encountered during the construction phase, the relevant activities which pose a risk to the population or community of concern must be stopped immediately, and a biodiversity specialist and representative of Mpumalanga Parks must be consulted in order to advise the best way forward.

4 SENSITIVITY MAPPING

Table 9 below provides a brief discussion pertaining to the habitat units and the associated areas of sensitivity. Figures 10 and 11 below conceptually illustrate the areas considered to be of increased faunal ecological sensitivity. The areas are depicted according to their sensitivity in terms of the presence or potential for faunal SCC, habitat integrity, levels of disturbance and overall levels of diversity. The table below presents the sensitivity of each area along with an associated conservation objective and implications for development.

Table 9: A summary of the sensitivity of each habitat unit and implications for the proposed development.

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
Montane Grasslands	**Moderately High**	Iota Pit, Iota WRD north and south Section of Browns Hill Several stretches if the Haul Road Portions of the Wishbone WRD Portions of the Theta Pits	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential in an ecologically sensitive manner. Offsetting or compensation for residual loss to be considered only as a last resort	This habitat unit offers ideal habitat for wide variety of species including mammals, reptiles and avifaunal species. Mining activities should be kept to a minimum within this habitat unit. In this regard, maintaining migratory corridors and connectivity is deemed essential in the remaining areas and as such footprint creep and edge effects must be strictly managed. Where mining is planned within habitat unit, care must be taken to prevent any negative impacts on vegetation and as such edge effects on the surrounding habitats, should be limited. All mitigation measure as set out in this report are to be correctly implemented.
Mountain Outcrops				The Mountain Outcrops habitat unit offers ideal habitat for numerous reptile SCC and arachnid species which will take advantage of the crevices for shelter. Any disturbance of sensitive faunal habitat must be actively avoided. In this regard, maintaining migratory corridors and connectivity along the Mountain Outcrops and with the Montane Grassland is deemed essential. If development will take place within a close proximity of this habitat unit, care must be taken to prevent any negative impacts on vegetation and as such edge effects on this, and surrounding habitats, should be limited. All mitigation measure as set out in this report are to be correctly implemented.
Forest Remnants	**Moderately High**	Wishbone WRD Downslope of and close proximity to Iota Pit	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential in an ecologically sensitive manner. Offsetting or compensation for residual loss to be considered only as a last resort	This habitat unit provides good habitat for arboreal mammal and reptile species, avifauna and invertebrates. In addition, there is a high likelihood that large raptors will also take advantage of the area for nesting purposes. Any disturbance of sensitive faunal habitat must be actively avoided. Portions of this habitat unit within the Wishbone WRD will be completely lost if current plans are approved, impacting notably on avifaunal species who roost and next in this area. Where development will take place within close proximity of this habitat unit (Iota Pit), care must be taken to prevent any negative impacts on vegetation and as such edge effects on this, and surrounding habitats, should be limited. All mitigation measures as set out in this report are to be correctly implemented.
Blyde River	**High**	Linear developments, mainly Haul Roads, Pump Column Iota PCD Downslope risk from Iota Pits and WRD's	Mining activities should be actively avoided in this habitat unit Offsetting or compensation for residual loss to be considered only as a last resort	This habitat unit provides ideal refuge for amphibians, small mammals, reptiles and waterfowl. Mining activities and infrastructure should be minimised in this habitat unit as far as possible due to the possible presence of several faunal SCC. Additionally, the Blyde River plays a pivotal and important function in terms of species support, notably as a corridor of movement and as a permanent source of drinking water. The proposed mining may pose a significant risk to the downstream habitat should activities not be suitably managed.

HU	Sensitivity	Impacting Infrastructure	Conservation Objective	Development Implications
Riparian Habitat -Drainage Lines	**Moderately High**	Small portion of Iota WRD and linear infrastructure	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential in an ecologically sensitive manner. Offsetting or compensation for residual loss to be considered only as a last resort	The habitat integrity of the drainage lines (tributaries of the Blyde) have been compromised as a result of the proliferation of AIPs. Although AIP species are present, there are still indigenous plant species present. This habitat unit still provides habitat for several faunal species, and whilst AIP species are present, these species still provide seasonal food resources (berries, seeds and flowers) for fauna. The increased vegetation density further provides areas of refuge for fauna.
	Intermediate	Wishbone WRD Linear developments Wishbone Dam	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	The habitat integrity of the drainage line have been compromised as a result of the proliferation of AIPs, outcompeting much of the indigenous plant species leading to notable habitat loss. Common faunal species do still utilise these areas, although to a lesser degree than the more intact habitats. In addition, these drainage lines are often used as access points by illegal miners, resulting in increased anthropogenic impacts and disturbances.
Degraded Habitat and Degraded Forest	**Moderately Low**	Sections of Iota Pit, Iota WRD North and Iota WRD South. Most of Browns Pit and southern sections of the Theta Pits, as well as sections of the Wishbone WRD Haul Roads and several stretches of the Linear Developments Stockpiles and Mine Contractors Site	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	This habitat is of moderately low importance for faunal species in the region. The degraded state of the habitat and proliferation of AIPs limit faunal habitation opportunities. Although faunal species do traverse, and in some instance common species inhabit this unit, the continued mismanagement of the areas will further result in habitat loss and degradation through AIP proliferation. Development within this habitat unit is not expected to lead to high impacts to the faunal community of the region.
Transformed Habitat	**Low**	Stockpiles, Dams, Portions of Theta Pit and areas of the Haul Road	Optimise development potential.	Development in this area is unlikely to have any impact on faunal species given the already large extent of habitat loss that has occurred. In order to ensure that no further species and habitat loss occurs, it is imperative that edge effects are managed and that no footprint creep occurs into the surrounding areas.

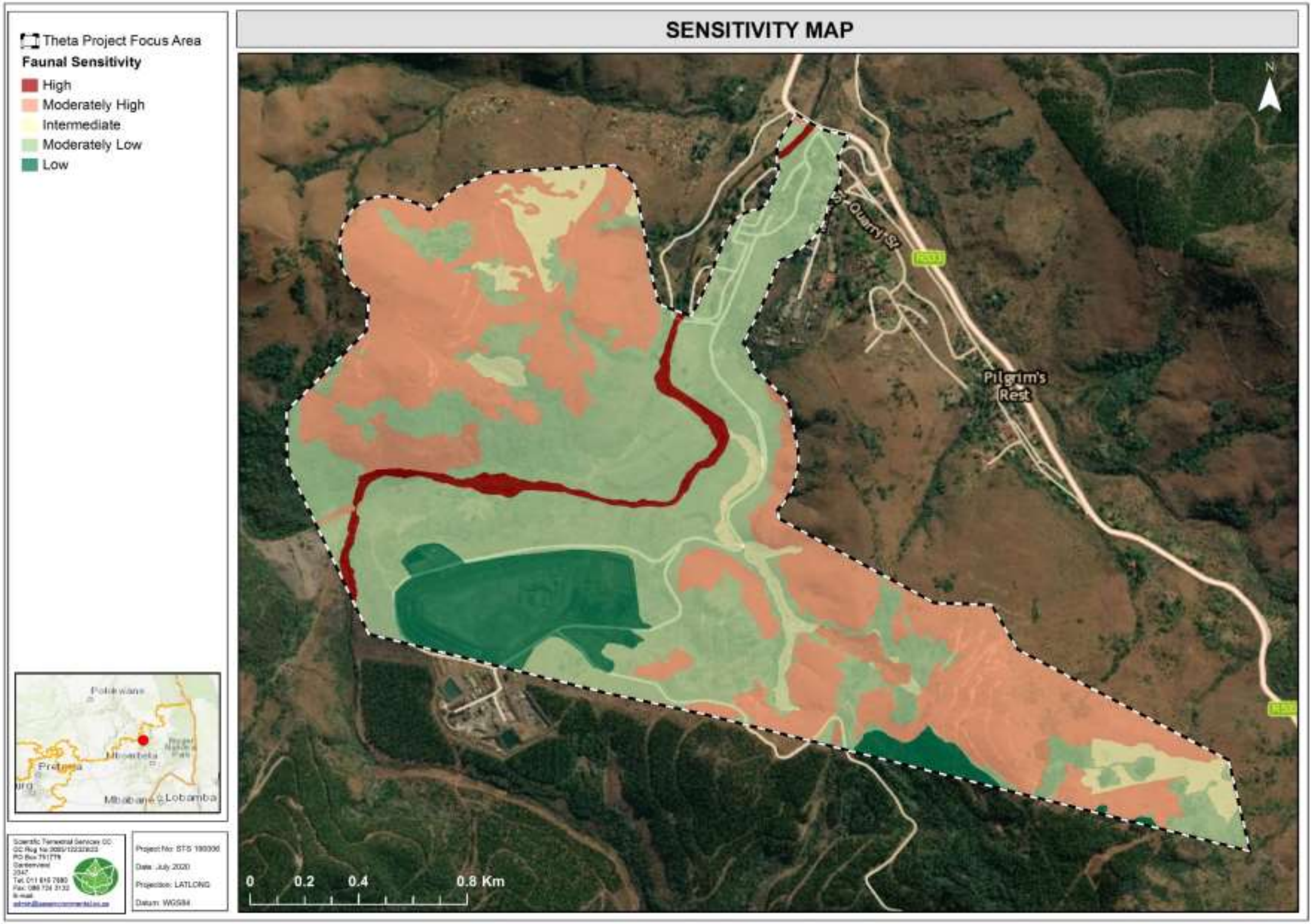


Figure 10: Sensitivity map for the focus area.

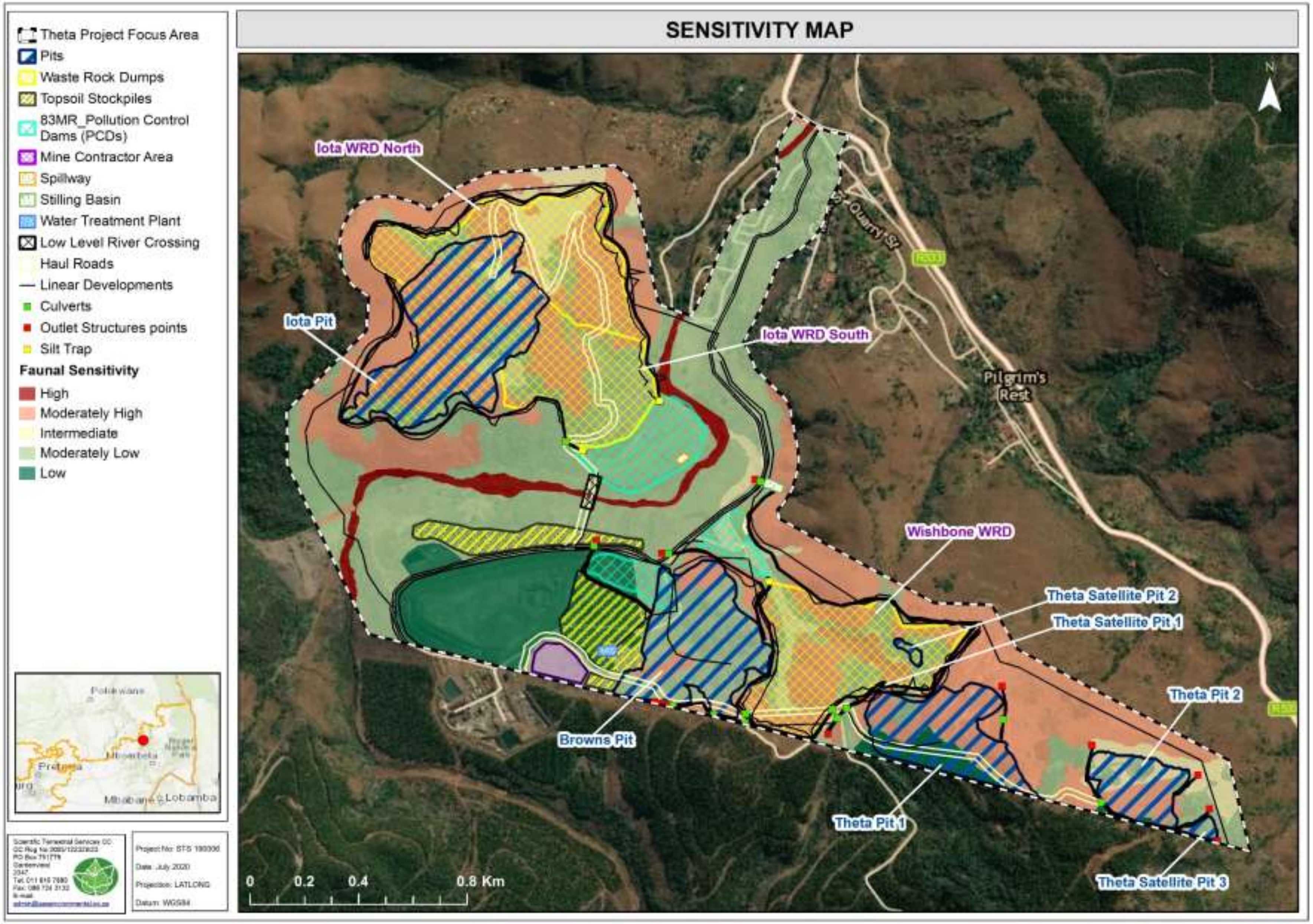


Figure 11: Proposed mine layout superimposed on the established sensitivities for the focus area.

5 IMPACT ASSESSMENT

The section below serves to summarise the significance of the perceived impacts on the faunal ecology of the proposed mining development. Individual impacts identified are presented in Section 5.1. A summary of all potential construction, operational and decommissioning phase impacts are provided in Section 5.1. All the required mitigatory measures needed to minimise the impact is presented in Appendix D.

5.1 Impacts on the faunal ecology of the focus area

The table below identifies potential activities that might take place during the various phases of the proposed mining development, which could impact on the faunal ecology of the area. It should be noted that these activities listed in the table below were utilised during the impact assessment as pre-mitigated impacts to ascertain the significance of the perceived impacts prior to mitigation measures.

Table 10: **Aspects and Activities register considering faunal resources.**

Pre-Construction	Construction	Operational	Decommissioning & Closure
The placement of opencast pits and waste rock dumps in sensitive faunal habitat.	Site clearing and the removal of vegetation leading to a loss of sensitive species and habitat.	On-going disturbance of habitat due to operational activities leading to a loss of sensitive species.	Ineffective rehabilitation of exposed and impacted areas leading to permanent losses of sensitive species.
Potential failure to initiate a biodiversity action plan, rehabilitation plan and alien floral control plan during the pre-construction phase.	Collision of vehicles with faunal species and potential SCC as well as potential increased risk of poaching and trapping of species.	Increased introduction and proliferation of alien plant species and further transformation of faunal habitat leading to a loss of faunal diversity.	On-going risk of contamination from mining facilities beyond closure leading to permanent impact on amphibian life and fauna dependent on the Blyde River for sustenance.
Planned placement of haul road crossing point over the Blyde River system	Movement of construction vehicles and access road construction through sensitive faunal habitat.	Risk of contamination from operational facilities may pollute receiving environment leading to a loss of faunal SCC.	On-going seepage and runoff may affect the groundwater and surface habitats beyond closure.
Failure to properly develop engineering and mining plans to ensure no footprint creep beyond that of the proposed footprints.	Placement of mine related infrastructure leading to loss of habitat connectivity	Collision of vehicles with faunal species. And an increased risk of poaching and trapping of faunal species.	Failure to implement a biodiversity action plan, rehabilitation plan and alien floral control plan during the decommissioning and closure phase.

Pre-Construction	Construction	Operational	Decommissioning & Closure
	Potential increased fire frequency during construction leading to a loss of sensitive species and habitat.	Additional pressure on sensitive species by increased human populations associated with the proposed mine.	Risk of larger raptors colliding with overhead powerlines.
	Potential failure to implement a biodiversity action plan, rehabilitation plan and alien plant control plan during the construction phase.	Potential increased fire frequency during operation leading to a loss of sensitive species.	
	Risk of larger raptors colliding with overhead powerlines.	Risk of larger raptors colliding with overhead powerlines.	

5.1.1 Results of the Impact Assessment

The tables below serve to summarise the findings of the impact study undertaken with reference to the perceived impacts stemming from the proposed mining activities of the Transvaal Gold Mining Estate (TGME) Mine Development Project. The table below indicates the significance of the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. The mitigated results of the impact assessment have been calculated on the premise that all mitigation measures as stipulated in this report and the Freshwater Resource Assessment (SAS 219038) are adhered to and implemented.

Proposed Mining Activities

The following table represents the findings of the impact assessment pertaining to the proposed activities on the faunal habitat, diversity and potential SCC.

Table 11: Impact on faunal habitat, species diversity and SCC for the focus area associated with pre-construction phase activities.

UNMANAGED							
Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
Iota Pit	-1	3	3	5	-4	-15	High
Browns Pit	-1	3	3	5	-4	-15	High
Theta Pit	-1	3	3	5	-4	-15	High
Iota WRD	-1	3	3	5	-4	-15	High
Wishbone WRD	-1	3	3	5	-5	-16	High
Stockpiles and Mine Contractors Site	-1	3	3	5	-4	-15	High
Iota Dam	-1	3	3	5	-5	-16	High
Wishbone PCD	-1	3	3	5	-5	-16	High
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	2	3	5	-4	-14	High
MANAGED							
Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
Iota Pit	-1	2	3	3	-4	-12	High
Browns Pit	-1	2	3	3	-4	-12	High
Theta Pit	-1	2	3	3	-4	-10	High
Iota WRD	-1	2	3	3	-4	-10	High
Wishbone WRD	-1	2	3	3	-4	-12	High
Stockpiles and Mine Contractors Site	-1	2	2	2	-4	-10	Medium
Iota Dam	-1	2	2	2	-4	-10	Medium
Wishbone PCD	-1	2	2	2	-4	-10	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	2	2	2	-4	-10	Medium

PROPOSED MITIGATION MEASURES

- Minimise loss of faunal habitat where possible through planning and suitable layouts. Limit placement of infrastructure within habitat of increased sensitivity. All pits and WRD should, as far as possible, be kept to a minimum within the areas of high sensitivity, with key management in place to ensure footprint creep does not occur and that edge effects do not impact on additional areas outside of the proposed footprint.
- The design of the proposed Iota Pit and Iota WRD must remain outside of the Department of Agriculture, Forestry and Fisheries (DAFF) recommended 30 m buffer around natural forests;
- Based on the findings of the Freshwater report (SAS 219038), it is considered imperative that during the planning phase, very careful consideration be given to the locality and layouts of surface infrastructure, to ensure that watercourses and their associated zones of regulation (in terms of both GN704 and GN509 as they relate to the National Water Act 1998 (Act No. 36 of 1998)) are avoided as much as possible;
- All stockpiles and WRDs must be designed in such a manner that runoff is contained;
- A Biodiversity Action Plan, Alien Invasive Management and rehabilitation Plan must be compiled;
- It is important that all current prospecting areas falling outside of the proposed mining footprint that have been disturbed are rehabilitated as soon as possible in order to limit further habitat disturbance; and
- All areas of increased ecological sensitivity falling outside of the direct mine footprint should be designated as No-Go areas and be off limits to all unauthorised construction vehicles and personnel. This includes the Mountain Outcrops, Montane Grasslands and the Riparian Habitat.

***In addition to the above mitigations listed, please refer to Section 5.3 for additional mitigation measures.**

Table 12: Impact on faunal habitat, species diversity and SCC for the focus area associated with construction phase activities.

Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
UNMANAGED							
Iota Pit	-1	3	3	5	-5	-16	High
Browns Pit	-1	3	3	5	-5	-16	High
Theta Pit	-1	3	3	5	-5	-16	High
Iota WRD	-1	3	3	5	-5	-16	High
Wishbone WRD	-1	3	3	5	-5	-16	High
Stockpiles and Mine Contractors Site	-1	3	3	5	-5	-16	High
Iota Dam	-1	3	3	5	-5	-16	High
Wishbone PCD	-1	3	3	5	-5	-16	High
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	3	3	5	-4	-15	High
MANAGED							
Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
Iota Pit	-1	2	3	4	-4	-13	High
Browns Pit	-1	2	3	3	-4	-12	High
Theta Pit	-1	2	3	4	-4	-13	High
Iota WRD	-1	2	3	4	-4	-13	High
Wishbone WRD	-1	2	3	4	-4	-13	High
Stockpiles and Mine Contractors Site	-1	2	2	3	-4	-11	Medium
Iota Dam	-1	2	2	3	-4	-11	Medium
Wishbone PCD	-1	2	2	3	-4	-11	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	2	2	3	-4	-11	Medium

PROPOSED MITIGATION MEASURES

Faunal Habitat and Diversity

- All construction personnel should undergo a basic environmental induction, to ensure no poaching of local fauna or possibility of a fire occurs;
- All areas of increased ecological sensitivity falling outside of the direct mine footprint should be designated as No-Go areas and be off limits to all unauthorised construction vehicles and personnel. This includes the Mountain Outcrops, Indigenous Forest Remnants, Montane Grasslands and the Riparian Habitat;
- The construction/ site clearing process should be phased to limit the extent of exposed areas at any one time and ensure that the time between initial disturbance and completion of construction is as short as possible;
- Site clearance must be limited to the project footprint areas only, with disturbance limited as far as possible;
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the construction activities. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept minimal;
- Adequate speed limits should be adhered to in order to curb the possibility of roadkill;
- It is important that all current prospecting areas falling outside of the proposed mining footprint that have been disturbed are rehabilitated as soon as possible in order to limit further habitat disturbance;
- Bird flappers and anti-collision devices should be placed on all overhead cables and powerlines;
- Construction of topsoil stockpiles and other surface infrastructure should be restricted to the transformed habitat unit; and
- The Biodiversity Action Plan and Alien Invasive Plant Management Plan must be initialled in this phase.

Faunal SCC

- If any potential faunal SCC are encountered during the construction phase, a suitably qualified ecologist should be contacted immediately for relocation purposes;
- Construction activities for the haul road within the buffers zone of the Blyde as well as the crossing point on the Blyde River must be done in such a way as to ensure that downstream sedimentation of the Blyde does not occur as well as ensuring that no construction waste is dumped, washed or allowed to seep into the river system. and
- Any unauthorised collection of faunal species, especially faunal SCC, by construction personnel should be strictly prohibited.

Disposal of construction related material

- All construction related waste and material is to be disposed of at a registered waste facility; and
- No waste of construction rubble is to be dumped in the surrounding natural habitats.

Increased personnel on site

- No illicit fires must be allowed during any phases of the proposed mining development. A Fire Management Plan (FMP) should be set in place to ensure that any fires that do originate can be managed and / or stopped before significant damage to the environment occurs; and
- No indiscriminate driving through the natural areas is allowed. As far as possible vehicles are to utilise the existing roads. Where this is not feasible, new roads are to be in areas of existing high disturbance, and not encroach upon sensitive habitats.

***In addition to the above mitigations listed, please refer to Section 5.3 for additional mitigation measures.**

Table 13: Impact on faunal habitat, species diversity and SCC for the focus area associated with operational phase activities.

UNMANAGED							
Proposed Activities	**Status of Impact**	**Extent**	**Duration**	**Probability**	**Intensity**	**Magnitude**	**Significance**
Iota Pit	-1	3	3	5	-4	-15	High
Browns Pit	-1	3	3	5	-4	-15	High
Theta Pit	-1	3	3	5	-4	-15	High
Iota WRD	-1	3	3	5	-4	-15	High
Wishbone WRD	-1	3	3	5	-4	-15	High
Stockpiles and Mine Contractors Site	-1	3	3	5	-4	-15	High
Iota Dam	-1	3	3	5	-5	-16	High
Wishbone PCD	-1	3	3	5	-5	-16	High
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	3	3	5	-4	-15	High
MANAGED							
Proposed Activities	**Status of Impact**	**Extent**	**Duration**	**Probability**	**Intensity**	**Magnitude**	**Significance**
Iota Pit	-1	2	2	4	-3	-11	Medium
Browns Pit	-1	2	2	4	-3	-11	Medium
Theta Pit	-1	2	2	4	-3	-11	Medium
Iota WRD	-1	2	2	4	-3	-11	Medium
Wishbone WRD	-1	2	2	4	-3	-11	Medium
Stockpiles and Mine Contractors Site	-1	2	2	3	-3	-10	Medium
Iota Dam	-1	2	2	3	-3	-10	Medium
Wishbone PCD	-1	2	2	3	-3	-10	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	1	2	3	-3	-9	Medium

PROPOSED MITIGATION MEASURES

Faunal Habitat and Diversity

- All areas of increased ecological sensitivity (i.e. Mountain Outcrops, Remnants of Northern Mistbelt Forest, Montane Grasslands and Riparian Habitat) should be designated as No-Go areas and be off limits to all unauthorised vehicles and personnel. Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities;
- No additional habitat is to be disturbed during the operational phase of the development. Stockpiles, WRDs and Dams, and their expansion as the material is deposited, should be restricted to the footprint area that is authorised. Weekly monitoring and recording of the footprint areas must be done;
- Well defined standard operating procedures should be established and implemented to minimise the adverse impacts on fauna associated with the Riparian Habitat Unit;
- Adequate speed limits should be adhered to, to limit the likelihood or roadkill;
- No uncontrolled or unsanctioned fires are allowed. A Fire Management Plan should be in place;
- Rehabilitation of the disturbed areas should be conducted during the operational phase to re–introduce indigenous vegetation and faunal habitat and food availability where areas become available;
- Bird flappers and anti-collision devices should maintained and replaced where necessary on electrical lines; and
- The haul road crossing point on the Blyde River must be monitored to ensure that downstream sedimentation of the Blyde does not occur as well as ensuring that no waste or oils/fuel from mine equipment is dumped, washed or allowed to seep into the river system.

Faunal SCC

- As part of a Biodiversity Action Plan (BAP), faunal monitoring should be done annually during operational activities. Please also refer to the monitoring guidelines in section 5.4.

Ongoing AIP Management

- AIPs must be monitored and must be removed throughout the operational phase of the project to prevent their spread beyond the development footprint areas;
- Alien plant seed dispersal within the top layers of the topsoil within footprint areas, that will have an impact on future rehabilitation, must be controlled; and
- Clearing of the AIPs, with specific emphasis on Category 1b alien species, encountered within the footprint area (preferably within the entire project perimeter), including the immediate surrounds, must take place in order to comply with existing legislation (NEMBA: Alien and Invasive Species Regulations (Notice number 864 of 29 July 2016 in Government Gazette 40166)).

Waste, discharge and pollution

- No operational-related waste material is to enter natural habitats;
- It must be ensured that the mine process water system is managed in such a way as to prevent discharge to the receiving environment;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- Any waste or toxic spills from vehicles or mining infrastructure must be dealt with immediately in accordance with the waste management plan.

***In addition to the above mitigations listed, please refer to Section 5.3 for additional mitigation measures.**

Table 14: Impact on faunal habitat, species diversity and SCC for the focus area associated with decommissioning and closure phase activities.

UNMANAGED

Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
Iota Pit	-1	4	3	5	-4	-16	High
Browns Pit	-1	4	3	5	-4	-16	High
Theta Pit	-1	4	3	5	-4	-16	High
Iota WRD	-1	4	3	5	-4	-16	High
Wishbone WRD	-1	4	3	5	-4	-16	High
Stockpiles and Mine Contractors Site	-1	4	3	5	-4	-16	High
Iota Dam	-1	4	3	5	-4	-16	High
Wishbone PCD	-1	4	3	5	-4	-16	High
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	4	3	5	-4	-16	High

MANAGED

Proposed Activities	Status of Impact	Extent	Duration	Probability	Intensity	Magnitude	Significance
Iota Pit	-1	2	3	3	-3	**-11**	Medium
Browns Pit	-1	2	3	3	-3	**-11**	Medium
Theta Pit	-1	2	3	3	-3	**-11**	Medium
Iota WRD	-1	2	3	4	-3	**-12**	High
Wishbone WRD	-1	2	3	3	-3	**-11**	Medium
Stockpiles and Mine Contractors Site	-1	2	3	3	-2	**-10**	Medium
Iota Dam	-1	2	2	3	-2	**-9**	Medium
Wishbone PCD	-1	2	2	3	-2	**-9**	Medium
Linear Development (Powerlines, Haul Roads, Access roads, Pump columns, Clean and Dirty Water Drainage)	-1	2	2	3	-2	**-9**	Medium

PROPOSED MITIGATION MEASURES

Faunal Habitat and Diversity

- Implement all recommendations as per the mine closure plan;
- All surface infrastructure should be removed, and waste material disposed of at a registered dump site. Waste and remnant mine related material should not be dumped or left within the focus area;
- Where soils have been compacted, they are to be ripped and where necessary reprofiled;
- Indigenous grass species are to be used for revegetation of disturbed areas. Due to the proposed layouts falling within CBAs, the end-goal of rehabilitation would need to aim to achieve the pre-mined condition as far as possible; and
- Continue monitoring of rehabilitation activities for a minimum period of 5 years following the mine closure or until an acceptable level of habitat and biodiversity reinstatement has occurred, in such a way as to ensure that natural processes and veld succession will lead to the re-establishment of the natural wilderness conditions which are analogous to the pre-mining conditions of the area.

Ongoing AIP Management

- A bi-annual alien vegetation clearance programme should be implemented for up to 2 years after closure. Where areas are disturbed during decommissioning activities, proliferation of alien invasive species within these areas should be continually monitored and controlled.; and
- Follow-up with alien and invasive plant control measures for a period of at least 5 years post-closure.

***In addition to the above mitigations listed, please refer to Section 5.3 for additional mitigation measures.**

5.2 Impact Discussion

Impact on Faunal Diversity and Habitat

The proposed Iota and Theta Hill open cast pits are located within the sensitive Montane Grasslands, Mountain Outcrops whilst the Iota pit is in close proximity to the Forest habitat. The Wishbone WRD will also result in impacts through the loss of Forest habitat and Montane Grasslands habitat. These habitat units provide habitat for most of the faunal classes, as such mining activities herein will result in the loss of faunal species diversity (mortality and displacement of species) and habitat. The displacement of faunal species will have a knock-on effect in the surrounding areas due to the likely increased competition rates for remaining areas of habitat and food resources, as well as inter and intra-specific species competition. The proposed haul roads are anticipated to impact upon the Blyde River itself as well as the riparian habitat due to the upgrading of the river crossing and road network. Clearing activities of the riparian areas associated with the haul roads are likely to result in the loss of habitat and displacement of amphibian and freshwater associated avifaunal species which inhabit and utilise these areas.

Impact on Faunal SCC

Several faunal SCC may be associated with the proposed areas of activities. As such, vegetation clearance during the construction phase, may result in the loss of faunal SCC from the focus areas as well as reduced numbers in the surrounding habitats which are impacted by edge effects. The loss of the habitat and faunal SCC therein will have a negative bearing on the current conservation efforts undertaken to ensure the continued survival of these species. The loss of SCC in the focus area is likely to have far reaching impacts as breeding pockets and individuals may be lost, of paramount concern with slower reproducing species and species that have a low fecundity rate.

The presence of several faunal SCC has been mentioned by IAPs. Short summaries of the mentioned faunal SCC and potential impact by the proposed mining activities are listed below.

Chrysospalax villosus (Rough-haired golden mole, VU) this species is generally associated with sandy soils of grasslands, meadows and wetlands (IUCN, 2019). They are known to have burrow entrances that have a bowl shape latrine situated outside. *Amblysomus septentrionalis* (Highveld Golden Mole, VU) is generally associated with high altitude grasslands of Mpumalanga, restricted to friable soils of valleys and mountainsides (IUCN, 2019). This species is solitary and aggressive towards other golden moles, foraging in subsurface tunnels which connect to deeper burrows. The proposed Theta and Iota Pits and the Theta Wishbone WRD poses a risk to this species if present.

Rhinolophus blasii (Blasius's horseshoe bat, NT - recorded), *Rhinolophus cohenae* (Cohen's horseshoe bat, VU), *Rhinolophus hildebrandtii* (Hildebrandt's horseshoe bat, NT) and *Rhinolophus swinnyi* (Swinny's horseshoe bat, VU) may occupy the old abandoned mine shafts within the focus area, however constant movement of illegal miners in these shafts may limit such. Bats are generally tolerant to anthropogenic influence using buildings to roost. It is recommended that if authorisation is approved a monitoring programme be established to record species in the area.

Based on comments received IAPs, it was stated that the focus area may be inhabited by breeding pairs of *Scotopelia peli* (Pel's Fishing Owl, EN). This species is nocturnal, uncommon and highly localised which may occur singly or in pairs, occurring within large slow-flowing well forested rivers. The Northern Mistbelt Forest adjacent to the Blyde River and the dense riparian vegetation may provide habitat for this species, as such, impacts herein, notably edge effects, must be adequately managed.

Necrosyrtes monachus (Hooded Vulture, CR) and *Gyps africanus* (White-backed Vultures, CR) have been recorded by IAPs within the area. The likelihood of permanent occurrence within the focus area is deemed to be limited due to the lack of carcasses associated with the focus area. Although nesting may take place within the large trees associated with the Northern Mistbelt Forest. The Northern Mistbelt Forest associated with the proposed Iota Pit and Theta Wishbone WRD pose a risk to this species if present.

Hydrictis maculicollis (Spotted Necked Otter, NT), *Podica senegalensis* (African Finfoot, VU) have also been recorded within the Blyde River historically. No direct impacts from the proposed activities are expected upon these species although edge effects from potential seepage may cause the displacement of these species. Mitigation as set out by the geohydrologist and aquatic reports should be strictly adhered to and must be retained for the operation and decommissioning phases to ensure no acid mine drainage or contaminants are not released into the surrounding watercourses. As such, biomonitoring must be undertaken for the life of the mine and all dirty water containment areas regularly inspected to ensure no leakage into the surrounding sensitive habitats.

The IAPs further mentioned the presence of *Hippopotamus amphibious* (Hippopotamus, VU) in the greater region. However, based on the river characteristics (shallow sections and cold temperatures), proximity of informal settlements/ the town of Pilgrims Rest and the current human presence from illegal miners, this species will not occur within the focus area.

Monitoring of avifaunal species is deemed to be important if authorisation is approved, mitigation as set out in Section 5.2 should be strictly adhered to if authorisation is approved. Other SCC likely to be directly impacted upon as a result of the proposed mining activities are presented in Section 3.8.

5.2.1 Probable Residual Impacts

Even with extensive mitigation, significant latent impacts on the receiving faunal ecological environment are deemed highly likely. The following points highlight the key latent impacts that have been identified:

- Destruction of ecologically intact, irreplaceable faunal habitat;
- Continued loss of faunal habitat and habitat diversity;
- Continued loss of and altered faunal species diversity;
- Continued loss of faunal SCC and suitable habitat; and
- Disturbed areas are highly unlikely to be rehabilitated to baseline levels of ecological functioning and significant loss of faunal habitat, species diversity and faunal SCC will most likely be permanent.

5.2.2 Cumulative Impacts

The proposed mining activities and mine vehicle movement will likely result in displacement of local avifauna this may be a concern due to the tourism importance of the area with the protected Kruger to Canyon Biosphere region located nearby.

Potential surface water runoff during the operational and rehabilitation may lead to the increased deposition of sediments and surface level pollutants into the freshwater systems. This will impact upon faunal species reliant on the Riparian habitat, notably amphibians, crabs and fish. In addition to this other faunal species feeding upon these species may also be impacted upon as a result of the transfer of toxins from prey to predator. These impacts are unlikely to be limited to only the impact site, with sediment and toxins being carried further downstream also affecting species therein.

Further clearance of indigenous vegetation both within and outside of the historic mining area, will lead to the further displacement of faunal species currently inhabiting these areas, pushing them out into the surrounding vegetated areas. This is likely to result in an increased abundance of species within the surrounding habitats, leading to increased competition for territories, breeding sites and food resources. As such, there is likely to be a knock-on dispersal affect, leading to increased resource competition and possible increased mortality rates, resulting in a decreased species abundance and possible further loss of species diversity.

5.3 Integrated Impact Mitigation

The table below highlights the key integrated mitigation measures that are applicable to all the proposed activities in order to suitably manage and mitigate the ecological impacts that are associated with the construction and operation phases of the proposed activities. Provided that all the management and mitigation measures as stipulated in this report are implemented the overall risk to faunal diversity, habitat and faunal SCC can be reduced in comparison to the non-mitigated scenario, however impacts will still remain significant.

Table 15: A summary of the mitigatory requirements for faunal resources

Project phase	*Construction Phase*
Impact Summary	*Loss of faunal habitat, species and faunal SCC*
Management Measures	***Proposed mitigation and management measures:*** - Upon approval a thorough walk through of the rocky habitat unit and grassland habitat units should be undertaken by a registered specialist for signs of *Harpactira hamiltoni* (Highveld Baboon Spider, NE) prior to construction, if present the necessary permits should be applied for and appropriate relocation plans drafted; - It is further recommended that a formal avifaunal monitoring program be established upon approval where: 1) Absolute counts and density estimates or abundance indices for large terrestrial birds and raptors are applied, 2) Passage rates of birds flying through the proposed mining areas are recorded, 3) Occupancy/numbers/breeding success at sensitive habitat units of avifaunal SCC, 4) Full details of any incidental sightings of priority species; - Vegetation outside of the footprints is not to be cleared; - Where overhead cables or powerlines are located near the Woody Ravine or Riparian habitats bird flappers are to be used in order to minimise the risk of bird strikes, notably as the mining area is located in an IBA; - As far as possible proposed mining areas should be accessed through the existing road network; - Vegetation clearance and commencement of construction activities should either be scheduled to coincide with low rainfall conditions when erosive stormwater is anticipated to be limited or alternatively stormwater controls must be established at the start of construction and dust suppression implemented; - Clearly define the boundaries of footprint areas (e.g. through the use of wooden stakes and danger tape) and demarcate routes to mining sites, ensuring that all activities remain within defined footprint areas so as to avoid additional disturbance as a result of footprint creep; - Excavated topsoil must be stored with associated native vegetation debris for subsequent use in rehabilitation; - A suitable rescue and relocation plan should be developed and overseen by a suitably qualified specialist or nominated mine personnel in order to ensure that species loss during construction activities is kept to a minimum; - Montane Grassland, Mountain Outcrops and the Riparian Habitat unit should be avoided so as to minimise disturbance to faunal species; - No mining activities or associated infrastructure should be located within any freshwater systems or their associated buffer zones, this will ensure the continued protection of these systems and the species they support through habitat and resource provision; - Removal/ cutting down of large trees (>4m) should be avoided, notably in the riparian areas, valleys between mountain slopes and along the mountain sides, as these are considered important for large raptors, and cannot be readily replaced through rehabilitation;

Project phase	*Construction Phase*
	- Spills and /or leaks from mining equipment must be immediately remedied and cleaned up so as to ensure that these chemicals do not enter into the freshwater systems; - Prior to vegetation clearing activities in the Mountainous areas, the sites should be inspected for the presence of baboon spider burrows. If located, these species should be carefully excavated ensuring no harm to the spider, and relocated to similar surrounding habitat outside of the footprint area; - Smaller species such as scorpions and reptiles are likely to be less mobile during the colder period, as such should any be observed in the construction site during clearing and construction activities, they are to be carefully and safely moved to an area of similar habitat outside of the disturbance footprint. Construction personnel are to be educated about these species and the need for their conservation. Smaller scorpion species and harmless reptiles should be carefully relocated by a suitably nominated construction person or nominated mine official. For larger venomous snakes, a suitably trained mine official should be contacted to affect the relocation of the species, should it not move off on its own; - No hunting/trapping or collecting of faunal species is allowed; - No informal fires by construction personnel are allowed; - Initiate an alien and invasive plant control plant; and - Initiate a biodiversity action plan.
Project phase	*Operational Phase*
Impact Summary	*Loss of faunal habitat, species and faunal SCC*
Management Measures	**Proposed mitigation and management measures:** - Post construction monitoring of avifauna should extend baseline results; - Each mining team should have a member/representative who is suitably qualified in snake catching and handling who can safely remove any snakes encountered during operational activities; - Educate personnel about venomous snakes, scorpions and spiders and that these species are not to be harmed. Should any such species be encountered they are to be safely moved outside of the disturbance footprint by a suitably qualified person; - With increased human presence comes an increase in the risk of rodent proliferation. No poison is to be used in an effort to control rodent species as this will lead to the long-term poisoning of predatory birds, reptiles and small carnivorous species; - Following heavy rains, all dams, stormwater dams and access roads are to be inspected for signs of erosion, which if found must be immediately rectified through appropriate erosion control measures; - When accessing the open cast areas, vehicles are to utilise the existing roads; - Continually monitor the operational activities of the mining activities to ensure that further disturbance of the surrounding habitat is not occurring; - Ensure that no unnecessary clearing of faunal habitat occurs by mine personnel; - No hunting/trapping or collecting of faunal species is allowed by mine personnel; - No informal fires by mine/ operation personnel are allowed; - Following heavy rains, mine infrastructure and access roads are to be inspected for signs of erosion, which if found must be immediately rectified through appropriate erosion control measures; - Mitigation as set out by the geohydrologist and aquatic reports should be strictly adhered to and must be retained for the decommissioning phase to ensure no acid mine drainage or contaminants are released into the surrounding watercourses. As such, biomonitoring must be undertaken for the life of the mine and all dirty water containment areas regularly inspected to ensure no leakage into the surrounding sensitive habitats; and - Continue with and update the alien and invasive plant control plan accordingly;
Project phase	*Decommissioning and Closure Phase*
Impact Summary	*Loss of faunal habitat, species and faunal SCC*
	Proposed mitigation and management measures:
	- Each closure team should have a member/representative who is suitably qualified in snake catching and handling who can safely remove any snakes encountered during operational activities; - Revegetation of disturbed areas should be carried out in order to restore habitat availability and minimise soil erosion and surface water runoff; - When rehabilitating a footprint site, it is imperative that as far as possible the habitat that was present prior to disturbances is recreated, so that faunal species that were displaced by vegetation clearing activities are able to recolonize the rehabilitated area; - No hunting/trapping or collecting of faunal species is allowed; and - Monitor the success of rehabilitation efforts of mining infrastructure, opencast pits and access roads seasonally.

5.4 Faunal Monitoring

A faunal monitoring plan must be designed and implemented throughout all phases of the mining development, should it be approved. It is recommended that monitoring activities be conducted on an annual basis. The following points aim to guide the design of the monitoring plan, and it must be noted that the monitoring plan must be continually updated and refined for site-specific requirements:

- It is recommended that monitoring points must be established in areas surrounding the mining area. These points must be designed to accurately monitor the following parameters:
  - Species diversity (mammal, invertebrate, amphibian, reptile and avifaunal);
  - Species abundance; and
  - Faunal community structure including species composition and diversity which should be compared to pre-development conditions.
- The following methods aim to guide the monitoring plan, although more detailed, site specific methods must be employed during the development and implementation of the monitoring plan:
  - Monitoring activities must take place on an annual basis as a minimum;
  - Pitfall traps can be used to monitor invertebrate diversity;
  - Sherman traps can be used to monitor small mammal diversity; and
  - Fixed and random points for bird counts to determine species composition and diversity trends.
- Results of the monitoring activities must be taken into account during all phases of the proposed mining development and action must be taken to mitigate impacts as soon as negative effects (negative deviation from baseline conditions as determined by the baseline ecological assessments) from mining related activities become apparent; and
- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.

5.5 Impact Statement on the No-go Alternative vs Authorised Mining

The following section presents the outcome and discussion of anticipated impacts on the faunal ecology, based on a number of scenarios surrounding the No-go alternative vs if the Theta Project is authorised. Assessing the No-go Alternative, or the scenario of a project not going ahead, requires that all possible scenarios be taken into account, including the implications of not authorising the project. For the Theta Project, four scenarios were identified, and their anticipated impacts on faunal ecology for the focus area and larger region (where applicable), assessed below:

- No-go with no management from relevant stakeholders;
- No-go with management from relevant stakeholders;
- Authorised mining in an ideal scenario; and
- Authorised mining practically achievable.

Discussion: No-go Alternative

Should the mining application not be successful, and the No-go route be taken, there will be no immediate and/or direct impact to the faunal habitat or faunal species within the proposed mine footprint. In addition, this will avoid the loss of CBAs and threatened ecosystems within the footprint, and as such not compromise the current land use and conservation goals for the area (see MTPA, 2014).

It must however be noted that the No-go Alternative is unlikely to preclude the areas from impacts and threats to biodiversity alone. To ensure that negative impacts to the faunal habitat and species does not occur, there would need to be agreement from all relevant stakeholders and provincial authorities to manage the current risks posed by illegal mining, snaring and AIP proliferation. Stakeholders and the authorities would need to ensure that the current illegal mining activities are suitably controlled, ensuring that long-term health of the Blyde River system as well as riparian habitat within the focus area and downstream. In addition, active management in terms of clearing of AIPs will need to be undertaken in order to ensure that no further AIP spread occurs, leading to extensive habitat degradation beyond that of the current AIP areas. Clearing activities will have to be suitably overseen and rehabilitation work carried out in order to ensure that indigenous species are reinstated, increasing faunal habitat and subsequently faunal species diversity. Unfortunately, given the realities of the situation and the limited resources available to authorities and stakeholders, this scenario is not likely, currently evident both within the Pilgrims Rest area and the larger region.

Pursuing the no-go alternative will most likely lead to both direct and indirect impacts to the current faunal assemblages if the current trend continues (i.e. no management from government and external stakeholders):

- Ongoing illegal (artisanal) mining. If the Theta Project is not approved, the necessary funding and resources required to control illegal miners will not be available, resulting in the ongoing pollution and sedimentation of the Blyde River and tributaries. Immediate impacts will include habitat being directly destroyed or fragmented by modifying riverbanks, channelizing and diverting flows, creating ponds, and through increased erosion, turbidity and sediment deposition. The anticipated long-term impacts include the possible degradation of the riparian habitat in these areas with significant impacts on downstream riparian habitat and water quality also anticipated. In addition, the continued influx of illegal miners into the area will result in an increase in snaring and poaching, leading a greater loss of faunal species in the focus area and greater region. The illegal miners will also clear vegetation outside of the mine shafts and along the banks in order to increase their own operations. Such operations will not be managed with biodiversity in mind and will be subject to environmental controls as stipulated in legislation; and
- AIP proliferation. The current state of AIPs within the focus area and beyond has already led to an unacceptable loss of faunal habitat. Without adequate resources managing the existing AIP populations, these species are likely to envelop the focus area in the years to come, leading to long term faunal habitat loss.

Discussion: Authorised Mining

The proposed project, if authorised, will result in the loss of important areas of faunal habitat which support a high diversity of species. In addition, the knock-on effects to the larger ecosystems if not managed properly will be high. The impacts associated with the Iota Pit, Iota WRDs, Wishbone WRD and Theta Pits will be notably significant. Below is a size estimation of fair to good condition habitat that will be directly impacted:

- Iota WRD (including the Iota Pit area): 34 ha of CBA Irreplaceable with 8 ha of Optimal CBA and 42 ha of Malmani Karstlands;
- Wishbone WRD: 0.001 ha of CBA Irreplaceable, 16 ha of Optimal CBA and 15ha of Malmani Karstlands;
- Iota Pit: 14 ha of Irreplaceable CBA with 5 ha of Optimal CBA and 19 ha of Malmani Karstlands;
- Theta Pits: 5 ha of CBA Irreplaceable with 8 ha of CBA Optimal and 6 ha of Malmani Karstlands;
- Browns Pit: 6 ha of CBA Optimal with 5 ha of Malnani Karstlands; and

- Pollution Control Dams: approximately 1 ha of Malmani Karstlands and 1 ha of CBA Optimal.

It is unlikely that the intact grasslands that are associated with the Theta Project can be completely restored following activities such as terrace mining. The proposed rehabilitation plan for the Theta Project, whilst good, will not allow for the return of the area to pre-mining ecological conditions. Whilst pre-mining conditions will not be achievable, the proposed rehabilitation plans will undoubtably allow some ecological functions to return over time, even allowing for thriving ecosystems to return in the future.

The second greatest threat to the current ecosystems within the focus area and greater region stems from the uncontrolled proliferation of AIPs. As these species spread, they will outcompete indigenous plant species, significantly decreasing faunal habitat availability and leading to a loss of faunal species in these areas. The stands of AIP's provide limited habitat and food resources to faunal species, and as such, species will migrate out of these areas into surrounding intact sites, leading to an increased demand on space and resources between species.

Should the mine receive authorisation, they will be obligated to implementing a host of mitigation measures to ensure sound and best practice environmental management in a mining scenario, to which they will be audited on. Strict control of mining activities, along with sound engineering designs, where AIPs are controlled and areas rehabilitated and no mine-related activities result in pollution or sedimentation of the Blyde River and downstream habitat, should be the goal. However, accidental discharge or spills are always a possibility, and this emphasises the necessity for strict adherence to cogent, well-conceived and ecologically sensitive mitigation measures along with readily available emergency action plans (discharge, fires, spillages etc.). Once in operation, and as resources become available, the mine will have the additional resources available to fully implement the necessary measures to control AIP species, whilst also increasing security measures to control illegal mining activities. The control of the illegal miners will have an immediate positive impact on the water quality of the Blyde with the subsequent long-term improvement of riparian habitat. In addition, snaring and / or poaching events will decrease, with the remaining natural and rehabilitated areas within the mine footprint becoming a possible safe haven for faunal species.

Large mining operations can have a greater impact potential when compared to small-scale artisanal mining, but they also have a greater capacity to minimise damage where artisanal mining practises rarely take responsibility for environmental damage. In addition, the artisanal mining, whilst small scale now, will likely ramp up over time to levels that are beyond any control of government, leading to widescale damage of ecosystems, significant degradation of the Blyde River and significantly increased levels of poaching.

The table below presents a summary of the assessment of each future land use alternative.

Table 16: Results of the impacts assessed associated with the various mining scenarios.

NO GO ALTERNATIVE VS MINING								IMPACT DESCRIPTION
Proposed Activities	**Status of Impact**	**Extent**	**Duration**	**Probability**	**Intensity**	**Magnitude**	**Significance**	
No-go with no management from relevant stakeholders	N	3	3	4	-4	**-14**	**High-**	Anticipated impacts on the faunal ecology include: - No direct loss of habitat or CBAs as no authorised mining will take place; - Loss of habitat and habitat degradation as illegal miners clear ground for operations around adits and along the Blyde River; - Increased poaching and snaring activities due to influx of illegal miners placing an increased demand on the informal bush meat trade; - Ongoing AIP proliferation along the Blyde River and its tributaries, as well as into Montane Grasslands; - Loss of faunal habitat and displacement of faunal SCC due to the encroaching AIPs into intact habitats; and - Ongoing pressure on Blyde River (and tributaries) from illegal mining activities, resulting in local and downstream impacts on Riparian Habitat and general biodiversity.
No-go with continuous ongoing management into perpetuity from relevant stakeholders	P	3	3	2	3	**11**	**Medium +**	Anticipated impacts on the faunal ecology include: - No direct loss of habitat or CBAs as no authorised mining will take place; - AIP controlled; - AIP cleared areas rehabilitated and sensitive habitat no longer fragmented with cleared areas being rehabilitated; - Return of biodiversity to previously invaded areas; - Long-term benefit to local and regional biodiversity targets; - Riparian habitat and water quality improved with control of illegal mining activities; and - Theoretical decrease in snaring and poaching events as illegal mining activities controlled.
Authorised mining in an ideal scenario	-	1	2	3	-3	**-3**	**Low**	Anticipated impacts on the faunal ecology include: - Loss of faunal habitat, faunal diversity and potential SCC within the footprint areas; - Rehabilitation of receiving environment to allow ecological functions or processes to continue without human intervention, resulting in the maximum possible ecosystem functioning post mining and permanent benefit; - Ongoing, adequate control of AIPs and the rehabilitation of AIP infested areas allowing for re-establishment of faunal communities; and - Ongoing, adequate control of illegal mining with subsequent recovery of Riparian Habitat impacted by illegal mining activities.
Authorised mining practically achievable	N	2	2	4	-3	**-11**	**(Medium High)**	Anticipated impacts on the faunal ecology include: - Loss of faunal habitat, species and CBAs within the mining footprint; - Rehabilitation of receiving environment to include revegetation with indigenous plant species, AIP control and improved habitat connectivity, however the overall ecological functions will likely continue in a modified yet functional way; - Downslope and downstream habitat may be impacted by accidental spills, discharges, sedimentation and erosion – though these will be managed by available emergency action plans; and - Illegal mining to continue, to a lesser extent, with some impacts on the Blyde River and faunal species still possible.

6 REASONED OPINION

Scientific Terrestrial Services (STS) was appointed to conduct a faunal and floral ecological assessment and impact assessments as part of the Environmental Authorisation and Environmental Impact Assessment (EIA) process for the Transvaal Gold Mining Estate (TGME) Mine Development Project: Application for the amendment of the existing environmental authorisation to include the proposed Theta Open Pit Project to include the Theta Hill, Browns Hill and Iota Hill projects near Pilgrim's Rest, Mpumalanga Province.

The objective of this study was to provide sufficient information on the faunal ecology of the area, together with other studies on the physical and socio-cultural environment for the Environmental Assessment Practitioner (EAP) and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. The needs for conservation as well as the risks to other spheres of the physical and socio-cultural environment need to be compared and considered along with the need to ensure economic development of the country.

During the course of the assessments two mammal SCC were observed, namely *Pelea capreolus* (Grey Rhebok, NT), *Rhinolophus smithersi (*Smithers Horseshoe Bat, NT) and *Rhinolophus blasii* (Blasius's Horseshoe Bat, NT). There is a high likelihood that some may occur within the focus area permanently whilst others are likely to use the area for foraging purposes. In addition to the observed SCC, it is likely that the focus area will be utilised by several other SCC, both on a temporary and permanent basis. Based on the impact assessment all proposed activities were rated High prior to mitigation due to the sensitivity of the habitat units and high species diversity expected for the focus area. The Kruger to Canyon Biosphere Region is noted to be situated nearby which increases the likelihood that avifaunal SCC will occur within and utilise the focus area. With proposed mitigation employed, most impacts may be reduced to medium, excluding the Iota, Browns Pit and the Theta Wishbone WRD, where loss of niche habitat is likely to be permanent for the construction and decommissioning phases. It must be noted however that the overall mine layout has already been adjusted in order to, as far as possible, avoid significant impacts to high sensitivity habitats. Due to the fact that the Browns Pit will only be partially backfilled and the most westerly section left open for future tailings deposition impacts pre and post mitigation remain high.

The Riparian Habitat unit is considered to be niche habitat with certain species only occurring in this habitat unit (Amphibians/Waterfowl and Mammals). The Montane Grassland and mountain outcrops habitat units are deemed to be sensitive due to the capacity of providing habitat for faunal SCC such as reptiles and small mammals. Mining activities should be restricted in these habitat units from an ecological point of view. It is of the utmost importance that if approval is granted that the proposed mining footprints and infrastructure locations be inspected by a suitably qualified and experienced ecologist approved by the MTPA to conduct thorough walkdowns of the proposed areas to minimize the possible impact to SCC.

Based on the results of the faunal assessment, it is the opinion of the specialist that this project will have negative impacts on the faunal ecology within the focus area and potentially on a local to regional scale and the impacts are relatively irreversible. The impact of the proposed project must however be contrasted with the risk that uncontrolled artisanal mining poses. If the project is to be approved for overriding socio-economic reasons, an appropriate biodiversity offset and compensation plan as well as appropriate funding of this initiative is considered essential.

It is the opinion of the ecologists that this study provides the relevant information required in order to implement an Integrated Environmental Management (IEM) plan and to ensure that the best long-term use of the ecological resources in the proposed mining area will be made in support of the principle of sustainable development

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APPENDIX A: Faunal Method of Assessment

It is important to note that due to the nature and habits of fauna, varied stages of life cycles, seasonal and temporal fluctuations along with other external factors, it is unlikely that all faunal species will have been recorded during the site assessment. The presence of human habitation nearby the focus area and the associated anthropogenic activities may have an impact on faunal behaviour and in turn the rate of observations. In order to increase overall observation time within the focus area, as well as increasing the likelihood of observing shy and hesitant species, camera traps were strategically placed within the focus area. Sherman traps were also used to increase the likelihood of capturing and observing small mammal species, notably small nocturnal mammals.

Mammals

Mammal species were recorded during the field assessment with the use of visual identification, spoor, call and dung. Specific attention was paid to mammal SCC as listed by the IUCN, 2015. Camera and Sherman traps were additionally used in order to observe the more cryptic mammals.

In order to specifically assess bat species, a bat detector was installed at various localities within the footprint areas were bats were likely to occur, whilst also being safe in order to minimise the risk of the equipment being stolen. A song meter SM4BAT device was used to record all bat calls and the kaleidoscope software was used to identify various bat species.

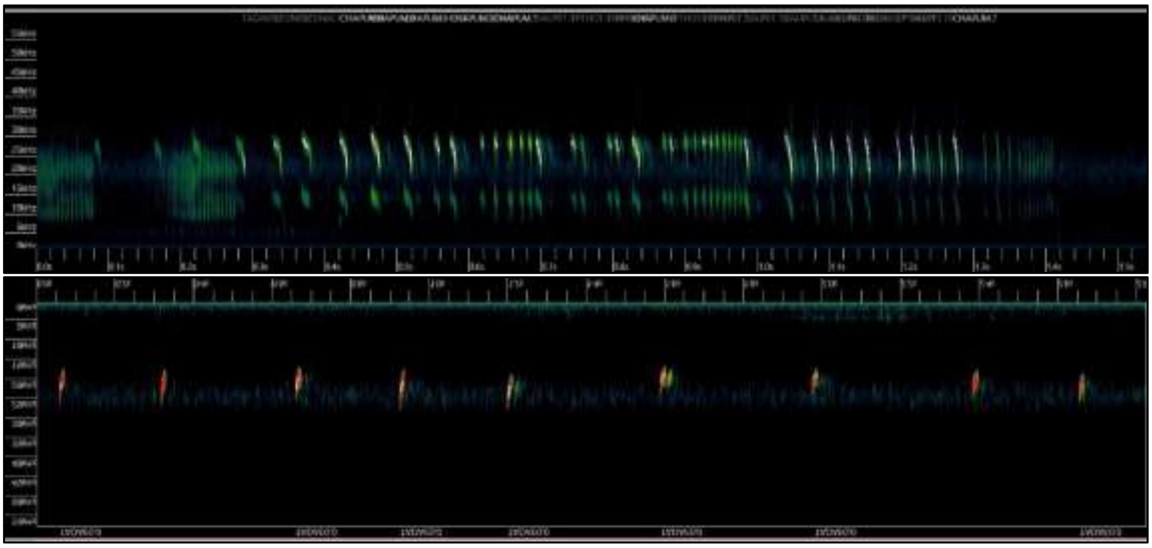

Figure 12: Visual representation of the ball call data analysis using the kaleidoscope software.

Figure 13: Visual representation of the Sherman and Camera traps used during the assessment.

Avifauna

The Southern African Bird Atlas Project 2 database (http://sabap2.adu.org.za/) was compared with the recent field survey of avifaunal species identified on the FOCUS AREA . Field surveys were undertaken utilising a pair of Bushnell 10x50 binoculars and bird call identification techniques were utilised during the assessment in order to accurately identify avifaunal species. Specific attention was given to avifaunal SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Reptiles

Reptiles were identified during the field survey. Suitable applicable habitat areas (rocky outcrops and fallen dead trees) were inspected and all reptiles encountered were identified. The data gathered during the assessment along with the habitat analysis provided an accurate indication of which reptile species are likely to occur on the focus area. Specific attention was given to reptile SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Amphibians

Identifying amphibian species is done by the use of direct visual identification along with call identification technique. Amphibian species flourish in and around wetland, riparian and moist grassland areas. It is unlikely that all amphibian species will have been recorded during the site assessment, due to their cryptic nature and habits, varied stages of life cycles and seasonal and temporal fluctuations within the environment. The data gathered during the assessment along with the habitat analysis provided an accurate indication of which amphibian species are likely to occur within the focus area as well as the surrounding area. Specific attention was given to amphibian SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Invertebrates

Whilst conducting transects through the focus area, all insect species visually observed were identified, and where possible photographs taken. Due to the terrain, and shallow/ rocky soil structure pitfall traps were not utilised during the site assessment.
It must be noted however that due to the cryptic nature and habits of insects, varied stages of life cycles and seasonal and temporal fluctuations within the environment, it is unlikely that all insect species will have been recorded during the site assessment period. Nevertheless, the data gathered during the assessment along with the habitat analysis provided an accurate indication of which species are likely to occur in the focus area at the time of survey. Specific attention was given to insect SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Arachnids

Suitable applicable habitat areas (rocky outcrops, sandy areas and fallen dead trees) where spiders and scorpions are likely to reside were searched. Rocks were overturned and inspected for signs of these species. Specific attention was paid to searching for Mygalomorphae arachnids (Trapdoor and Baboon spiders) as well as potential SCC scorpions within the focus area.

Faunal Species of Conservational Concern Assessment

The Probability of Occurrence (POC) for each faunal SCC was determined using the following four parameters:

- Species distribution;

- Habitat availability;
- Food availability; and
- Habitat disturbance.

The accuracy of the calculation is based on the available knowledge about the species in question. Therefore, it is important that the literature available is also considered during the calculation.
Each factor contributes an equal value to the calculation.

Scoring Guideline				
Habitat availability				
No Habitat	Very low	Low	Moderate	High
1	2	3	4	5
Food availability				
No food available	Very low	Low	Moderate	High
1	2	3	4	5
Habitat disturbance				
Very High	High	Moderate	Low	Very Low
1	2	3	4	5
Distribution/Range				
Not Recorded		Historically Recorded		Recently Recorded
1		3		5

[Habitat availability + Food availability + Habitat disturbance + Distribution/Range] / 20 x 100 = POC%

Faunal Habitat Sensitivity

The sensitivity of the focus area for each faunal class (i.e. mammals, birds, reptiles, amphibians and invertebrates) was determined by calculating the mean of five different parameters which influence each faunal class and provide an indication of the overall faunal ecological integrity, importance and sensitivity of the focus area for each class. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Faunal SCC:** The confirmed presence or potential for faunal SCC or any other significant species, such as endemics, to occur within the habitat unit;
- **Habitat Availability:** The presence of suitable habitat for each class;
- **Food Availability:** The availability of food within the focus area for each faunal class;
- **Faunal Diversity:** The recorded faunal diversity compared to a suitable reference condition such as surrounding natural areas or available faunal databases; and
- **Habitat Integrity:** The degree to which the habitat is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the suitability and sensitivity of the focus area for each faunal class. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the focus area in relation to each faunal class. The different classes and land-use objectives are presented in the table below:

Table A1: Faunal habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1 < 1.5	Low	Optimise development potential.
≥1.5 <2.5	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
≥2.5 <3.5	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
≥3.5<4.5	Moderately high	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance.
≥4.5 ≤5.0	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.

APPENDIX B: Faunal SCC

The tables below list the faunal Species of Conservation Concern for Mpumalanga:

Table B1: List of mammal species and IUCN Red List Category (Cohen & Camacho, 2002a) as listed in the Mpumalanga State of the Environment Report (2003).

English Name	Species	MP 2003 Status
Cape Mole Rat	*Georychus capensis*	EN
Sclater's Golden Mole	*Chlorotalpa sclateri montana*	CR
Highveld Golden Mole	*Amblysomus septentrionalis*	VU
Rough-Haired Golden Mole	*Chrysospalax villosus rufopallidus*	CR
Rough-Haired Golden Mole	*Chrysospalax villosus rufus*	EN
Juliana's Golden Mole	*Neamblysomus julianae*	EN
Robust Golden Mole	*Amblysomus robustus*	VU
Meester's Golden Mole	*Amblysomus hottentotus meesteri*	VU
Laminate Vlei Rat	*Otomys laminatus*	VU
Peak-Saddle Horseshoe Bat	*Rhinolophus blasii empusa*	EN
Lesser Long-Fingered Bat	*Miniopterus fraterculus*	VU
Welwitsch's Hairy Bat	*Myotis welwitschii*	EN
Short-Eared Trident Bat	*Cloeotis percivali australis*	EN
Antbear	*Orycteropus afer*	NE
Oribi	*Ourebia ourebi*	VU
African Striped Weasel	*Poecilogale albinucha*	NE
Wild Dog	*Lycaon pictus*	EN
Pangolin	*Manis temminckii*	VU
Aardwolf	*Proteles cristatus*	LC
African Leopard	*Panthera pardus*	VU
Natal Red Rock Rabbit	*Pronolagus crassicaudatus ruddi*	NE
Serval	*Leptailurus serval*	NT
Swamp musk shrew	*Crocidura mariquensis*	NT

EN= Endangered; CR= Critically Endangered; VU= Vulnerable; NE=Not Evaluated

Table B2: List of bird species and IUCN Red List Category (Cohen & Camacho,2002b) as listed in the Mpumalanga State of the Environment Report (2003).

English Name	Species	Status
Whitewinged Flufftail	*Sarothrura ayresi*	CR
Rudd's Lark	*Heteromirafra ruddi*	CR
Yellowbreasted Pipit	*Hemimacronyx chloris*	VU
Bald Ibis	*Geronticus calvus*	VU
Botha's Lark	*Spizocorys fringillaris*	EN
Wattled Crane	*Bugeranus carunculatus*	CR
Blue Crane	*Anthropoides paradiseus*	VU
Grey Crowned Crane	*Balearica reguloru,*	EN
Blue Swallow	*Hirundo atrocaerulea*	CR
Pinkthroated Twinspot	*Hypargos margaritatus*	NT
Chestnutbanded Plover	*Charadrius pallidus*	NT
Striped Flufftail	*Sarothrura affinis*	VU
Southern Ground Hornbill	*Bucorvus leadbeateri*	VU
Blackrumped Buttonquail	*Turnix hottentotta nana*	EN
Blue Korhaan	*Eupodotis caerulescens*	VU
Denham's Bustard	*Neotis denhami*	VU
African Marsh Harrier	*Circus ranivorus*	VU
Grass Owl	*Tyto capensis*	VU

Lesser Flamingo	*Phoeniconaias minor*	NT
Greater Flamingo	*Phoeniconaias roseus*	NT
Whitebellied Korhaan	*Eupodotis senegalensis*	VU
Saddlebilled Stork	*Ephippiorhynchus senegalensis*	CR
Lappetfaced Vulture	*Torgos tracheliotos*	EN
Whiteheaded Vulture	*Trigonoceps occipitalis*	EN
Bateleur	*Terathopius ecaudatus*	VU
Cape Vulture	*Gyps coprotheres*	VU
Martial Eagle	*Polemaetus bellicosus*	VU
Peregrine Falcon	*Falco peregrinus minor*	VU
Taita Falcon	*Falco fasciinucha*	NT

EN= Endangered; CR= Critically Endangered; VU= Vulnerable; NT= Near Threatened

Table B3: List of reptile species and their IUCN Red List Category (Williamson & Theron, 2002) as listed in the Mpumalanga State of the Environment Report (2003).

English Name	Species	Status
Haacke's Flat Gecko	*Afroedura haackei*	EN
Abel Erasmus Pass Flat Gecko	*Afroedura rupestris*	EN
Mariepskop Flat Gecko	*Afroedura indet*	EN
Rondavels Flat Gecko	*Afroedura rondavelica*	EN
Forest/Natal Purpleglossed Snake	*Amblyodipsas concolor*	VU
Lowveld Shieldnosed Snake	*Aspidelaps scutatus intermedius*	VU
Dwarf Chameleon	*Bradypodion transvaalense complex*	VU
Sungazer/ Giant Girdled Lizard	*Cordylus giganteus*	VU
Barberton Girdled Lizard	*Cordylus warreni barbertonensis*	NT
Lebombo Girdled Lizard	*Cordylus warreni*	VU
Swazi Rock Snake	*Lamprophis swazicus*	VU
Transvaal Flat Lizard	*Platysaurus orientalis*	NT
Wilhelm's Flat Lizard	*Platysaurus wilhelmi*	VU
Montane Burrowing Skink	*Scelotes mirus*	NT
Breyer's Longtailed Seps	*Tetradactylus breyeri*	VU
Coppery Grass Lizard	*Chamaesaura aenea*	NT

EN= Endangered; VU= Vulnerable; NT= Near Threatened; LC= Least Concern

Table B4: List of amphibian species and their IUCN Red List Category (Williamson & Theron, 2002) as listed in the Mpumalanga State of the Environment Report (2003).

English Name	Species	Status
Karoo Toad	*Bufo gariepensis nubicolus*	VU
Natal Ghost Frog	*Heleophryne natalensis*	VU
Spotted Shovel-Nosed Frog	*Hemisus guttatus*	NT
Yellow Striped Reed Frog	*Hyperolius semidiscus*	VU
Plain Stream Frog	*Strongylopus wageri*	VU
Giant Bullfrog	*Pyxicephalus adspersus*	VU
Greater Leaf-Folding Frog	*Afrixalus fornasini*	VU
Whistling Rain Frog	*Breviceps sopranus*	VU

VU= Vulnerable

Table B5: List of invertebrate species and their IUCN Red List Category (De Wet, 2002) as listed in the Mpumalanga State of the Environment Report (2003).

English Name	Species	Status
Aloeides rossouwi	Rossouw's Copper	EN
Aloeides barbarae	Barbara's Copper	EN
Lepidochrysops swanepoeli	Swanepoel's Blue	EN
Lepidochrysops jefferyi	Jeffery's Blue	EN
Dingana fraterna	Stoffberg Widow	EN
Metisella meninx	Marsh Sylph	VU
Aloeides nubilis	Cloud Copper	VU
Pseudagrion coeleste	Catshead Sprite - Coenagrionidae	CR

Pseudagrion inopinatum	Balinsky's Sprite - Coenagrionidae	VU
Pseudagrion newtoni	Newton's Sprite - Coenagrionidae	VU
Pseudagrion sjoestedti pseudojoestedti	Sjostedt's Sprite - Coenagrionidae	CR
Aeshna ellioti usambarica	Elliot's Hawker-Aeshnidae	VU
Phyllomacromia monoceros	Unicorn Cruiser - Corduliidae	CR

EN= Endangered; CR= Critically Endangered; VU= Vulnerable

Table B6: Protected Species for the Mpumalanga Province (2015) as listed in Government Notice 256 Threatened or Protected Species (TOPS) as published in the Government Gazette 38600 of 2015 as it relates to the National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004);

Scientific Name	Common Name	Conservation Status RSA	Conservation Status MTPA
MAMMALS			
Georychus capensis (Mpumalanga subpopulation)	Cape mole-rat	DD	DD
Lycaon pictus	Africa Wild Dog	EN	EN
Neamblysomus julianae	Juliana's golden mole	EN	EN
AVIFAUNA			
Stephanoaetus coronatus	African Crowned Eagle	VU	VU
Hirundo atrocaerulea	Blue Swallow	CR	CR
Tyto capensis	African Grass-Owl	VU	VU
Falco biarmicus	Lanner Falcon	VU	VU
Falco peregrinus	Peregrine Falcon	VU	
Gorsachius leuconotus	White-backed Night-Heron	VU	VU
Podica senegalensis	African Finfoot	VU	VU
Alcedo semitorquata	Half-collared Kingfisher	NT	NT
Nettapus auritus	African Pygmy-Goose	VU	VU
Ciconia nigra	Black Stork	VU	VU
Gyps africanus	White-backed Vulture	CR	CR
Polemaetus bellicosus	Martial Eagle	EN	EN
Schoenicola brevirostris	Broad-tailed Warbler	NT	
Aquila verreauxii	Verreauxs' Eagle	VU	VU
Macheiramphus alcinus	Bat Hawk	EN	EN
REPTILES			
Crocodylus niloticus	Nile Crocodile	NT	NT
Afroedura multiporis haackei	Haacke's rock gecko	LC	EN
Platysaurus intermedius wilhelmi	Common flat lizard	LC	NT
Smaug barbertonensis	Barberton girdled lizard	LC	NT
INVERTEBRATES			
Lepidochrysops swanepoeli	Swanepoel's blue	EN	EN
Lepidochrysops jefferyi	Jefferyi's blue	EN	EN
Aloeides barbarae	Barbara's copper	EN	EN
Pseudagrion sjoestedti	Variable sprite	CR	CR

EN= Endangered; CR= Critically Endangered; VU= Vulnerable; P = Protected

Species Recorded historically in the associated QDS's (2430DC and 2430DD)

Table B7: List of mammal species and IUCN Red List Category (Cohen & Camacho, 2002a) as listed in the Mpumalanga State of the Environment Report (2003).

Scientific name	Common Mammal name	MTPA	IUCN status
Amblysomus hottentotus meesteri	Meester's golden mole	NE	NYBA
Cercopithecus mitis labiatus	Samango monkey	EN	NYBA
Chrysospalax villosus	Rough-haired golden mole	VU	VU
Crocidura fuscomurina	Tiny musk shrew	LC	LC
Leptailurus serval	Serval	NT	LC
Mellivora capensis	Honey badger	NT	LC
Orycteropus afer	Aardvark	LC	LC
Otomys laminatus	Laminate vlei rat	NT	NT
Ourebia ourebi	Oribi	EN	LC
Panthera pardus	Leopard	NT	VU
Pelea capreolus	Grey rhebok	LC	NT
Proteles cristatus	Aardwolf	LC	LC
Rhinolophus blasii	Peak-saddle horseshoe bat	NT	LC
Rhinolophus cohenae	Cohen's horseshoe bat	VU	VU
Rhinolophus fumigatus	Ruppell's horseshoe bat	LC	LC
Rhinolophus hildebrandtii	Hildebrandt's horseshoe bat	NT	LC
Rhinolophus swinnyi	Swinny's horseshoe bat	VU	LC

CR = Critically Endangered, EN = Endangered, VU = Vulnerable; NYBA: Not Yet Been Assessed

Table B8: List of bird species and IUCN Red List Category (Cohen & Camacho, 2002b) as listed in the Mpumalanga State of the Environment Report (2003).

Scientific name	Common Bird Name	MTPA	IUCN status
Eupodotis senegalensis	**White-bellied Korhaan**	**VU**	**LC**
Falco peregrinus	Peregrine Falcon	VU	LC
Geronticus calvus	Southern Bald Ibis	VU	CU
Gyps coprotheres	Cape Vulture	EN	EN
Hirundo atrocaerulea	Blue Swallow	CR	NT
Neotis denhami	Denhams Bustard	VU	NT
Sagittarius serpentarius	Secretarybird	VU	VU
Sarothrura affinis	Striped Flufftail	VU	LC
Stephanoaetus coronatus	African Crowned Eagle	VU	NT
Zoothera gurneyi	Orange Ground-Thrush	NT	LC

CR = Critically Endangered, **EN** = Endangered, **VU** = Vulnerable, **NT** = Near Threatened.

Table B9: List of reptile species and their IUCN Red List Category (Williamson & Theron, 2002) as listed in the Mpumalanga State of the Environment Report (2003).

Scientific name	Common Reptile Name	MTPA	IUCN status
Bradypodion transvaalensis	Wolkberg Dwarff Chameleon	VU	NYBA
Chamaesaura anguina	Cape Grass Lizard	NT	NYBA
Homoroselaps lacteus	Spotted Harlequin Snake	NT	LC
Lamprophis fuscus	Yellow Bellied Snake	NT	LC
Amblyodipsas concolor	KwaZulu-Natal Purple-glossed Snake	VU	LC
Chamaesaura aenea	Transvaal Grass Lizard	NT	NYBA
Chamaesaura macrolepis	Large Scale Grass Lizard	NT	LC
Amplorhinus multimaculatus	Many Spotted Snake	NT	LC
Tetradactylus breyeri	Breyers Long Tailed Seps	VU	LC

CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened; LC = Least Concern, NYBA: Not Yet Been Assessed

Table B10: List of amphibian species and their IUCN Red List Category (Williamson & Theron,2002) as listed in the Mpumalanga State of the Environment Report (2003).

Scientific name	Common Amphibian Name	MTPA	IUCN status
Hadromophryne natalensis	Natal Ghost Frog	NT	LC

VU = Vulnerable

Table B11: List of invertebrate species and their IUCN Red List Category (De Wet, 2002) as listed in the Mpumalanga State of the Environment Report (2003).

Scientific name	MTPA	IUCN
Aloeides nubilus	EN	EN
Diplacodes pumila	EN	LC
Lepidochrysops irvingi	EN	NYBA
Orachrysops violescens	VU	NYBA
Proischnura rotundipennis	VU	LC
Pseudagrion newtoni	VU	VU
Pseudonympha swanepoeli	CR	NYBA

LC = Least Concern, NYBA = Not yet been assessed by the IUCN EN: Endangered VU: Vulnerable

South African Bird Atlas Project 2 list for quadrant 2430DC & 2430DD

Table B12: Avifaunal Species for the pentad 2450_3040, 2450_3045, 2455_3045 and 2455_3040 within the QDS 2430DC & 2430DD

Pentads	Link to pentad summary on the South African Bird Atlas Project 2 web page
2455_3045	http://sabap2.adu.org.za/coverage/pentad/2455_3045
2450_3045	http://sabap2.adu.org.za/coverage/pentad/2450_3045
2455_3040	http://sabap2.adu.org.za/coverage/pentad/2455_3040
2450_3040	http://sabap2.adu.org.za/coverage/pentad/2450_3040

APPENDIX C: Faunal Species List

Table C1: Mammal species recorded during the field assessment.

Scientific Name	Common Name	Conservation Status
Canis mesomelas	Black-backed Jackal	LC
Elephantulus myurus	Eastern Rock Sengi	LC
Tragelaphus strepsiceros	Greater Kudu	LC
Aethomys namaquensis	Namaqua Rock Mouse	LC
Cryptomys hottentotus	Southern African Mole-rat	LC
Papio ursinus	Chacma Baboon	LC
Chlorocebus pygerythrus	Vervet Monkey	LC
Hystrix africaeaustralis	Porcupine	LC
Lepus saxatilis	Scrub Hare	LC
Oreotragus oreotragus	Klipspringer	LC
Rattus norvegicus	Brown Rat	LC
Sylvicapra grimmia	Common Duiker	LC
Redunca fulvorufula	Mountain Reedbuck	LC
Pelea capreolus	Grey Rhebok	NT

NT = Near Threatened, LC = Least Concern

Table C2: Bat species recorded and identified using a SM4BAT Detector and the Kaleidoscope Pro Software.

Scientific Name	Common Name	Conservation Status
Pipistrellus hesperidus	Dusky Pipistrelle Bat	LC
Neoromicia capensis	Cape Serotine Bat	LC
Pipistrellus hesperidus	Dusky Pipistrelle Bat	LC
Rhinolophus smithersi	Smithers Horseshoe Bat	NT
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC
Chaerephon pumilus	Little Free-tailed Bat	LC
Miniopterus natalensis	Natal Long-fingered Bat	LC
Rhinolophus hildebrandtii	Hildebrandt's Horseshoe Bat	LC
Sauromys petrophilus	Robert’s Flat-headed Bat	LC
Eptesicus hottentotus	Long-tailed House Bat	LC
Rhinolophus blasii	Blasius’s Horseshoe Bat	NT
Rhinolophus clivosus	Geoffroy’s Horseshoe Bat	LC
Scotophilus dinganii	African Yellow Bat	LC

Table C3: Avifaunal species recorded during the field assessment.

Scientific name	English name	Conservation Status
Threskiornis aethiopicus	African Sacred Ibis	LC
Cossypha dichroa	Chorister Robin-chat	LC
Cossypha caffra	Cape Robin-chat	LC
Merops apiaster	European Bee-eater	LC
Merops bullockoides	White-fronted Bee-eater	LC

Scientific name	English name	Conservation Status
Monticola rupestris	Cape Rock Thrush	LC
Buteo rufofuscus	Jackal Buzzard	LC
Falco rupicolus	Rock Kestrel	LC
Onychognathus morio	Red-winged Starling	LC
Halcyon albiventris	Brown-hooded Kingfisher	LC
Plocepasser mahali	White-browed Sparrow Weaver	LC
Saxicola torquatus	African Stonechat	LC
Elanus caeruleus	Black-shouldered Kite	LC
Vanellus armatus	Blacksmith Lapwing	LC
Passer melanurus	Cape Sparrow	LC
Streptopelia capicola	Cape Turtle Dove	LC
Motacilla capensis	Cape Wagtail	LC
Cisticola fulvicapilla	Neddicky	LC
Lanius collaris	Common Fiscal	LC
Pycnonotus tricolor	Dark-capped Bulbul	LC
Crithagra mozambicus	Yellow-fronted Canary	LC
Terpsiphone viridis	Paradise-flycatcher	LC
Upupa africana	African Hoopoe	LC
Anthus cinnamomeus	African Pipit	LC
Anthus similis	Long-billed Pipit	LC
Oenanthe bifasciata	Buff-streaked Chat	LC
Apalis thoracica	Bar-throated Apalis	LC
Tchagra senegalus	Black-crowned Tchagra	LC
Uraeginthus angolensis	Blue Waxbill	LC
Estrilda melanotis	Swee Waxbill	LC
Telophorus zeylonus	Bokmakierie	LC
Serinus gularis	Streaky-headed Canary	LC
Hirundo fuligula	Rock Martin	LC
Ardea cinerea	Grey Heron	LC
Numida meleagris	Helmeted Guineafowl	LC
Trachyphonus vaillantii	Crested Barbet	LC
Vanellus coronatus	Crowned Lapwing	LC
Dicrurus adsimilis	Fork-tailed Drongo	LC
Malaconotus blanchoti	Grey-headed Bush-Shrike	LC
Colius striatus	Speckled Mousebird	LC
Corvus albus	Pied crow	LC
Streptopelia semitorquata	Red-eyed Dove	LC
Pternistis swainsonii	Swainson's Spurfowl	LC
Nectarinia famosa	Malachite sunbird	LC
Cinnyris afra	Greater Double-collared Sunbird	LC
Batis capensis	Cape Batis	LC
Lagonosticta rubricate	African Firefinch	LC
Passer domesticus	House Sparrow	LC
Streptopelia senegalensis	Laughing Dove	LC

Scientific name	English name	Conservation Status
Apus affinis	Little Swift	LC
Prinia subflava	Tawny-flanked Prinia	LC
Corvus capensis	Cape Crow	LC
Streptopelia semitorquata	Red-eyed Dove	LC
Zosterops virens	Cape White-eye	LC
Urocolius indicus	Red-faced Mousebird	LC
Ploceus velatus	Southern Masked Weaver	LC
Euplectes orix	Southern Red Bishop	LC
Cisticola juncidis	Zitting Cisticola	LC

LC = Least Concern, N-End Near-endemic

Table C4: Reptile species recorded during the field assessment.

Scientific name	Common Name	Conservation Status
Chamaeleo dilepis	Common Flap-necked Chameleon	LC
Psammophylax tritaeniatus	Striped Grass Snake	LC
Philothamnus natalensis occidentalis	Western Natal Green Snake	LC
Agama aculeata distanti	Eastern Ground Agama	LC
Lygodactylus capensis capensis	Common House Gecko	LC
Trachylepis varia	Variable Skink	LC
Panaspis wahlbergi	Wahlberg's Snake-eyed Skink	LC
Pseudocordylus melanotus	Drakensburg Crag Lizard	LC

LC = Least Concern, NYBA = Not Yet Been Assessed

Table C5: General invertebrate recorded during the field assessment.

Scientific Name	Common Name	Conservation Status
Belenois aurota	Brown-veined White	NYBA
Junonia hierta	Yellow Pansy	LC
Musca domestica	House Fly	NYBA
Acanthacris ruficornis	Garden Locust	NYBA
Dysdercus nigrofasciatus	Cotton Stainer	NYBA
Byblia ilythia	Spotted Joker	LC
Trichostetha fascicularis	Green Protea Beetle	NYBA
Sphodromantis gastrica	Giant Mantid	LC
Apis mellifera scutellata	African Honeybee	NYBA
Catopsilia florella	African migrant	LC
Phalanta phalantha aethiopica	African leopard	LC
Platypleura hirta	Cicada	NYBA
Catacroptera cloanthe cloanthe	Pirate	LC
Family Bacillidae	Stick Insect	NYBA
Maransis rufolineatus	Grass Stick Insect	
Dischista rufa	Fruit Chafer	NYBA
Anisorrhina umbonata	Saddle Fruit Chafer	NYBA
Papilio nireus lyaeus	Green-banded Swallowtail	LC
Papilio euphranor	Forest Swallowtail	LC
Papilio demodocus demodocus	Citrus Swallowtail	LC
Phymateus viridipes	Green Milkweed/ Stinkweed Locust	NYBA
Decapotoma lunata	Lunate Blister Beetle	NYBA
Belenois creona severina	African Common White	LC

Scientific Name	Common Name	Conservation Status
Leptotes babaulti	Babault's Blue	LC
Platylesches neba	Flower-girl hopper	NYBA
Colotis euippe Omphale	Smokey Orange Tip	LC
Cyligramma latona	Cream-striped Owl	NYBA
Dictyophorus spumans	Koppie Foam Grasshopper	NYBA
Anax imperator	Blue Emperor	LC
Orthetrum Julia	Julia Skimmer	LC
Eyprepocnemis sp/	N/A	NYBA
Grammodes stolida	Stolid Lines	NYBA
Acrida acuminate	Common Stick Grasshopper	NYBA
Azanus moriqua	Thorn-tree Blue	LC
Solenopsis punctaticeps	Fire Ant	NYBA
Azanus ubaldus	Velvet-spotted Blue	LC
Anthene definita definita	Common Hairtail	LC
Onosandrus sp	N/A	N/A
Pachycondyla tarsata	African Stink Ant	NYBA
Afreumenes sp	Potter Wasps	NYBA
Camponotus maculatus	Spotted Sugar Ant	NYBA
Byblia ilithyia	Spotted Joker	LC
Macronemurus tinctus	White-tip Grassland Antlion	NYBA
Hagenomyia tristis	Gregarious Antlion	NYBA
Anoplolepis custodiens	Pugnacious Ant	NYBA
Tmetanota sp	Grasshoppers	NYBA
Rhinocoris sp	Flower Assassin	NYBA
Acanthogryllus fortipes	Brown Cricket	NYBA
Kedestes barberae	Barber's Ranger	NYBA
Veterna sp	Grass Stink Bugs	NYBA
Anubis scalaris	Skunk Longhorn	NYBA
Orthoctha dasycnemis	N/A	NYBA
Bactrododema reyi	Walking Stick Insect	NYBA
Popa undata	Stick Mantid	NYBA
Precis archesia pelasgis	Garden Inspector	LC
Epioscopomantis chalybea	Mantis	NYBA
Locris sp	Spittle Bug	NYBA
Dichtha sp	Toktokkie	NYBA
Garret asp	Dung Beetle	NYBA
Proagoderus aciculatis	Dung Beetle	NYBA
Deropeltis erythrocephala	Cockroach	NYBA
Acraea nohara nohara	Light Red Acraea	NYBA
Anthia sp	Tyrant Ground Beetle	NYBA
Notogomphus praetorius	Yellow jack Dragonfly	LC
Spialia spio	Mountain Sandman	NYBA
Catantops humeralis	Grasshopper	NYBA
Rhachitops sp	Grasshopper	NYBA
Truxalis sp	Grasshopper	NYBA
Plagiodera caffra	Beetle	NYBA
Family Psychidae	Bagworms	NYBA
Phaneroptera sp	Leaf Katydid	NYBA

Scientific Name	Common Name	Conservation Status
Evides pubiventris	Emerald Jewel Bug	NYBA
Precis octavia sesamus	Gaudy Commodore	LC
Hodotermes mossambicus	Northern Harvester Termite	NYBA
Scutigera coleoptrata	House centipede	NYBA
Gastrimargus sp	N/A	NYBA
Bicyclus anynana anynana	Squinting Bush Brown	LC
Platycypha caligata	Dancing Jewel	LC
Anterhynchium natalense	N/A	NYBA
Pseudagrion spernatum	Upland Sprite	NYBA
Xeloma tomentosa	Gold-haired Fruit Chafer	NYBA
Cyrtothyrea marginalis	Common Dotted Fruit Chafer	NYBA
Acraea natalica	Natal Acraea	LC
Danaus chrysippus	African Monarch	LC
Papilio demodocus	Citrus Swallowtail	LC
Mylothris agathina	Common Dotted Border	LC

LC = Least Concern, NYBA = Not yet been assessed by the IUCN

Table C6: Arachnid species recorded during the site assessment.

Common Name	Scientific Name	Conservation Status
Harpactira hamiltoni	Highveld Baboon Spider	NYBA
Agriope trifasciata	Banded Argiope	NYBA
Perenethis simoni	Nursery-web spider	NYBA
Hyllus argyrotoxus	Jumping Spider	NYBA
Leucauge festiva	Masked Vlei Spider	NYBA
Peucetia viridis	Green Lynx Spiders	NYBA
Monaeses sp	N/A	NYBA
Tibellus sp	N/A	NYBA
Runcinia flavida	N/A	NYBA
Thomisus stenningi	N/A	NYBA
Oxyopes bothai	Grass Lynx Spiders	NYBA
Oxyopes angulitarsus	Grass Lynx Spiders	NYBA
Oxyopes sp	Grass Lynx Spiders	NYBA
Solifugae sp.	Sun Spider	NYBA
Family Thomisidae	Crab Spiders	NYBA
Argiope australis	Common garden orb-web spiders	NYBA
Gasteracantha versicolor	Medium-wing Kite Spider	NYBA
Cheloctonus intermedius	Intermediate Creeper	NYBA
Cheloctonus jonesii	Jone's Creeper	NYBA

LC = Least Concern, NYBA = Not Yet Been Assessed

Table C7: Amphibian species recorded during the field assessment.

Scientific name	Common Name	Conservation Status
Afrana angolensis	Angola River Frog	LC
Amietophrynus gutturalis	Guttural Toad	NYBA
Amietophrynus rangeri	Raucous Toad	NYBA

LC = Least Concern, NYBA = Not Yet Been Assessed

Table C8: Amphibian species previously recorded for the QDS according to SAFAP.

Scientific name	Common Name	Conservation Status
Breviceps adspersus	Bushveld Rain Frog	LC
Breviceps mossambicus	Mozambique Rain Frog	LC
Breviceps verrucosus	Plaintive Rain Grog	LC
Afrana angolensis	Angola River Frog	LC
Cacosternum boettgeri	Common Caco	LC
Cacosternum parvum	Mountain Caco	LC
Heleophryne natalensis	Natal Ghost Frog	NT
Kassina senegalensis	Senegal Kassina	LC
Phrynobatrachus natalensis	Natal Dwarf Puddle Frog	LC
Schismaderma carens	African Red Toad	LC
Strongylopus grayii	Gray's Stream Frog	LC
Tomopterna natalensis	Natal Sand Frog	LC
Amietophrynus garmani	Eastern Olive Toad	LC
Cacosternum nanum	Bronze Caco	LC
Hyperolius marmoratus	Marbled Reed Frog	LC

LC = Least Concern, NYBA = Not Yet Been Assessed

APPENDIX D: Responses to Issues and Risks highlighted by I&AP

Comments regarding the faunal ecology associated with the project were received and are outlined in the below table, including the responses to each.

Table D1: Responses to issues and risks highlighted by Interested and Affected Parties from a faunal perspective.

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FAUNAL ECOLOGIST
FAUNA			
1	The proposed mining is very close to a protected nature area on the farms Desire and Grootfonteinberg. The buffer zone is 5 km. One should also take cognisance of national protected areas (MTPA) development also falls adjacent to the Mount Sheba Nature Reserve, Morgenzon Nature Reserve and a the new proposed Morgenzon South Nature Reserve (K2C / AWARD)	Distance of protected areas to mining activity Buffer zone	The protected nature reserves that the comment refers to are the Mount Sheba Private Nature Reserve, located approximately 0.84km south-southwest of the proposed layout, and the Motlatse Canyon Provincial Nature Reserve, approximately 1.6 km southeast of the focus area (the latter is not in the latest SAPAD database). According to the Mpumalanga Biodiversity Sector Plan Handbook (2014), Quarrying/Opencast Mining is deemed a **conflicting land use** to the management objective for Protected Areas – thus not permissible if the ecological and tourism functionality of the protected area is to be maintained or improved. Other planned mine activities, mainly construction and operations of roads, powerlines, canals etc. are also considered to be a land use that may compromise biodiversity objectives of the protected areas and can only be permitted under certain circumstances. Due to the proximity of these protected areas the likelihood that these species may be occasionally utilising the focus area is deemed to be high Within Sections 3.1 of Section A (Background Information) explicitly states and maps protected and conservation areas in close proximity (within 10 km) of the focus area (SAPAD, 2018; SACAD, 2018; NPAES, 2009), including a brief discussion of the significance and consequence thereof for the proposed Theta mine activities.
2	Impact on Critical Biodiversity Areas (CBA). Open-cast mining is a land use that will compromise the biodiversity objective and is not supported within CBA areas (MTPA) – ALSO: proposed development sites indicate fragmentation of the CBA areas with high exotic tree infestations (also AWARD / K2C / SANPARKS)	CBA	The extent of the CBAs within the focus area is mapped in Section 3.1 of Section A (Background Information) and their significance/ importance explained from a desktop perspective. The significance of CBA areas from a faunal perspective cannot be understated as it acts as refuge and migration corridors for faunal species. The layout was significantly amended due to the results from the biodiversity studies and the WRD locations and pit perimeters were reduced in size as a matter of avoidance and minimisation. Within Section C (faunal assessment), these CBAs have been ground-truthed within the footprint of the proposed mine activities. Due to the short duration of the survey it is difficult

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FAUNAL ECOLOGIST
			to establish at this time if faunal species use these CBAs for migratory purposes.
3	MTPA would insist on on-site verification of the studies. Site visits must be undertaken in the growing seasons.	Timing of site visits and phased approach of specialist studies	A field assessment was undertaken from the 26th to the 29th of March 2019 (late summer season) and again in January 2020, to determine the faunal habitat, diversity and possible occurrence of SCC. During the assessment one faunal SCC was observed namely *Pelea capreolus* (Grey Rhebok) listed Near Threatened (NT) by the IUCN (2019). It is further recommended that, due to the short duration of the assessment and high numbers of expected SCC, an additional mid-summer assessment be undertaken to further evaluate the habitat and faunal communities. Such an assessment will be better timed in order to provide additional valuable data on possible avifaunal SCC as well as other important faunal groups. If authorisation is approved the mitigation as listed in Section 5 should be strictly adhered to.
4	Due to it being a CBA area, the corridors linking different areas and the effects on the areas outside that specific site area should be taken into account (MTPA)	Corridors linking CBA	The proposed mine activities have already and will continue to result in the fragmentation of the CBAs. The result of such fragmentation is emphasised within the Faunal report. The resultant fragmented CBA will evidently lead to habitat loss and faunal communities being displaced. Fragmented habitat not only impacts on faunal species but also limits the migration of faunal species. Overall, it is anticipated that the fragmentation of CBAs will result in lowered biodiversity for the area. The layout was significantly amended due to the results from the biodiversity studies and the WRD locations and pit perimeters were reduced in size as a matter of avoidance and minimisation in order to try limit habitat fragmentation.
5	The terrestrial section of the report needs information on bat species, and sub-terrain animals e.g. the Golden Moles and so forth.	Bat species Sub terrain animals	The expected protected bat and subterranean species are discussed within the mammal dashboard Section 3.2 and within the Section 5- Impact upon Faunal SCC.
6	The biodiversity values of the buffer zones must be highlighted	Biodiversity Values Buffer Zones	Based on the faunal assessment the Riparian Habitat Mountain Outcrops and Remnants of Northern Mistbelt Forest Habitat units are considered to be sensitive from a faunal perspective offering habitat for various faunal SCC. It has been recommended that layouts be revised to preserve these habitat units.
7	Request MTPA: A detailed botanical survey is required to assess the sensitivity of the mining footprint area - in addition, specialist studies should also be conducted looking at birds, reptiles, fish, Odonata (responsible for the CBA Aquatic species in the MBSP freshwater map), and small mammals	Faunal survey details	A single survey of all the mentioned faunal groups were undertaken, results are displayed in Section 3.1 to Section 3.7. Due to the short duration of the survey desktop information from the iNaturalist database and Virtual Museum were included to determine which species may be present within the focus area. For the methodologies used in the assessment please refer to Appendix A. Please refer to the separate reports dealing with the floral and freshwater aspects: Section B: Floral Assessment and the Freshwater Assessment.

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FAUNAL ECOLOGIST
8	The mining application falls within the Kruger to Canyons Biosphere Region (K2C)	K2C Biosphere status regarding development	Within Section A: Background Information (section 3.1), as well as within Section B: Floral Assessment (sections 3.1 – 3.4), it is acknowledged that according to the South African Conservation Areas Database (SACAD, 2018), the entire proposed layout falls within the Kruger to Canyons Biosphere Reserve and, therefore is recognised under the UNESCO (United Nations Educations, Scientific and Cultural Organisation) Man and the Biosphere Programme. Depending on the spatial zonation of a Biosphere Reserve (core area, buffer zone or transitional zone), these areas can be granted legal protection or can be used for sustainable developments. It is unclear what the spatial zonation is of the section of the Biosphere Reserve in which the focus area is located. Specific mention of the Kruger to Canyon Biosphere region has been made throughout the Faunal Report.
9	There are a number of highly threatened bird species living and breeding along the Blyde River. My colleagues and I have been monitoring the breeding of these birds for the past 4 years. These include critically endangered Hooded Vultures and White-backed Vultures, as well as the charismatic Pel's Fishing-owls, and Finfoot. There are also otters, hippos and crocodiles in the Blyde River, which are all reliant on clean water for their survival (EWT)	Threatened bird species	Comment acknowledged, specific mention has been made within Section 5 – Impact upon potential faunal SCC.
10	The amount of time spent in the field to establish the species composition was scant at best, and cannot be considered sufficient to establish the potential presence of threatened species (EWT)	Timing of studies vs. threatened species	We acknowledge that more time on site was necessary for a more saturated species list. Although relying on historic background data, data provided by MTPA, species lists obtained for the relevant QDS from online datasets (e.g. the Virtual Museum and Botanical Database of Southern Africa) and experience in the area will not allow the provision of a complete representation of the area's floral and faunal diversity. Assessments of this nature, whilst of limited duration serve, with the assistance of background and desktop data, to provide the relevant proponent with an overview of the sensitivity of the area as well as areas of concern and issues. Species diversity, habitat condition and SCC are discussed highlighted and the proposed risk to these facets by mining is present in Section 5. Ecological surveys that form part of the EIA process will and can never match such studies undertaken over a number of years, as this is not economically feasible or tenable. As such, where these studies have been undertaken and data is made available, it has been incorporated into this study. Additional surveys are recommended as part of the mitigation measures (Section 5): Surveys to be overseen by MTPA and

No.	COMMENT	ISSUE / RISK	RESPONSE FROM THE FAUNAL ECOLOGIST
			would need to be conducted within the months of January/ February to record possible migrant avifaunal SCC which may be utilising the area, and when other faunal groups are most active. In light of this, the layout was significantly amended following the results from the biodiversity studies and the WRD locations and pit perimeters were reduced in size in order to try to avoid or minimise impacts to sensitive habitat and faunal SCC.
11	Affecting trees can also be considered a transgression, and therefore the creation of a buffer area of at least 30 m wide around natural forest patches is important (DAFF)	Buffer area for natural forest areas	This comment has been taken into consideration and a 30 m buffer around natural forest areas are depicted on the habitat unit maps of Section B (Floral report - Section 3).

Phase 1 Cultural Heritage Assessment:

AMENDMENT TO AN ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED THETA PROJECT, NEAR PILGRIM'S REST, MPUMALANGA

Prepared for:

Batho Earth Environmental Consulting: Ms D Verster

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Prepared by:

J A van Schalkwyk (D Litt et Phil),

- Heritage Consultant: ASAPA Registration No.: 164 - Principal Investigator: Iron Age, Colonial Period, Industrial Heritage.
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Report No: 2019/JvS/042

- Date: September 2019
- Revision No: 3
- Status: Final
- Date: June 2020







Specialist competency:

Johan A van Schalkwyk, D Litt et Phil, heritage consultant, has been working in the field of heritage management for more than 40 years. Originally based at the National Museum of Cultural History, Pretoria, he has actively done research in the fields of anthropology, archaeology, museology, tourism and impact assessment. This work was done in Limpopo Province, Gauteng, Mpumalanga, North West Province, Eastern Cape Province, Northern Cape Province, Botswana, Zimbabwe, Malawi, Lesotho and Swaziland. Based on this work, he has curated various exhibitions at different museums and has published more than 70 papers, most in scientifically accredited journals. During this period, he has done more than 2000 impact assessments (archaeological, anthropological, historical and social) for various government departments and developers. Projects include environmental management frameworks, roads, pipeline-, and power line developments, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments.

J A van Schalkwyk
Heritage Consultant
June 2020

SPECIALIST DECLARATION

I, J A van Schalkwyk, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist

J A van Schalkwyk
June 2020

EXECUTIVE SUMMARY

Phase 1 Cultural Heritage Assessment:
AMENDMENT TO AN ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED THETA PROJECT, NEAR PILGRIM'S REST, MPUMALANGA

Transvaal Gold Mining Estates Limited (TGME) is situated in the Sabie / Pilgrim's Rest goldfields area of Mpumalanga. The proposed mining operation is located adjacent to the existing TGME metallurgical plant, which is situated 2.5km southwest of the town of Pilgrim's Rest, Mpumalanga Province. TGME, through an engineering scoping study and an engineering feasibility study, has identified the opportunity to mine gold bearing reefs via modified terrace mining and this has triggered the need to amend its current MP 30/5/1/2/2/83MR right to include the new mining sections.

In accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by *Batho Earth Environmental Consultants* to conduct a cultural heritage assessment to determine the cultural heritage significance of the areas where the new mining sections is located. A number of previous studies, Fourie (2008); Henning (1981); Pistorius (2005); Reinders, Mason & Van Wyk (2007), have been done regarding the heritage features on the farm Ponieskrans. The main aim of the current study was therefore to determine what impact the proposed development would have on these sites and features.

This report describes the methodology used, the limitations encountered, the heritage features that were identified and the recommendations and mitigation measures proposed relevant to this. The investigation consisted of a desktop study (archival sources, database survey, maps and aerial imagery) and a physical survey that also included the interviewing of relevant people. It should be noted that the implementation of the mitigation measures is subject to SAHRA/PHRA's approval.

The cultural landscape qualities of the region essentially consist of two components. The first is made up of a limited pre-colonial (Stone Age and Iron Age) occupation. The second component is a rural area in which the human occupation consists of two elements. The discovery of gold during the late 19th century resulted in a flood of people entering the area, establishing gold mining activities all over the landscape. The second element is a rural farming community, which, since the early 20th century revolved around forestry, which altered the landscape beyond recognition. These two elements led to the establishment of a number of smaller towns in the region, all which are now part of an ongoing tourism industry.

Identified sites

During the survey, the following sites, features or objects of cultural significance were identified, only some of which are deemed to be conservation/documentation worthy:

Name	Latitude	Longitude	Impact	Management
001 Fort	-24,91824	30,75706	Inside Theta Hill Pit	Avoid/Retain
002 Cemetery	-24,91814	30,74484	Outside development	Avoid/Retain
003 Burial site	-24,91806	30,74478	Outside development	Avoid/Retain
004 Burial site	-24,91792	30,74353	Outside development	Avoid/Retain
005 Graves	-24,91748	30,74682	Outside development	Avoid/Retain
019 Pump house	-24,90674	30,74701	Close to access road	Avoid/Retain
024 Cocopan bridge	-24,90787	30,74648	Integral part of remaining track	Avoid/Retain
025 Cocopan track (east)	-24,91013	30,74188	In proposed haul road	Document

026 Cocopan track (west)	-24,91006	30,73983	In proposed haul road	Document
032 Concrete structure	-24,91243	30,74408	Inside waste rock dump area	No further action
033 Foundations	-24,91222	30,74263	Inside waste rock dump area	No further action
034 Farmer's race	-24,91245	30,74267	Inside waste rock dump area	No further action
038 Foundations	-24,91383	30,73645	In proposed haul road	No further action
046 Informal settlement	-24,91581	30,74291	People to be relocated	Document
047 Compound	-24,91712	30,74277	Abandoned 1972	No further action

Impact assessment and proposed mitigation measures

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development:

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
Old fort					
001	Historic structure	Section 34	High significance Grade 4-A	60 27	(1) Avoidance/Preserve; (2) Archaeological investigation
Mitigation					
(1) Avoidance/Preserve • Currently, the Theta Pit boundary approaches the fort to within about 22m. It is recommended that a buffer zone of at least 15m is created around the outer edges of the fort and that this is formalised with a suitable, permanent fence (with an access gate).					

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
Cocopan bridge and track					
024 - 026	Historic structure	Section 34	High significance Grade 4-A	60 27	(1) Avoidance/Preserve; (2) Archaeological investigation
Mitigation					
(2) Archaeological investigation: If this feature, i.e. the section to be covered by the proposed PCD and haul road, cannot be avoided it should be documented in full before destruction. It is also proposed that: • The section of the track extending from the road towards TGME (in the vicinity of the old pump station) westwards up until and including the metal bridge crossing the Blyde River be declared a no-go area and that it is protected and retained as a sample of this type of technology. o It is also sufficiently close to the reduction works to be used part of a possible future tourism attraction. o Material salvaged from the section the be impacted on by the proposed mining activities should be used to rehabilitate the section that is to be retained, and the rest should be placed in a secure place for safekeeping.					

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
"Built" adits					
008 - 013	Historic structures	Section 34	High significance Grade 4-A	27 27	(1) Avoidance/Preserve; (2) Archaeological investigation
Mitigation					
(1) Avoidance/Preserve					

- No further action required

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
Burial sites					
002 - 005	Graves, Cemeteries and Burial Grounds	Section 36	High significance Grade 4-A	27 27	(1) Avoidance/Preserve; (2) Archaeological investigation

Mitigation

(1) Avoidance/Preserve

- No further action required

<u>Legal requirements</u>

The legal requirements related to heritage specifically are specified in Section 3 of this report. For this proposed project, the assessment has determined that no sites, features or objects of heritage significance occur in the study area. If heritage features are identified during construction, as stated in the management recommendation, these finds would have to be assessed by a specialist, after which a decision will be made regarding the application for relevant permits.

- In the event that any of the identified structures is to be impacted on, a valid permit would be required from SAHRA/PHRA prior to its destruction. Such a permit will only be issued after the site has been fully documented – mapped, photographed and described.

<u>Reasoned opinion as to whether the proposed activity should be authorised</u>:

- From a heritage point of view, it is recommended that the proposed development be allowed to continue on acceptance of the conditions proposed below.

<u>Conditions for inclusion in the environmental authorisation</u>:

- The Palaeontological Sensitivity Map (SAHRIS) indicate that most of the study area has a very high sensitivity of fossil remains to be found and therefore a field assessment and protocol for finds is required. A smaller section on the western side of the development has a high sensitivity and therefore a desktop assessment is required. Based on the outcome of that, a field assessment might be required.
- In the unlikely event that any of the identified structures is to be impacted on, it must be fully documented – mapped, photographed and described – beforehand.
- Should archaeological sites or graves be exposed in other areas during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.

J A van Schalkwyk
Heritage Consultant
June 2020

TECHNICAL SUMMARY

Project description	
Description	Development of new mining areas
Project name	Theta Mining Project

Applicant
Transvaal Gold Mining Estates Limited (TGME)

Environmental assessors
Batho Earth Environmental Consulting
Ms D Verster

Property details						
Province	Mpumalanga					
Magisterial district	Pilgrim's Rest					
District municipality	Thaba Cweu					
Topo-cadastral map	2430DC & 2430DD					
Farm name	Ponieskrans 543KT					
Closest town	Pilgrim's Rest					
Coordinates	Centre point (approximate)					
	No	Latitude	Longitude	No	Latitude	Longitude
	1	S 24,91132	E 30,74776			

Development criteria in terms of Section 38(1) of the NHR Act	Yes/No
Construction of road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length	No
Construction of bridge or similar structure exceeding 50m in length	No
Development exceeding 5000 sq m	Yes
Development involving three or more existing erven or subdivisions	No
Development involving three or more erven or divisions that have been consolidated within past five years	No
Rezoning of site exceeding 10 000 sq m	No
Any other development category, public open space, squares, parks, recreation grounds	No

Land use	
Previous land use	Mining
Current land use	Mining

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GLOSSARY OF TERMS AND ABBREVIATIONS

TERMS

Bioturbation: The burrowing by small mammals, insects and termites that disturb archaeological deposits.

Cumulative impacts: "Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

Debitage: Stone chips discarded during the manufacture of stone tools.

Factory site: A specialised archaeological site where a specific set of technological activities has taken place – usually used to describe a place where stone tools were made.

Historic Period: Since the arrival of the white settlers - c. AD 1830 - in this part of the country.

Holocene: The most recent time period, which commenced c. 10 000 years ago.

Iron Age (also referred to as **Early Farming Communities**)**:** Period covering the last 1800 years, when new people brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and they herded cattle as well as sheep and goats. As they produced their own iron tools, archaeologists call this the Iron Age.

Early Iron Age	AD 200 - AD 900
Middle Iron Age	AD 900 - AD 1300
Later Iron Age	AD 1300 - AD 1830

Midden: The accumulated debris resulting from human occupation of a site.

Mitigation, means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.

National Estate: The collective heritage assets of the Nation.

Pleistocene: Geological time period of 3 000 000 to 20 000 years ago.

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.

Early Stone Age	2 500 000 - 150 000 Before Present
Middle Stone Age	150 000 - 30 000 BP
Later Stone Age	30 000 - until c. AD 200

Tradition: As used in archaeology, it is a seriated sequence of artefact assemblages, particularly ceramics.

ACRONYMS and ABBREVIATIONS

ASAPA	Association of Southern African Professional Archaeologists
BCE	Before the Common Era (the year 0)

BP	Before Present (calculated from 1950 when radio-carbon dating was established)
CE	Common Era (the year 0)
DMR & E	Department of Mineral Resources and Energy
ESA	Early Stone Age
EIA	Early Iron Age
HIA	Heritage Impact Assessment
I & AP's	Interested and Affected Parties
LIA	Late Iron Age
LSA	Later Stone Age
MIA	Middle Iron Age
MSA	Middle Stone Age
NASA	National Archives of South Africa
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
TPA	Transvaal Provincial Administration
TGME	Transvaal Gold Mining Estates Limited

COMPLIANCE WITH APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R982	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	 Front page Page i Addendum Section 6
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 4
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7.3
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 4.2.2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
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;	Addendum Section 5; Figure 9 & 10
g) an identification of any areas to be avoided, including buffers;	Section 8
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 9 & 10 Addendum Section 5
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7
k) any mitigation measures for inclusion in the EMPr;	Section 9 & 10
l) any conditions for inclusion in the environmental authorisation;	Section 10
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	 Section 10 Section 8, 9, 10
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	-
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	-
q) any other information requested by the competent authority.	-
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	-

Phase 1 Cultural Heritage Assessment:
AMENDMENT TO AN ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED THETA PROJECT, NEAR PILGRIM'S REST, MPUMALANGA

1. INTRODUCTION

1.1 Background

In 1974 the historic village of Pilgrim's Rest, situated on Portion 42 of the farm Ponieskrans 543KT (originally spelt as Ponieskrantz) was bought by the Transvaal Provincial Administration (TPA) and developed as a National Monument under the National Monuments Act, No. 28 of 1969 (as amended). This was later extended to include the rest of the farm and in 1975 the part on which Alanglade (the house of the general manager) and the golf course are situated, were also bought by TPA. However, with the promulgation of the National Heritage Resources Act, No. 25 of 1999, the Pilgrim's Rest site lost its national status and reverted to be a site of provincial heritage status.

Transvaal Gold Mining Estates Limited (TGME) is situated in the Sabie / Pilgrim's Rest goldfields area of Mpumalanga. The proposed mining operation is located adjacent to the existing TGME metallurgical plant, which is situated 2,5km southwest of the town of Pilgrim's Rest, Mpumalanga Province. TGME, through an engineering scoping study and an engineering feasibility study, has identified the opportunity to mine gold bearing reefs via modified terrace mining and this has triggered the need to amend its current MP 30/5/1/2/2/83MR right to include the new mining sections.[1]

The Transvaal Gold Exploration Company was first formed in 1883, but following a name change and merger the company was reconstituted as Transvaal Gold Mining Estates Limited (TGME) on 16 May 1895, making it the oldest gold mining company in South Africa. Gold was mined continuously by TGME until 1971 and again from 1986 until 2015. The metallurgical plant is currently on care and maintenance pending the next project development phase. The metallurgical plant, which has not produced commercial quantities of gold since 2015, remains connected to the national electricity grid, with all other existing infrastructure in place including tailings storage facility, water resource access and an accessible road network.

Batho Earth Environmental Consultants was appointed to undertake the EIA for the amend of the current MP 30/5/1/2/2/83MR right to include the new mining sections.

South Africa's heritage resources, also described as the 'national estate', comprise a wide range of sites, features, objects and beliefs. However, according to Section 27(18) of the National Heritage Resources Act (NHRA), No. 25 of 1999, no person may destroy, damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site without a permit issued by the heritage resources authority responsible for the protection of such site.

In accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by *Batho Earth Environmental Consultants* to conduct a cultural heritage assessment to determine the cultural heritage significance of the areas where the new mining sections is located. A number of previous studies, Fourie (2008); Henning (1981); Pistorius (2005); Reinders, Mason & Van Wyk (2007), have been done regarding the heritage features on the farm Ponieskrans. The main aim of the current study was therefore to determine what impact the proposed development would have on these sites and features.

[1] All information regarding the mining site and project development was taken *ad verbum* from the *Draft Scoping Report* (Verster 2019a).

This report forms part of the Environmental Impact Assessment (EIA) as required by the EIA Regulations in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended and is intended for submission to the South African Heritage Resources Agency (SAHRA).

1.2 Terms and references

1.2.1 *Scope of work*

The aim of this study is to determine the cultural heritage significance of the sites, features and objects a where the new mining sections is to take place. This included:

- Conducting a desk-top investigation of the area;
- A visit to the proposed development site.

The objectives were to:

- Evaluate the potential impacts of construction, operation and maintenance of the proposed development on archaeological, cultural and historical resources;
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance.

1.2.2 *Assumptions and Limitations*

The investigation has been influenced by the following factors:

- It is assumed that the description of the proposed project, provided by the client, is accurate.
- The unpredictability of buried archaeological remains.
- No subsurface investigation (i.e. excavations or sampling) were undertaken, since a permit from SAHRA is required for such activities.
- It is assumed that the public consultation process undertaken as part of the Environmental Impact Assessment (EIA) is sufficient and that it does not have to be repeated as part of the heritage impact assessment.
- Old maps relating to the previous mining operations were not available, contribution to a lack of causal understanding.
- Access to some areas could not be achieved due to the presence of very aggressive illegal miners, colloquially referred to as “zama-zama’s.” Although this was not the case in the study areas specifically, it did served to limit the possibility of obtaining a causal overview of smaller elements located in the larger landscape.

2. LEGISLATIVE FRAMEWORK

2.1 Background

Heritage Impact Assessments are governed by national legislation and standards and International Best Practise. These include:

- South African Legislation
  - National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA);
  - Mineral and Petroleum Resources Development Act, 2002 (Act No. 22 of 2002) (MPRDA);
  - National Environmental Management Act 1998 (Act No. 107 of 1998) (NEMA); and
  - National Water Act, 1998 (Act No. 36 of 1998) (NWA).
- Standards and Regulations

  - South African Heritage Resources Agency (SAHRA) Minimum Standards;
  - Association of Southern African Professional Archaeologists (ASAPA) Constitution and Code of Ethics;
  - Anthropological Association of Southern Africa Constitution and Code of Ethics.
- International Best Practise and Guidelines
  - ICOMOS Standards (Guidance on Heritage Impact Assessments for Cultural World Heritage Properties); and
  - The UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage (1972).

2.2 Heritage Impact Assessment Studies

South Africa's unique and non-renewable archaeological and palaeontological heritage sites are 'generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, Section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority.

The National Heritage Resources Act (Act No. 25 of 1999, Section 38) provides guidelines for Cultural Resources Management and prospective developments:

"38 (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as:

> *(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;*
> *(b) the construction of a bridge or similar structure exceeding 50m in length;*
> *(c) any development or other activity which will change the character of a site:*
> *(i) exceeding 5 000 m^2 in extent; or*
> *(ii) involving three or more existing erven or subdivisions thereof; or*
> *(iii) involving three or more erven or divisions thereof which have been consolidated within he past five years; or*
> *(iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;*
> *(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or*
> *(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development."*

And:

"38 (3) The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)(a): Provided that the following must be included:

> *(a) The identification and mapping of all heritage resources in the area affected;*
> *(b) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;*
> *(c) an assessment of the impact of the development on such heritage resources;*
> *(d) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;*
> *(e) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;*
> *(f) if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and*
> *(g) plans for mitigation of any adverse effects during and after the completion of the proposed development."*

3. HERITAGE RESOURCES

3.1 The National Estate

The National Heritage Resources Act (No. 25 of 1999) defines the heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations that must be considered part of the national estate to include:

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, including-
    - ancestral graves;
    - royal graves and graves of traditional leaders;
    - graves of victims of conflict;
    - graves of individuals designated by the Minister by notice in the Gazette;
    - historical graves and cemeteries; and
    - other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- sites of significance relating to the history of slavery in South Africa;
- movable objects, including-
    - objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
    - objects to which oral traditions are attached or which are associated with living heritage;
    - ethnographic art and objects;
    - military objects;
    - objects of decorative or fine art;
    - objects of scientific or technological interest; and
    - books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

3.2 Cultural significance

In the NHRA, Section 2 (vi), it is stated that ‘‘cultural significance’’ means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. This is determined in relation to a site or feature’s uniqueness, condition of preservation and research potential.

According to Section 3(3) of the NHRA, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of

- its importance in the community, or pattern of South Africa's history;
- its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;

- its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
- sites of significance relating to the history of slavery in South Africa.

A matrix (see **Section 2** of **Addendum**) was developed whereby the above criteria were applied for the determination of the significance of each identified site. This allowed some form of control over the application of similar values for similar identified sites.

4. STUDY APPROACH AND METHODOLOGY

4.1 Extent of the Study

This survey and impact assessment cover the identified property, referred to as the Theta Mining Project, as is presented in Section 5 below and illustrated in Figures 3 & 4.

4.2 Methodology

4.2.1.1 Survey of the literature
A survey of the relevant literature was conducted with the aim of reviewing the previous research done and determining the potential of the area. In this regard, various anthropological, archaeological and historical sources were consulted – see list of references in Section 10.

- Information on events, sites and features in the larger region were obtained from these sources.

4.2.1.2 Survey of heritage impact assessments (HIAs)
A survey of HIAs done for projects in the region by various heritage consultants was conducted with the aim of determining the heritage potential of the area – see list of references in Section 10.

- Information on sites and features in the larger region were obtained from these sources.

4.2.1.3 Data bases
The *Heritage Atlas Database,* various SAHRA databases, the *Environmental Potential Atlas*, the *Chief Surveyor General* and the *National Archives of South Africa* were consulted.

- Database surveys produced a number of sites located in the larger region of the proposed development.

4.2.1.4 Other sources
Aerial photographs and topographic and other maps were also studied - see the list of references below.

- Information of a very general nature were obtained from these sources

4.2.1.5 Public participation
The EIA public participation process has been conducted by an independent specialist in collaboration with the EAP and other specialists in the various fields of expertise. Interested and affected parties were invited to raise their concerns regarding the proposed development.

- Comments received during this process (Verster 2019b), on any matter related to the proposed project, including heritage concerns that may arise as a result of the project, have been included in this HIA report.

4.2.1.6 Interviews

During the field surveys interviews were also conducted with the following people:

- Ms R Reinders of the Pilgrim's Rest Museum;
- Ms J Mason of the Pilgrim's Rest Museum;
- Ms C van Wyk, former director of the Pilgrim's Rest Museum;
- Ms S Mthuke, long-time local resident.

4.2.2 *Field survey*

The site was visited on 26 and 27 March 2019 and again on 30 July 2019. The field survey was done according to generally accepted archaeological practices, and was aimed at locating all possible sites, objects and structures. The area that had to be investigated was identified by the *Batho Earth* by means of maps and .k*ml* files indicating the development area. This was loaded onto an ASUS digital device and used in Google Earth during the field survey to access the areas.

During the first field survey, the vegetation cover was high and thick, obscuring ground visibility, making the location and evaluation of the various identified features very difficult. Therefore, a second visit was undertaken during the winter when the vegetation cover was down, and all identified features were revisited. Unfortunately, some areas could not be accessed due to the presence of very aggressive illegal miners, colloquially referred to as "zama-zama's."

 Summer	 Winter

Figure 1. Seasonal variations in ground visibility

Google Earth: 2004

Google Earth: 2018

Figure 2. Variations in ground visibility over time

5. PROJECT DESCRIPTION

5.1 Site location

Transvaal Gold Mining Estates Limited (TGME) is situated in the Sabie / Pilgrim's Rest goldfields area of Mpumalanga. The proposed mining operation is located adjacent to the existing TGME metallurgical plant, which is situated 2.5km southwest of the town of Pilgrim's Rest, Mpumalanga Province (Fig. 3). For more information, see the Technical Summary on p. V above.

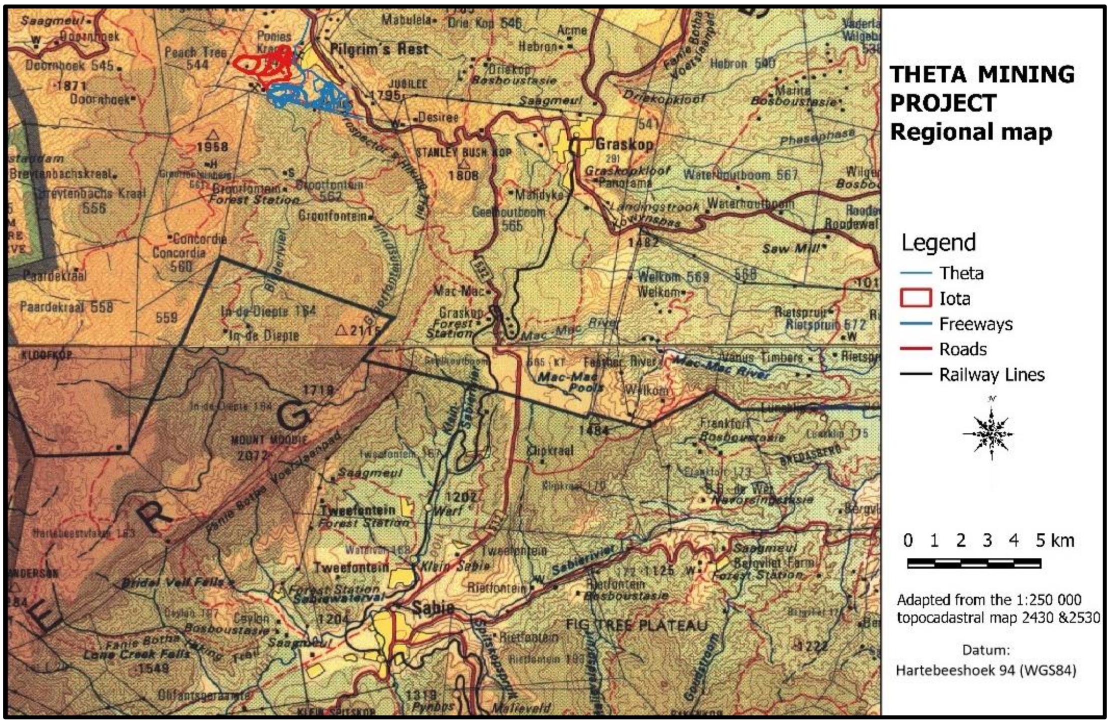


Figure 3. Location of the study area in regional context.

5.2 Project description

The activity relates to an existing mining right for which an amendment to the approved Environmental Impact Assessment & Environmental Management Plan is being applied for.

Three mining areas were identified based on exploration and evaluation work done within the study area. The three areas are referred to as:
• Theta Pit;
• Browns Pit; and
• Iota Pit.

The proposed area of influence will be situated on Portion 42 of the farm Ponieskrans 543KT. The area of influence referred to as part of this application is the area where the proposed infrastructure will be located and were the actual mining operations will take place.

The mining method selected for this project is referred to as modified terrace mining. This mining method is suited to the mountainous profile of the current topography. The ore deposit is considered stratified and inclined. The elevation and nature of the deposit eliminated the use of draglines and conventional strip mining. To overcome the steeply dipping orientation the ore will be extracted on a flat surface whereby all the reefs are extracted on the horizontal plane via a surface miner.

The modified terrace mining method allows for potential backfilling (where applicable) and landscaping of the waste material. The overburden or waste material will be removed with a combination of excavators and trucks with the assistance of Xcentric rippers via a dozer. Selective rock breaking via blasting could also be required. The ore will then be mined utilising a combination of surface miner or conventional loading and haul techniques.

The mine scheduling strategy is to target sufficient ore is produced to maintain a live ore stockpile (<2 months) which could feed the processing plant at 500 ktpa.

Infrastructure associated with the terrace mining operations include:
• Iota Pit;
• Theta Pit;
• Browns Pit;
• Haul Roads and river crossing;
• Topsoil stockpiles,
• Run-of mine stockpiles,
• Strategic Ore stockpile;
• Waste rock dumps;
• Pollution Control Dams and
• Settling Dam

5.3 Progression of site layouts

The following was taken *ad verbum* from Pieterse (2019) and is included in this document is a portrayal of the progression from an initial to the most feasible site layout related to the Theta Project. The progression has been significantly influenced by engineering, economical, environmental and social considerations and is described in detail in the subsequent sections.

Engineering Feasibility Study

The applicant Transvaal Gold Mining Estates (TGME), through an engineering feasibility study, has identified the opportunity to mine gold bearing reefs via modified terrace mining and therefore the need to amend its current environmental authorisation linked to their existing mining right (83MR) to include the new mining sections to mine the near surface material.
Three mining areas were identified based on exploration and evaluation work done within the study area. The three areas are referred to as:

- Theta Pit;
- Browns Pit; and
- Iota Pit.

The engineering feasibility study formed the basis for the permitting phase, and informed the initial site layout (Figure 1) which was incorporated into the Environmental Authorisation application which comprises a Scoping Phase and an Environmental Impact Assessment Phase, which results in the develpoment of an Environmental Management Plan for consideration by the competent authority (The Department of Minerals Resources and Energy).

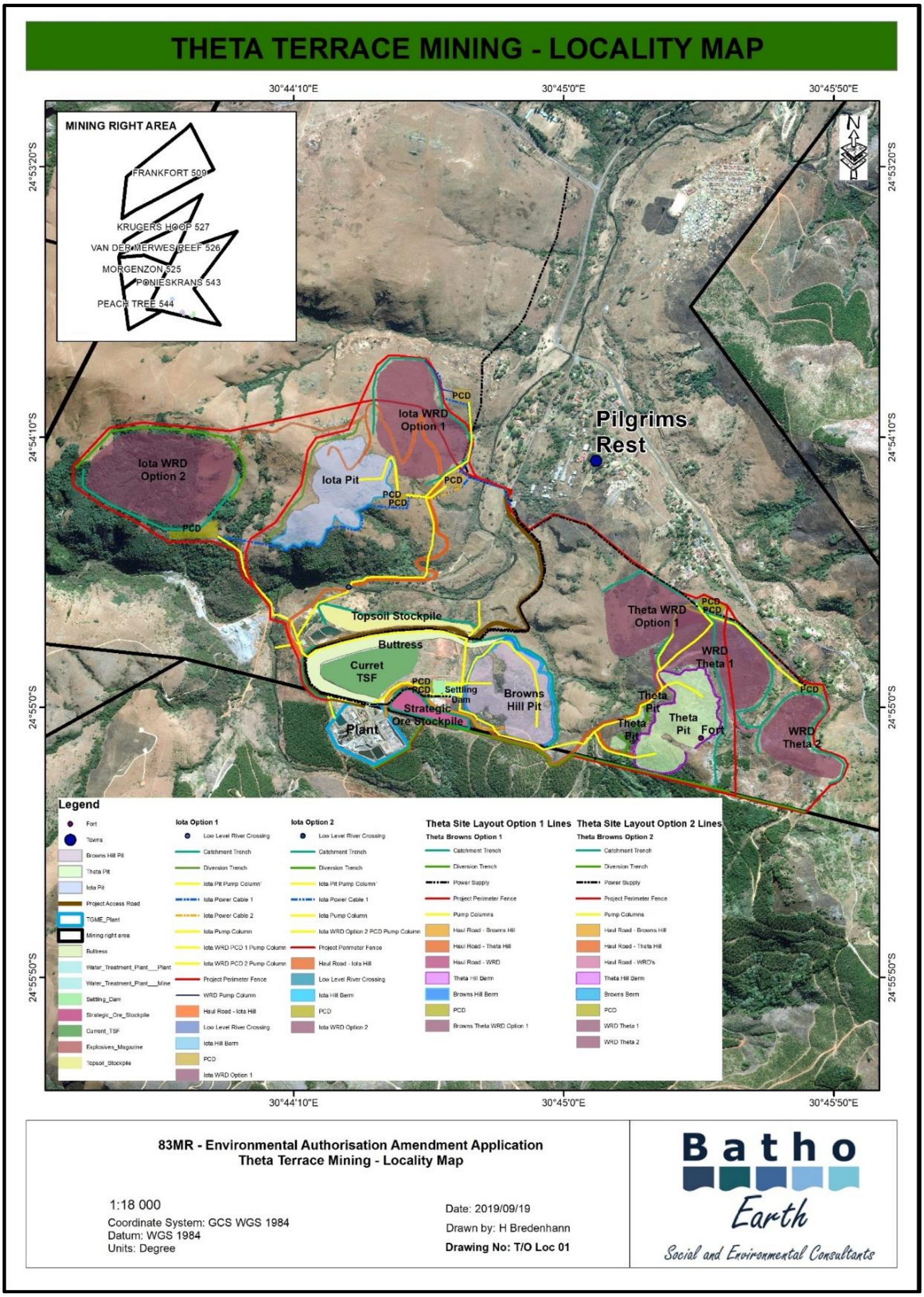


Figure 1: General Site Layout – Scoping Phase

Environmental Scoping Phase

Infrastructure associated with the terrace mining operations include topsoil stockpiles, run-of mine ore stockpiles, waste rock dumps and haul roads.

The general mining site infrastructure will include offices, change houses and laundry facilities, control room, first aid station, stores and laydown yard, salvage yard and waste sorting area, transformer substation, fuel storage facility, refuelling bay, wash bay, workshops, brake test ramp and parking areas. In terms of the placement of the related infrastructure, a few design or layout alternatives were considered initialy for the various Waste Rock Dumps (WRD).

As part of the operational activities two potential options were proposed for the locations of the associated Waste Rock Dumps (WRD) at both Theta and Iota Hills. These are detailed as follows:

- Theta/Browns Waste Rock Dump Option 1: This option is situated between both Browns and Theta Pit (Figure 2);
- Theta/Browns Waste Rock Dump Option 2: Located to the north eastern side of Theta Pit, incorporates two smaller pockets separated by a tributary (Figure 3);
- Iota Waste Rock Dump Option 1: Located to the north western corner of the Iota Pit (Figure 4); and
- Iota Waste Rock Dump Option 2: Is located to the north eastern boundary of the Iota Pit (Figure 5).

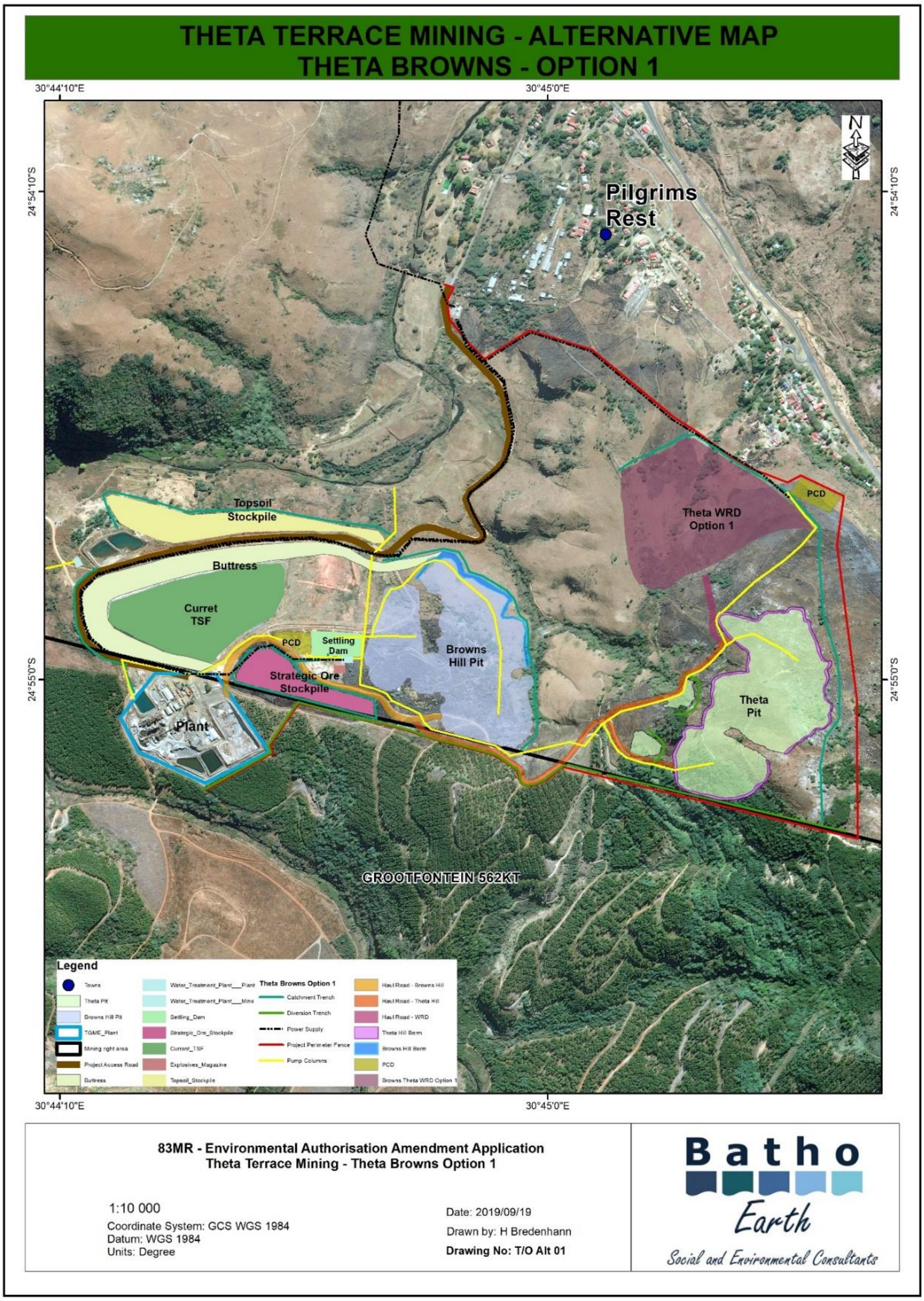


Figure 2: Theta & Browns - Option 1

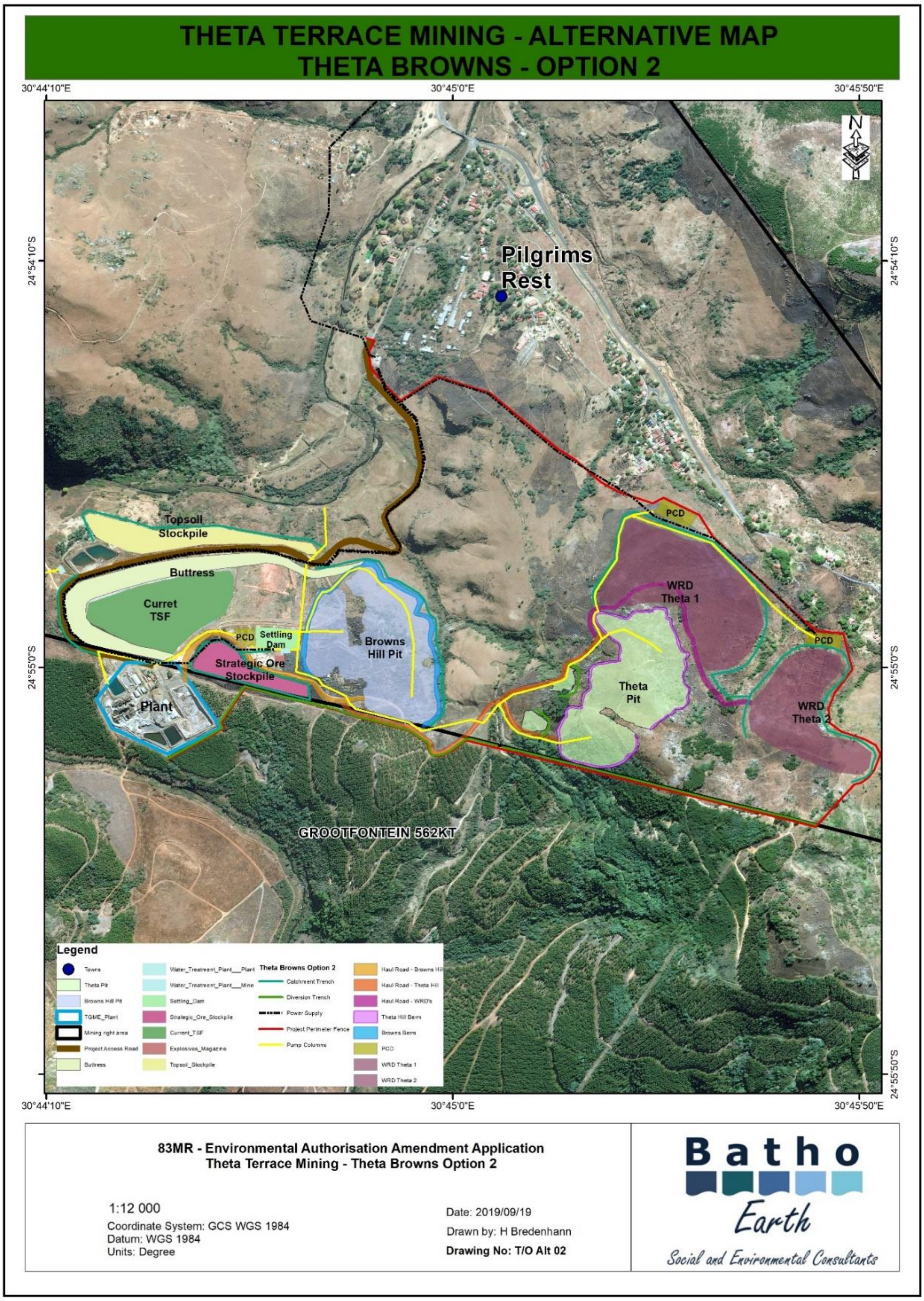


Figure 3: Theta & Browns – Option 2

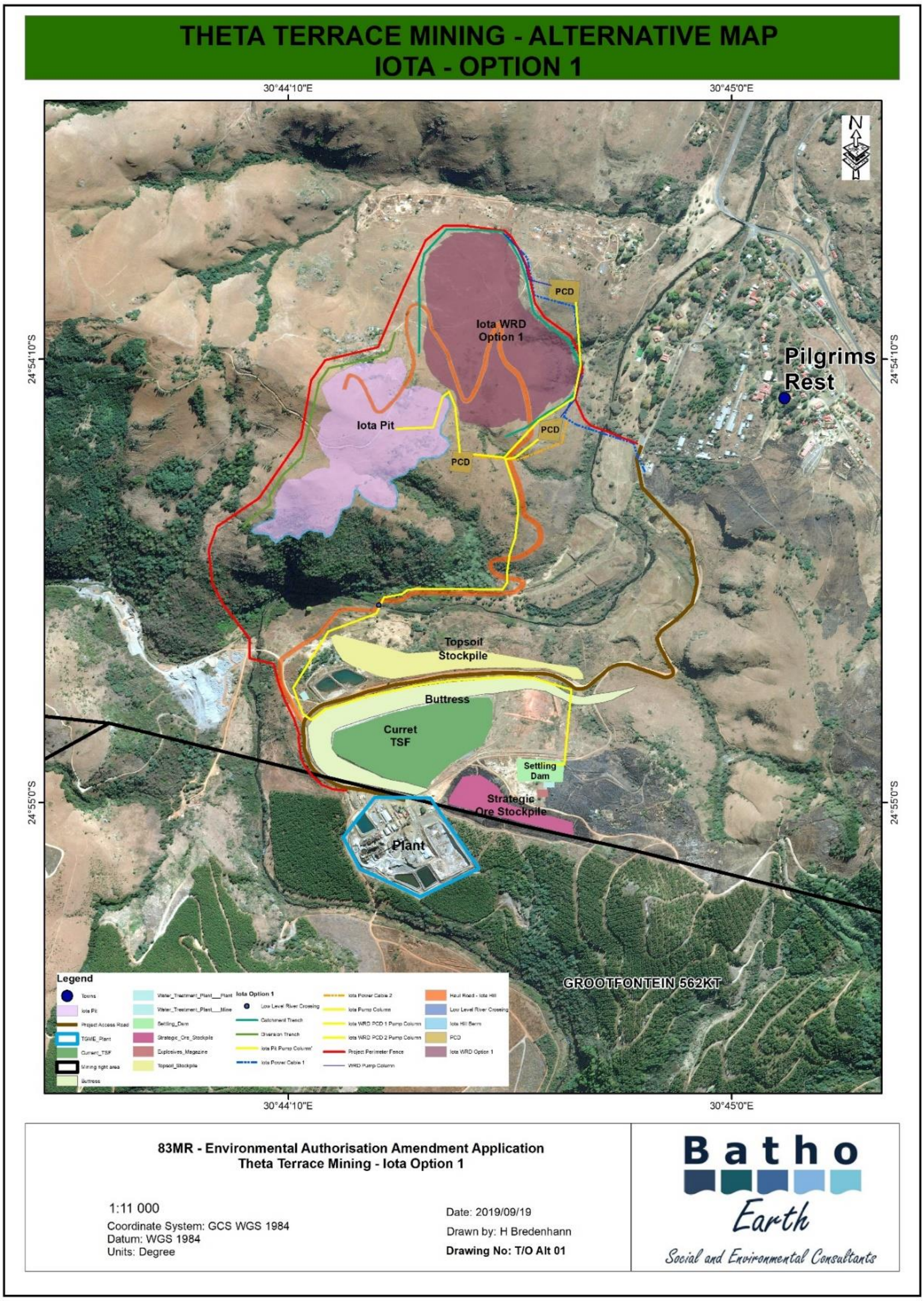


Figure 4: Iota – Option 1

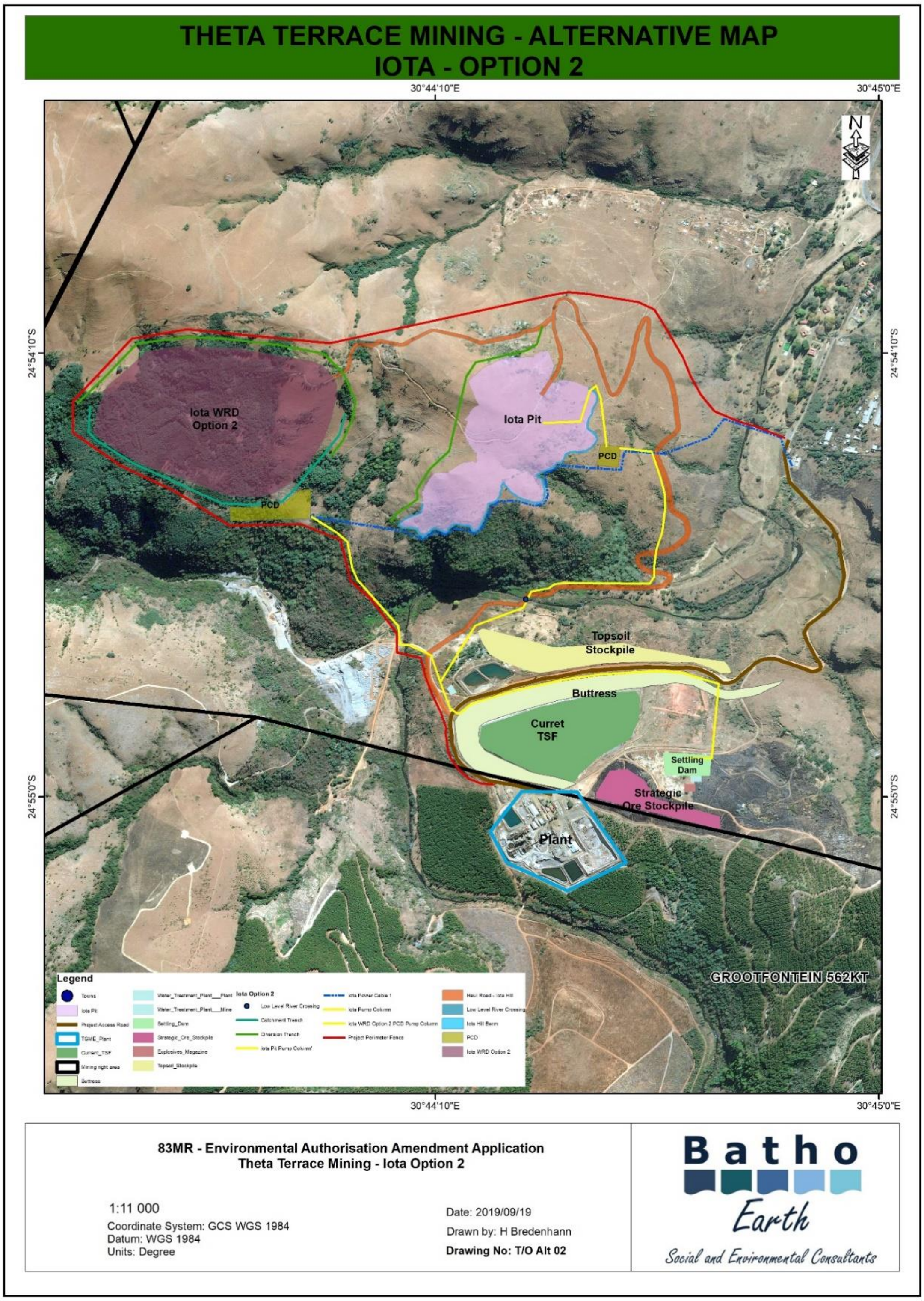


Figure 5: Iota – Option 2

Environmental Impact Assessment Phase

The plan of study proposed in the Scoping Report made provision for various biophysical and social studies which would determine the baseline conditions at the project site as well as make recommendations related to the feasibility of the proposed localities and alternatives as per the initial site layout plan (Figure 1).

The outcome of these biophysical and social studies was used to inform the final site layout plan, as is common practice in Integrated Environmental Management. Integrated environmental management (IEM) is a philosophy that is concerned with finding the right balance between development and the environment. The difference between IEM and an Environmental Impact Assessment (EIA) is that IEM is a whole philosophy whereas EIA is just one tool or technique used to gather and analyse environmental information that is a part of the IEM process (Source: Enviropaedia).

Environmental and social management practices are based on following the precautionary principle, which, simply defined, means developing actions on issues considered to be uncertain, for instance applied in assessing risk management.

Development of a Feasible Site Layout

Certain biophysical and social baseline studies, namely terrestrial ecology (fauna and flora), soils and land capability, air quality, noise and vibration, visual impact, socio-economic and health impact, water quality, heritage and the rehabilitation objectives, returned substantial environmental and social sensitivities and nuances.

However, the process of EIA, within which the above-mentioned studies were undertaken, is inhibited in its ability to assess year-round baseline conditions due to the legislated timeframes imposed by South African law and regulation. In these instances, which is typical of EIA processes, the Environmental Assessment Practitioner (EAP) imposes the precautionary approach by informing the site layout plan from an environmental and social perspective to assist the applicant to achieve the most feasible site layout plan.

In the case of the Theta Project, the application of the precautionary approach resulted in an alteration of the site layout plan as initially presented in the Scoping Report. The alteration reflects revised pit layouts (with the Theta Pit being largely affected), new waste rock dump (WRD) locations as well as optimisation of the overall project footprint to achieve the best IEM scenario considering the extent of baseline information available at the time.

The altered site layout plan was achieved through the implementation of the following mitigation hierarchy:

1. Avoid the potential impact altogether;
2. Minimise the area of the potential impact as far as possible;
3. Rehabilitate and restore the affected area; and
4. Secure a biodiversity offset area as compensation for the affected area.

In this instance, the pit shells were reduced in size and waste rock dump sites were relocated to avoid/minimise the impacts on the ground-truthed portions of highest biodiversity significance to minimize the extent of areas requiring detailed rehabilitation and to limit the requirements for offsets of residual impacts.

Refer to Figure 6 for the revised site layout plan which will be incorporated into the Environmental Impact Assessment Report and Environmental Management Plan. Additional seasonal studies are planned as part of the ongoing environmental, social and rehabilitation programmes. The results of these planned studies might decrease current uncertainties to which the precautionary principle was applied which could lead to future layout developments.

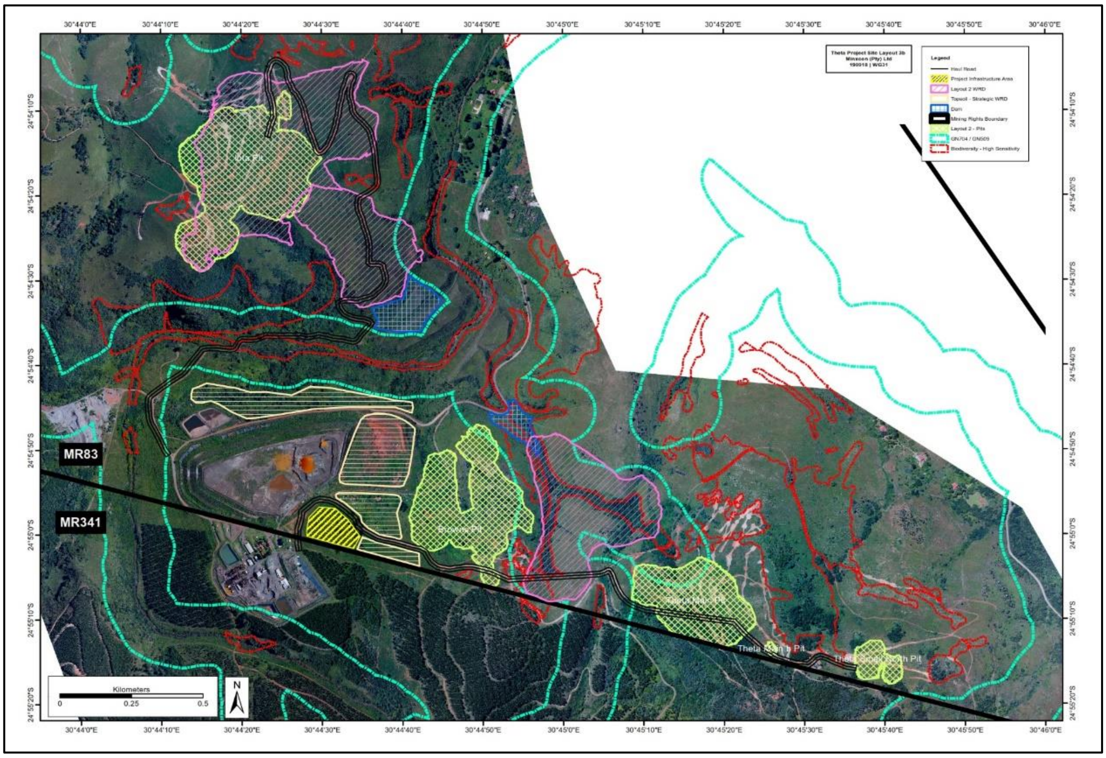


Figure 6: Revised layout (EIA/EMP Phase)

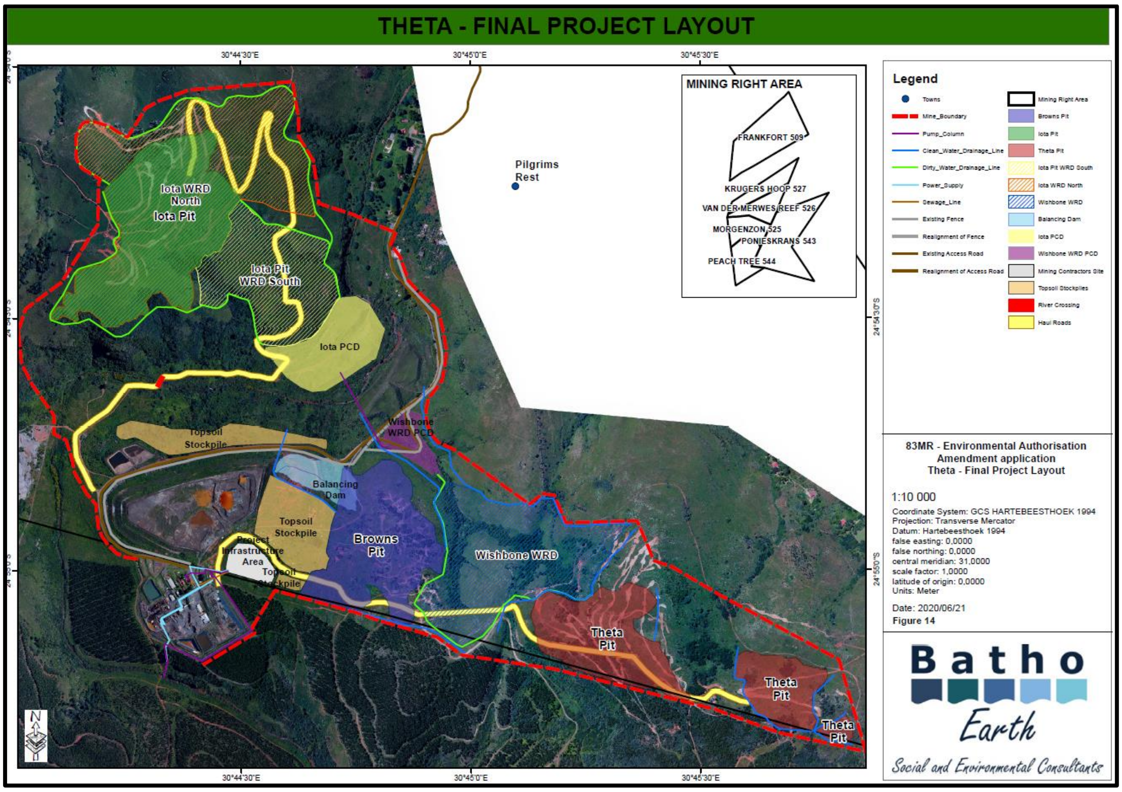


Figure 7: Final layout (June 2020)

6. DESCRIPTION OF THE AFFECTED ENVIRONMENT

6.1 Cultural landscape

The cultural landscape qualities of the region essentially consist of two components. The first is made up of a limited pre-colonial (Stone Age and Iron Age) occupation. The second component is a rural area in which the human occupation consists of two elements. The discovery of gold during the late 19th century resulted in a flood of people entering the area, establishing gold mining activities all over the landscape. The second element is a rural farming community, which, since the early 20th century revolved around forestry, which altered the landscape beyond recognition. These two elements led to the establishment of a number of smaller towns in the region, all which are now part of an ongoing tourism industry.

6.1.1 Early history

Very little habitation of the eastern highveld and escarpment area took place during Early Stone Age times. One exception is at Bushman Rock Shelter, which has deposits covering the complete span of human occupation, since Early Stone Age to early historic times.

It was only during the Middle Stone Age (MSA) that people, by applying a range of strategies for survival and using more complex tool kits, manage to occupy areas that were earlier avoided. During Middle Stone Age times (c. 150 000 – 30 000 BP), people became more mobile, occupying areas formerly avoided. In many cases, tools dating to this period are found on the banks of the many pans that occur all over. The MSA is a technological stage characterized by flakes and flake-blades with faceted platforms, produced from prepared cores, as distinct from the core tool-based ESA technology.

Late Stone Age (LSA) people had even more advanced technology than the MSA people and therefore succeeded in occupying even more diverse habitats. Some sites are known to occur in the region. These are mostly open sites located near river and pans. For the first time we also get evidence of people's activities derived from material other than stone tools. Ostrich eggshell beads, ground bone arrowheads, small bored stones and wood fragments with incised markings are traditionally linked with the LSA.

The LSA people have also left us with a rich legacy of rock art, which is an expression of their complex social and spiritual believes. Such sites are located on a number of farms such as London, Ledophine, Berlyn, Ponieskrantz, Dientjie, Bourke's Luck and Clear Stream (Van Wyk-Rowe 1997).

Iron Age people started to settle in southern Africa c. AD 200 at Silver Leaves and AD 280 at Eiland. Having only had cereals (sorghum, millet) that need summer rainfall, Early Iron Age (EIA) people did not move outside this rainfall zone, and neither did they occupy the central interior highveld area. Because of their specific technology and economy, Iron Age people preferred to settle on the alluvial soils near rivers for agricultural purposes, but also for firewood and water. Sites dating to the Early Iron Age are found, for example near Lydenburg, as well as Ohrigstad (Van Wyke-Rowe 1997).

The occupation of the larger geographical area (including the study area) did not start much before the 1500s. By the 16th century things changed, with the climate becoming warmer and wetter, creating condition that allowed Late Iron Age (LIA) farmers to occupy areas previously unsuitable, for example the highveld regions of Mpumalanga, where they established hundreds of stone walled settlements.

6.1.2 *Historic period*

History of Gold Mining in Pilgrim's Rest Area

The first gold in the Pilgrim's Rest valley was discovered in 1873 by a lone traveller and prospector, Alec "Wheelbarrow" Patterson - nicknamed as such due to his years of using a wheelbarrow to transport all his possessions across the Eastern Transvaal on his quest to find gold. He kept his rich findings of alluvial gold a secret, fearing the multitude of prospectors that would descend on the area. However, news of gold in the Pilgrim's Rest area made international headlines when, shortly after Patterson, William Trafford also discovered gold in the area. Legend has it that the area acquired its name when Trafford, in pure delight, yelled loudly: "The Pilgrim is at Rest" and the mountains echoed back "Pilgrim's rest…rest".

Officially declared as a goldfield on 14 May 1873, the large amount of alluvial gold in the area led to a stampede of prospectors and their families vying for claims. The mines commissioner had to relocate from Mac-Mac in order to deal with the situation as, within a year after the gold discovery, 1 500 settlers were already working their own claims. Numerous hills around the area were also found to be rich with ore, the highest yielding ones being Jubilee, Ponieskrantz, Desiree, Brown's Hill, Bourke's Luck, Poverty Creek and Starvation Gulch. During the first few years of mining the retrieval of alluvial gold remained the most popular and profitable, with an estimated yield worth two million Rand being retrieved (TPA B&M 1981:1).

The town of Pilgrim's Rest grew from a camp of temporary tents and "*sinkwonings"* into what is roughly still visible today. Efforts to declare Pilgrim's Rest as a town started in 1894, but even by the outbreak of the Anglo-Boer war in 1899 this decision had still not been finalised by talks between the state and mining industry. By that time the town consisted of some 200 white settlers, with several thousand black inhabitants living in surrounding areas. By 1899 the business sector in the town consisted of two hotels, the Royal and the Pilgrim's, two banks and ten shops that included a butchery, pharmacy and general merchants. The school was housed in an old wooden building up until 1896, when it was moved to and old town hall. The education law instating English to be taught as a second language in 1896 led to the priest, Hon. Colin Rae opening the St. Mary's School at the Wesleyan church. It was only in 1899 that the state agreed to take over and subsidise the school, leading to the foundation of the new school building to be lain on the 1st of February 1899 (TPA B&M 1981:5, 6)

The period of plenty was not to last however, as the annexation of the Transvaal by the British in 1877 and the First Independence War (1880 – 1881) caused the mining sector to come to grinding halt. Despite securing their independence again in 1881, large scale depression was evident among the population, forcing the newly reinstated Republican Government to make exclusive concessions to certain individuals and companies in order to reignite all manner of industries (TPA B&M 1981:2).

David Benjamin, a financer from London, brokered an arrangement with the Government for mining rights in the areas of Ponieskranz, Ledovine, Waterhoutboom, Driekop, Grootfontein and Belvedere. The details of this contract were as follows: Benjamin would pay an annual sum of £ 1 000 to the Government, guaranteed to have full mining industry works back to full earning within two years and to employ a minimum of 25 white personnel at the same time. The Government agreed to this contract, but included that Benjamin had to reimburse(?) the current occupants and owners in the area. With the aid of the State attorney, Jorrisen, the contract was finalised and led to the creation of the Transvaal Gold Exploration Company in 1882. Garner Williams, a well-known mining engineer from Kimberley, was given the post of local manager. The company was initially unable to declare any dividends, but after gold was discovered at Jubilee and Columbia Hill by Charlie Robinson, production started increasing rapidly. Soon numerous other mining companies formed, the most important of which were to be Pilgrim's Mining and Estate Company, Jubilee Mines Ltd. and New Clewer Estates (TPA B&M 1981:2).

In 1885 H. Eckstein & Co., a mining company from the Witwatersrand, acquired a majority stake in the Transvaal Gold Exploration Company and, amalgamated with several other mining groups, was renamed the Lydenburg Gold Mining Estates (TPA B&M 1981:2). During a special meeting on 29 July 1896 the company was once again renamed, this time becoming The Transvaal Gold Mining Estates Ltd (TGME) (Fowler 1986:292). TGME's mining industries were prolific for some time in the Pilgrim's Rest valley, with more than a dozen mines operating at the same time, while TGME's mines in Ponieskrantz - oddly named as letters of the Greek alphabet – Beta (that produced gold for 85 years until 1971), Eta, Theta, Iota and Chi, were also showing dividends. Till today no one knows why, or who, decided to name these mines in a foreign alphabet (TPA B&M 1981:3).

The first consultant engineer for TGME, Mr Wertheman, decided to create a central processing plant where the ore from Jubilee, Clewer, Beta and Theta could be processed at the same time and he thus also insisted on having a train line laid down from the mines to the central processing plant. This endeavour proved difficult as there were no natural deposits of coal to power steam engines, but TGME decided to lay down an electric railroad which ran on hydroelectricity generated at the Brown's Hill plant. The original railway was insufficient for the needs of the mines, so in 1897 a tramline, running for 12km and built at the cost of £17 000, was laid down. Only ore from the Clewer and Beta mines were transported via this railway, while for 60 years the other mines made successful use of mules to transport ore (TPA B&M 1981:3).

TGME mines had a good understanding with their employees for many years, reporting no strikes or unrest. It was only during the unrest in the Rand mines that TGME had to deal with renegotiating salaries, but it was achieved peacefully with no strikes or violence (TPA B&M 1981:6; Fowler 1986:296).

In 1899 another war broke out between the Transvaal Republic and the British, which would once again bring all mining in the area to a full halt. As the British never cared much for the land east of Lydenburg, the *Boerekommandoes* used it as a place of rest between their attacks. Despite efforts to maintain gold production for the Boere the majority of TGME miners were banished to Delagoabaai, with only two men left behind to look after the mines. The war brought a shortage of money, and it was decided to use the gold and tools left behind in the TGME workshops to start the small production of coins, called "*veldsponde*". Barberton's school principal, Mr P.J. Kloppers, was put in charge of the "Staatsmunt te Velde" where a 986 "*veldsponde*", branded with "*Z.A.R. 1902*" on one side, and "*Een Pond*" on the other, were produced. Partially made from gold mined at Pilgrim's Rest and partially by that supplied from the Pretoria Munt, these coins still hold great value as collector's items today (TPA B&M 1981:4; Fowler 1986:293).

Despite the complete cessation of all production during the war, the mine equipment has sustained no damage, and thus production was restored almost immediately. However, this was not to be without its own challenges. New manager, Hugh Hughes, due to severe lack of able-bodied workers, was forced to bring in a work force of Asian immigrants to try reach previous production values. Furthermore, the devastation left after the war meant that the cost of shipping had increased exponentially, leaving hundreds of tons worth of gold piling up at Machadodorp. The closets railways were at Nelspruit and Machadodorp, leaving the inhabitants of Pilgrim's Rest with no other choice but to return to the use of oxen and *"ossewaens"* (ox drawn wagons) to collect and replenish their necessary foodstuff and goods, although the services of mule drawn carriages – the "*Zeerderberg-poskoets"* were available for passengers, this type of transport was ineffective and completely useless to the mines. Despite talks of building a railway between Pilgrim's Rest and Graskop, this would only be realised in 1914. Mining profits were only achieved again in 1904, with the Theta mine producing more than 40 000 ton of ore in 1907. This was followed by another gold rush in 1908, where 500 miners came to stake claims, mostly in the Jubilee mine surroundings (TPA B&M 1981:4).

The next two years would show some horrific disasters: firstly, the old mill in Camel's Creek burnt to the ground on the 9th of July 1908, and second, even more grievously, the devastating flood on 2 January 1909, where a seven-hour long storm wreaked havoc on the town and mines. The Blyderiver rose approximately 30 feet, with rain fall exceeding 212.5mm. It swept away all bridges, the Jubilee station, the central cyanide compound and the electric tramline, killing 6 people in Clewer as well as causing the deaths of three boys and injuring another four people in a landslide that overwhelmed a village of huts. The damage to the mines was also devastating, with the main drives at various mines collapsing at the mouths (TPA B&M 1981:5).

TGME would only start to see true difficulties in the Pilgrim's Rest area after 1914, with production in the mines falling sharply from a record amount of R570 936 in 1914, steadily declining until only showing profits of R31 102 in 1919. The years after the First World War proved even more difficult for TGME, and in an effort to stem loss of profit it was decided to develop an experimental plantation to enter the profitable lumber industry. Led by project manager Mr. Robert Gardner, the planting of wattle trees and "*bloekombome"* had reached 3 664 acres by 1927. This would become a national operation, which still flourishes today (TPA B&M 1981:6). The announcement of the devaluation of the pound, announced by Mr Havenga in 1932, brought temporary relief to the mines, as the price of gold now rose from 4s 10d to 124s per ounce. However, the 1940's led to yet another decline in mine production in the area, despite another devaluation of the pound in 1941 (Fowler 1986:293). TGME had been through tumultuous times in its history in the Pilgrim's Rest area, having delivered some 300 000 tons of ore per year between 1935 and 1955, with a record yield of 403 000 ton during the 1941 – 1942 financial year, but production had dwindled to an average of roughly 50 000 ton per year during the 1950's. Despite having had to face natural disasters, pestilence (eg. *"runderpest"* in 1896*)*, low grade ore, three wars, unstable ground, veld fires, horse-sickness and mudslides (Fowler 1986:296) the sheer amount of ore generated in the area is actually astounding, with the area having delivered R16 350 000 000 (of which the first R2 000 000 was from alluvial gold). Sadly, the decline in production meant that mines started closing and in 1968 TGME was forced to sell some of their rights to Rand Mines Properties (RMP). After the closing of its last mine, Beta, TGME sold the last of their assets to RMP in 1971 (TPA B&M 1981:7).

Bourke's Luck Gold Mine, underlying sections of the farms Dientjie 453KT, Bourke's Luck 454 KT and Willemsoord 475KT, was closed in 1955 but yielded approximately 4,5 t of gold over a span of 7,5 km and also yielded sellable copper and iron pyrite by-products (Ward & Wilson 1998:362).

Pilgrim's Rest Central Mines were formed by approximately a dozen or so mines in the area, with the highest yielding being Desire, Theta, Beta, Columbia Hill, Duke's Hill-Clewere, Jubilee and Ponieskrans Mines. The approximate gold ore yield of about 106,8 t was transported from the mines to a centralised, common beneficiation and roasting plant, which aided in prolonging the profitability of Transvaal Gold Mining Estate's interests in the Vaalhoek and Pilgrim's Rest area. As with most mines in the area there were widespread complications with broken ground, underground water and refractory ore (Fowler 1986).

Other mines in the area, namely Vaalhoek Gold Mine, closed in 1956, Elandsdrift mine, underlying the farm Elandsdrift 220JT which was an opencast mine closed in 1944 and the Mamre-Slaaihoek Mines, all closed due to the same problems as the bigger mines as well as due to the poor quality and erratic distribution of gold ore (Ward & Wilson 1998:363).

6.2 Site specific review

6.2.1 *Heritage status*

In 1974 the historic village of Pilgrim's Rest, situated on Portion 42 of the farm Ponieskrans 543KT (originally spelt as Ponieskrantz) was bought by the Transvaal Provincial Administration and developed as a National Monument under the National Monuments Act, No. 28 of 1969 (as amended). This was later extended to include the rest of the farm and in 1975 the part on which Alanglade (the house of the general manager) and the golf course are situated, were also bought by TPA. However, with the promulgation of the National Heritage Resources Act, No. 25 of 1999, the Pilgrim's Rest site lost its national status and reverted to be a site of provincial heritage status.

6.2.2 *World heritage listing*

In 2007 efforts were made to have the Central Reduction Works declared as World Heritage site by having it added to UNESCO's Tentative List for World Heritage Status (Rowe & Venter 2007). However, at the last available revision of the Tentative Lists, dated 15/04/2015 (http://whc.unesco.org/en/tentativelists/), it seems as if this listing was terminated as the Pilgrim's Rest Central Reduction Works is not included on the list.

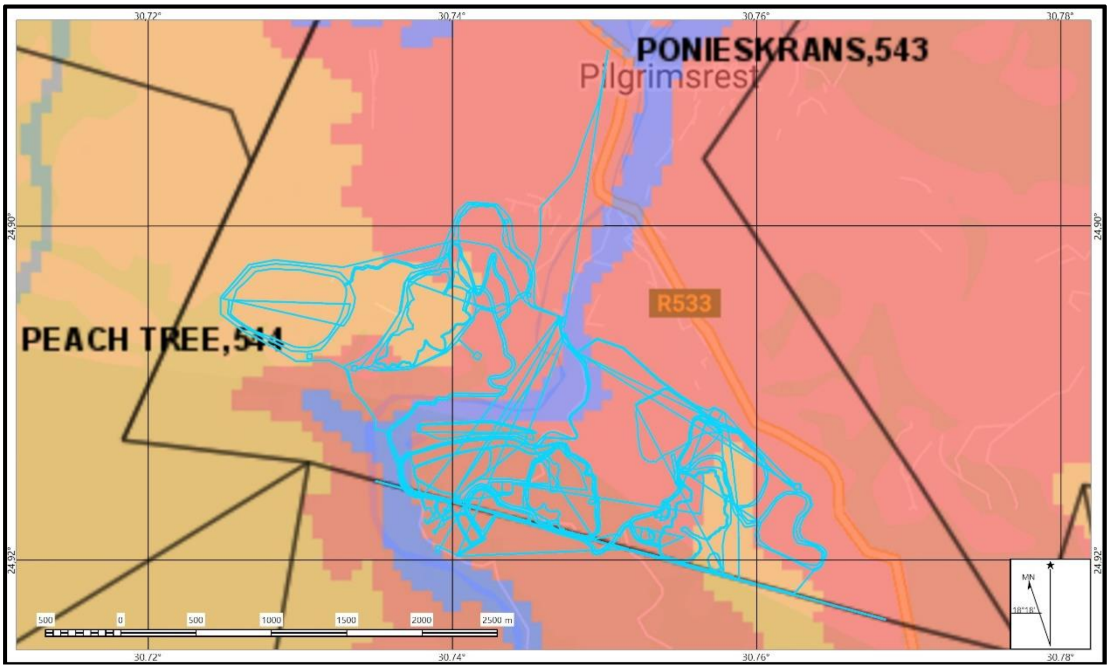
6.2.3 *Fragmented heritage*

As can be expected, over time, with new developments and expansion taking place, subsequent closing down of the operations, opening up the mining activities again, and final closure, many of the structures and features that operated in causal manner to successfully extract the gold over a large geographic region, were adapted, modified, forgotten, cannibalized and vandalised. Especially linear developments such as pipelines, cocopan tracks, electricity power lines and even roads suffered the most. In most cases only isolated elements or even parts of elements remain in the landscape. But people and communities also had to be relocated to different areas.

Fortunately, much of this causal context have been documented by the mine itself, e.g. in reports and maps, but also by the activities of the Pilgrim's Rest Museum, the latter which also included oral history documentation. The heritage context of surviving, fragmentary elements in the landscape are therefore not dependant on being protected *in situ* but are actually already protected in a virtual context.

6.2.4 *Palaeontological sensitivity*

The Palaeontological Sensitivity Map (SAHRIS) indicate that most of the study area (Fig. 4) has a very high sensitivity of fossil remains to be found and therefore a field assessment and protocol for finds is required. A smaller section on the western side of the development has a high sensitivity and therefore a desktop assessment is required. Based on the outcome of that, a field assessment might be required.



Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 4. The Palaeontological sensitivity of the study area

7. SURVEY RESULTS

7.1 Known heritage sites and features

The list presented in Table 1 below is based on own observations, supported by previous work done in the region: Fourie (2008); Henning (1981); Pistorius (2005); Reinders, Mason & Van Wyk (2007); Van Wyk-Rowe (2003).

Table 1. Known heritage sites and features in the larger region as well as the study area

Label	Comment	Latitude	Longitude
001 Fort	Extant	-24,91825	30.75707
002 Cemetery	Extant	-24,91814	30.7448400
003 Graves	Extant	-24,91793	30.7435350
004 Graves	Unknown	-24,91765	30.7429167
005 Graves	Unable to verify	-24,91748	30.7468167
006 Wesleyan mission	Defunct	-24,91202	30.7467000
007 Mission Suisse Romande	Defunct	-24,91309	30.7497100
008 Adit	Extant	-24,91748	30.7588650
009 Adit	Extant	-24,90683	30.7258440
010 Adit	Extant	-24,90774	30.7220730
011 Adit	Extant	-24,90740	30.7217730
012 Adit	Extant	-24,91478	30.7340667
013 Adit	Extant	-24,90950	30.7305970
014 Mine dump	Extant	-24,91072	30.7470833
015 Mine dump	Extant	-24,91038	30.7435333
016 Ore bin	Defunct	-24,91285	30.7345333
017 Ore floor	Defunct	-24,91152	30.7449000
018 Browns Hill Mill	Defunct	-24,91138	30.7452833
019 Pump house	Extant	-24,90674	30.74701
020 Roy's Race	Extant (partial)	-24,90837	30.7477333
021 Water regulator	Extant (partial)	-24,91128	30.7452500
022 Point of race	Extant (partial)	-24,91127	30.7448333
023 Weir	Extant (partial)	-24,91075	30.7401944
024 Coco pan bridge	Extant	-24,90793	30.74649
025 Coco pan track	Extant	-24,91013	30.7418833

026 Coco pan track	Extant	-24,91007	30.7398333
027 Concrete structure	Extant (partial)	-24,90892	30.7475167
028 Concrete structure	Extant	-24,90972	30.7472500
029 Concrete structure	Extant	-24,91038	30.7467333
030 Concrete structure	Extant	-24,91132	30.7459167
031 Culvert	Extant (partial)	-24,91125	30.7445333
032 Concrete structure	Extant (partial)	-24,91243	30.7440833
033 Foundations	Extant (partial)	-24,91222	30.7426333
034 Farmer's race	Extant (partial)	-24,91245	30.7426667
035 Suspension bridge achor	Extant (partial)	-24,91053	30.7394333
036 Suspension bridge	Extant (partial)	-24,91087	30.7391667
037 Low Level Bridge	Extant	-24,91194	30.73516
038 Foundations	Extant (partial)	-24,91383	30.7364500
039 Suspension bridge remains	Extant (partial)	-24,91420	30.7342000
040 Beta Structure	Defunct	-24,91335	30.7332667
041 Beta Structure	Extant	-24,91405	30.7349500
042 Beta West Water	Extant	-24,91223	30.7315833
043 Historic structure	Defunct	-24,91331	30.7305556
044 Historic settlement	Defunct	-24,91450	30.7316944
045 Previous settlement	Defunct	-24,91820	30.7356167
046 Informal settlement	Extant	-24,91580	30.7429000
047 Compound	Defunct	-24,91712	30.7427667
048 Blacklow's Cutting	Extant (partial)	-24,91710	30.7420700
049 Concrete structure	Extant (partial)	-24,90547	30.7293840
050 Rock art site	Extant	-24,91413	30.7306500
051 Browns Hill Pit	Extant (partial)	-24,91642	30.7470725
052 Theta Hill Pit	Extant (partial)	-24,91776	30.7558404

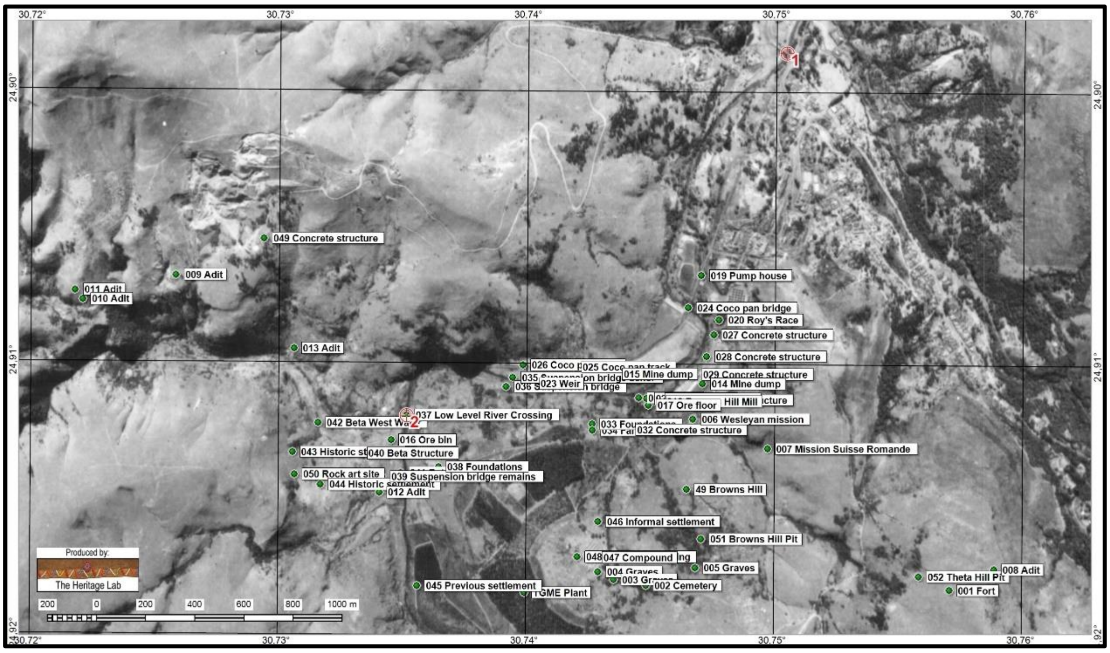


Figure 5. Know heritage sites indicated on the aerial photograph dating to 1953
(Photo: 325_036_05740) (Red wheel-crosses = calibration points)

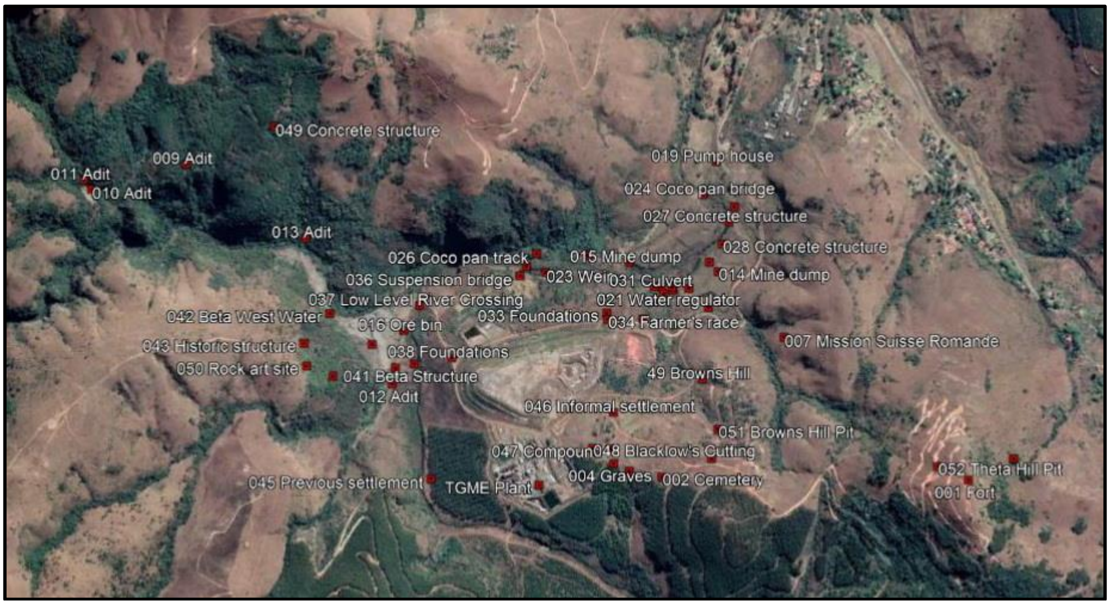


Figure 6. Know heritage sites indicated on the aerial photograph dating to 2018
(Photo: Google Earth)

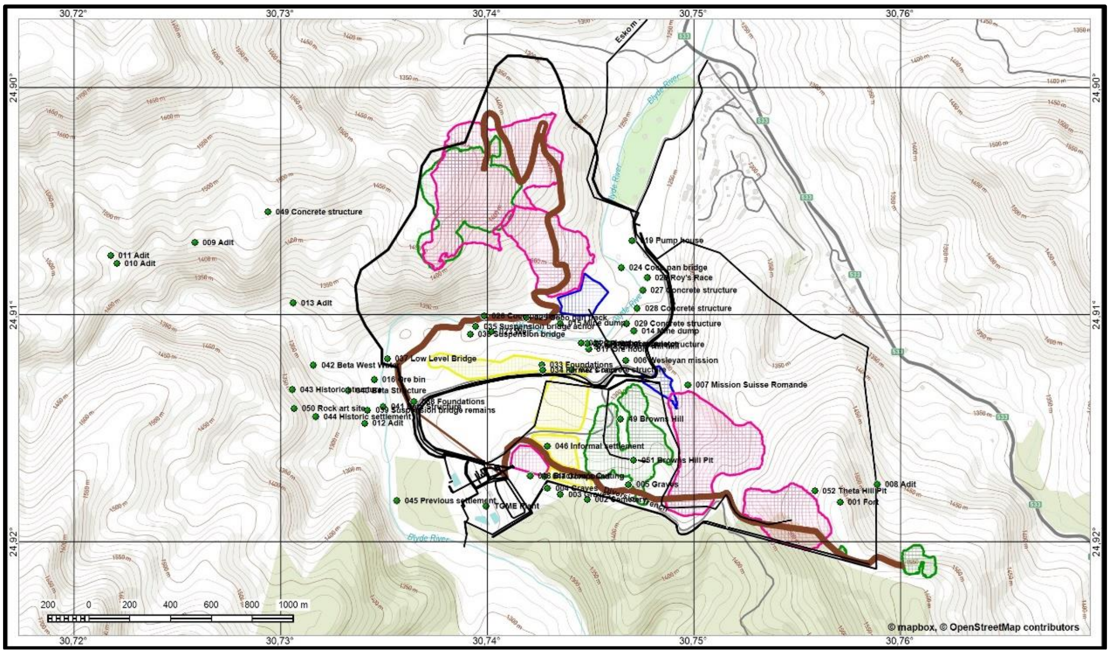


Figure 7. Known heritage sites in relation to the development

After evaluating the identified sites with reference to them being impacted on by the proposed development, we are left with only a few (Table 2 below). However, there are a number which will not be directly impacted on but are viewed to be of high enough significance to be listed as sites to be avoided and are consequently also included in Table 2.

Table 2. Known heritage sites and features in close proximity of the development area

Name	Latitude	Longitude	Impact	Management
001 Fort	-24,91824	30,75706	Inside Theta Hill Pit	Avoid/Retain
002 Cemetery	-24,91814	30,74484	Outside development	Avoid/Retain
003 Burial site	-24,91806	30,74478	Outside development	Avoid/Retain
004 Burial site	-24,91792	30,74353	Outside development	Avoid/Retain
005 Graves	-24,91748	30,74682	Outside development	Avoid/Retain
019 Pump house	-24,90674	30,74701	Close to access road	Avoid/Retain
024 Cocopan bridge	-24,90787	30,74648	Integral part of remaining track	Avoid/Retain
025 Cocopan track (east)	-24,91013	30,74188	In proposed haul road	Document
026 Cocopan track (west)	-24,91006	30,73983	In proposed haul road	Document
032 Concrete structure	-24,91243	30,74408	Inside waste rock dump area	No further action
033 Foundations	-24,91222	30,74263	Inside waste rock dump area	No further action
034 Farmer's race	-24,91245	30,74267	Inside waste rock dump area	No further action
038 Foundations	-24,91383	30,73645	In proposed haul road	No further action
046 Informal settlement – dating to the late 1980s	-24,91581	30,74291	People to be relocated	No further action
047 Compound	-24,91712	30,74277	Abandoned 1972	No further action

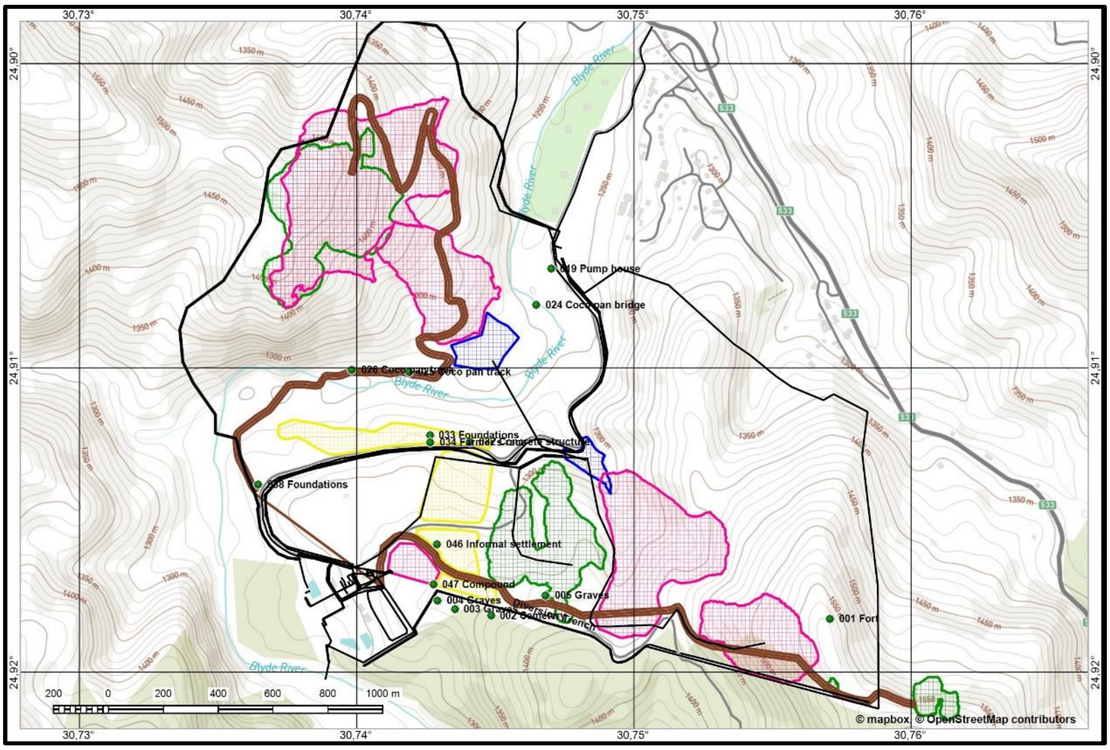


Figure 8. Heritage sites in close proximity of the development area

7.2 Inventory of identified cultural heritage sites and features to be protected

NHRA Category	**Structures older than 60 years - Section 34**

001. Type: Fort. **Farm**: Ponieskrantz 543KT. **Coordinates**: S 24,91825; E 30,75707
Description
A rectangular structure of packed stone. It occupies a commanding position on a hill overlooking not only Pilgrim's Rest town, but the larger region as well. Research has shown that the intended function of this feature might be a fortification that was built in preparation for expected hostilities that might arise during the so-called Sekhukhune War's (1876-1879). As far as is known, it fortunately was never used for its intended purpose.

Front view

Rear view

View in the direction of Pilgrim's Rest

Significance of site/feature	Generally protected: High significance - Grade 4-A
Reasoned opinion: This site represents the remains of a period in South African history where the groundwork for the future development of the country was laid. Sites representing struggle for the possession of the land and its resources are usually few and far between and therefore the destruction of a single such site would have a proportionate high impact on the occurrences of similar features in the larger landscape.	

References

Mason, J. 2011. *Historical archaeological investigation of a stone structure at Pilgrim's Rest that probably served as a fortification during the First (1876) and Second (1878/79) Sekhukhune Wars*. Unpublished report: Pilgrim's Rest.

Smith, K.W. 1967. The Campaigns against the Bapedi of Sekhukhune, 1877-1879. *Argiefjaarboek vir Suid-Afrikaanse Geskiedenis* 30(2):1-69.

024-026. Type: Cocopan bridge. **Farm**: Ponieskrantz 543KT. **Coordinates**: S 24,90793; E 30,74649
S 24,90674; E 30,74701
East S 24,91013; E 30,74188
West S 24,91007; E 30,73983

Description

A section of the old electrified cocopan track extending from the road towards TGME (at the old pump station) westwards to the metal bridge across the Blyde River. This track operated between Beta Mine and the Central Reduction Works but represents only a small section of what was in use over the larger region. Unfortunately, most of this feature that was used in the larger region have been vandalised.

 Side view	 Top view
 Track and electricity pylons	

Significance of site/feature	Generally protected: High significance - Grade 4-A

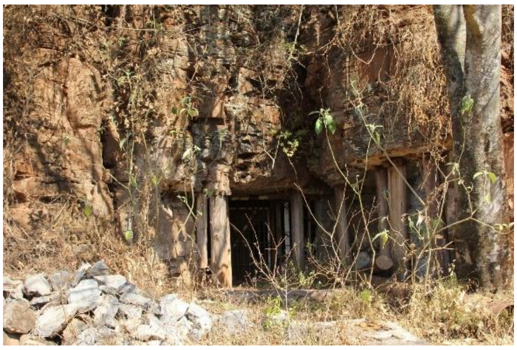
Reasoned opinion: This site represents the remains of a technology that became redundant due to the cessation in demand of its original purpose. For its time it represented a remarkable progressive and modern technology. Sites representing industrial heritage are usually few and far between and therefore the destruction of a single such site, or even a segment of it, would have a proportionate high impact on the occurrences of similar features in the larger landscape.

- This feature is older than 60 years and therefore enjoy general protection under the Heritage Act. As this is a linear development, an impact on even a section of it would have a proportionate high impact on the occurrences of similar features in the larger landscape. Large sections this feature has already been destroyed, with this the only section that is still reasonably intact.

References

-

008-013. Type: Adits. **Farm**: Ponieskrantz 543KT.
Description
A number of old adits are scattered around the larger region. Most are simple holes dug into the side of the hill, whereas others are shored up with stone walls, concrete casings and pillars. None of the built ones are known to be located in the development area, but they are mentioned here in case some unknown ones are located during future mining operations.

Significance of site/feature	Generally protected: High significance - Grade 4-A
Reasoned opinion: These sites represents the remains of a technology that became redundant due to the cessation in demand of its original purpose. However, they are older than 60 years and therefore enjoy general protection under the Heritage Act. Such sites representing mining heritage are usually well represented in the larger landscape and some have been declared formal heritage site, e.g. in the Steelpoort River valley.	

References
-

NHRA Category	**Graves, Cemeteries and Burial Grounds - Section 36**

002-005. Type: Burial sites. **Farm**: Ponieskrantz 543KT **Coordinates**: 002: S 29,91814; E 30,74484
003: S 24,91793; E 30,74353
004: S 24,91765; E 30,74291
005: S 24,91748; E 30,74681

Description

Four informal burial sites have been identified that still exist in the region of the proposed development. Originally there were a larger number, but some of these have been relocated as far back as 2007-2008 (see Fourie 2008).

The graves all belong to former labourers at the mine or their family members. The burial sites range in size from nearly 60 individuals to as few as two or three persons.

Some of the sites were much overgrown with vegetation and have little evidence of grave markers, making their verification very difficult.


Site 002


Site 003


Site 004


Site 005

Significance of site/feature	Generally protected: High significance – Grade IV-A

Reasoned opinion: Burial sites are viewed as having high emotional and sentimental value. However, mitigation is possible if proper procedures have been followed.

References
Fourie (2008)

8. RESULTS: IMPACT ASSESSMENTS AND MITIGATION MEASURES

8.1 Impact assessment

Heritage impacts are categorised as:

- Direct or physical impacts, implying alteration or destruction of heritage features within the project boundaries;
- Indirect impacts, e.g. restriction of access or visual intrusion concerning the broader environment;
- Cumulative impacts that are combinations of the above.

The significance of the anticipated impact on heritage resources is determined through a synthesis of various characteristics in a formula presented below, and can be assessed as low, medium or high (for a detailed version, see Section 2 of the Addendum at the end of this document):

S = (E+D+M) x P; where
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

Significance of impact		
Points	Significant Weighting	Discussion
< 30 points	Low	Where this impact would not have a direct influence on the decision to develop in the area.
31-60 points	Medium	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
> 60 points	High	Where the impact must have an influence on the decision process to develop in the area.

8.2 Mitigation measures

Mitigation: means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.

For the current study, the following mitigation measures are proposed (see Section 3 of the Addendum for a discussion of all mitigation measures) and are summarised in Table 3 below.

Table 3: Impact assessment

NHRA Category	Structures older than 60 years - Section 34

001. Type: Fort. **Farm**: Ponieskrantz 543KT. **Coordinates**: S 24,91825; E 30,75707

Impact assessment

Currently, the Theta Pit boundary approaches the fort to within about 22m – see image below.

Mitigation

(1) Avoidance/Preserve: Because of its location within the larger project development area, it would be possible to avoid this site as it actually occupies a small footprint;

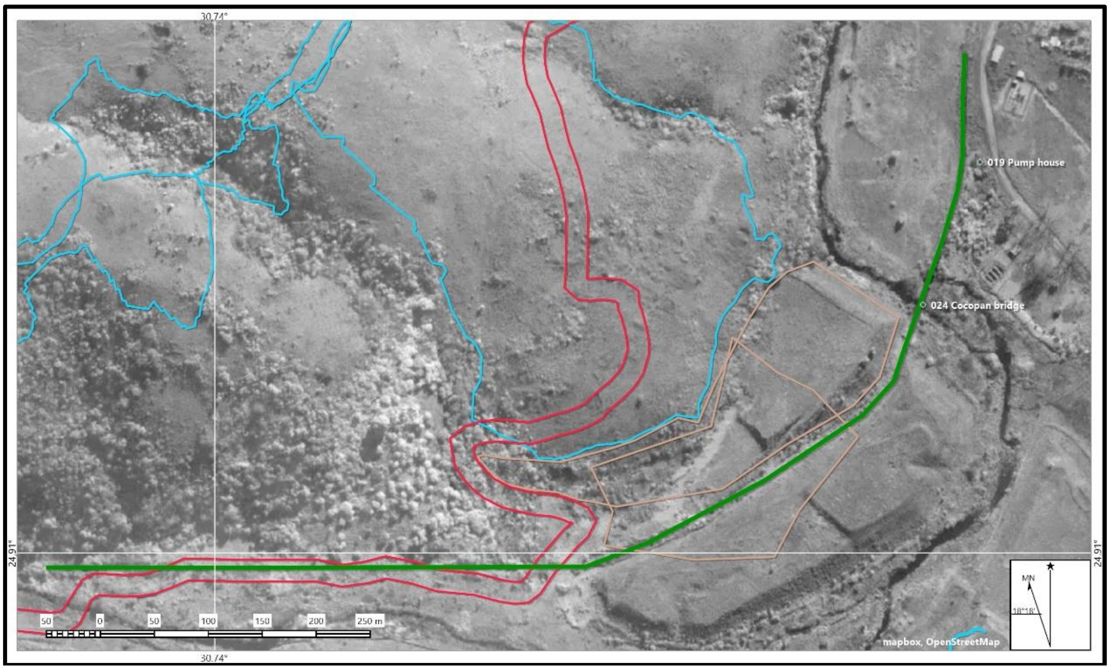
- It is recommended that a buffer zone of at least 15m is created around the outer edges of the fort and that this is formalised with a suitable, permanent fence (with an access gate).

Significance of impact: before/after mitigation					
Extent	**Duration**	**Intensity**	**Probability**	**Significance**	**Weight**
3	5	4	5	60	Medium
1	5	3	3	27	Low
Requirements					

Should there be an impact on the site, a permit would be required from the provincial heritage authority.

024-026. Type: Cocopan track and bridge. **Farm**: Ponieskrantz 543KT. **Coordinates**: S 24,90674; E 30,74701; S 24,90793; E 30,74649

Impact assessment
A section of the cocopan track (green polyline below) will be impacted on due to the proposed construction of a new pollution control dam (PCD) (brown polygons below), as well as a new haul road (red polygon below). (Blue polygons = waste rock dump)



Mitigation

(2) Archaeological investigation: If this feature, i.e. the section to be covered by the PCD and the haul road, cannot be avoided it should be documented in full before destruction. It is also proposed that:

- The section of the track extending from the road towards TGME (in the vicinity of the old pump station) westwards up until and including the metal bridge crossing the Blyde River be declared a no-go area and that it is protected and retained as a sample of this type of technology.
    - It is also sufficiently close to the reduction works to be used part of a possible future tourism attraction.
    - Material salvaged from the section the be impacted on by the proposed mining activities should be used to rehabilitate the section that is to be retained, and the rest should be placed in a secure place for safekeeping.

Significance of impact: before/after mitigation

Extent	Duration	Intensity	Probability	Significance	Weight
3	5	4	5	60	Medium
1	5	3	3	27	Low

Requirements
The site should be mitigated before impacting on it. A permit for its destruction would be required from the provincial heritage resources authority.

008-013. Type: Built adits. **Farm**: Ponieskrantz 543KT.

Impact assessment
These sites are not located inside the development area and therefore the possibility that it might be impacted on is minimal. However, they are included in this list as areas that has to be avoided.

Mitigation
(1) Avoidance/Preserve: Because of its location within the larger project development area, it would be possible to avoid these sites.

Significance of impact: before/after mitigation					
Extent	**Duration**	**Intensity**	**Probability**	**Significance**	**Weight**
1	5	3	3	27	Low
1	5	3	3	27	Low

Requirements
No further action required

NHRA Category	Graves, Cemeteries and Burial Grounds - Section 36

002-005. Type: Burial sites. **Farm**: Ponieskrantz 543KT **Coordinates**: 002: S 29,91814; E 30,74484 003: S 24,91793; E 30,74353 004: S 24,91765; E 30,74291 005: S 24,91748; E 30,74681

Impact assessment
All four sites are located outside the proposed development area and therefore there would be no direct impact on them. However, they are included in this list as areas that has to be avoided.

Mitigation
(1) Avoidance/Preserve: Because of their location outside the larger project development area, it would be possible to avoid these sites. In addition, they occupy a small footprint, which can be easily fenced off and protected.

Significance of impact: before/after mitigation					
Extent	Duration	Intensity	Probability	Significance	Weight
1	5	3	3	27	Low
1	5	3	3	27	Low

Requirements
No further action required

9. MANAGEMENT MEASURES

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the proposed development can be excavated/recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.

Sources of risk were considered with regards to development activities defined in Section 2(viii) of the NHRA that may be triggered and are summarised in Table 4A and 4B below. These issues formed the basis of the impact assessment described. The potential risks are discussed according to the various phases of the project below.

9.1 Objectives

- Protection of archaeological, historical and any other site or land considered being of cultural value within the project boundary against vandalism, destruction and theft.
- The preservation and appropriate management of new discoveries in accordance with the NHRA, should these be discovered during construction activities.

The following shall apply:

- Known sites should be clearly marked in order that they can be avoided during construction activities.
- The contractors and workers should be notified that archaeological sites might be exposed during the construction activities.

- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;
- All discoveries shall be reported immediately to a heritage practitioner so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999), Section 51. (1).

9.2 Control

In order to achieve this, the following should be in place:

- A person or entity, e.g. the Environmental Control Officer, should be tasked to take responsibility for the heritage sites and should be held accountable for any damage.
- Known sites should be located and isolated, e.g. by fencing them off. All construction workers should be informed that these are no-go areas, unless accompanied by the individual or persons representing the Environmental Control Officer as identified above.
- In areas where the vegetation is threatening the heritage sites, e.g. growing trees pushing walls over, it should be removed, but only after permission for the methods proposed has been granted by SAHRA. A heritage official should be part of the team executing these measures.

Table 4A: Construction Phase: Environmental Management Programme for the project

Action required	Protection of heritage sites, features and objects		
Potential Impact	The identified risk is damage or changes to resources that are generally protected in terms of Sections 27, 28, 31, 32, 34, 35, 36 and 37 of the NHRA that may occur in the proposed project area.		
Risk if impact is not mitigated	Loss or damage to sites, features or objects of cultural heritage significance		
Activity / issue	**Mitigation: Action/control**	**Responsibility**	**Timeframe**
1. Removal of Vegetation 2. Construction of required infrastructure, e.g. access roads, water pipelines	See discussion in Section 9.1 above	Environmental Control Officer	During construction only
Monitoring	See discussion in Section 9.2 above		

Table 4B: Operation Phase: Environmental Management Programme for the project

Action required	Protection of heritage sites, features and objects		
Potential Impact	It is unlikely that the negative impacts identified for pre-mitigation will occur if the recommendations are followed.		
Risk if impact is not mitigated	Loss or damage to sites, features or objects of cultural heritage significance		
Activity / issue	**Mitigation: Action/control**	**Responsibility**	**Timeframe**
1. Removal of Vegetation 2. Construction of required infrastructure,	See discussion in Section 9.1 above	Environmental Control Officer	During construction only

e.g. access roads, water pipelines			
Monitoring	See discussion in Section 9.2 above		

10. CONCLUSIONS AND RECOMMENDATIONS

This report describes the methodology used, the limitations encountered, the heritage features that were identified and the recommendations and mitigation measures proposed relevant to this. The investigation consisted of a desktop study (archival sources, database survey, maps and aerial imagery) and a physical survey that also included the interviewing of relevant people. It should be noted that the implementation of the mitigation measures is subject to SAHRA/PHRA's approval.

The cultural landscape qualities of the region essentially consist of two components. The first is made up of a limited pre-colonial (Stone Age and Iron Age) occupation. The second component is a rural area in which the human occupation consists of two elements. The discovery of gold during the late 19th century resulted in a flood of people entering the area, establishing gold mining activities all over the landscape. The second element is a rural farming community, which, since the early 20th century revolved around forestry, which altered the landscape beyond recognition. These two elements led to the establishment of a number of smaller towns in the region, all which are now part of an ongoing tourism industry.

Identified sites

During the survey, the following sites, features or objects of cultural significance were identified, only some of which are deemed to be conservation/documentation worthy:

Name	**Latitude**	**Longitude**	**Impact**	**Management**
001 Fort	-24,91824	30,75706	Inside Theta Hill Pit	Avoid/Retain
002 Cemetery	-24,91814	30,74484	Outside development	Avoid/Retain
003 Burial site	-24,91806	30,74478	Outside development	Avoid/Retain
004 Burial site	-24,91792	30,74353	Outside development	Avoid/Retain
005 Graves	-24,91748	30,74682	Outside development	Avoid/Retain
019 Pump house	-24,90674	30,74701	Close to access road	Avoid/Retain
024 Cocopan bridge	-24,90787	30,74648	Integral part of remaining track	Avoid/Retain
025 Cocopan track (east)	-24,91013	30,74188	In proposed haul road	Document
026 Cocopan track (west)	-24,91006	30,73983	In proposed haul road	Document
032 Concrete structure	-24,91243	30,74408	Inside waste rock dump area	No further action
033 Foundations	-24,91222	30,74263	Inside waste rock dump area	No further action
034 Farmer's race	-24,91245	30,74267	Inside waste rock dump area	No further action
038 Foundations	-24,91383	30,73645	In proposed haul road	No further action
046 Informal settlement	-24,91581	30,74291	People to be relocated	Document
047 Compound	-24,91712	30,74277	Abandoned 1972	No further action

Impact assessment and proposed mitigation measures

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development:

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
Old fort					
001	Historic structure	Section 34	High significance Grade 4-A	60 27	(1) Avoidance/Preserve; (2) Archaeological investigation
Mitigation					
(1) Avoidance/Preserve • Currently, the Theta Pit boundary approaches the fort to within about 22m. It is recommended that a buffer zone of at least 15m is created around the outer edges of the fort and that this is formalised with a suitable, permanent fence (with an access gate).					

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
Cocopan bridge and track					
024 - 026	Historic structure	Section 34	High significance Grade 4-A	60 27	(1) Avoidance/Preserve; (2) Archaeological investigation
Mitigation					
(2) Archaeological investigation: If this feature, i.e. the section to be covered by the proposed PCD and haul road, cannot be avoided it should be documented in full before destruction. It is also proposed that: • The section of the track extending from the road towards TGME (in the vicinity of the old pump station) westwards up until and including the metal bridge crossing the Blyde River be declared a no-go area and that it is protected and retained as a sample of this type of technology. ○ It is also sufficiently close to the reduction works to be used part of a possible future tourism attraction. ○ Material salvaged from the section the be impacted on by the proposed mining activities should be used to rehabilitate the section that is to be retained, and the rest should be placed in a secure place for safekeeping.					

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
“Built” adits					
008 - 013	Historic structures	Section 34	High significance Grade 4-A	27 27	(1) Avoidance/Preserve; (2) Archaeological investigation
Mitigation					
(1) Avoidance/Preserve • No further action required					

IDENTIFIED HERITAGE RESOURCES					
Site No.	**Site type**	**NHRA category**	**Field rating**	**Impact rating: Before/After mitigation**	**Proposed mitigation (Refer to definitions in Section 12.3)**
Burial sites					
002 - 005	Graves, Cemeteries and Burial Grounds	Section 36	High significance Grade 4-A	27 27	(1) Avoidance/Preserve; (2) Archaeological investigation
Mitigation					
(1) Avoidance/Preserve • No further action required					

<u>Legal requirements</u>

The legal requirements related to heritage specifically are specified in Section 3 of this report. For this proposed project, the assessment has determined that no sites, features or objects of heritage significance occur in the study area. If heritage features are identified during construction, as stated in the management recommendation, these finds would have to be assessed by a specialist, after which a decision will be made regarding the application for relevant permits.

- In the event that any of the identified structures is to be impacted on, a valid permit would be required from SAHRA/PHRA prior to its destruction. Such a permit will only be issued after the site has been fully documented – mapped, photographed and described.

<u>Reasoned opinion as to whether the proposed activity should be authorised</u>:

- From a heritage point of view, it is recommended that the proposed development be allowed to continue on acceptance of the conditions proposed below.

<u>Conditions for inclusion in the environmental authorisation</u>:

- The Palaeontological Sensitivity Map (SAHRIS) indicate that most of the study area has a very high sensitivity of fossil remains to be found and therefore a field assessment and protocol for finds is required. A smaller section on the western side of the development has a high sensitivity and therefore a desktop assessment is required. Based on the outcome of that, a field assessment might be required.
- In the unlikely event that any of the identified structures is to be impacted on, it must be fully documented – mapped, photographed and described – beforehand.
- Should archaeological sites or graves be exposed in other areas during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.

11. REFERENCES

11.1 Data bases

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Environmental Potential Atlas, Department of Environmental Affairs and Tourism.
Heritage Atlas Database, Pretoria
National Archives of South Africa
SAHRA Archaeology and Palaeontology Report Mapping Project (2009)
SAHRIS Database

11.2 Literature

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11.3 Maps, aerial photographs and websites

1: 50 000 Topocadastral maps
Aerial photographs: Chief Surveyor-General
Google Earth
US Department of the Interior: Office of Surface Mining Reclamation and Enforcement. https://osmre.gov

12. ADDENDUM

1. Indemnity and terms of use of this report

The findings, results, 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 the author 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.

Although all possible care is taken to identify all sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the study. The author of this report will not be held liable for such oversights or for costs incurred as a result of such oversights.

Although the author exercises due care and diligence in rendering services and preparing documents, he accepts no liability and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of the information contained in this document.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

2. Assessing the significance of heritage resources and potential impacts

A system for site grading was established by the NHRA and further developed by the South African Heritage Resources Agency (SAHRA 2007) and has been approved by ASAPA for use in southern Africa and was utilised during this assessment.

2.1 *Significance of the identified heritage resources*

According to the NHRA, Section 2(vi) the **significance** of a heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Matrix used for assessing the significance of each identified site/feature

1. SITE EVALUATION			
1.1 Historic value			
Is it important in the community, or pattern of history			
Does it have strong or special association with the life or work of a person, group or organisation of importance in history			
Does it have significance relating to the history of slavery			
1.2 Aesthetic value			
It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group			
1.3 Scientific value			
Does it have potential to yield information that will contribute to an understanding of natural or cultural heritage			
Is it important in demonstrating a high degree of creative or technical achievement at a particular period			
1.4 Social value			
Does it have strong or special association with a particular community or cultural group for social, cultural or spiritual reasons			
1.5 Rarity			
Does it possess uncommon, rare or endangered aspects of natural or cultural heritage			
1.6 Representivity			
Is it important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects			
Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class			
Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.			
2. Sphere of Significance	High	Medium	Low
International			
National			
Provincial			
Regional			
Local			
Specific community			
3. Field Register Rating			
1.	National/Grade 1: High significance - No alteration whatsoever without permit from SAHRA		
2.	Provincial/Grade 2: High significance - No alteration whatsoever without permit from provincial heritage authority.		
3.	Local/Grade 3A: High significance - Mitigation as part of development process not advised.		

4.	Local/Grade 3B: High significance - Could be mitigated and (part) retained as heritage register site	
5.	Generally protected A: High/medium significance - Should be mitigated before destruction	
6.	Generally protected B: Medium significance - Should be recorded before destruction	
7.	Generally protected C: Low significance - Requires no further recording before destruction	

2.2 *Significance of the anticipated impact on heritage resources*

All impacts identified during the HIA stage of the study will be classified in terms of their significance. Issues would be assessed in terms of the following criteria:

Nature of the impact
A description of what causes the effect, what will be affected and how it will be affected.

Extent
The physical **extent**, wherein it is indicated whether:
- 1 - The impact will be limited to the site;
- 2 - The impact will be limited to the local area;
- 3 - The impact will be limited to the region;
- 4 - The impact will be national; or
- 5 - The impact will be international.

Duration
Here it should be indicated whether the lifespan of the impact will be:
- 1 - Of a very short duration (0–1 years);
- 2 - Of a short duration (2-5 years);
- 3 - Medium-term (5–15 years);
- 4 - Long term (where the impact will persist possibly beyond the operational life of the activity); or
- 5 - Permanent (where the impact will persist indefinitely).

Magnitude (Intensity)
The magnitude of impact, quantified on a scale from 0-10, where a score is assigned:
- 0 - Small and will have no effect;
- 2 - Minor and will not result in an impact;
- 4 - Low and will cause a slight impact;
- 6 - Moderate and will result in processes continuing but in a modified way;
- 8 - High, (processes are altered to the extent that they temporarily cease); or
- 10 - Very high and results in complete destruction of patterns and permanent cessation of processes.

Probability
This describes the likelihood of the impact actually occurring and is estimated on a scale where:
- 1 - Very improbable (probably will not happen);
- 2 - Improbable (some possibility, but low likelihood);
- 3 - Probable (distinct possibility);
- 4 - Highly probable (most likely); or
- 5 - Definite (impact will occur regardless of any prevention measures).

Significance
The significance is determined through a synthesis of the characteristics described above (refer to the formula below) and can be assessed as low, medium or high:

S = (E+D+M) x P; where
S = Significance weighting

E = Extent
D = Duration
M = Magnitude
P = Probability

Significance of impact		
Points	Significant Weighting	Discussion
< 30 points	Low	Where this impact would not have a direct influence on the decision to develop in the area.
31-60 points	Medium	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
> 60 points	High	Where the impact must have an influence on the decision process to develop in the area.

Confidence
This should relate to the level of confidence that the specialist has in establishing the nature and degree of impacts. It relates to the level and reliability of information, the nature and degree of consultation with I&AP's and the dynamic of the broader socio-political context.

- High, where the information is comprehensive and accurate, where there has been a high degree of consultation and the socio-political context is relatively stable.
- Medium, where the information is sufficient but is based mainly on secondary sources, where there has been a limited targeted consultation and socio-political context is fluid.
- Low, where the information is poor, a high degree of contestation is evident and there is a state of socio-political flux.

Status

- The status, which is described as either positive, negative or neutral.

Reversibility

- The degree to which the impact can be reversed.

Mitigation

- The degree to which the impact can be mitigated.

Nature:		
	Without mitigation	With mitigation
Construction Phase		
Probability		
Duration		
Extent		
Magnitude		
Significance		
Status (positive or negative)		
Operation Phase		
Probability		
Duration		
Extent		
Magnitude		
Significance		
Status (positive or negative)		
Reversibility		
Irreplaceable loss of resources?		
Can impacts be mitigated		

3. Mitigation measures

- *Mitigation: means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.*

Impacts can be managed through one or a combination of the following mitigation measures:

- Avoidance
- Investigation (archaeological)
- Rehabilitation
- Interpretation
- Memorialisation
- Enhancement (positive impacts)

For the current study, the following mitigation measures are proposed, to be implemented only if any of the identified sites or features are to be impacted on by the proposed development activities:

- (1) Avoidance/Preserve: This is viewed to be the primary form of mitigation and applies where any type of development occurs within a formally protected or significant or sensitive heritage context and is likely to have a high negative impact. This measure often includes the change / alteration of development planning and therefore impact zones in order not to impact on resources. The site should be retained *in situ* and a buffer zone should be created around it, either temporary (by means of danger tape) or permanently (wire fence or built wall). Depending on the type of site, the buffer zone can vary from
  - 10 metres for a single grave, or a built structure, to
  - 50 metres where the boundaries are less obvious, e.g. a Late Iron Age site.

- (2) Archaeological investigation/Relocation of graves: This option can be implemented with additional design and construction inputs. This is appropriate where development occurs in a context of heritage significance and where the impact is such that it can be mitigated. Mitigation is to excavate the site by archaeological techniques, document the site (map and photograph) and analyse the recovered material to acceptable standards. This can only be done by a suitably qualified archaeologist.
  - This option should be implemented when it is impossible to avoid impacting on an identified site or feature.
  - This also applies for graves older than 60 years that are to be relocated. For graves younger than 60 years a permit from SAHRA is not required. However, all other legal requirements must be adhered to.
    - Impacts can be beneficial – e.g. mitigation contribute to knowledge

- (3) Rehabilitation: When features, e.g. buildings or other structures are to be re-used. Rehabilitation is considered in heritage management terms as an intervention typically involving the adding of a new heritage layer to enable a new sustainable use.
  - The heritage resource is degraded or in the process of degradation and would benefit from rehabilitation.
  - Where rehabilitation implies appropriate conservation interventions, i.e. adaptive reuse, repair and maintenance, consolidation and minimal loss of historical fabric.
    - Conservation measures would be to record the buildings/structures as they are (at a particular point in time). The records and recordings would then become the ‘artefacts’ to be preserved and managed as heritage features or (movable) objects.
    - This approach automatically also leads to the enhancement of the sites or features that are re-used.

- (4) Mitigation is also possible with additional design and construction inputs. Although linked to the previous measure (rehabilitation) a secondary though 'indirect' conservation measure would be to use the existing architectural 'vocabulary' of the structure as guideline for any new designs.
    - The following principle should be considered: **heritage informs design**.
        - This approach automatically also leads to the enhancement of the sites or features that are re-used.

- (5) No further action required: This is applicable only where sites or features have been rated to be of such low significance that it does not warrant further documentation, as it is viewed to be fully documented after inclusion in this report.
    - Site monitoring during development, by an ECO or the heritage specialist are often added to this recommendation in order to ensure that no undetected heritage/remains are destroyed.

4. Curriculum vitae

Johan Abraham van Schalkwyk

Personal particulars

Date of birth:	14 April 1952
Identity number:	520414 5099 08 4
Marital status:	Married; one daughter
Nationality:	South African

Current address: home
62 Coetzer Ave, Monument Park, Pretoria, 0181
Mobile: 076 790 6777; E-mail: jvschalkwyk@mweb.co.za

Qualifications

1995	DLitt et Phil (Anthropology), University of South Africa
1985	MA (Anthropology), University of Pretoria
1981	BA (Hons), Anthropology, University of Pretoria
1979	Post Graduate Diploma in Museology, University of Pretoria
1978	BA (Hons), Archaeology, University of Pretoria
1976	BA, University of Pretoria

Non-academic qualifications
12th HSRC-School in Research Methodology - July 1990
Dept. of Education and Training Management Course - June 1992
Social Assessment Professional Development Course - 1994
Integrated Environmental Management Course, UCT - 1994

Professional experience
Private Practice
2017 - current: Professional Heritage Consultant

National Museum of Cultural History
1992 - 2017: Senior researcher: Head of Department of Research. Manage an average of seven researchers in this department and supervise them in their research projects. Did various projects relating to Anthropology and Archaeology in Limpopo Province, Mpumalanga, North West Province and Gauteng. Headed the Museum's Section for Heritage Impact Assessments.
1978 - 1991: Curator of the Anthropological Department of the Museum. Carried out extensive fieldwork in both anthropology and archaeology

Department of Archaeology, University of Pretoria
1976 - 1977: Assistant researcher responsible for excavations at various sites in Limpopo Province and Mpumalanga.

Awards and grants
1. Hanisch Book Prize for the best final year Archaeology student, University of Pretoria - 1976.
2. Special merit award, National Cultural History Museum - 1986.
3. Special merit award, National Cultural History Museum - 1991.
4. Grant by the Department of Arts, Culture, Science and Technology, to visit the various African countries to study museums, sites and cultural programmes - 1993.
5. Grant by the USA National Parks Service, to visit the United States of America to study museums, sites, tourism development, cultural programmes and impact assessment programmes - 1998.
6. Grant by the USA embassy, Pretoria, under the Bi-national Commission Exchange Support Fund, to visit cultural institutions in the USA and to attend a conference in Charleston - 2000.
7. Grant by the National Research Foundation to develop a model for community-based tourism - 2001.

8. Grant by the National Research Foundation to develop a model for community-based tourism - 2013. In association with RARI, Wits University.

Publications
Published more than 70 papers, mostly in scientifically accredited journals, but also as chapters in books.

Conference Contributions
Regularly presented papers at conferences, locally as well as internationally, on various research topics, ranging in scope from archaeology, anthropological, historical, cultural historical and tourism development.

Heritage Impact Assessments
Since 1992, I have done more than 2000 Phase 1 and Phase 2 impact assessments (archaeological, anthropological, historical and social) for various government departments and developers. Projects include environmental management frameworks, roads, pipeline-, and power line developments, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments.

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WATERCOURSE ECOLOGICAL ASSESSMENT AND IMPACT ASSESSMENTS AS PART OF THE ENVIRONMENTAL AUTHORISATION AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS FOR THE TGME THETA PROJECT TO INCLUDE THE THETA HILL, BROWNS HILL AND IOTA HILL NEAR PILGRIM'S REST, MPUMALANGA PROVINCE

Prepared for

Batho Earth Social and Environmental Consultants (EIA Process)

AND

MVB Consulting (WULA Process)
July 2020

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Date:	**July 2020**

SAS Environmental Group of Companies

EXECUTIVE SUMMARY

Numerous freshwater and aquatic resources (all classified as watercourses as defined in the NWA) were identified within the study areas and within 500m thereof. Private farm/irrigation dams and aquifers (groundwater) were not assessed, and no naturally occurring wetlands were identified in the study areas. These watercourses (Blyde River and associated tributaries) with associated riparian habitat were assessed and largely found to be of in a good condition ecologically, of high importance and sensitivity, particularly in the upper reaches where anthropogenic disturbances are limited.

In the lower reaches where historical mining and agricultural activities have occurred, the systems are considered to have been exposed to limited and low levels of modification with impacts occurring only to a limited extent. However, during the January 2020 assessment of the Blyde River and its tributaries, the Peach Tree Stream and the Pilgrims Creek, an emerging impact in terms of illegal artisanal mining on the Blyde River was observed in the vicinity of the proposed project. At the time of the January 2020 assessment, impacts associated with these illegal artisanal mining activities were relatively limited, with some recovery of the system observed further downstream of these activities, however, should the scale of this unregulated illegal artisanal mining expand, the impacts to the Blyde River and its associated tributaries could increase (with special mention of impacts related to sedimentation, loss of habitat, and impairment of water quality).

Based on the findings of this study, it was determined that the various project components pose varying degrees of risk based on the distance of each operation from the watercourses in the region. Numerous watercourses (Blyde River and associated tributaries) are situated downgradient of the various study areas, and therefore there is significant potential for the systems to be impacted on by the proposed mining activities, particularly in terms of sedimentation and impacts on water quality. It is therefore considered imperative that during the detailed design phase, very careful consideration be given to the locality and layouts of surface infrastructure, to ensure that watercourses and their associated zones of regulation (in terms of both GN704 and GN509 as they relate to the National Water Act 1998 (Act No. 36 of 1998)) are avoided as much as possible.

Due to the sensitivity of the watercourses in the region, if the project is authorised to proceed, a very high level of mitigation, aligned to the mitigation hierarchy will be required to ensure that the sensitive and important receiving environment is not unacceptably impacted. Implementation of such mitigation measures along with general ecologically sensitive mining and construction methods are deemed essential to ensure that the ecological integrity of the highly important and sensitive freshwater resources in the vicinity of mining activities is not compromised to such a degree that the Resource Quality Objectives for these drainage systems cannot be met, there is a change in EcoStatus and that long term and/or irreversible impacts on the watercourses of the area occur. Consideration may need to be given to offsetting residual impacts likely to be associated with the project, although it should be noted that some impacts, such as impacts on water quality for example cannot be offset.

It is the key objective of this study to provide detailed information to guide the proposed project activities in the vicinity of the watercourses within the study area, to ensure 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. This report provides sufficient detail on the relevant information to allow for decision making as part of the EIA process as required to fulfil the needs of Integrated Environmental Management.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater resource and aquatic ecological assessment as part of the Water Use Licensing Process in terms of the National Water Act, 1998 (Act No. 36 of 1998) and the Environmental Impact Assessment process in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) for the proposed Transvaal Gold Mining Estates (TGME) Theta Project, near Pilgrim's Rest, Mpumalanga Province.

The TGME Theta Project comprises various proposed mining areas, namely:
- Browns Pit;
- Theta Pit;
- Iota Pit; and
- Associated infrastructure

Within these study areas, construction of terrace mining pits is proposed, along with various mining related surface infrastructure. The TGME Theta Project is located adjacent to the existing TGME metallurgical plant, which is situated 2.5km southwest of the town of Pilgrim's Rest, Mpumalanga Province. The dominant land use in the area is commercial forestry with some agriculture as well as artisanal mining activities occurring close to Pilgrim's Rest.

The proposed mining operation is located within the jurisdiction of the Ehlanzeni District Municipality and the local Municipality of Thaba Chweu. TGME has an existing and approved mining right over the area, with DMR reference MP 30/5/1/2/2/83MR.

The total 83MR area encompasses the following farms and cover a total area of some 9,413.3366 ha:
- Frankfort 509KT: RE, Ptn 1, Ptn 2, Ptn 3, Ptn 4, Ptn 5;
- Krugers Hoop 527KT;
- Van der Merwes Reef 526KT: RE, Ptn 1;
- Morgenzon 525KT RE, Ptn 1, Ptn 2;
- Peach Tree 544KT and
- Ponieskrans 543KT: RE, Ptn 18, Ptn 42, Ptn 43, Ptn 44.

The proposed area of influence will be situated on Portion 42 of the farm Ponieskrans 543KT.

It is envisaged that the Life of Mine (LoM) will be approximately five and a half years, with a construction period of approximately 10 months. In addition to the terrace mining, related surface infrastructure required includes:
- Haul Roads and river crossing;
- Topsoil stockpiles,
- Run-of mine stockpiles,
- Strategic Ore stockpile;
- Waste rock dumps (including the Wishbone and Iota South and North waste rock dumps);
- Pollution Control Dams and
- Settling Dam.

The following alternatives will be assessed as part of the EIA Process:
- Design for the final position of the infrastructure plan in terms of local environmental aspects such as watercourses, sensitive areas, and existing/historical mining operations; and
- No go alternatives (i.e. should the project not be approved).

The purpose of this report is to define the freshwater ecology of the watercourses associated with the study areas in terms of freshwater resource characteristics, including mapping of the various freshwater resources, defining areas of increased Ecological Importance and Sensitivity (EIS), defining the Present Ecological State (PES) of the freshwater resources associated with the study 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 freshwater resources. 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.

Summary of results

Numerous watercourses, including the highly sensitive Blyde River, the Peach Tree Stream and the Pilgrims Creek, as well as numerous smaller ephemeral drainage lines with riparian vegetation draining into the Blyde River, were identified within and in the vicinity of the three study areas, i.e. Browns Pit, Theta Pit, and Iota Pit. These watercourses were assessed in order to define their ecological condition, importance and sensitivity, and provisioning of goods and services (i.e. ecological functioning and socio-cultural benefits). The various watercourses were found to be of high ecological importance and sensitivity, and to provide intermediate to moderately high levels of various ecological services such as biodiversity maintenance (especially in the upper reaches of systems [with special mention of the Blyde River] where disturbances were fewer), flood attenuation, assimilation of nutrients and toxicants and streamflow regulation. As a result of the increased ecological integrity and the degree to which ecoservices are provisioned, all systems were deemed to be of moderate to high ecological importance and sensitivity.

The aquatic assemblages of the various rivers and streams assessed (i.e. the Blyde River, the Peach Tree Stream and the Pilgrims Creek) of the assessed sites were defined as being extremely sensitive to water quality changes as well as changes in flow regimes, with these two aspects also considered to be the most important ecological parameters in the Blyde River system (affected by both natural seasonal variation as well as existing anthropogenic impact) with more significant influence from the changes in flow regime. Two species of concern, the Treur River Barb (*Enteromius cf treurensis*) (Critically Endangered) and the Marico Barb (*Entromius motebensis)* (Near Threatened) were observed within and in the vicinity of the proposed project in the January 2020 assessment. Special mention is made of the Treur River Barb, which is isolated to a single population in the upper reaches of the Blyde River catchment. The temporal and spatial results of the aquatic ecological assessment indicate that the integrity of the Blyde River, while still largely classified overall as an Ecological Category B along the entire portion of the Blyde River assessed, has begun to decline in a downstream direction over time. This decline may be largely related to the surrounding land-use activities, including forestry, illegal artisanal mining activities, seepage and runoff from historical mining areas, increasing urbanization and proliferation of alien and invasive species (resulting in altered surface runoff into the river and changes to the stream bed characteristics), and the ingress of sewage related to the Pilgrims Rest WWTW. The illegal artisanal mining activities observed has resulted in severe sedimentation in some areas and may potentially have contributed to blanketing of benthos and algal proliferation, which has begun to compromise the habitat integrity and water clarity of the Blyde River in a downstream direction.

Land-use activities were largely to blame for the short-term variability in EC observed, as well as impacts to the habitat availability and suitability. However, with some recovery of the aquatic assemblages further downstream (site BRN3), it was concluded that the resilience of the Blyde River was such that the impact of the historical mining and ongoing illegal artisanal mining activities, forestry and altered surface runoff profiles still have the potential to be absorbed. However, should the scale of impact increase, the cumulative land-use impacts would place the Blyde River under significant strain and a decline in Ecological Category would be inevitable. According to the "*Classes and Resource Quality Objectives of Water Resources for the Olifants Catchment"* (DWS, 2018), all efforts need to be made to prevent the proposed activities from impacting on the water quality and the integrity of the aquatic assemblage of this Class I, sensitive system.

It is important to note that it is unlikely that should further impacts to the Blyde River and its associated tributaries occur, that the river would have the potential to be restored to its original ecological state. Post-closure seepage and decant is likely to impact the water quality of the Blyde River into perpetuity and it is likely that a number of the sensitive species observed during the seasonal studies carried out may be lost. It is therefore considered critical that should the proposed mining project be authorised, very strict adherence to cogent, well-developed mitigation measures must take place throughout the life of the project, with specific mention of planning, separation of clean and dirty water, management of potential decant, dewatering and sedimentation of the receiving environment as well as, during closure, rehabilitation of affected areas.

Following the assessment of the various freshwater resources, an impact assessment was undertaken to ascertain the significance of potential impacts on the receiving environment which may arise as a result of the proposed mining activities.

Various layout options have been considered since the inception of the proposed project and the application of the precautionary approach resulted in an alteration of the site layout plan as initially presented in the Scoping Report. The alteration reflects revised pit layouts (with the Theta Pit being significantly changed), new WRD and PCD locations, as well as optimisation of the overall project footprint to achieve the best project scenario considering the extent of baseline information available at the time and in consideration of economic, socio-cultural and environmental requirements.

The altered site layout plan was achieved through the implementation of the following mitigation hierarchy:

1. Avoid the potential impact altogether;
2. Minimise the area of the potential impact as far as possible;
3. Rehabilitate and restore the affected area; and
4. Secure a biodiversity offset area as compensation for the affected area.

Consideration was given to all facets of biodiversity and ecology. In terms of aquatic biodiversity, however, the revised WRD localities and extents, as well as that of the proposed PCDs (specifically in the vicinity of the Iota Pit), were observed to further encroach on the riparian zone of the Blyde River. This has resulted in an increased risk (reflected in the risk ratings) to the health and integrity of the Blyde River, with specific mention of the potential for impacts to water quality, loss of habitat and the potential for erosion and sedimentation. This impact must be carefully contrasted with the risk that uncontrolled illegal mining is currently having, leading to a very significant impact on the Blyde River. Formal large scale mining that is held to account is potentially a more appropriate land use than the uncontrolled illegal mining which will inevitably severely impact the Blyde River with no closure plans or closure funds in place to rehabilitate and mitigate the impacts.

The table below presents a summary of the identified risks. It must be noted that the impact significance results summarised below are *post-mitigation* impact ratings.

Summary of the results of the impact assessment applied to the various study areas. Results are *post-mitigation*.

No.	Phases	Activity	Aspect	Risk Rating
1	Pre-construction planning	Planning of proposed surface infrastructure layout and proposed open pit mining areas.	The location of infrastructure (most signifcantly the Wishbone WRD, the Iota South WRD and the PCDs, as well as various road crossings, powerline crossings and pump columns etc) occur directly within watercourses (especially in the case of linear infrastructure which traverse several drainage systems) and within the 32m or 100m zones of regulation according to the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Government Notice (GN) 704 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).	H
2	Construction	Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.	Topsoil removal and creation of temporary stockpiles.	M
3		Clearing of vegetation in proximity to the drainage systems for contractor laydown areas and construction of surface infrastructure, including preparation of open pits (outside of drainage lines).	Establishment of laydown areas, site clearing, removal of vegetation and associated disturbances to soils.	H
3a		Clearing of vegetation within the drainage systems in preparation for construction of various linear developments; loss of vegetation within the drainage line directly impacted by the Wishbone WRD and PCDs.		H
4		Construction of additional access and haul roads, resurfacing of existing roads and refurbishment of existing buildings.	Altered drainage patterns due to increased impermeable surfaces. Installation of culverts/pipes as part of the construction of stream crossings.	M
5		Construction of surface infrastructure (e.g. additional mine offices, ablutions, stormwater management systems, etc.).	Risk of contaminated stormwater runoff (e.g. hydrocarbons, sediment, originating from impermeable surfaces).	M
			Stockpiling of topsoil and overburden, earthworks, movement of vehicles within lower reaches of drainage systems.	H
			Potential disposal of hazardous and non-hazardous materials in riverine areas.	L
5a		Construction of surface infrastructure within drainage systems: Wishbone WRD, PCDs, linear developments including but not limited to haul and access roads, perimeter fence, diversion trench and so forth.	As for Activity 5 above.	H
6		Opening of pits by means of dozer ripping (strip mining method).	Excavations will lead to denuding of landscape, thus increasing the risk of increased sediment loads entering the watercourses.	M
7	Operations	Alteration of the local hydrological regime due to potentially poorly managed stormwater and compaction of soils and increased extent of impermeable surfaces.	Altered drainage patterns, potentially leading to the formation of preferential flow paths and/or concentrated flows.	M
8		Presence of clean and dirty separation infrastructure upstream of surface infrastructure; Presence of diversion trench around perimeter fence.	Loss of catchment yield due to stormwater containment.	M
9		Deposition of tailings, waste rock, general operations of the mine, with special mention of the Wishbone WRD, Wishbone PCD, Iota WRD South and Iota PCD	Possible pollution of surface water as result of seepage/runoff from proposed infrastructure (e.g. water treatment facilities, ROM stockpiles, PCD, WRD, TSF and workshop/fuel storage areas). Potential groundwater pollution, leading to plumes, which may affect watercourses downstream of the surface infrastructure.	H
			Increased risk of sediment transport in surface runoff from surface infrastructure to watercourses, leading to altered water quality and sedimentation of freshwater systems.	M
10		Continued dozer ripping (strip mining method) of pits.	Excavations will lead to denuding of landscape, thus increasing the risk of increased sediment loads entering the watercourses.	M
11	Closure and latent impacts	Decommissioning / removal of surface infrastructure.	Compacted soils, latent impacts of vegetation losses.	M

Based on the findings of the impact assessment, key mitigation measures are provided to minimise the impact on the freshwater ecology, as discussed in Section 8 and Appendix E. Key measures include (but are not limited to):

Key mitigation measures developed for the TGME mining project.

Aspect	Mitigation measures
1. Project footprint, infrastructure design and general construction phase	➢ All activities should adhere to the requirement of GN704 of the National Water Act, 1998 (Act No 36 of 1998) (NWA); ➢ During the planning phase, the location of access roads should take into consideration the sensitivity maps provided in Section 7.1 of this report, and wherever possible, access roads should not be planned adjacent to, or traversing, any watercourse. Should it be essential that access roads cross over any watercourse, this should be planned at existing crossing points or points of existing disturbance within the river and/or riparian zone; ➢ As far as possible no development of any geographically variable infrastructure should take place within 100m of the Blyde River, its tributaries, or any other delineated freshwater resource in line with regulation GN704 of the National Water Act as far as possible, while ensuring that mining is done safely and to optimise resource abstraction as far as possible without causing irreversible harm to the watercourses of the region; ➢ All road crossings over watercourses must be kept to the bare minimum and are adequately designed to prevent impacts on habitat, instream flow, pattern and timing of water and water quality. ➢ All mining infrastructure must remain out of the riparian zones and associated zones of regulation in line with the requirements of GN704 and GN509 of the NWA. Any mining infrastructure within the applicable zones of regulation in terms of GN704 and GN509 must be appropriately authorised; ➢ Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of clean water runoff areas and catchment yield and the concomitant recharge of streams in the area; ➢ Design of infrastructure should be environmentally and structurally sound and all possible precautions taken to prevent contamination of surface and resources present; ➢ No dirty water runoff must be permitted to reach the watercourses, in line with GN704 as it relates to the NWA and appropriate clean and dirty water separation and stormwater management controls must be developed as the first part of the construction activities of each project/mining unit; ➢ It is deemed essential that the mine be designed in such a way as to ensure that decant is prevented for the life of the proposed mining activities and beyond closure unless measures to treat decant to background water qualities can be ensured until the quality of the decant naturally returns to these background levels; ➢ Water quality, with special mention of pH and dissolved salts need to be managed, and monitored in order to ensure that reasonable water quality occurs downstream of the mined areas to allow for the on-going survival of a riparian and aquatic community in line with the REC and RMO, and in support of Resource Quality Objectives for the major watercourses of the region and most notably the Blyde River; ➢ Mine design and planning must ensure that connectivity of the freshwater resources is maintained; ➢ All proposed haul and access roads, fences and any additional linear infrastructure (e.g. PCD pump columns and Eskom power supply) must cross the watercourses at the narrowest point and at a 90-degree angles. As much as possible, existing access roads and river crossings must be utilised (if necessary, upgraded) to minimise further disturbances to the watercourses; ➢ The substrate characteristics of the watercourse and instream connectivity must be maintained; ➢ Obstruction of flow should not take place or should only occur for very short periods, if absolutely essential; ➢ Restrict construction of clean and dirty water systems and within watercourses (e.g. Wishbone WRD and bridge crossings) to the drier winter months to avoid sedimentation of the watercourses in the vicinity of the proposed mining project; ➢ Vehicles to be serviced at the contractor laydown area and all refueling is to take place outside of the watercourses and applicable setback zones; and ➢ Sanitation services must be provided for construction personnel, whereby at least one portable toilet will be provided per ten personnel and will be emptied regularly.
2. Access control	➢ During any further exploration activities or the construction phase no vehicles must be allowed to indiscriminately drive through the watercourses and vehicles must remain on designated roadways; ➢ New crossings of the watercourses should be avoided. If new crossings are required, the substrate conditions of the watercourses and stream connectivity must be maintained; ➢ Permit only essential construction personnel beyond approved construction areas; and ➢ All areas of increased ecological sensitivity (i.e. the watercourses and areas which are important in terms of recharge) must be designated as "No-Go" areas and be off limits to all unauthorised vehicles and personnel during all phases of the proposed mining project.
3. Hydrological drivers and consumption management	➢ If decant will occur, all water is to be treated to background water quality values prior to release into the receiving environment; and

Aspect	Mitigation measures
	➢ Measures to contain and reuse as much water as possible within the mine process water system must be sought, and very strict control of water consumption must take place. Detailed monitoring must be implemented and maintained to ensure that all water usage is continuously optimised; ➢ No dirty water runoff must be permitted to reach the riverine resources during the entire life of mine, and clean and dirty water management systems must be put in place to prevent the contaminated runoff (suspended solids and salts and water with low pH) from entering the receiving aquatic environment. Clean and dirty water runoff systems must be constructed before construction of any other infrastructure takes place; ➢ Any dirty water runoff containment facilities must remain outside of the defined riparian areas and their buffers (setback zones / zones of regulation) as a measure to minimise the impact on the receiving environment; ➢ Strict control of sewage water treatment must take place and the sewage system must form part of the mine's closed process water system; ➢ All dirty water containment structures must be designed to contain a minimum storm event of a 24 hour 1 in 50 year flood event; ➢ All pollution control facilities must be managed in such a way as to ensure that storage and surge capacity is available if a rainfall event occurs; ➢ All storage facilities (WRD, PCD, stockpiles) to be lined with appropriate liners to prevent seepage; ➢ Adequate stormwater management must be incorporated into the design of the proposed mining project in order to prevent erosion and the associated sedimentation of the riparian and instream areas. In this regard special mention is made of: • Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed; • Runoff from paved surfaces should be slowed down by the strategic placement of berms; and • All overburden stockpiles and waste stockpiles must have berms and/catchment paddocks at their toe to contain runoff from the facilities. ➢ The use of 'green' stormwater management techniques such as vegetated swales, constructed wetlands (attenuation ponds), and permeable paving (where practical, e.g. in parking areas) is strongly recommended. Such methods will assist in polishing stormwater runoff, thus minimising potential pollution of the receiving aquatic environment; ➢ Stormwater trenches/berms must be constructed, and water contained therein may be recycled and utilised within the mine water circuit (dust suppression), or pumped to a Pollution Control facility for evaporation; and ➢ Monitor all potentially affected drainage systems for changes in riparian vegetation structure related to water stress should variation in the vegetation be observed.
4. Waste and contamination management	➢ No material may be dumped, disposed of or stockpiled within any of the watercourses in the vicinity of the proposed mining project. If any spills occur, they must be immediately cleaned up; and ➢ No dirty water (as defined by GN704) is to be released into the receiving environment.
5. Geomorphological drivers and habitat management	➢ All areas affected by construction or decommissioning activities must be rehabilitated upon closure of the mining expansion. All contaminated soils must be removed and disposed of at an appropriate facility. Affected areas must be reshaped to be free draining and reseeded with indigenous grasses should take place as required; ➢ Ensure that all stockpiles are well managed and have measures such as berms and protection with hessian sheets or silt traps as deemed applicable by the project engineers implemented to prevent erosion, sedimentation and eutrophication (Reno mattresses, gabions, re-vegetation etc.), which may lead to transformation of riparian and/or aquatic habitat and lead to impaired water quality; ➢ All erosion noted within any study area must be remedied immediately and included as part of an ongoing rehabilitation plan; ➢ Strict supervision of all construction activities to ensure that edge effects are minimised and that development remains within the approved footprint; ➢ During the construction and operational phases of the proposed TGME mining expansion, erosion berms should be installed to prevent the formation of erosion gullies as a result of the formation of any preferential surface flow paths, and the possible sedimentation of the assessed sites and surrounding freshwater systems; and ➢ The following points serve to guide the placement of erosion berms when implementing erosion control: • Where the track has slope of less than 2%, berms every 50m should be installed; • Where the track slopes between 2% and 10%, berms every 25m should be installed; • Where the track slopes between 10%-15%, berms every 20m should be installed; • Where the track has slope greater than 15%, berms every 10m should be installed.
6. Vegetation	➢ Implement alien vegetation control program within freshwater resource areas with special mention of water loving tree species. Throughout the life of mine measures to control alien vegetation must be implemented and specific attention to riverine features should be paid; ➢ Limit footprint of vegetation clearing to what is essential; ➢ Retain as much indigenous vegetation as possible; and ➢ Rehabilitation and re-vegetation of disturbed areas immediately after construction.

Aspect	Mitigation measures
7. Closure	➢ The following recommendations must be considered in conjunction with the recommendations of the geohydrologist. The geohydrologist recommendations must take precedence over the recommendations presented below: • Strict monitoring throughout LOM and post-closure is required in order to ensure the health and functioning of watercourses is retained and monitoring data must be proactively utilised to identify any possible pollutants entering the system. • Drilling of groundwater monitoring boreholes to monitor water levels and quality as the groundwater rebounds. ➢ Demolition footprint must be clearly demarcated and no related activities, including the movement of vehicles, must be permitted to occur outside of the footprint area; ➢ All related waste and rubble must be removed from site and disposed of according to relevant SABS standards. No waste must be permitted to enter watercourses; ➢ Edge effects such as erosion must be monitored and managed as recommended during construction and operational phases; ➢ All areas affected by stockpiling during the operational phase of the mine must be rehabilitated and stabilised using cladding or a suitable grass mix to prevent sedimentation of the watercourses in the area; ➢ Rehabilitation must ensure that riparian structure and function are reinstated in such a way as to ensure the ongoing functionality of the larger drainage systems at pre-mining levels; ➢ All areas must be resloped and an appropriate layer of topsoil reapplied and where necessary and reseeded with indigenous grasses; ➢ It is critical that ongoing monitoring of alien vegetation is maintained post-closure, as proliferation of alien vegetation in the demolition areas is expected; and ➢ Ongoing watercourse (riparian) and aquatic biomonitoring must take place throughout the closure phase of the mine and must continue into the post closure phase for a period of ten years to define latent impacts that need to be mitigated.

Watercourse monitoring

- Any areas where active erosion is observed must be rehabilitated and a system of berms and swales must be utilised to slow movement of water;
- Riparian resources need to be monitored using the wetland assessment protocols as defined below unless updated and/or more appropriate methods are developed in future:
  - PES according to the IHI method (Kleynhans 2008) as applicable;
  - Riparian zonation monitoring to determine whether impacts on base flow levels are occurring;
  - Water quality monitoring as part of the mine's water quality monitoring program; and
  - Monitoring of the riparian vegetation assemblage, in particular alien vegetation. Where applicable, VEGRAI should be used as part of the monitoring process.
- Ongoing monitoring of the trends in ecological integrity of the assessed sites in the vicinity of the existing and proposed TGME mining facilities is deemed essential, in order to monitor the impacts of the mining activities of these very sensitive and ecologically important systems. Aquatic biomonitoring should take place on a bi-annual basis by a SA RHP Accredited assessor, in order to identify any emerging issues in the receiving environment using the following indices in the assessment:
  - Habitat assessments using IHAS (6 monthly) and the IHIA (annually);
  - Aquatic macro-invertebrates using SASS5 and the MIRAI EcoStatus tool (6 monthly);
  - Fish community integrity using the FRAI EcoStatus tool (Annually in summer).
  - Specific reporting on the populations of Treur River Barb (*Enteromius cf treurensis*) (Critically Endangered) and the Marico Barb (*Entromius motebensis)* (Near Threatened) is deemed essential; and
  - Diatoms and the application of the SPI index (6 monthly).
- Close monitoring of water quality (surface water, groundwater and process water) must take place. Monitoring of water quality should take place monthly, during which time basic parameters such as pH, Dissolved Oxygen (DO) and Electrical Conductivity (EC) are measured;
- Should EC or pH values reach an undesirable level, suitable mitigation measures should be implemented;
- Sediment monitoring at selected sites along the Blyde River should take place concurrently with the aquatic biomonitoring to monitor pollution levels in sediments over time;
- Toxicity testing of the mine's process water facilities, the groundwater and surface water resources should take place concurrently with the biomonitoring program, in order to monitor

the toxicological risk of the process water system to the receiving environment and in particular the groundwater resources. These ongoing toxicological tests should be compared to baseline data to monitor and manage any emerging impacts over time. Tests should include the following test organisms as a minimum:

- *Vibrio fischeri*;
- *Poecilia reticulata*; and
- *Daphnia pulex*.

- Should emergency discharge from any process water system be required, definitive toxicological testing according to the Direct Estimation of Ecological Effect Potential (DEEEP) protocol should take place, in order to define safe discharge volumes and ensure sufficient dilution;
- Results of future assessments should be compared spatially and temporally to the results of this study. If it is observed through biomonitoring information that significant negative changes are taking place in ecological integrity (Change of Class), it should be taken as an indication that the system is suffering stress and mitigatory actions should be identified and where possible, implemented; and
- Biomonitoring results very strongly rely on the competency level of the assessor. All future biomonitoring studies should be undertaken by an accredited assessor and it would be preferable to utilise the same assessor in subsequent studies in order to allow for more accurate comparison of data over time.

DOCUMENT GUIDE

The table below provides the specialist report requirements as per the Environmental Impact Assessment regulations (2014), as amended as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix N
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix N
b)	A declaration that the specialist is independent	Appendix N
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 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
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 4
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 6 and 7
g)	An identification of any areas to be avoided, including buffers	Section 7.1
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 7.1
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 6
k)	Any mitigation measures for inclusion in the EMPr	Section 8.2
l)	Any conditions for inclusion in the environmental authorisation	Section 8
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8.3
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 9
(iA)	Regarding the acceptability of the proposed activity or activities	Section 9
(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 9
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	Appendix M
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.
Average Score Per Taxon (ASPT):	The average sensitivity of the aquatic community obtained by determining the sum of the sensitivity scores for each aquatic macro-invertebrate family observed and then dividing by the number of families present.
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 flow 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.
Dissolved Oxygen (DO):	Dissolved Oxygen is the amount of oxygen that is present in the water. It is measured in milligrams per litre (mg/L).
Ecological Importance and Sensitivity (EIS):	Ecological importance refers to the diversity, rarity or uniqueness of the habitats and biota. Ecological sensitivity refers to the ability of the ecosystem to tolerate disturbances and to recover from certain impacts.
Ecological Water Requirements (EWR):	The flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition. This term is used to refer to both the quantity and quality components.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Electrical Conductivity (EC):	Electrical conductivity (EC) is a measure of the ability of water to conduct an electrical current. This ability is a result of the presence in water of ions such as carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium, all of which carry an electrical charge. It is expressed as millisiemens per meter (mS/m).
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.
Fish Response Assessment Index (FRAI):	The FRAI is an assessment index based on the environmental intolerances and preferences of the reference fish assemblage and the response of the constituent species of the assemblage to particular groups of environmental determinants or drivers.
Geodesic:	Relating to or denoting the shortest possible distances between two points on a sphere or other curved surface.
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.
Index of Habitat Integrity (IHI):	The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale, that are comparable to the characteristics of natural habitats of the region.
Integrated Habitat Assessment System (IHAS):	An assessment index to determine the suitability of the habitat at any assessment point for colonisation by aquatic macro-invertebrates.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Macro-invertebrate Response Assessment Index (MIRAI):	MIRAI integrates the ecological requirements of the invertebrate taxa in a community or assemblage to their response to modified habitat conditions.
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 occurrences).
Percentage Dissolved Oxygen Saturation (% DO sat):	In aquatic environments, oxygen saturation is a ratio of the concentration of dissolved oxygen in the water to the maximum amount of oxygen that will dissolve in the water at that temperature and pressure under stable equilibrium, expressed as a percentage.
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.
Present Ecological State (PES):	The current state or condition of a water resource in terms of its biophysical components (drivers) such as hydrology, geomorphology and water quality and biological responses viz. fish, invertebrates, riparian vegetation. The degree to which ecological conditions of an area have been modified from natural (reference) conditions.
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.
Resource Quality Information Services (RQIS):	RQIS provides national water resource managers with aquatic resource data, technical information, guidelines and procedures that support the strategic and operational requirements for assessment and protection of water resource quality.
Resource Quality Objectives (RQO):	Guidelines set by the South African Department of Water and Sanitation (DWS), formerly DWA or DWAF, for specific water resources – the Olifant's Catchment in particular.
Resource Water Quality Objectives (RWQO):	Guidelines set by the South African Department of Water and Sanitation (DWS), formerly DWA or DWAF, for various physico-chemical and biological parameters for various uses as well as ecosystem functioning.
Rheophilic Species:	Species preferring or living in flowing water.
Riparian Vegetation Response Assessment Index (VEGRAI):	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 presented as EcoStatus Categories.
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.
South African River Health Programme (SA RHP):	The RHP serves as a source of information regarding the overall ecological status of river ecosystems in South Africa. For this reason, the RHP primarily makes use of in-stream and riparian biological communities (e.g. fish, invertebrates, vegetation) to characterise the response of the aquatic environment to multiple disturbances.
South African Scoring System (SASS5):	An index to determine the integrity of the aquatic macro-invertebrate community at any given assessment point.
Sub-quaternary Reach (SQR):	A finer subdivision of the quaternary catchments (the catchment areas of tributaries of main stem rivers in quaternary catchments).
Target Water Quality Requirement (TWQR):	Guidelines set by the South African Department of Water and Sanitation (DWS), formerly the Department of Water Affairs and Forestry (DWAF), for various physico-chemical and biological parameters for various uses as well as ecosystem functioning (see note below).
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.
Water Management System (WMS):	WMS is a suite of computer programmes developed for the Department of Water and Sanitation to provide information for water resource monitoring and management in South Africa.
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.

Notes on water quality guidelines consulted:

A) South African water quality guidelines volume 7, Aquatic ecosystems (DWS 1996): This reference provides percentage change guidelines as follows:

- **Electrical conductivity (EC)/Total Dissolved Solids (TDS)** concentrations should not be changed by > 15% from the normal cycles of the water body under unimpacted conditions at any time of the year, and the amplitude and frequency of natural cycles in EC/TDS concentrations should not be changed;
- **pH values** should not be allowed to vary from the range of the background pH values for a specific site and time of day, by > 0.5 of a pH unit, or by > 5%, and should be assessed by whichever estimate is the more conservative.
- **Dissolved Oxygen (DO)** concentration should be 80% to 120% of saturation. In addition, for the purposes of this report, any spatial or temporal change exceeding 15% will be considered significant.

Note that EC and pH comparisons refer to temporal comparisons. However, as no guidelines are available for spatial comparisons, the percentage change recommendations will also be applied to spatial comparisons. For the purpose of this report, a temporal or spatial change of 15% will be considered significant with reference to DO.

B) National Water Act, 1998 (Act no. 36 of 1998). Reserve Determination of Water Resources for the Catchments of the Olifants and Letaba in terms of Section 16 (1) and (2) of the NWA. Government Gazette number 41887 (7 September 2018).

Upper Blyde River – Olifants_BLY1	**pH**	**Electrical Conductivity (mS/m)**	**Dissolved Oxygen (mg/ℓ)**
	5.9 – 8.8	≤ 30	≥ 8.0

** With reference to the TWQR definition, 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 is the name that will be used.

Note that in dashboard table discussions that follow, comparison to the DWS (2018) guideline will be considered primary to the RWQO (DWAF, 1996).

ACRONYMS

% DO sat	Percentage Dissolved Oxygen Saturation
ASPT	Average Score Per Taxon
°C	Degrees Celsius.
BAR	Basic Assessment Report
BAS	Best Attainable State
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CPC	Chemical Pollutants of Concern
CSIR	Council of Scientific and Industrial Research
DD	Data Deficient
DEA	Department of Environmental Affairs
DEMC	Desired Ecological Management Class
DMR	Department of Mineral Resources
DO	Dissolved Oxygen
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Electrical Conductivity
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Program
EN	Endangered
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
FRAI	Fish Response Assessment Index
GIS	Geographic Information System
GMP	Gold Mining Project
GN	General Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
HRM	Hard Rock Mining
IUCN	International Union for Conservation of Nature
IHAS	Integrated Habitat Assessment System
IHI	Index of Habitat Integrity
IWQS	Institute for Water Quality Studies
ktpa	Kilo Tonnes Per Annum
LoM	Life of the Mine
m	Meter
MBSP	Mpumalanga Biodiversity Sector Plan
MIRAI	Macro-invertebrate Response Assessment Index
MPRDA	Mineral and Petroleum Resources Development Act
NA	Not Applicable
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
PTS	Peach Tree Stream
PMR	Pre-mined Residue
REC	Recommended Ecological Category

Ref.	Reference
RMO	Recommended Management Objective
RHP	River Health Program
RQIS	Research Quality Information Services
RQO	Resource Quality Objectives
RWQO	Resource Water Quality Objectives
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
SA RHP	South African River Health Programme
SAS	Scientific Aquatic Services
subWMA	Sub-Water Management Area
SQR	Sub-quaternary Reach
TGME	Transvaal Gold Mining Estates Pty (Ltd)
TWQR	Target Water Quality Requirement
VEGRAI	Riparian Vegetation Response Assessment Index
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission

1. INTRODUCTION

1.1 Background Information

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater resource and aquatic ecological assessment as part of the Water Use Licensing Process in terms of the National Water Act, 1998 (Act No. 36 of 1998) and the Environmental Impact Assessment process in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) for the proposed Transvaal Gold Mining Estates (TGME) Theta Project, near Pilgrim's Rest, Mpumalanga Province.

The TGME Theta Project comprises of various proposed mining areas, which will henceforth collectively be referred to as the study areas[1], namely:

- Browns Pit;
- Theta Pit; and
- Iota Pit.

The TGME project (comprising the above-mentioned study areas) is located adjacent to the existing TGME metallurgical plant, which is situated 2.5km southwest of the town of Pilgrim's Rest, Mpumalanga Province. The dominant land use in the area is agriculture, with some commercial forestry as well as artisanal mining activities occurring close to Pilgrim's Rest (Figures 1 and 2).

1.2 Scope of work and structure of this report

This report investigates the impact significance of the proposed mining activities as described in Section 1.3 below, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as well as the National Water Act, 1998 (Act No. 36 of 1998) by means of the Risk Assessment Matrix, as promulgated in Government Notice (GN) 509 of 2016. The following structure applies to this report:

Section 1: Introduction

Provides an introduction, outlines the structure of this report, defines scope of work, discusses the assumptions and limitations and the legislative requirements and provincial guidelines.

[1] Within these study areas, construction of terrace mining pits are proposed, along with various mining related surface infrastructure. For the purpose of this report, Hill or Pit will be used interchangeably to refer to any particular study area (e.g. Browns Hill and Browns Pit will be considered synonyms of the same study area

Section 2: Project Description

Provides the location of the proposed TGME mining project as well as a summary of the proposed activities associated with the site.

Section 3: Assessment Approach

Provides the relevant methodology and definitions applicable to this report, a description of the sensitivity mapping and the risk assessment approach.

Section 4: Freshwater Systems Analysis Results of Desktop Assessment and Section 5: Aquatic Ecological Description

Reports on desktop assessment results of the relevant national, provincial and municipal datasets [such as the National Freshwater Ecosystem Priority Areas [NFEPA], 2011 database; the DWS Resource Quality Information System (RQIS) Present Ecological State (PES)/ Ecological Importance and Sensitivity (EIS), 2014 database; Classes and Resource Quality Objectives of Water Resources for Catchments of the Olifants in terms of Section 13(1) (A) and (B) of the National Water Act (Act No. 36 of 1998) and the Mpumalanga Biodiversity Sector Plan (2014)] which was undertaken to aid in defining the PES and EIS of the watercourses.

Section 6: Results of the Freshwater Assessment

This section reports the following:

- The watercourse classification according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al.,* 2013);
- Watercourses were delineated according to "DWAF, 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 watercourses. In addition, all freshwater watercourses within the investigation area were delineated on a desktop basis in accordance with Government Notice 09 of 2016 as it pertains to the National Water Act, 1998, (Act No. 36 of 1998);
- The EIS of the watercourses according to the method described by Rountree & Kotze, (2013) as well as DWAF (1999);
- The PES of the watercourses was determined according to the resource-directed measures guideline of Macfarlane *et al.* (2008) as well as the River EcoClassification: Index of Habitat Integrity (IHI) as advocated by the Water Research Commission (WRC) and Kleynhans *et al.* (2008), the Integrated Habitat Assessment System (IHAS) method according to the protocol of McMillan (1998), the Riparian Vegetation

Response Assessment Index (VEGRAI), according to the protocol of Kleynhans *et al.*, 2007b, the Fish Response Assessment Index (FRAI), as described by Kleynhans (2007), and the integrity of the aquatic macro-invertebrate community was assessed using the South African Scoring System version 5 (SASS5) as defined by Dickens & Graham (2002), as well as through the application of the Macro-Invertebrate Response Assessment Index (MIRAI) EcoStatus tool as described by Thirion (2007), as applicable;

- Collection of baseline data and present recommendations with the intention to:
  - Maintain the PES of the system in support of the EIS of the aquatic ecosystem;
  - Ensure that connectivity of the aquatic resources is maintained between the areas upstream and downstream of the proposed development areas;
  - Ensure that no further incision and erosion of the river system takes place as a result of the proposed development;
  - Ensure that no significant persistent impact on water quality will take place;
- The ecological goods and services provided by the natural watercourses according to the method of Kotze *et al.* (2009) in which services to the ecology and people are considered;
- Freshwater resources were mapped according to the ecological sensitivity of each hydrogeomorphic unit in relation to the investigation area. In addition to the freshwater resource boundaries, the appropriate provincial recommended buffers and legislated zones of regulation were depicted where applicable; and
- Allocation of a suitable Recommended Ecological Class (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS) category to the freshwater resources based on the results obtained from the PES, Ecoservices and EIS assessments.

Section 7: Sensitivity Mapping as well as Legislative Requirements

This section reports the following:

- Provides the applicable legislative requirements based on the findings from Section 5 and indicates any applicable zones of regulation that may trigger various authorisation requirements.

Section 8: Impact and Risk Assessment

Provides the DWS Risk Assessment Matrix results which highlight all potential impacts and that may affect the watercourses. Management and mitigation measures are provided which must be implemented during the various development phases to assist in minimising the impact on the receiving environment.

Section 9: Conclusion
Summarises the key findings and recommendations based on the impact assessment and risk assessment outcomes.

1.3 Assumptions and Limitations

The following points serve to indicate the assumptions and limitations with regard to the freshwater and aquatic assessment:

- ***Determination of Boundaries:*** The determination of the freshwater resource boundaries and the assessment thereof, is confined to the study areas. All freshwater resources identified within 500m of the study areas 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. These resources were not assessed except where they were located downgradient of study areas and may therefore be impacted upon by the proposed activities. The general surroundings were, however, considered in the desktop assessment of the study areas;
- ***Global Positioning System (GPS) technology:*** 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 freshwater resources will need to be surveyed and pegged according to surveying principles and with survey equipment;
- ***Transitional Areas:*** 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;
- ***Reference conditions are unknown:*** Considering existing mining activities in the larger catchment, the composition of aquatic biota in the study areas, prior to disturbance associated with approximately a century of mining activity as well as the associated settlement of people in the area, is unknown. The majority of aquatic resources associated with the study areas is subject to plantations, extensively utilised for forestry (*Eucalyptus* spp. and *Pinus* spp.). These forestry disturbances have been

in place for decades and current plantations are evident on digital satellite imagery. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available such as the Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database, as discussed in Section 4.2.2.

- ***Temporal variability:*** The data presented in this report is based predominantly on three site visits during early spring (October 2018), early autumn (March 2019), and mid-summer (January 2020), however, where historical data was available, this was used to draw temporal comparisons. The effects of natural seasonal and long-term variation in the ecological conditions and aquatic biota found in the streams are, therefore, unknown at the time of writing this report. Ideally aquatic assessments should be undertaken, as a minimum, in the summer/high flow and winter/low flow seasons, to account for and define seasonal variability. However, consideration was given to local data on the DWS RQIS PES/EIS database as well as a previous study conducted by SAS in 2008[2]. Said information assists in understanding variability in the system and thus ensures that observations and discussions on impacts are adequately understood to inform this study;
- ***Ecological assessment timing:*** Aquatic ecosystems are dynamic and complex. It is possible that aspects, some of which may be important, could have been overlooked. A more reliable assessment of the biota would require seasonal sampling, with sampling being undertaken under both low flow and high flow conditions (also see previous point, "Temporal variability"). Due to the nature of the aquatic systems, the observations made in this study are deemed adequate to: a) provide the information required to define the risk to the aquatic ecosystem, and b) to ensure that sufficient insight into management and mitigation measures is provided, to allow adequate protection and maintain the PES of the system; and
- ***Accessibility:*** Due to access constraints relating to terrain and personal safety concerns, limitations were experienced in site selection as well as the verification of the extent and characteristics of some sections of some watercourses. Due to the limitations, some aspects of the aquatic ecology of the area, some of which may be important, may have been overlooked (also see previous point, "Ecological assessment timing"). However, based on the available desktop assessment reference and assessment results, it is deemed adequate to provide the required level of understanding of the systems for the study. Furthermore, limitations were experienced

[2] Scientific Aquatic Services (2008). Aquatic Ecological Study of the Blyde River in the vicinity of proposed Beta Mine expansion at the TGME Mine, Pilgrims Rest. GCS (Pty) Ltd. November 2008.

in accessing the full extent of some freshwater resources within the study areas and 500m thereof during the site visits. In addition, seasonal variations in terms of vegetation as well as recent veld fires in some of the study areas during October 2018, limited the use of vegetation indicators, and therefore some delineations were undertaken utilising historical and current digital satellite imagery and relevant topographic maps. Where field verification was feasible, the desktop delineations proved to be accurate, and the delineations as presented in this report are thus regarded as a best estimate of the temporary or riparian zone boundaries (as applicable) based on the site conditions present at the time of assessment;

- ***Risk Assessment Matrix:*** The risk assessment was undertaken based on available information pertaining to the proposed terrace mining footprint areas, which indicates that the proposed mining areas will be placed within sensitive areas. Thus, when undertaking the risk assessment, the principles enshrined in the relevant South African legislation and advocated by the DEA *et al* (2013), the precautionary principle was followed and a "worst case scenario" was considered.

1.4 Legislative requirements and Provincial guidelines

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

- The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996);
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEMBA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice (GN) 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- Government Notice 704 as published in the Government Gazette Vol 408 No. 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998); and
- The Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA).

The following provincial databases and guidelines were also considered:

- The Mpumalanga Biodiversity Sector Plan (2014); and
- The Mpumalanga Biodiversity Sector Plan Handbook (2014).

2 PROJECT DESCRIPTION[3]

The Theta Project Mineral Resources traverse two mining right areas, namely 83MR for the portion within Ponieskrantz 543 KT, and 341MR for the portion within Grootfontein 562 KT. Only the portion within Ponieskrantz 543 KT, i.e. 83MR, is investigated in this study. The entire 83MR is situated on various portions of the farms Frankfort 509-KT, Krugers Hoop 527-KT, van der Merwes Reef 526-KT, Morgenzon 525-KT, Peach Tree 544-KT and Ponieskrans 543-KT, and encompasses an area of 9,413 hectares (ha). Extent of the area required for mining is 286 ha.

The existing and approved 83MR allows for the mining of gold ore, silver ore, copper ore and stone aggregate over the extensive 9,413 ha of land. The mining right was granted, registered and executed and expires on 15 October 2023. A Section 102 Amendment application has been submitted for 83MR to include the proposed Theta Open Pit Project. In support of this, an Environmental Authorisation and IWULA amendment process is underway.

Historically the area on 83MR has operated in terms of open cut as well as underground gold mines. Theta Hill, Browns Hill and Iota have historically been exploited as mainly underground mines with very limited open pits. The Theta Hill, Browns Hill and Iota surface projects, collectively referred to as the “Theta Project”, entails surface mining operations at the abovementioned three locations, with an anticipated Life of Mine (LoM) of five and a half years (excluding construction years).

To effectively establish the open pit mining operation, a number of infrastructure items will be required. Extent of the area required for the proposed Theta mine is listed in the below table. A depiction of the proposed mine layout is provided in Figure 1. The existing TGME Plant falls within the MR341 mining licence area. Included in this area will be the newly proposed mining site (Offices, workshops, stores, etc.).

[3] Mining Work Programme submitted in support of an application for an amendment to a Mining Right as required in terms of Section 23 (a), (b) and (c) read together with Regulation 11(1) (g) of the Mineral and Petroleum Resources Development Act (Act 28 of 2002). This application is made in support of an amendment in terms of Section 102 of the Mineral and Petroleum Resources Development Act (act 28 of 2002).

Table 1: Extent of the infrastructure associated with the Theta Project.

MINE INFRASTRUCTURE	EXTENT
Mining Contractors Site	1.843 ha
Topsoil Stockpiles	12,4229 ha
Dams	
Wishbone WRD Pollution Control Dam	2,751 ha
Iota WRD Pollution Control Dam	8.357 ha
Balancing Dam Option 1	3,921 ha
Pits	
Browns Pit	17.856 ha
Theta Pit (west)	6.511 ha
Theta Main Pit	13.189 ha
Iota Pit	25.613 ha
Theta Pit (east)	0.729 ha
Waste Rock Dumps	
Iota WRD North	44.31 ha
Iota WRD South	16.723 ha
Wishbone WRD	24.253 ha
Linear Development	
Clean Water Drainage	6,47 km
Dirty Water Drainage	6,04 km
Existing Access Road	3,25 km
Existing Powerline	2,50 km
Haul Roads	11,12 km
Mine Boundary	6,42 km
New Access Road Alignment	0,24 km
New Powerline Alignment	0,25 km
Pump Column	0,40 km

2.1 Proposed Mining Method

The mining method selected for this project is modified terrace mining because it is suited to the mountainous profile of the current topography. The mining method consists of continuous removal of overburden / waste material to expose ore. The mining method requires the removal of topsoil which will be stockpiled to be utilised for rehabilitation purposes. The topsoil stockpile will also be utilised as a berm to divert the ingress of water and will be situated close to the mining area to enable short hauling for the rehabilitation of the backfilled areas. Topsoil will be removed as an ongoing process as the open pit progresses.

Due to the mountainous topography there is limited space available for WRDs on the project area. The planned mining strategy is to utilise space in the mined-out areas for backfilling of waste, this will ultimately reduce the WRD footprint.

Once mining has progressed and enough area has been created in the pit some overburden/waste material will be backfilled into this space.

2.2 Mining of ore

The primary method of breaking rock on the project will be by means of Dozer ripping. Ripping is a method of loosening material by means of pulling a ripper shank attached to the back of a tracked dozer through densely packed material. In areas where the planned dozer may not be capable of ripping the material an eccentric ripper will be used as the secondary method of breaking rock. Material requiring no breaking will be free dig and will be removed with a truck and shovel combination. Once material has been broken sufficiently via ripping, the material will be loaded into dump trucks with excavators and hauled via dedicated haul roads to the ROM pad.

2.3 Mining of waste

Waste material will be mined in a similar fashion to that of the ore. Broken waste - which will be achieved by nonexplosive breakage by ripping with a dozer or eccentric rippers - will be loaded onto haul trucks by an excavator and hauled to a waste storage facility keeping in mind the overall strategy remains to minimise to overall WRD footprint. During the early stages of mining there will be limited space available to backfill waste back into the pits and this material will have to be place on a WRD.

Back filling: As mining progresses waste removed from the pit will be hauled directly to dedicated areas within the pit, this is very similar to roll-over mining. The dedicated areas for backfilling are selected based on available area and overall slope angles to ensure safe placement of waste material in the pit. Once a pit is mined out there will be a void remaining – this void is a function of the initial material placed in WRDs and other constraints limiting complete backfill. The philosophy is to not re-handle any waste material.

2.4 Progression of site layouts from Environmental Scoping Phase to EIA Phase

Included in this section is a portrayal of the Theta Project progression from an initial layout to the most feasible site layout related. The progression has been significantly influenced by engineering, economic, environmental and social considerations and is described in detail in below.

2.4.1 *Engineering Feasibility Study*

The applicant, TGME, through an engineering feasibility study, has identified the opportunity to mine gold bearing reefs via modified terrace mining and therefore the need to amend its current environmental authorisation linked to their existing mining right (83MR) to include the new mining sections to mine the near surface material.

Three mining areas were identified based on exploration and evaluation work done within the study area. The three areas are referred to as the Theta Pit, Browns Pit and Iota Pit.

The engineering feasibility study formed the basis for the permitting phase, and informed the initial site layout (Figure 1) which was incorporated into the Environmental Authorisation application which comprises a Scoping Phase and an EIA Phase. These phases results in the develpoment of an Environmental Management Plan (EMP) for consideration by the competent authority, namely the Department of Minerals and Energy (DMR).

2.4.2 *Environmental Scoping Phase*

Infrastructure associated with the terrace mining operations for the Scoping Phase included topsoil stockpiles, run-of mine ore stockpiles, WRDs, Pits, and haul roads.

The general mining site infrastructure included offices, change houses and laundry facilities, control room, first aid station, stores and laydown yard, salvage yard and waste sorting area, transformer substation, fuel storage facility, refuelling bay, wash bay, workshops, brake test ramp and parking areas.

In terms of the placement of the related infrastructure, a few design or layout alternatives were initialy considered for the various WRDs.

As part of the operational activities, two potential options were proposed for the locations of the associated WRDs at both Theta and Iota Hills. These are detailed in Figure 1 and briefly outlined below:

- Theta/Browns Waste Rock Dump Option 1: This option is situated between both Browns and Theta Pit (Figure 1);
- Theta/Browns Waste Rock Dump Option 2: Located to the north eastern side of Theta Pit, incorporates two smaller pockets separated by a tributary (Figure 1);
- Iota Waste Rock Dump Option 1: Located to the north western corner of the Iota Pit (Figure 1); and
- Iota Waste Rock Dump Option 2: Is located to the north eastern boundary of the Iota Pit (Figure 1).

2.4.3 *Environmental Impact Assessment Phase*

The plan of study proposed in the Scoping Report made provision for various biophysical and social studies which would determine the baseline conditions at the project site as well as make recommendations related to the feasibility of the proposed localities and alternatives as per the initial site layout plan (Figure 2).

The outcome of these biophysical and social studies was used to inform the final site layout plan, as is common practice in Integrated Environmental Management (IEM). IEM is a philosophy that is concerned with finding the right balance between development and the environment. The difference between IEM and an EIA is that IEM is a whole philosophy whereas EIA is just one tool or technique used to gather and analyse environmental information that is a part of the IEM process (Source: Enviropaedia).

Environmental and social management practices are based on following the precautionary principle, which, simply defined, means developing actions on issues considered to be uncertain, for instance applied in assessing risk management.

2.4.4 *Development of a Feasible Site Layout*

Certain biophysical and social baseline studies, namely terrestrial ecology (fauna and flora), freshwater and aquatic ecology, soils and land capability, air quality, noise and vibration, visual impact, socio-economic and health impact, water quality, heritage and the rehabilitation objectives, returned substantial environmental and social sensitivities and nuances. Refer to Figure 12 in Section 6.2 for the freshwater and aquatic sensitivities.

However, the process of EIA, within which the above-mentioned studies were undertaken, is inhibited in its ability to assess year-round baseline conditions due to the legislated timeframes imposed by South African law and regulation. In these instances, which is typical of EIA processes, the Environmental Assessment Practitioner (EAP) imposes the precautionary approach by informing the site layout plan from an environmental and social perspective to assist the applicant to achieve the most feasible site layout plan.

The application of the precautionary approach resulted in an alteration of the site layout plan as initially presented in the Scoping Report. The alteration reflects revised pit layouts (with the Theta Pit being largely affected), new WRD and PCD locations as well as optimisation of the overall project footprint to achieve the best IEM scenario considering the extent of baseline information available at the time.

The altered site layout plan was achieved through the implementation of the following mitigation hierarchy:

5. Avoid the potential impact altogether;
6. Minimise the area of the potential impact as far as possible;
7. Rehabilitate and restore the affected area; and
8. Secure a biodiversity offset area as compensation for the affected area.

Consideration was given to all facets of biodiversity and ecology. In terms of aquatic biodiversity, however, the revised WRD localities and extents, as well as that of the proposed PCDs, were observed to further encroach on the riparian zone of the Blyde River. This has resulted in an increased risk to the health and integrity of the Blyde River, with specific mention of the potential for impacts to water quality, loss of habitat and the potential for erosion and sedimentation.

Refer to Figure 2 for the revised site layout plan (as of September 2019) which will be incorporated into the EIA Report and EMP. Additional seasonal studies by some specialists (not necessarily the freshwater and aquatic specialists) are planned as part of the ongoing environmental, social and rehabilitation programmes. The results of these planned studies might decrease current uncertainties to which the precautionary principle was applied which could lead to future layout refinements.

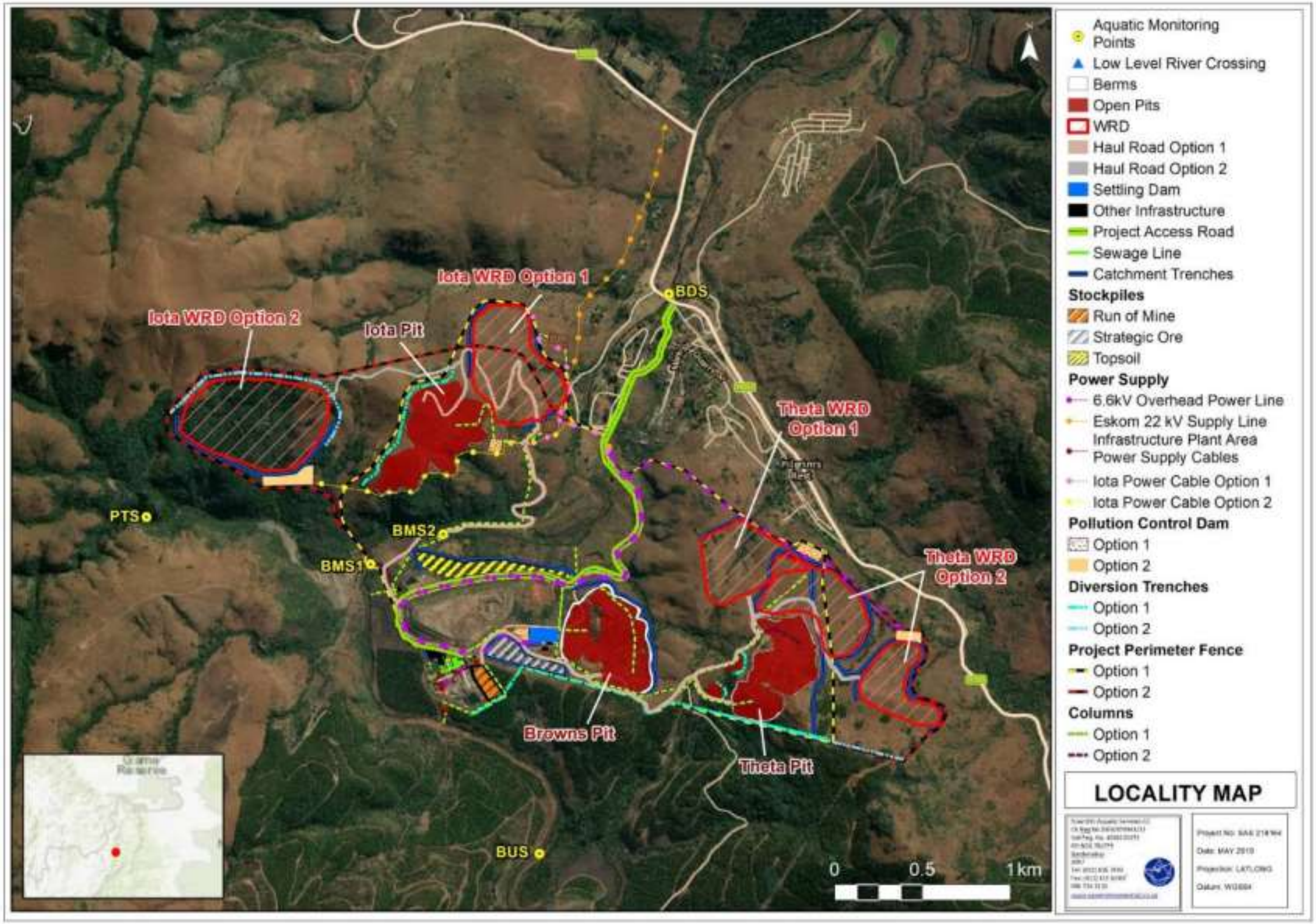


Figure 1: The initial proposed mine layout for the Theta Project as part of the Scoping Phase.

2.5 Site description

This document presents the results obtained during the aquatic ecological assessments performed during early spring (October 2018), early autumn (March 2019), and mid-summer (January 2020). It includes a desktop assessment of the aquatic ecosystems and a field assessment. All three assessments were performed at four sites along the Blyde River, one upstream of the study area (BUS), two sites within the study areas (BMS1 and BMS2) and one site downstream of the study area (BDS). During the first assessment in October 2018 and in the third assessment in January 2020, an unnamed tributary of the Blyde River, known locally as Peach Tree Stream (PTS) was assessed. During the January 2020 assessment an additional three sites were assessed on the Blyde River (BRN1, BRN2 and BRN3), and an additional two sites were assessed on another tributary of the Blyde River known as the Pilgrim's Creek. Assessment of points on the PTS, the Blyde River and the Pilgrim's Creek included the following:

- assessment of the *in-situ* water quality;
- a survey of habitat conditions for aquatic macro-invertebrates;
- aquatic macro-invertebrate community integrity; and
- fish community integrity.

The protocols of applying the indices were strictly adhered to, and all work was carried out by a South African River Health Program (SA RHP) accredited assessor. An impact assessment based on the findings of both the desktop and field assessments is provided. Table 1 contains geographic information for each of the biomonitoring assessment points.

Table 2: Co-ordinates of the biomonitoring assessment points on the Blyde River and its associated tributaries.

Site*	Study Area	Description	GPS co-ordinates	
			South	East
BUS	Between Theta Pit and Browns Pit Opencast	Upstream site situated in the upper reaches of the Blyde River, upstream from the town of Pilgrims Rest and the active mining area. Site serves as a reference site for the sites further downstream as well as for future monitoring.	24°55'36.69"	30°44'37.69"
BMS1	Between Iota Pit and Browns Pit Opencast	Located downstream of the BUS site, below the mine's site office on the Blyde River adjacent to the Iota Hill study area.	24°54'43.43"	30°44'06.58"
BMS2		Located downstream of the BMS1 site, downstream of the confluence of the Peach Tree Stream flowing adjacent to Iota Hill Opencast study area.	24°54'37.93"	30°44'19.96"
BDS	Downstream of Iota Pit Opencast	Downstream site situated in the lower reaches of the Blyde River, downstream of Pilgrim's Caravan Park and Iota Hill Opencast study area.	24°53'53.69"	30°45'01.49"
PTS	Adjacent to Iota Pit Opencast	Located on an unnamed tributary, locally known as Peach Tree Stream (PTS) of the Blyde River adjacent to the Iota Hill Opencast study area.	24°54'34.74"	30°43'25.38"

BRN1	Between Iota Pit and Browns Pit Opencast	Located in the upper reaches of the Blyde River, downstream of the BUS site, but upstream of the BMS1 site and mine's site office.	24°55'12.99"	30°44'19.50"
BRN2	Adjacent to the Iota Pit WRD	Located downstream of site BMS2 and downstream of various small-scale artisanal mining operations. Located upstream of the Pilgrim's Caravan Park.	24°54'18.09"	30°44'45.42"
BRN3	Downstream of the study area and the Pilgrims Rest town and WWTW	Located at the historical River Health Programme (RHP) monitoring site, downstream of the Pilgrim's Rest town and downstream of the Pilgrim's Rest WWTW facility.	24°52'40.05"	30°45'39.65"
PCN1	Upstream of the Theta North Small Pit	Located on the Pilgrim's Creek upstream of the historical town of Pilgrims Rest and the proposed mining operations.	24°55'10.21"	30°46'4.30"
PCN2	Downgradient of the Theta North Small Pit, the Theta Main Pit and the Browns Pit	Located on the Pilgrim's Creek downstream of the historical town of Pilgrims Rest and the proposed mining operations prior to its confluence with the Blyde River	24°53'53.97"	30°45'6.73"
BRO1	Visual observation points within and in the vicinity of the proposed project area	Located at selected points on the Blyde River	24°54'30.16"	30°44'50.53"
BRO2			24°54'21.91"	30°44'44.34"
GOP			24°53'53.70"	30°45'2.48"
PCO1		Located at selected points on the Pilgrims Creek	24°54'23.20"	30°45'26.45"
PCO2			24°54'1.15"	30°45'11.77"

Figure 2 indicates the location of the study areas and monitoring points on a digital satellite image.

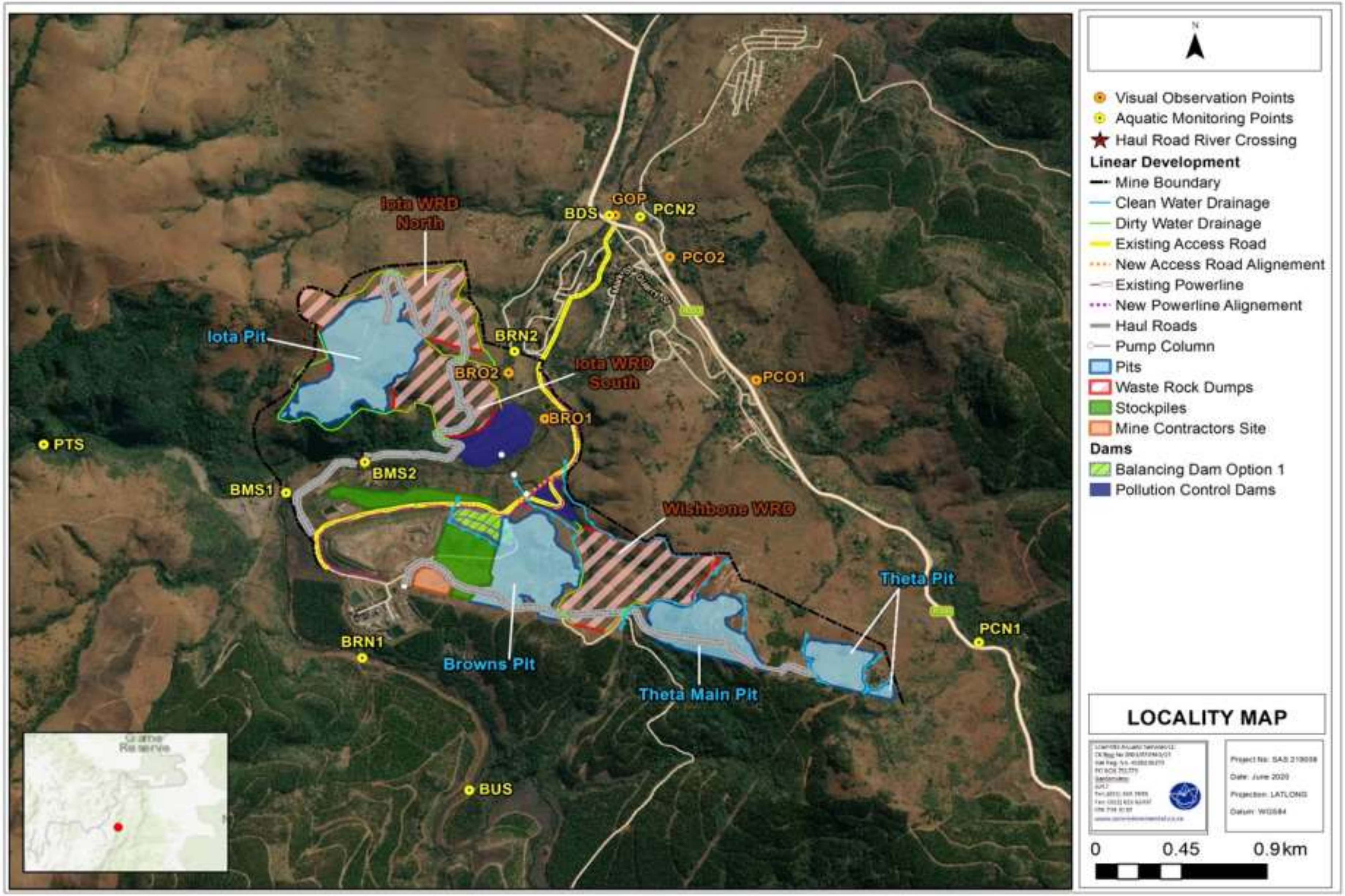


Figure 2: Aquatic ecological assessment points associated with the refined study areas (September 2019) presented on a digital satellite image.

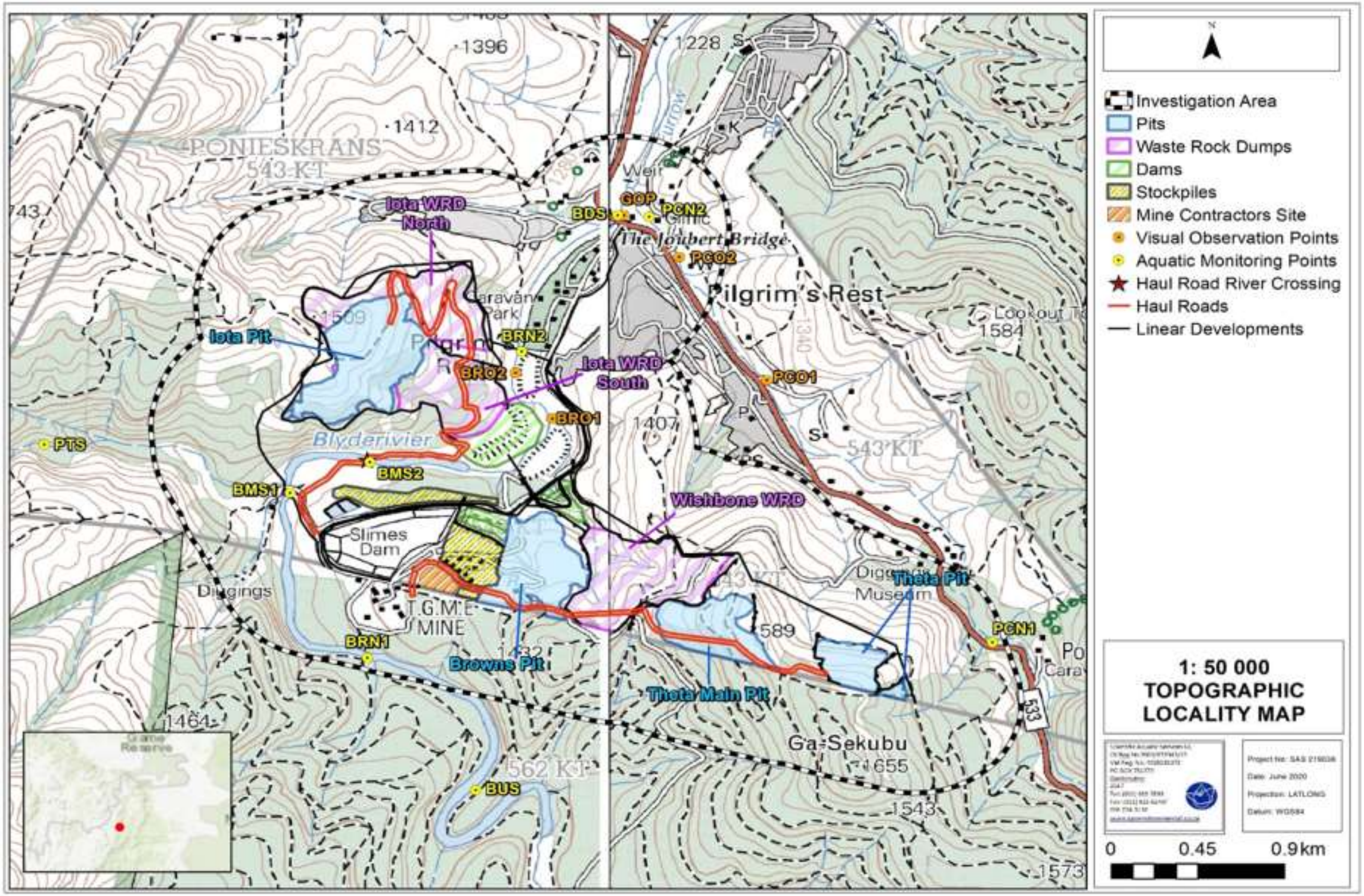


Figure 3: The refined project footprint (September 2019) depicted on a 1:50 000 topographical map in relation to the surrounding area.

3 ASSESSMENT APPROACH

3.1 Freshwater Resource Field Verification

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

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.

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."

As noted in Section 1.4, constraints relating to terrain and personal safety concerns limited accessibility to all freshwater resources identified within the study and investigation areas; thus, use was made of various desktop methods to aid in the delineation of the resources following the field assessment. The following was taken into consideration when utilising desktop methods 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 delineations were 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 between 1 to 3 October 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). It is important to note that, with the exception of isolated areas of anthropogenically induced ponding, leading to vegetation responses commonly associated with wetlands, no true wetland characteristics, meeting the definition contained in the NWA, were observed during this site assessment (please refer to Section 6 and Appendix I for further information in this regard).

The second site visit, undertaken between 26 to 27 March 2019, and the third site visit, undertaken between 28 to 31 January 2020, were conducted primarily for the purposes of conducting a seasonal aquatic sampling; however, during the second field visit any additional watercourses with riparian characteristics that were observed were included in the delineations presented in 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.

3.2 Aquatic Ecological Assessment Methodology

Best practice methodologies (detailed methodologies provided in Appendix C) were used to assess the aquatic ecological integrity of the various sites based on water quality, instream and riparian habitat condition and biological impacts and integrity. All work was undertaken by a South African River Health Program (SA RHP) accredited assessor. Factors investigated included the following:

- Visual conditions of the site, including an assessment of impacts on the system, at each point;
- On-site testing of biota specific water quality parameters including pH, Electrical Conductivity (EC), Dissolved Oxygen concentration (DO) and temperature. The results aid in the interpretation of the data obtained by the biomonitoring;
- Water Quality – Guidelines Consulted:

- *South African water quality guidelines volume 7, Aquatic ecosystems*, by the Department of Water Affairs and Forestry (DWAF), now Department of Water and Sanitation (DWS). Water quality parameter values were also compared to guideline values from this reference, denoted as DWAF (1996) in discussions that follow. Note that EC and pH comparisons refer to temporal comparisons. However, as no guidelines are available for spatial comparisons, the percentage change recommendations will also be applied to spatial comparisons; and
- *Reserve Determination of Water Resources for the Catchments of the Olifants and Letaba*, Department of Water and Sanitation (DWS, 2018). This publication provided updated classes and resource quality objectives of water resources for the Olifants catchment. The Upper Blyde River reserve for B60A (Olifants_BLY1) applies. Details on the recommended ecological category are included in Section 5.2.3 of this report, and was used to aid in interpretation of biological monitoring data.

➢ **Habitat suitability** for aquatic macro-invertebrates was determined using the Integrated Habitat Assessment System (IHAS) method and was applied according to the protocol of McMillan (1998);

➢ The **general habitat integrity** of each site was assessed based on the application of the Index of Habitat Integrity (IHI), based on the protocol of Kleynhans *et al.* (2008);

➢ Assessment of the **riparian vegetation** was performed using the Riparian Vegetation Response Assessment Index (VEGRAI), designed in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans *et al.*, 2007b);

➢ The **integrity of the aquatic macro-invertebrate community** was assessed using the South African Scoring System version 5 (SASS5) as defined by Dickens & Graham (2002), as well as through the application of the Macro-Invertebrate Response Assessment Index (MIRAI) EcoStatus tool as described by Thirion (2007). Aquatic macro-invertebrate taxa expected within the system were derived from the (DWS) Resource Quality Information Services (RQIS) PES/EIS database (see Section 5.2.3);

➢ The **integrity of the fish community** was assessed using the Fish Response Assessment Index (FRAI), as described by Kleynhans (2007);

➢ The **Ecological Importance and Sensitivity of the aquatic resources** was determined according to the protocols of DWAF (1999);

➢ The **DWS Risk Assessment Matrix** was applied to identify the impacts that may affect the aquatic resources as a result of the proposed Gold Mining Activities, and to aim to quantify the significance thereof.

3.3 Sensitivity Mapping

All freshwater resources associated with the study areas were delineated with the use of a GPS. Geographic Information System (GIS) was used to project these features onto digital satellite imagery and topographic maps. The sensitivity map presented in Section 7 should guide the refining of the design and layout of the proposed mining project.

3.4 Risk Assessment and Recommendations

Following the completion of the assessment, a risk assessment was conducted (please refer to Section 8 and Appendix D for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed developments.

The recommendations provided also include general 'best practice' management measures, which apply to the proposed development as a whole, and which are presented in Appendix E. Mitigation measures have been developed to address issues in all phases throughout the life of the operation including planning, construction and operation. The detailed site-specific mitigation measures are outlined in Section 8.

4 FRESHWATER SYSTEMS ANALYSIS: RESULTS OF DESKTOP INVESTIGATION

The following section contains data accessed as part of the desktop assessment and is presented as a "dashboard style" report (Table 2). The dashboard reports aim to present concise summaries of the data on as few pages as possible in order to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided.

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 study areas' actual site characteristics at the scale required to inform the environmental authorisation and/or water use licensing processes. However, this information is considered to be 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 3: Desktop data relating to the character of watercourses within the study area and surrounding region.

Aquatic ecoregion and sub-regions in which the study areas are located	
Ecoregion	Northern Escarpment Mountains
Catchment	Olifants North
Quaternary Catchment	B60A
WMA	Olifants
subWMA	Lower Olifants
Dominant characteristics of the Northern Escarpment Mountains Aquatic Ecoregion Level II (10.01) (Kleynhans *et al.,* 2007)	
Dominant primary terrain morphology	Closed hills, mountains; moderate and high relief
Dominant primary vegetation types	Patches Afromontane Forest, North Eastern Mountain Grassland, Sour Lowveld Bushveld
Altitude (m a.m.s.l)	500 to 2100
MAP (mm)	500 to 1000
Coefficient of Variation (% of MAP)	<20 to 29
Rainfall concentration index	55 to 64
Rainfall seasonality	Early to mid-summer
Mean annual temp. (°C)	10 to 22
Winter temperature (July)	0 – 24 °C
Summer temperature (Feb)	8 – 30 °C
Median annual simulated runoff (mm)	40 to 150; 200 to >250
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 10)	
Sub-quaternary reach	B60A – 00653 (Blyde River)

Detail of the study areas in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The study areas are located within a **subWMA currently defined as a Freshwater Ecosystem Priority Area (FEPA) catchment**. River FEPAs achieve biodiversity targets for river ecosystems and threatened fish species and were identified as rivers that are currently in a good condition (A or B ecological category). Although the FEPA status applies to the actual river reach, shading of the whole sub-quaternary catchment reach indicates that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition of the river reach. Furthermore, the river systems in this area (specifically the Blyde River and Treur River – the latter is not within the study areas but is a tributary of the Blyde River) are important for threatened fish species *Enteromius treurensis (synonym Barbus treurensis)* (CR), as well as the Vulnerable *Pseudagrion newtoni* ("Harlequin sprite" damselfly), and amphibian species (*Hadromophryne natalensis* – Vulnerable in Mpumalanga).
NFEPA Wetlands	According to the NFEPA database there are **no wetland features** situated within the study areas, however there is one artificial unchanneled valley bottom wetland feature indicated within the investigation area. This artificial unchanneled valley bottom wetland feature is indicated by NFEPA to be critically modified (Figure 4).
Wetland Vegetation Type (Figure 5)	The Theta pit, Browns pit and the majority of Iota pit fall within the Mesic Highveld Grassland Group 9 WetVeg group (Least Threatened), while a small portion within both Iota pit and Iota Waste Rock Dump option 2 fall within the Mesic Highveld Grassland Group 6 (Least Threatened) (conservation statuses taken from Mbona *et al.* 2014).
NFEPA Rivers	The Blyde River flows between the Iota and Browns pits. The **Blyde River is considered a FEPA River** (Figure 4) and therefore, in terms of the NFEPA Implementation Manual (2011), mining (and/or prospecting) is not considered a compatible land use within 1km (1000m) of a riverine buffer around a river FEPA. According to the PES 1999 Classification the Blyde River is moderately modified (Class C), while the NFEPA database classifies the Blyde River as largely natural with few modifications (Class B).
Detail of the study areas in terms of the Mpumalanga Biodiversity Sector Plan (MBSP, 2014) (Figure 6 & 7)	
Critical Biodiversity Area (CBA) Rivers	**The Blyde River is considered a CBA FEPA River** according to the MBSP Database. The MBSP Handbook (2014) stipulates a 1000m (1km) buffer for CBA Rivers, which needs to be maintained in a good ecological condition in order to meet biodiversity targets for freshwater ecosystems and threatened invertebrate and fish species. Mining and/or prospecting is not considered a compatible land use within this buffer zone according to the MBSP Handbook (2014). According to the Mpumalanga Tourism and Parks Agency, the Blyde River, and specifically the reach which flows through the farm Ponieskranz, is designated as a CBA Aquatic Species due to the occurrence of a Vulnerable damselfly species (order Odonata) as well as various fish species (mentioned above under NFEPA).

<table>
<tr><td>Proximity to study areas</td><td>Flows between Beta Mine and Browns Pit Opencast areas</td><td rowspan="2">Ecological Support Area (ESA): Strategic Water Source Area</td><td rowspan="2">The study areas are situated within an ESA Strategic Water Source Area. These areas have high rainfall that produce 50% of Mpumalanga’s runoff in only 10% of the surface area, thus supporting biodiversity and underpinning regional water security. According to MTPA – Mining in this area is not a supported land-use in these areas.</td></tr>
<tr><td>Assessed by expert?</td><td>Yes</td></tr>
<tr><td>PES Category Median</td><td>Moderately Modified (Class C)</td><td rowspan="3">ESA: Important Sub-catchments</td><td rowspan="3">The majority of the study areas fall within an area considered ESA: Important Sub-catchments, that are associated with river FEPAs and/or Fish Support Areas.</td></tr>
<tr><td>Mean Ecological Importance (EI) Class</td><td>High</td></tr>
<tr><td>Mean Ecological Sensitivity (ES) Class</td><td>Very High</td></tr>
<tr><td>Stream Order</td><td>1</td><td rowspan="2">Heavily Modified</td><td rowspan="2">The remaining portions of the study areas are considered to be heavily modified. These include all areas currently modified to such an extent that any valuable biodiversity and ecological function has been lost.</td></tr>
<tr><td>Default Ecological Class (based on median PES and highest EI or ES mean)</td><td>Very High (Class A)</td></tr>
<tr><td colspan="4">Importance according to the Mining and Biodiversity Guidelines (2013) (Figure 8)</td></tr>
<tr><td colspan="4">The Theta, Browns and the majority of Iota pits fall within areas considered to be of Highest Biodiversity Importance. The remaining portions of the study areas fall within High Biodiversity Important Areas. 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. High Biodiversity Importance areas include protected area buffers (including buffers around National Parks, World Heritage Sites and Nature Reserves), Transfrontier Conservation Areas (remaining areas outside of formally proclaimed protected areas), other identified priorities from provincial spatial biodiversity plans and high-water yield areas, amongst others.

These areas are important for conserving biodiversity, for supporting or buffering other biodiversity priority areas, for maintaining important ecosystem services for particular communities or the country as a whole. An environmental impact assessment should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. Mining options may be limited in these areas, and red flags for mining projects are possible. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations.</td></tr>
</table>

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; MBSP = Municipal Biodiversity Summary Project; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State WMA = Water Management Area; CR = Critically Endangered

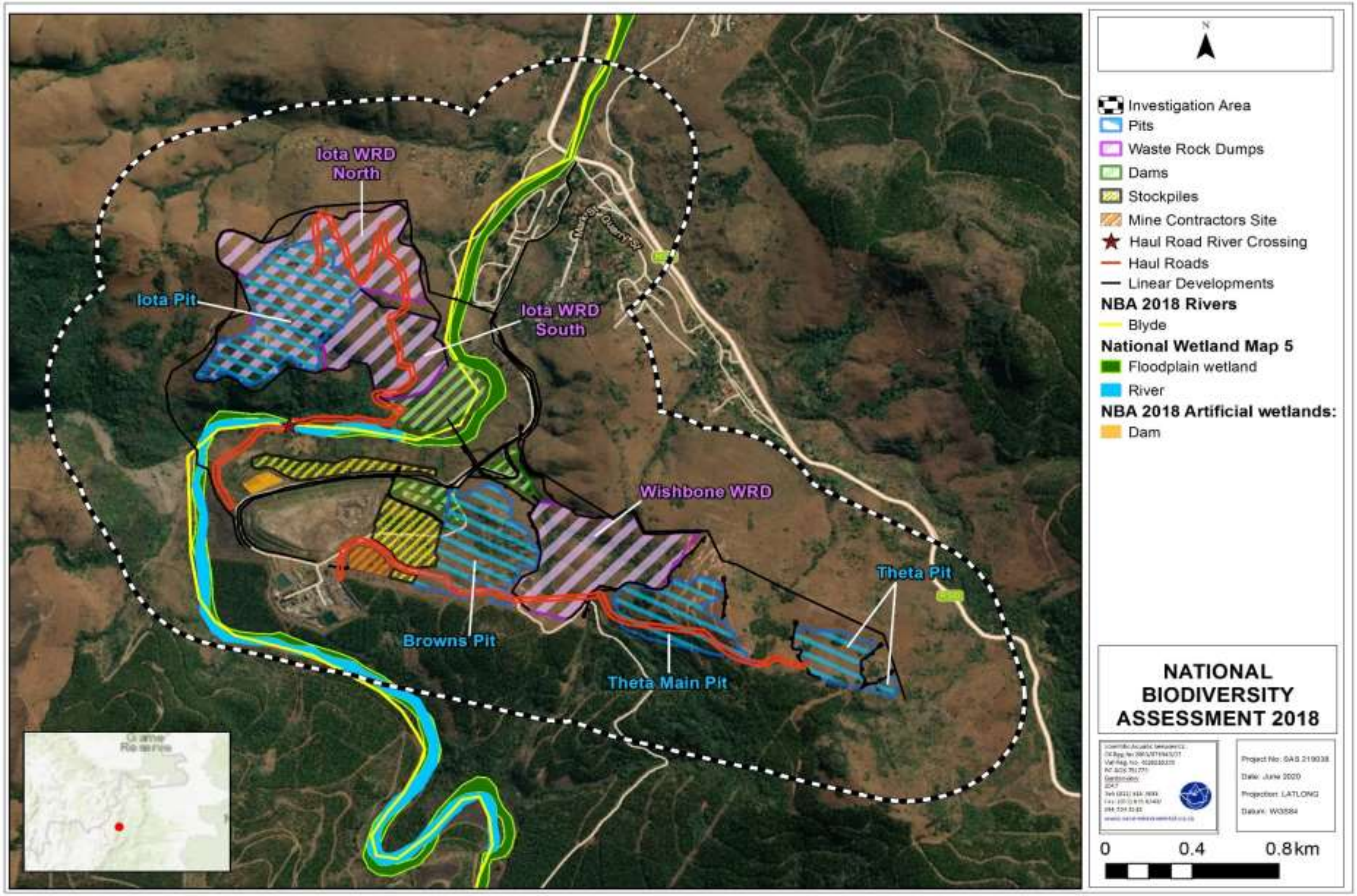


Figure 4: The Blyde River, floodplain wetland and artificial dam situated in the investigation area according to the NBA 2018 Dataset.

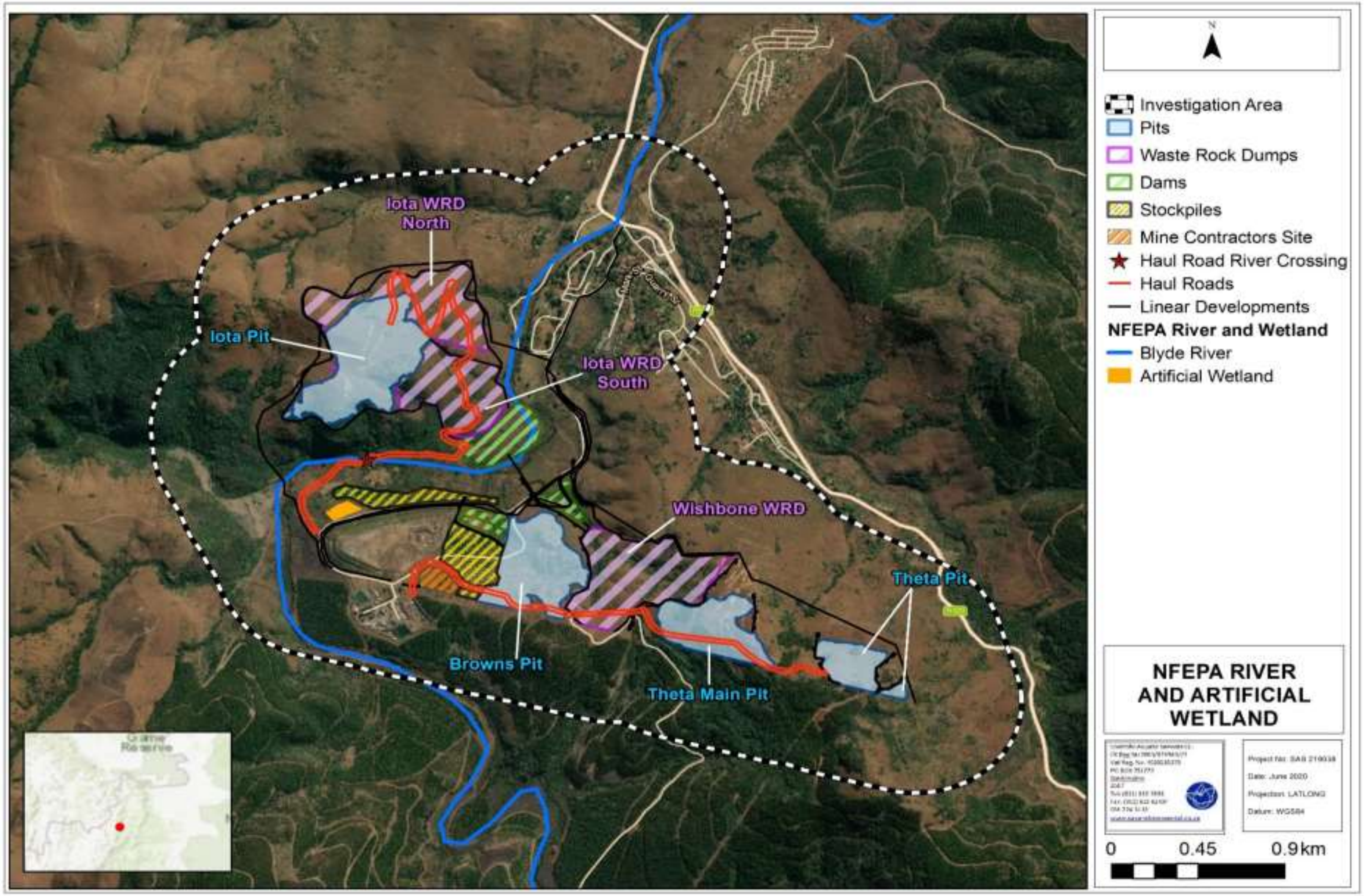


Figure 5: The Blyde River and artificial wetland feature situated in the investigation area according to the NFEPA Database (2011).

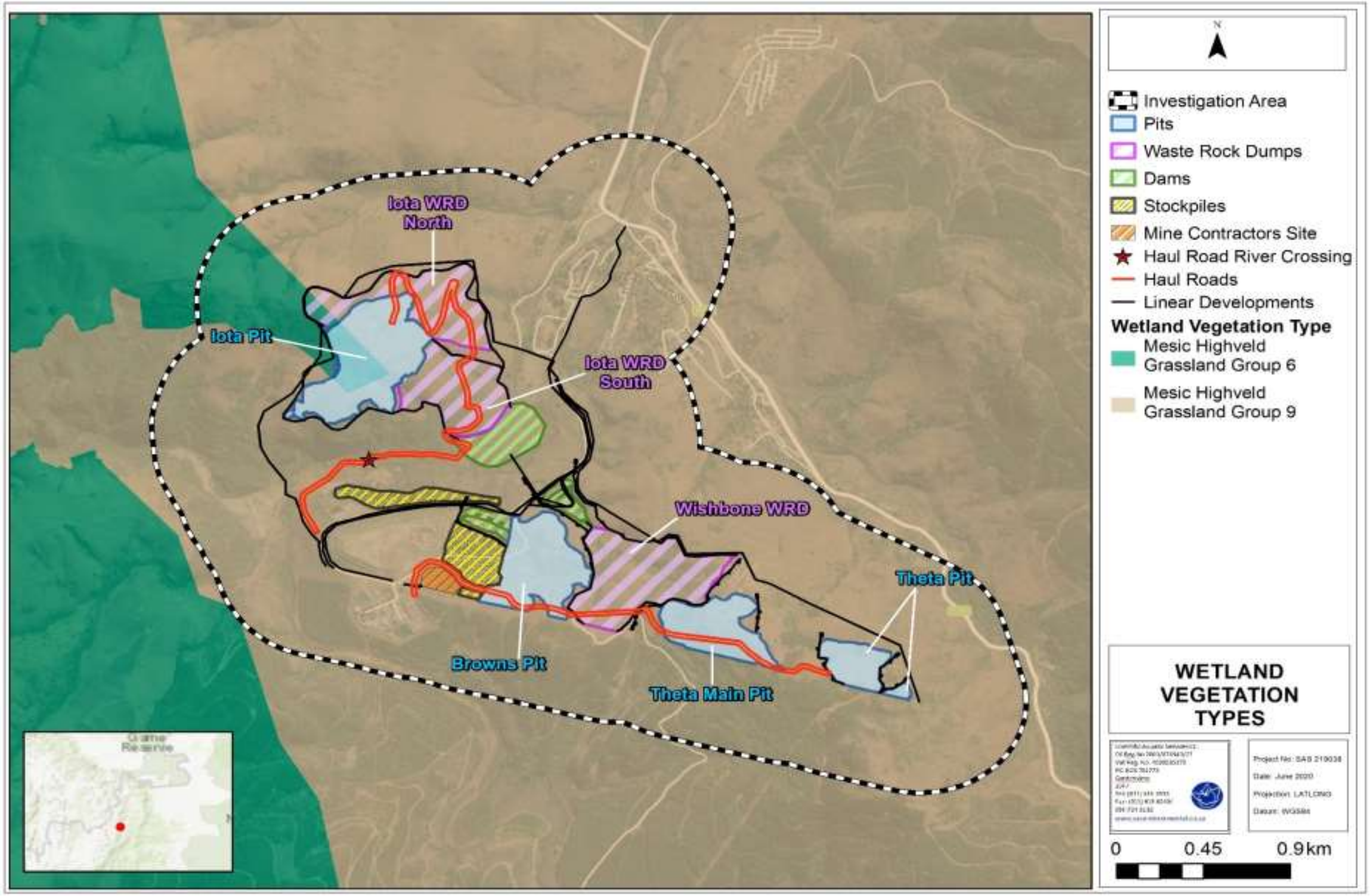


Figure 6: The wetland vegetation types associated with the study areas according to the NFEPA Database (2011).

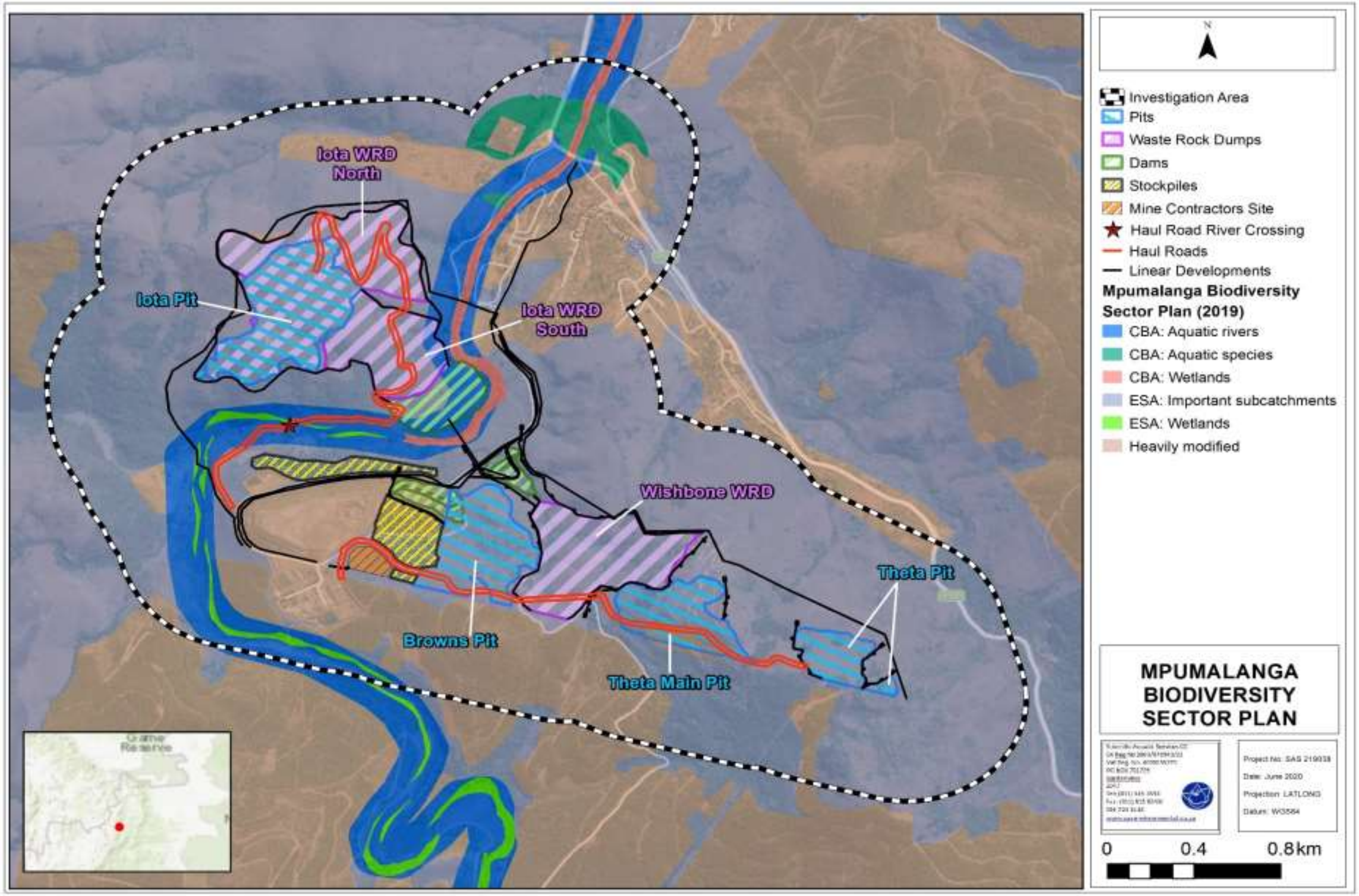


Figure 7: CBA Rivers and ESA Strategic Water Source Areas associated with the study areas (MBSP Aquatic Database, 2014).

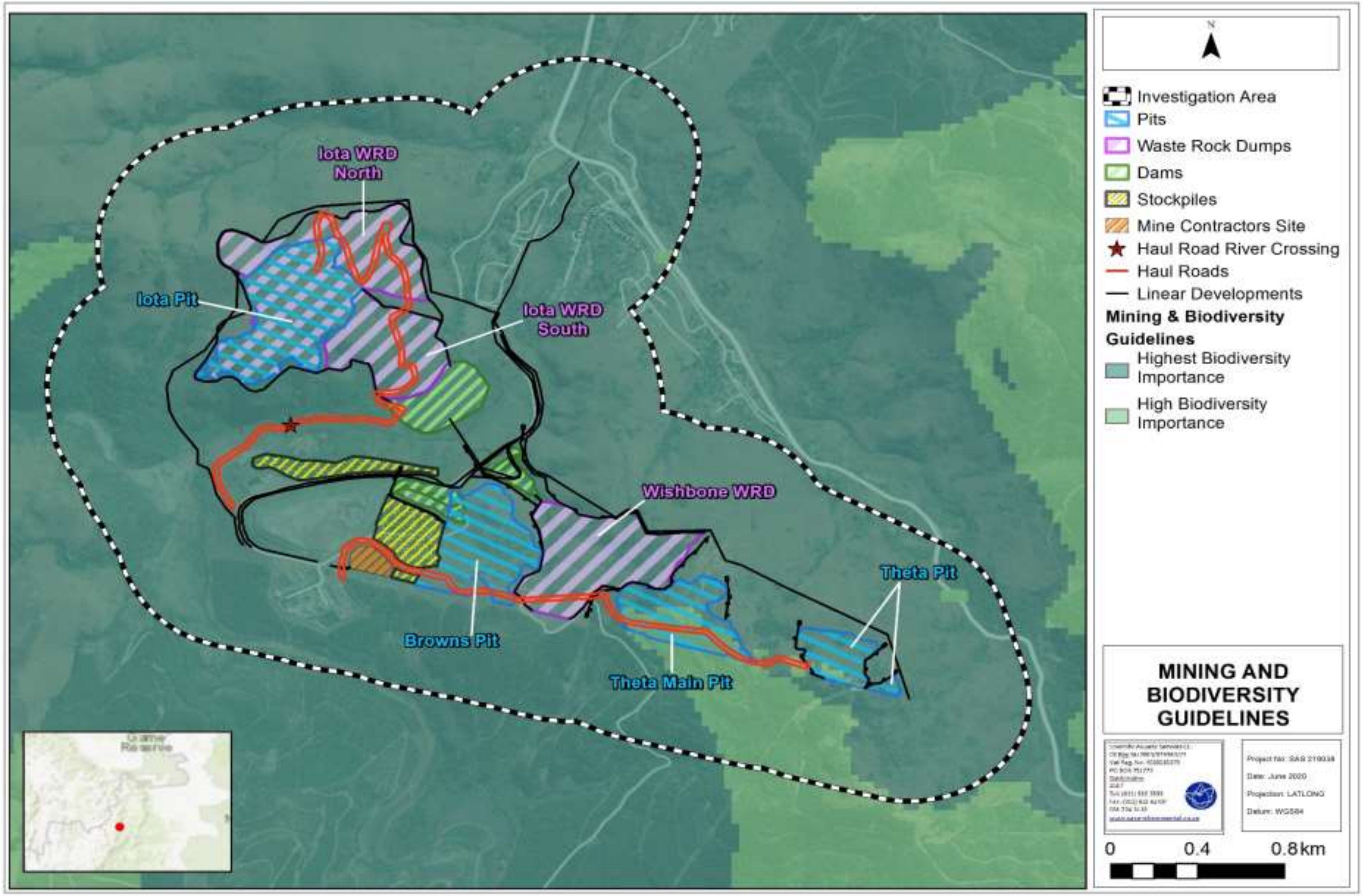


Figure 8: Biodiversity importance of the study areas according to the Mining and Biodiversity Guidelines (2013).

5 AQUATIC ECOLOGICAL ANALYSIS: DESKTOP INVESTIGATION

5.1 *Ecoregions*

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the study areas are located within. This knowledge allows improved interpretation of data, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment. With reference to expected macro-invertebrate and fish taxa, refer to Section 5.2.3 [Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database]. The study areas fall within the Northern Escarpment Mountains Ecoregion (see Table 2) and is located within the B60A quaternary catchment (refer to Figure 10).

5.2 *EcoStatus*

5.2.1 *Historical Quaternary Catchment Information from Kleynhans, 1999*

Water resources are generally classified according to the degree of modification or level of impairment. The classes used by the South African River Health Program (RHP) are presented in the table below and will be used as the basis of classification of the systems in this field and desktop study, as well as in future field studies.

Table 4: Classification of river health assessment classes in line with the RHP.

Class	Description
A	Unmodified, natural.
B	Largely natural, with few modifications.
C	Moderately modified.
D	Largely modified.
E	Extensively modified.
F	Critically modified.

In addition, the Ecological Category (EC) classification will be employed using the eco-status A to F continuum approach (Kleynhans *et al.,* 2007a). This approach allows for boundary categories denoted as B/C, C/D etc., as illustrated in Figure 9.

Figure 9: Ecological Categories (EC) eco-status A to F continuum approach employed.

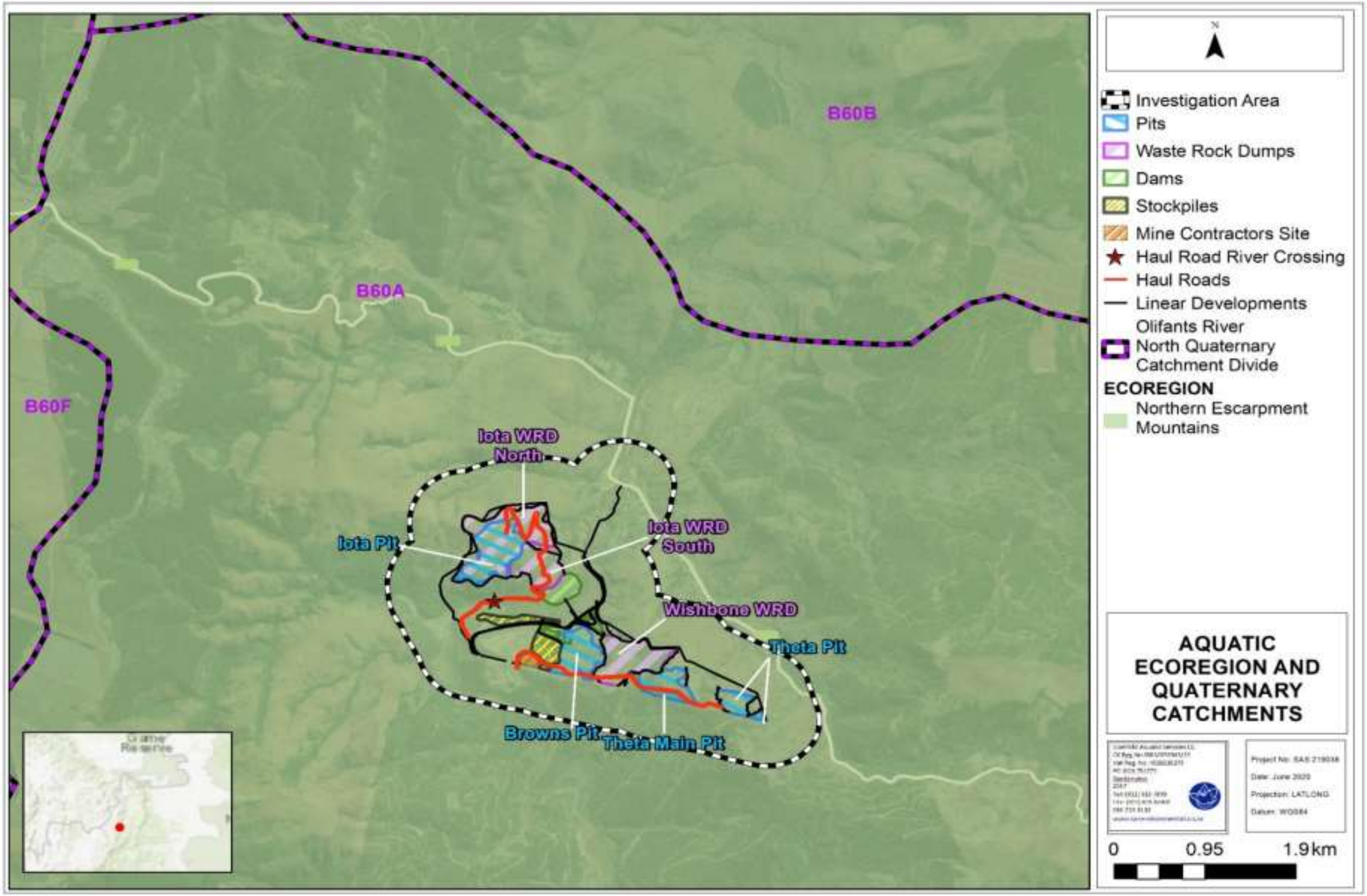


Figure 10: Aquatic Ecoregions and Quaternary Catchments associated with the TGME study areas.

Studies undertaken by the Institute for Water Quality Studies (IWQS) assessed all quaternary catchments as part of the Resource Directed Measures for Protection of Water Resources. In these assessments the Ecological Importance and Sensitivity (EIS), Present Ecological Management Class (PEMC) and Desired Ecological Management Class (DEMC) were defined and serve as a useful guideline in determining the importance and sensitivity of aquatic ecosystems prior to assessment or as part of a desktop assessment.

To define the EIS, PEMC and DEMC, a study undertaken by Kleynhans (1999) helped define the quaternary catchment of concern (B60A, refer to Figure 11). The findings by Kleynhans (1999) forms part of the project entitled: “A procedure for the determination of the ecological reserve for the purpose of the national water balance model for South African rivers”. The results of the assessment are summarised in the table below.

Table 5: Quaternary catchment information.

Catchment	Resource	EIS	PEMC	DEMC
B60A	Blyde River	Very High	Class C: Moderately Modified	A: Highly Sensitive System

5.2.2 *Classes and Resource Quality Objectives of Water Resources for Catchments of the Olifants in terms of Section 13(1) (A) and (B) of the National Water Act (Act No.36 of 1998)*

The classes and resource quality objectives are determined for all or part of every significant water resource within the catchments of the Olifants as set out below (DWS, 2018):

Water Management Area: Olifants

Drainage Regions: B primary drainage region

Rivers: Blyde River System

The results for the Reserve determination and ecological categorization for the Olifants and Letaba Systems, where the Reserve are expressed as a percentage of the Natural Mean Annual Runoff (NMAR) for the respective catchments (cumulative) in terms of section (16)(1), applies.

The tables below and overleaf are summaries of the quantity component for the Upper Blyde River (Olifants_BLY1) which includes the Ecological Water Requirement (EWR) and Basic Human Needs (BHN) for the priority areas (DWS, 2018):

Table 6: Summary of the quantity component for the Upper Blyde (Olifants_BLY1) which includes the Ecological Water Requirement (EWR) and Basic Human Needs (BHN) for the priority area.

Quaternary Catchment	Water Resource	PES	EI_ES	TEC[1]	Ecological Reserve[2] (%NMAR)	BHN Reserve[3] (%NMAR)	Total Reserve[4] (%NMAR)	NMAR[5] (MCM)
B60B	Upper Blyde – Olifants_BLY1	C	High	B	46.08	0.005	46.085	164.45

1 Target Ecological Category (TEC): The ultimate target to achieve a sustainable system both ecologically and economically taking into account the PES and REC.

2 Represents the percentage of BHN.

3 This amount represents the long-term mean based on the NMAR. If the NMAR changes, this volume will also change.

4 The total Reserve amount accounts for both the Ecological Reserve and the Basic Human Needs Reserve (BHN).

5 NMAR is the Natural Mean Annual Runoff.

Table 7: Summary of the quantity component for the Upper Blyde (Blyde – confluence with Lisbon River) which includes the EWR and BHN for the biophysical nodes.

Quaternary Catchment	Water Resource	PES	EI	ES	REC	Ecological Reserve (%NMAR)	BHN Reserve (%NMAR)	Total Reserve (%NMAR)	NMAR (MCM)
B60A	Blyde (confluence with Lisbon)	C	High	Very High	C	18.73	0.015	18.745	87.10

Table 8: Resource Quality Objectives for RIVER INSTREAM HABITAT and BIOTA in the Olifants catchment (adapted from DWS, 2016).

IUA	Class[1]	River	RU	REC	RQO	Numerical Limits
13. Blyde River catchment area	I	Blyde	117	B	Instream habitat must be in a close to natural condition. Instream biological assemblages must be in a moderately modified or better condition. The habitat requirements of species of special ecological importance must be provided for to ensure viable and sustainable populations. Low and high flows must be suitable to maintain the river habitat and ecosystem condition. Water quality: The sediment situation must be improved to support the protected status of this river.	Instream Habitat Integrity category: ≥ B (≥ 82) Fish ecological category: ≥ B (≥ 82) Macro-invertebrate ecological category: ≥ B (≥ 82) Instream EcoStatus category: ≥ B (≥ 82) Hydrological category: ≥ B (≥ 82) Water Quality category: ≥ B (≥ 82)

[1] Integrated Units of Analysis (IUA) are classified in terms of their extent of permissible utilization and protection as either Class I: indicating high environmental protection and minimal utilization; or Class II indicating moderate protection and moderate utilization; and Class III indicating sustainable minimal protection and high utilization.

5.2.3 *Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database*

The PES/EIS database, as developed by the DWS RQIS department, was utilised to obtain additional background information on the project area. The information from this database is based on information at a sub-quaternary catchment reach (SQR) level. Descriptions of the aquatic ecology is based on information collated by the DWS RQIS department from available sources of reliable information, such as SA RHP sites, Ecological Water Requirements (EWR) sites and Hydro Water Management system (WMS) sites.

In this regard, information for the SQRs for the Blyde River (B60A – 00653) is applicable. Key information on background conditions within the study areas, as contained in this database and pertaining to the Present Ecological State (PES), ecological importance and ecological sensitivity for the Blyde River, is tabulated in Table 8 overleaf.

According to the Ecological Importance (EI) data for the Blyde River (B60A – 00653), the following fish species are expected to occur at the sites:

Amphilius natalensis	*Enteromius neefi*	*Tilapia sparrmanii*
Chiloglanis pretoriae	*Enteromius treurensis*	
Enteromius motebensis	*Labeobarbus marequensis*	

The EI data for SQRs Blyde River (B60A – 00653), indicate that the following macro-invertebrate taxa are expected to occur at the sites:

Aeshnidae	Empididae	Notonectidae
Ancylidae	Ephydridae	Oligochaeta
Athericidae	Gerridae	Oligoneuridae
Baetidae >2 sp	Gomphidae	Perlidae
Belostomatidae	Gyrinidae	Philopotamidae
Blephariceridae	Helodidae	Physidae
Caenidae	Heptageniidae	Pisuliidae
Calopterygidae	Hirudinea	Planorbinae
Ceratopogonidae	Hydracarina	Pleidae
Chironomidae	Hydraenidae	Porifera
Chlorocyphidae	Hydrometridae	Potamonautidae
Chlorolestidae	Hydrophilidae	Prosopistomatidae
Coenagrionidae	Hydropsychidae 2 sp	Psephenidae
Corbiculidae	Hydroptilidae	Psychodidae
Corduliidae	Lepidostomatidae	Psychomyiidae/Xiphocentronidae
Corixidae	Leptoceridae	Simuliidae
Crambidae (Pyralidae	Leptophlebiidae	Sphaeriidae
Culicidae	Libellulidae	Tabanidae
Dixidae	Lymnaeidae	Tipulidae
Dytiscidae	Muscidae	Tricorythidae
Ecnomidae	Naucoridae	Turbellaria
Elmidae/Dryopidae	Nepidae	Veliidae/Mesoveliidae

Furthermore, the river systems in this area (specifically the Blyde River and Treur River – the latter is not within the study areas but is a tributary of the Blyde River) are important for threatened fish species *Enteromius treurensis (synonym Barbus treurensis)* (EN), *Amphilius natalensis* (DD), *Amphilius* sp. *'natalensis* cf. *treur'* (DD), as well as the Vulnerable *Pseudagrion newtoni* ("Harlequin sprite" damselfly), and amphibian species (*Hadromophryne natalensis* – Vulnerable in Mpumalanga), as mentioned under FEPACODE in Section 4.

Table 9: Summary of the ecological status of the sub-quaternary catchment (SQ) reach B60A-00653 (Blyde River) based on the DWS RQS PES/EIS database.

<table>
<tr><th colspan="6">Synopsis (SQ reach B60A-00653 Blyde River)</th></tr>
<tr><th>PES[1] category median</th><th>Mean EI[2] class</th><th>Mean ES[3] class</th><th>Length</th><th>Stream order</th><th>Default EC[4]</th></tr>
<tr><td>C (Moderately Modified)</td><td>High</td><td>Very High</td><td>45,2</td><td>1</td><td>A</td></tr>
<tr><th colspan="6">PES details</th></tr>
<tr><td colspan="2">Instream habitat continuity MOD</td><td>Small</td><td colspan="2">Riparian/wetland zone MOD</td><td>Moderate</td></tr>
<tr><td colspan="2">RIP/wetland zone continuity MOD</td><td>Moderate</td><td colspan="2">Potential flow MOD activities</td><td>Small</td></tr>
<tr><td colspan="2">Potential instream habitat MOD activities</td><td>Moderate</td><td colspan="2">Potential physico-chemical MOD activities</td><td>Moderate</td></tr>
<tr><th colspan="6">EI details</th></tr>
<tr><td colspan="2">Fish spp/SQ</td><td>7</td><td colspan="2">Fish average confidence</td><td>3,57</td></tr>
<tr><td colspan="2">Fish representivity per secondary class</td><td>Low</td><td colspan="2">Fish rarity per secondary class</td><td>Very High</td></tr>
<tr><td colspan="2">Invertebrate taxa/SQ</td><td>67</td><td colspan="2">Invertebrate average confidence</td><td>4,07</td></tr>
<tr><td colspan="2">Invertebrate representivity per secondary class</td><td>Very High</td><td colspan="2">Invertebrate rarity per secondary class</td><td>Very High</td></tr>
<tr><td colspan="2">EI importance: riparian-wetland-instream vertebrates (excluding fish) rating</td><td>High</td><td colspan="2">Habitat diversity class</td><td>Moderate</td></tr>
<tr><td colspan="2">Habitat size (length) class</td><td>Very High</td><td colspan="2">Instream migration link class</td><td>Very High</td></tr>
<tr><td colspan="2">Riparian-wetland zone migration link</td><td>High</td><td colspan="2">Riparian-wetland zone habitat integrity class</td><td>High</td></tr>
<tr><td colspan="2">Instream habitat integrity class</td><td>High</td><td colspan="2">Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m</td><td>Moderate</td></tr>
<tr><td colspan="5">Riparian-wetland natural vegetation rating based on expert rating</td><td>Very High</td></tr>
<tr><th colspan="6">ES details</th></tr>
<tr><td colspan="2">Fish physical-chemical sensitivity description</td><td>Very High</td><td colspan="2">Fish no-flow sensitivity</td><td>Very High</td></tr>
<tr><td colspan="2">Invertebrates physical-chemical sensitivity description</td><td>Very High</td><td colspan="2">Invertebrates velocity sensitivity</td><td>Very High</td></tr>
<tr><td colspan="5">Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description</td><td>Very High</td></tr>
<tr><td colspan="5">Stream size sensitivity to modified flow/water level changes description</td><td>Very High</td></tr>
<tr><td colspan="5">Riparian-wetland vegetation intolerance to water level changes description</td><td>Low</td></tr>
</table>

[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;
[2] EI = Ecological Importance;
[3] ES = Ecological Sensitivity
[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

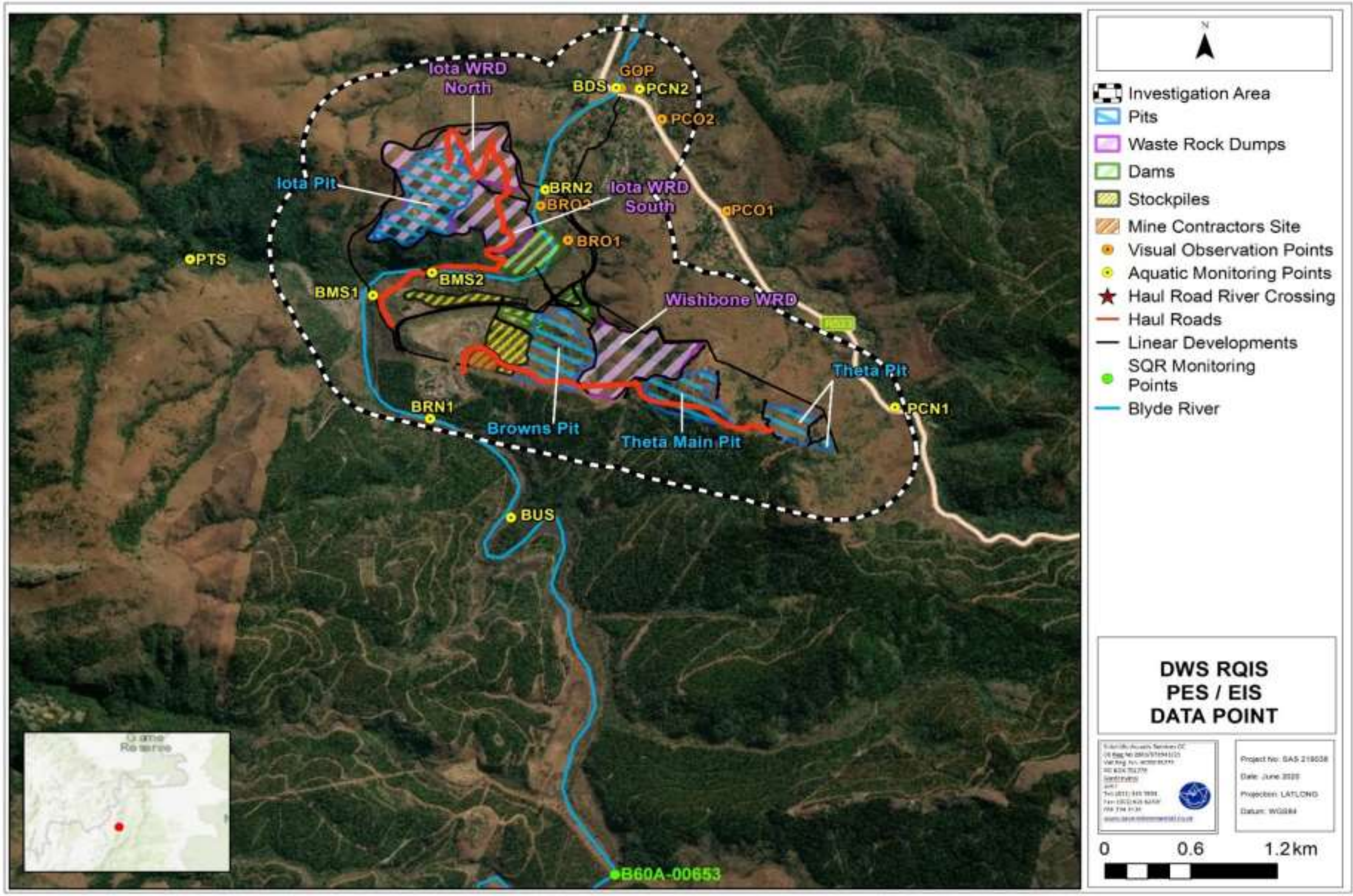


Figure 11: Relevant Sub-Quaternary Catchment Reach (B60A-00653) in the vicinity of the study areas.

6 RESULTS AND INTERPRETATION

6.1 Hydropedological Opinion on the Occurrence of Wetlands within the Study Areas

SAS was requested in April 2019 to provide a hydropedological opinion and impact statement considering the mining and related activities impacts on water courses, indicating how the proposed mining development could affect the Present Ecological State of the water courses and propose mitigation thereof as deemed necessary. This memorandum is appended to this report as Appendix H.

According to SAS (2019), the study area is characterized by lithic (Mispah and Glenrosa) soil forms, which are typically shallow, responsive soils, meaning that these soils 'respond' quickly to rain events and typically generate overland flow due to lack of storage capacity attributed to their shallow nature. The surrounding soils are therefore not considered significant hydropedological drivers of the surrounding watercourses, however, surface water hydrology is considered one of the most significant drivers. Based on discussions with the project team and consideration of available data, it is the understanding of the soil specialist that the importance of geohydrological processes within the proposed mining areas in terms of driving the hydrological processes of the Blyde River and its tributaries is negligible. It should be noted that the vadose zone of the surrounding soils is very shallow due to the dominance of very shallow soils.

Based on the hydropedological opinion as well as observations during the site assessments conducted in October 2018, March 2019, and January 2020 it is therefore considered highly unlikely that any true wetlands [as per the definition contained in the National Water Act, 1998 (Act No. 36 of 1998)] are likely to occur within the study areas.

6.2 Delineation

Due to the access limitations experienced during the site assessment as previously discussed, the watercourses were partially delineated in the field, and the delineations subsequently refined 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 zone boundaries based on the site conditions present at the time of assessment.

During the March 2019 assessment, the following indicators were used to delineate the boundaries of the riparian zones of the watercourses:

- Terrain units were utilised as the primary determinant to ascertain in which parts of the landscape watercourses would be likely to occur, since clear and discernible landscape units were present;
- The vegetation indicator was utilised as the secondary indicator, and was considered to be a useful guide as to the boundaries of the various watercourses;
- The soil form indicator was considered, however, due to changed soil profiles as a result of historical mining and agricultural activities, this indicator was not considered useful throughout all areas as the soil profiles did not necessarily show the typical mottling or gleying that can be expected in wetland areas, nor did the soils display signs of wetness. Please refer to Appendix H and above in Section 6.1 of this report for the hydropedological opinion; and
- Due to the degree and nature of disturbances and access limitations within some portions of the various study areas, historical and current digital satellite imagery, as well as historical aerial photographs were also utilised to aid in the delineation.

6.3 Freshwater Resource System Analysis

Due to the extent of the various study areas as well as access constraints as previously mentioned, prior to the field survey, aerial photographs, digital satellite imagery as well as provincial and national wetland databases (as outlined in Section 3 of this report) were used to identify areas of interest at a desktop level. Thereafter, the identified points of interest and any additional potential riparian or wetland areas/watercourses noted during the field survey were also assessed. Although all possible measures were undertaken to ensure all wetland features and riparian zones were identified, assessed and delineated, some smaller features may have been overlooked within the study areas.

Numerous smaller ephemeral drainage features, episodic preferential surface flow paths and erosion gullies associated with the larger freshwater resources within the various study areas were also identified. These features do not receive and retain sufficient water to support wetland or riparian characteristics (such as facultative or obligate wetland vegetation; soils with prolonged and frequent saturation; indication of a saturated soil zone within 50cm of the soil surface and no significant change in structure and composition of bankside vegetation due to hydromorphological drivers). However, in certain areas, vegetation growth was more prominent, mainly due to ideal microclimatic conditions, protection from fires, frost etc. that these ravine areas provide. Although these flow paths cannot be classified as riparian resources in the ecological sense thereof due to the lack of saturated soils and wetland/riparian vegetation (and were therefore not assessed), they do still function as a waterway, through episodic conveyance of water, and therefore potentially enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998), if the features are large enough to possess a 1:100 floodline.

The emphasis of this report is on true watercourses which are perceived to have an increased likelihood of being impacted to varying degrees by the proposed mining activities. This includes freshwater resources which are not necessarily located within the infrastructure areas but are located downgradient thereof. Resources located outside of these key focus areas, i.e. those within the zone of regulation - within the 500m investigation area, but not within the same catchment - of the proposed infrastructure areas, were delineated using digital satellite imagery, with limited or no field verification. However, when field verification of features which were delineated using desktop techniques took place, delineations proved to be sufficiently accurate to allow for informed decision making. It should also be noted that although the freshwater resources identified may extend beyond the boundaries of the applicable study areas, only portions located within the study areas were assessed and ground truthed where feasible and safe. Nonetheless, the potential impacts of activities such as mining, forestry, agriculture, erosion and clearing of natural vegetation within the greater catchment were taken into consideration during the assessment.

The freshwater resources which were identified within the overall study areas as outlined in Section 3 of this document were classified according to the Ollis *et. al* (2013) Classification System, as Inland Systems, falling within the Northern Escarpment Mountains Aquatic Ecoregions and predominantly within the Mesic Highveld Grassland Group 9 WetVeg group, although a small portion of the Iota Hill pit and WRD Option 2 is located within the Mesic Highveld Grassland Group 6 WetVeg group, both of which are classified as 'Least Threatened' by Mbona *et al*. 2014.

For ease of reference, the identified freshwater resources are discussed in relation to the applicable study area (please refer to Section 3.1 for further detail). The classification of these freshwater resources is summarised in the table overleaf, whilst Figure 12 depicts the locality of these freshwater resources in relation to the various study areas.

Table 10: Characterisation of the freshwater resources identified, associated with various TGME study areas according to the Classification System (Ollis *et. al.,* 2013).

Freshwater resource (in relation to the applicable study area)	Level 3: Landscape unit	Level 4: HGM Type
Browns Pit, Theta Pit and Iota Pit	**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.
		Ephemeral Drainage Line (EDL) with riparian vegetation. A description for these is not contained in Ollis *et al* 2013, thus the following definition is utilised: **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.

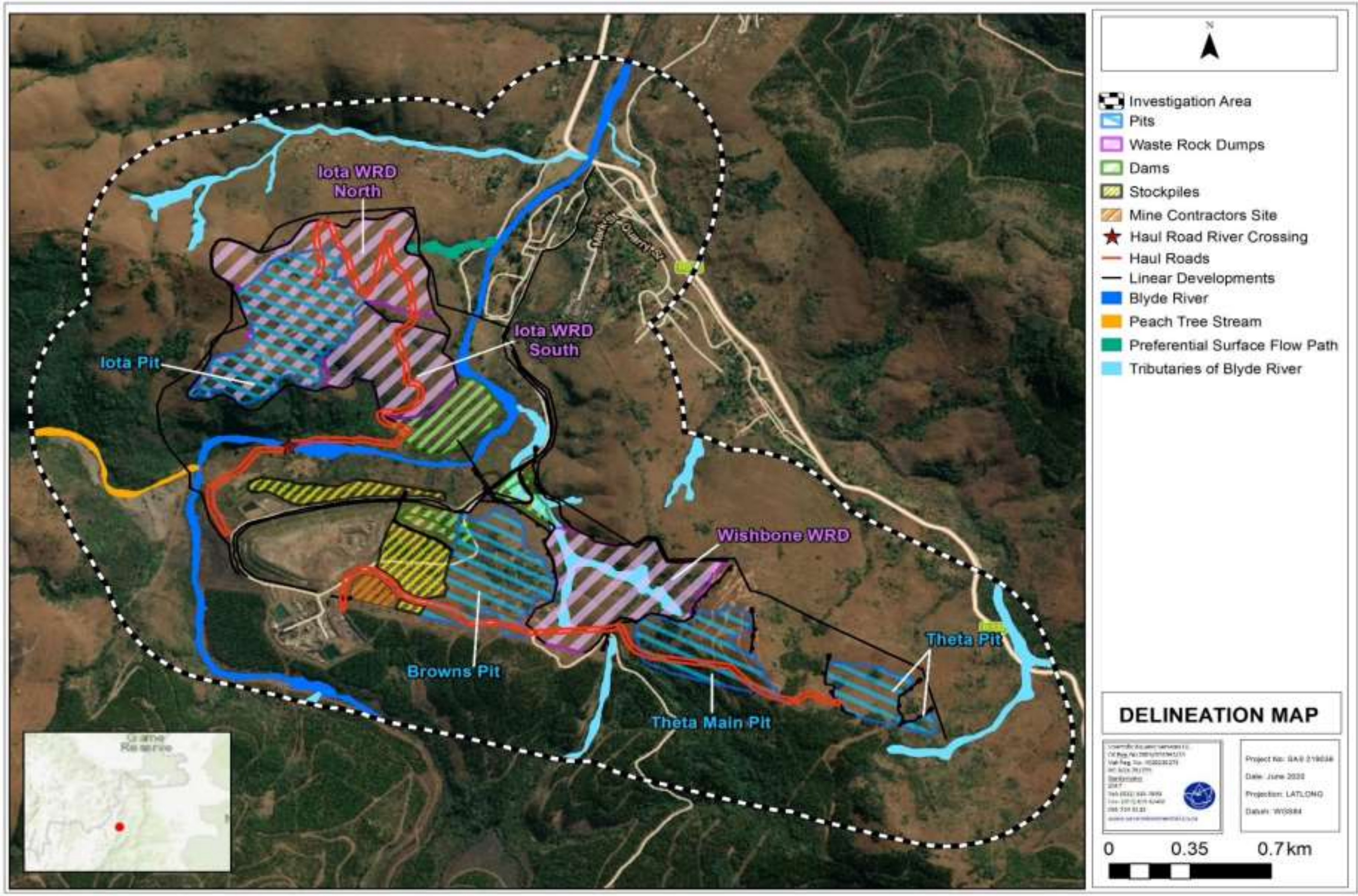


Figure 12: The location of the identified watercourses within the study and investigation areas, in relation to the surrounding landscape.

6.4 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 of the identified freshwater resources. The headwaters of several smaller freshwater systems are located outside of, but downgradient of various study areas, with specific mention of one small system located to the south-east of the Theta WRD Option 2 (please refer to Figure 12 above; the system is identified in the figure as "Headwater of Blyde River Tributary"). The PES and EIS of this system was not assessed since it is not within the Theta pit study area. However, it was taken into consideration when applying the DWS Risk Assessment Matrix (2016), and mitigation measures discussed in Section 8 are equally applicable to these small systems as they are to the larger systems which were assessed.

The freshwater resources were assessed and are discussed on a system level in relation to the applicable study areas as dashboard style reports. These dashboard reports aim to present concise summaries of the data on as few pages as possible, in order to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided.

The following should be noted when reading the results presented below:

- Although the Blyde River is not situated directly within any single study area covered by this study, the reach of the river within the investigation area was assessed, as this reach is located downgradient of the existing TGME operations, as well as downgradient of the Iota pit and Iota WRD Option 1, and downgradient of the Browns pit and associated topsoil stockpile. The results of the ecological assessment of the Blyde River are presented in Table 10 below;
- Since the impacts and modifications to the various small, unnamed tributaries of the Blyde River associated with the Iota, Browns and Theta pits are similar in nature and magnitude, for ease of reference and in the interests of presenting a concise but factual discussion, the results pertaining to these smaller tributaries associated with these three areas are presented in one dashboard;
- The drainage system located to the east and downgradient of the Theta Pit study area was not assessed individually, as it did not fall within the regulated zone for a river in terms of GN509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), i.e. it is located further than 100m (approximately 300m) from the WRD associated with the proposed Theta Pit. Additionally, access to this watercourse was limited due to terrain and personal safety concerns. Furthermore, it is located on the eastern side of

the town of Pilgrims Rest and is further separated from the area of influence by the R533 road. Therefore, the quantum of risk posed to this watercourse is greatly reduced, although mitigation measures to prevent any potential impacts associated with the proposed activities at Theta Pit on this watercourse must nevertheless be implemented. However, based on analysis of available desktop information and digital satellite imagery, as well as the specialists' experience of freshwater systems within the Pilgrims Rest area, it was concluded that this system is likely to be of a similar ecological integrity and sensitivity to other tributaries of the Blyde River that were assessed. Therefore, it was included in the discussion on the unnamed tributaries of the Blyde River;

- The results pertaining to the unnamed tributary of the Blyde River known locally as the Peach Tree Stream along with the smaller tributary thereof (located downgradient and south of Iota pit) are presented in a single dashboard; and
- Whilst consideration is given to water quality in line with the requirements of the DWS Chief Directorate: Instream Water Use, further details of the water quality and aquatic ecological assessments of the Blyde River, the Peach Tree Stream and the Pilgrims Creek can be found further on in this section.

The details pertaining to the methods of assessment used to assess the various features is contained in Section 1 and detailed methods contained in Appendix C. The results of the PES and EIS assessments are conceptually presented in the figures which follow the dashboard results which contain summaries of the findings of the study.

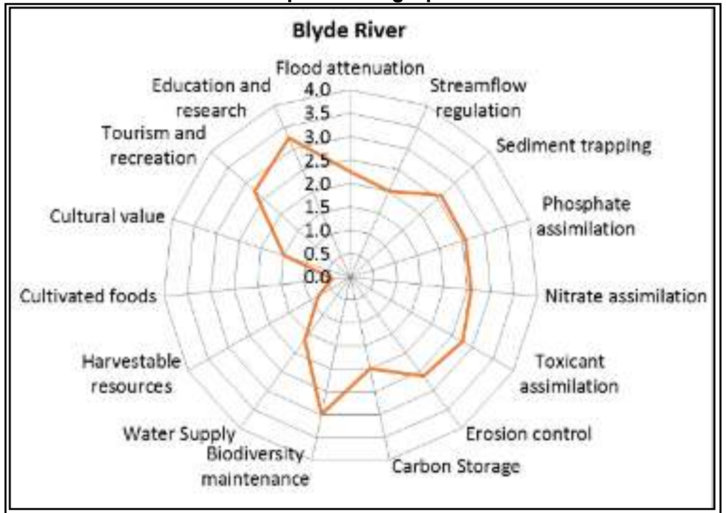
Regarding the aquatic ecological assessment, results are similarly presented as "dashboard" style reports. To avoid repetition, the following was applied to each of the aquatic dashboards;

- SASS5 reference score = 188 and ASPT reference score = 6.5;
- For pH "deterioration"/"improvement" significant changes were indicated using red text, as conditions at either end of the spectrum (either too acidic or too alkaline) pose a risk to aquatic systems;
- For dissolved oxygen (DO) percentage change is calculated using concentration values as measured in mg/L and not expressed in percentage saturation values. Classification of "deterioration"/ improvement" was thus not evaluated in terms of the guideline, but a change exceeding 15% was considered significant;
- For electrical conductivity (EC) percentage change is calculated using concentration values as measured in mg/L and classification of "deterioration"/ improvement" was evaluated in terms of the guideline (DWAF, 1996), which advocates that seasonal and temporal changes should not exceed 15%;

- **Bold text** = significant change (compared to guideline – DWAF, 1996), **red text** = significant deterioration and **blue text** = significant improvement; and
- Abbreviations pertaining to the dashboards are as follows: NA = Not Applicable, Var = variation, ref = reference and prev = previous.

6.5 The Blyde River

Table 11: Freshwater System Analysis Summary of the assessment reach of the Blyde River associated with the various study areas, and within the investigation area.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:

</td>
<td colspan="2"> </td></tr>
<tr><td rowspan="2">PES and VEGRAI discussion</td>
<td rowspan="2">IHI Riparian PES Category: B/C
VEGRAI Category: B/C
It should be noted that the above results pertain only to those areas of the Blyde River that were assessed during the site visits, and not necessarily to the entire reach of the river.
The assessed portions of the Blyde River have been impacted to some extent by historical mining and agricultural activities in terms of the removal of riparian vegetation. In areas which have been subjected to greater disturbances, both alien and indigenous invasive vegetation was observed, although the degree of alteration in this regard is considered minimal at this time. Additionally, some areas of streambank incision were noted although again, at this time, are not considered to be severe. Various bridge crossings exist throughout the reach that was assessed, which will have an effect on flow patterns and distribution of water particularly during high flow periods.</td>
<td>Photograph notes</td>
<td>Representative photographs of sections of the Blyde River, depicting the riparian zone associated with the river, as well as a portion of one of the low-lying bridges that traverses the river (right).</td></tr>
<tr><td colspan="2">Watercourse characteristics:
a) Hydraulic regime
Within the assessed reaches of the river, flow-modifying structures within the river (such as bridges and weirs) are likely to have altered flow patterns and connectivity to some extent. For example, connectivity has been slightly impeded where a gravel road traverses the river, and similar impacts were observed both upstream and downstream of the existing TGME mining facilities. Whilst no active abstraction was observed during the site assessment, it is apparent that historically, it has occurred, and is conceivable that in active farming area, still takes place, thus potentially reducing instream flow.</td></tr>
<tr><td>Ecoservice provision</td>
<td>Moderately High
The Blyde River is considered to provide moderately high levels of ecological services, and intermediate to moderately low levels of socio-cultural benefits. Ecoservices provisioned by the river include flood attenuation, nutrient and toxicant assimilation, sediment trapping, erosion control and biodiversity maintenance. In terms of socio-</td>
<td colspan="2">b) Water quality
For details pertaining to water quality within the Blyde River, please refer to Tables 15 - 19 below. In summary, testing of basic water quality parameters (pH, Dissolved Oxygen, Electrical Conductivity and Total Dissolved Solids) at various localities along the Blyde River indicates that overall, the water quality of the upper-reaches of the Blyde River is considered largely natural and unmodified, meeting the Resource Water Quality Objectives (RWQO) of South Africa (DWA, 2011).</td></tr>
</table>

	cultural benefits, it is likely to provide water for human use (e.g. abstraction for agricultural purposes). Although not observed during the site assessment, it may provide some harvestable resources (e.g. fish), although is not considered to be highly important from this perspective, since other sources of food and goods are available nearby. It is, however, considered to be very important in terms of tourism, recreation and education and is likely to retain residual cultural value to local communities.	**c) Geomorphology and sediment balance** Geomorphological processes within the Blyde River remain largely intact, although as illustrated in the photograph above, some areas of streambank incision and erosion have occurred. It is anticipated that sediment inputs to the river have increased due to agricultural activities (historical and current), historical mining activities, in particular the historical Beta Mine Waste Rock Dump (located approximately 50m to the west of the river), and increased gravel roads in the catchment. This (sediment inputs) may in turn influence the composition and structure of instream vegetation, as well as potentially smothering biota.
EIS discussion	**EIS Category: High** Due to the levels of hydro-functionality of the river (such as flood attenuation and streamflow regulation), as well as biodiversity support and regional context of the high ecological integrity, the Blyde River is deemed to be highly ecologically important. It is also considered to be moderately ecologically sensitive to significant fluctuations in water volumes and flood peaks.	**d) Habitat and biota** Although riparian vegetation has been removed or otherwise altered in some areas, the riparian habitat is considered to be reasonably intact, providing suitable breeding and foraging habitat for a number of faunal species, as well as providing an essential migratory corridor. As with the tributaries of this system, the Blyde River is also considered to provide important habitat for species such as *Hadromophryne natalensis* (Natal Ghost Frog) as well as several rare and endangered fish species (see example below), and the Vulnerable damselfly species, *Pseudagrion newtoni* as recorded on the Farm Ponieskranz 543KT by the Mpumalanga Tourism and Parks Board (information obtained from M. Lotter, MTBP). It was considered possible that the rare and endangered species [status indicated as endangered by the International Union for Conservation of Nature (IUCN)], namely, *Enteromius treurensis* (Treur River Barb) would be present at the sites (Kleynhans, 1999) however, it was not collected during the current sampling efforts.
REC/RMO and BAS Categories	**REC: Category B** **RMO: Maintain** **BAS: Category B** Due to the increased ecological integrity and sensitivity, impacts on the Blyde River and its associated riparian zone as a result of the proposed mining activities must not be permitted, and strict adherence to cogent, well-planned mitigation measures must be enforced throughout all phases of the proposed project if it is authorised in order to ensure that the ecological integrity of the riparian zone and aquatic habitat associated with the Blyde River is maintained. It is the opinion of the ecologists that with strict mitigation and appropriate management of the proposed mining activities, the Best Attainable State (BAS) is a Category B.	**Possible significant impacts, business case, conclusion and mitigation requirements:** The Blyde River is located downgradient of the proposed Browns and Iota mining areas, therefore, very strict adherence to mitigation measures as provided in Section 8 must take place during all phases of the proposed project in order to ensure that no impacts associated with the proposed activities occur on the Blyde River. Of particular importance is the prevention of sedimentation of the river, since the aquatic biota associated with the system are considered very sensitive to changes in habitat conditions which may be altered if excess sediment enters the system. In addition, no contaminated runoff or decant (with specific mention of Acid Mine Drainage) must be permitted to reach the river. Thus, it is deemed critical that, should the project be authorised, clean and dirty water separation systems are established on site prior to the commencement of any construction activities, and continued monitoring of clean and dirty water separation controls must take pace throughout the life of the project. It is also deemed critical that post-closure risk of decant be managed in accordance with mitigation measures contained in Section 8, and in accordance with any recommendations made by a suitably qualified geohydrologist in this regard. Additional key mitigation measures include (but are not limited to): ➢ It should be ensured that no development take place within 100m of the Blyde River, its respective tributaries, or any other delineated freshwater resource in line with GN 704 of the National Water Act, 1998 (Act No. 36 of 1998) except for any essential linear features. Linear developments (e.g. road crossings) may be considered permissible provided that all relevant mitigation measures are adhered to, including utilising existing crossings prior to considering construction of new crossings; ➢ All mining infrastructure must remain out of the riparian zones and associated zones of regulation in line with the requirements of GN704 and GN509 of the National Water Act 1998 (Act No. 36 of 1998). The placement of mining infrastructure (such as WRDs) within drainage systems is not supported by the specialist; ➢ It is deemed essential that the mine be designed in such a way as to ensure that decant is prevented for the life of the proposed mine expansion and beyond closure unless measures to treat decant to background water qualities can be ensured until the quality of the decant naturally returns to these background levels.

Table 12: Results of the Aquatic Ecological Assessment at Site BUS (Upstream site situated in the upper reaches of the Blyde River, upstream from the town of Pilgrims Rest and the active mining area) during the October 2018, March 2019 and January 2020 assessments.

Site BUS

Figure 13: Upstream view of the BUS site at the time of the October 2018 assessment

Algal proliferation	No algae was observed in either the October 2018 or the March 2019 assessments. Isolated patches of algae were observed in the January 2020 assessment.
Depth profiles	Depth profiles were largely consistent over time. The depth varied from shallow runs over cobble and stones to deeper pools. Shallow runs dominated the site.
Flow condition	Flow conditions during the October 2018 and March 2019 assessment periods were regarded as moderate. Moderate to fast flows were observed in the January 2020 assessment. The site was dominated by a mix of flow types with slow to still pools, moderate flowing runs and fast flowing rapids.
Riparian zone characteristics	The riparian zone was dominated by shrubs and trees. Both banks well covered with no indication of erosion.

***In situ* physico-chemical water quality**

	Oct 2018	Mar 2019	Jan 2020	DWS (2018)	
pH	7.75	8.59	8.10	**pH**	5.9 – 8.8
EC (mS/m)	28.0	7.2	10.3	**EC (mS/m)**	≤ 30
DO (mg/ℓ)	8.91	4.42	8.69	**DO (mg/ℓ)**	≥ 8.0
DO (% sat)	109.2	52.7	105.4		
Temp (℃)	18.3	18.1	17.70		

Seasonal variations in water quality (% var from October 2018)

	Mar 2019	Jan 2020
pH	**+10.8**	**+4.5**
EC (mS/m)	**-74.3**	**-63.2**
DO (mg/ℓ)	**-50.4**	**-2.5**

Index of Habitat Integrity

	Oct 2018	Mar 2019	Jan 2020
Instream IHI	89.6 (Category A/B)	89.6 (Category A/B)	89.6 (Category A/B)
Riparian IHI	86.5 (Category B)	86.3 (Category B)	86.3 (Category B)

Riparian Vegetation Response Assessment Index (VEGRAI score)

Oct 2018	Mar 2019	Jan 2020
78.9 (Category B/C)	78.9 (Category B/C)	77.8 (Category B/C)

Comment:

- The pH value complied with the recommended range as defined by the Department of Water and Sanitation (DWS, 2018) for all three assessments. No adverse effects on the aquatic ecology in terms of altered pH was thus deemed likely;
- Electrical Conductivity (EC) complies with the DWS (2018) recommendation (< 30 mS/m). Some variability in the EC was observed at this point. Although no adverse effects on the aquatic ecology was observed, it is recommended that should the proposed project proceed, that this trend be monitored as this site serves as a reference site for the other Blyde River sites;
- Dissolved oxygen (DO) saturation was considered as adequate in supporting a diverse and sensitive aquatic community as it complied with the > 8 mg/ℓ concentration recommendation (DWS, 2018) in both the Oct 2018 and Jan 2020 assessment periods. The lower measured DO concentration results observed during the Mar 2019 assessment can potentially be attributed to probe malfunction as all DO measurements were lower during the second assessment);
- Overall, any adverse effects on the biota specific water quality of the site as a result of the upstream forestry and historic mining activities is considered limited, yet the sensitivity of this system needs to be continually monitored to manage any potential adverse effects to the water quality.

Aquatic macro-invertebrate community integrity

	Oct 2018	Mar 2019	Jan 2020
SASS5 score	179	178	199
Number of Taxa	27	26	29
ASPT score	6.6	6.8	6.88
IHAS score	90 (Excellent)	89 (Excellent)	85 (Excellent)

Seasonal variations in aquatic macro-invertebrate community integrity (% var from October 2018)

	Mar 2019	Jan 2020
SASS5 score	-0.6	**+11.2**
ASPT score	+3.0	+3.0
IHAS score	-1.1	-5.6

Fish Community Assessment (FRAI score)

Oct 2019	Mar 2019	Jan 2020
90.0 (Category A)	90.0 (Category A)	53.4 (Category D, automated) 99.1 (Category A, adjusted)
No fish captured during the Oct 2018 or Mar 2019 assessments but based on historical data, expected species and suitable water quality and habitat conditions at this site, a Category A was assigned.		*Enteromius neefi* (LC) *Enteromius paludinosis* (LC) *Enteromius. cf treurensis* (CR) – striae on scales not counted

Macro-invertebrate Response Assessment Index (MIRAI score)

Oct 2018	Mar 2019	Jan 2020
76.3 (Category C)	83.4 (Category B)	85.9 (Category B)

Comment:

- The integrity of the macro-invertebrate assemblage improved from a Category C classification in Oct 2018 to a Category B classification during the Mar 2019 and Jan 2020 assessments according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability was regarded as excellent at the time of all three assessments, with a presence of a diversity of habitat and flow types, thus being ideally suited to supporting a diverse and sensitive aquatic macro-invertebrate assemblage;
- The instream and riparian zones were regarded as unmodified to largely natural with no signs of erosion and sedimentation in the instream and riparian zones;
- The fish community integrity (FRAI) at the site was regarded as unmodified with an adjusted classification of a Category A assigned at the time of all three assessments based on suitable water quality and habitat conditions at the site. In the Jan 2020 assessment, the species *Enteromius cf treurensis* (Critically endangered according the IUCN Red List) was collected at this point;
- Overall, the EcoStatus Categories for the IHI, MIRAI, VEGRAI and FRAI classifications comply with the RQIS PES (DWS, 2014) classification of Category C conditions for this upstream section of the Blyde River.

			The overall Integrated EcoStatus Category for the BUS site complies with the RQIS PES (DWS, 2014) classification and due to the sensitivity of the system, any further impact must be avoided.

Water clarity and odour	Water was very clear with no odours observed for all three assessment periods.

SITE ECOSTATUS CATEGORY			
	Oct 2018	**Mar 2019**	**Jan 2020**
MIRAI **Instream IHI** **Riparian IHI** **VEGRAI** **FRAI**	**Category C** **Category A/B** **Category B** **Category B/C** **Category A**	**Category B** **Category A/B** **Category B** **Category B/C** **Category A**	**Category B** **Category A/B** **Category B** **Category B/C** **Category A**
Integrated Ecological Category	**80.4% (Category B/C)**	**83.2% (Category B)**	**86.6% (Category B)**

Key Drivers of System Change and Business Case

- Possible cumulative impacts on the water quality as a result of upstream historic mining and forestry activities, as well as potential sediment loading within the system may occur. However, this is not clearly reflected in either the water quality, fish, or macro-invertebrate assessment results, indicating any potential impact prior to the proposed mining activities is likely limited;
- The lack of abundant aquatic vegetation habitat at this point may limit the occurrence of species with preferences for aquatic vegetation;
- An impact on water quality due to past mining activities and the increasing threat of illegal artisanal mining activities in the area. This needs to be monitored as this site serves as a reference point for spatial and future data comparision;

In conclusion: presence of diverse flow conditions and good water quality are considered important ecological variables (exemplified by presence of sensitive taxa such as Psephenidae, Heptageniidae, Blepharoceridae and Chlorocyphidae). Given the sensitivity of the system and the overall integrated ecological category of moderate to largely natural maintaining system integrity is considered critical in this ecologically important watercourse. The sensitivity of this watercourse is exemplified by the presence of the critically endangered *Enteromius cf treurensis* (Treur River Barb) which is known to only be found in the upper reaches of the Blyde River and the Treur River, hence, maintaining the integrity of this system remains vital. The mine must be managed in such a way that no change in the EcoStatus (Change in PES Class) of the river takes place.

Furthermore, it is deemed essential to manage impacts in line with the mitigation hierarchy as defined in the mining and biodiversity guidelines by, in order, avoiding, minimising, rehabilitating and, as a last resort, offsetting latent impacts on the biodiversity of the area.

Table 13: Results of the Aquatic Ecological Assessment at Site BRN1 (Between Iota Pit and Browns Pit Opencast, downstream of the BUS site, but upstream of the BMS1 site and mine's site office) during the January 2020 assessment.

Site BRN1

Figure 14: Upstream view of the BRN1 site at the time of the January 2020 assessment.

Algal proliferation	None observed
Depth profiles	Upstream of the road the site was dominated by a moderately deep run, downstream of the road the site was dominated by moderately shallow runs and rapids.
Flow condition	The site was comprised of a mix of flow types, with upstream flow profiles somewhat affected by the road crossing. The downstream portion of the site consisted of strong rapids and runs.
Riparian zone characteristics	The riparian zone was dominated by grasses, shrubs and trees. Both banks well covered with limited indication of erosion.
Water clarity and odour	Water was very clear and no odours were evident.

SITE ECOSTATUS CATEGORY

MIRAI	**Category B**
Instream IHI	**Category B**
Riparian IHI	**Category B**
VEGRAI	**Category B/C**
FRAI	**Category A**
Integrated Ecological Category	**86.5% (Category B)**

***In situ* physico-chemical water quality**

		DWS (2018)	
pH	8.0	**pH**	5.9 – 8.8
EC (mS/m)	18.53	**EC (mS/m)**	≤ 30
DO (mg/ℓ)	9.60	**DO (mg/ℓ)**	≥ 8.0
DO (% sat)	118.0		
Temp (℃)	18.53		

Index of Habitat Integrity

Instream IHI	85.1 (Category B)
Riparian IHI	86.3 (Category B)

Riparian Vegetation Response Assessment Index

VEGRAI score	77.8 (Category B/C)

Comment:

- The pH value complied with the recommended range as defined by the (DWS, 2018);
- The EC fell within the DWS (2018) recommendation (< 30 mS/m) and was unlikely to limit the sensitivities of the aquatic assemblages likely to occur at this point;
- The DO saturation could be considered as adequate in supporting a diverse and sensitive aquatic community as it complied with the > 8 mg/ℓ concentration recommendation (DWS, 2018, and no impact on the aquatic ecology was anticipated; and
- Overall, any adverse effects on the biota specific water quality of the site as a result of the upstream forestry and historic mining activities was considered limited.

Aquatic macro-invertebrate community integrity

Invertebrate community assessment (SASS5 and IHAS)

SASS5 score	196
Number of Taxa	30
ASPT score	6.53
IHAS score	85 (Excellent)

Fish Community Assessment

FRAI score	65.3 (Category C, automated) 99.1 (Category A, adjusted)

Enteromius neefi (LC)
Enteromius viviparus (LC)
Enteromius paludinosis (LC)
Enteromius anoplus (LC)
Oncorhynchus mykiss (Alien)

Macro-invertebrate Response Assessment Index

MIRAI score	85.3 (Category B)

Comment:

- The site was considered to be in a Category B condition according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability was regarded as excellent and likely to support a diverse and sensitive aquatic assemblage;
- The instream and riparian zones were regarded as largely natural with some instream and marginal impacts related to the road crossing;
- The fish community integrity at the site was regarded as unmodified with an adjusted classification of Category A assigned. The alien species *Oncorhynchus mykiss* was observed, which preys on indigenous fishes and may result in impacts to the fish community diversity expected at this point;
- Overall, the EcoStatus Category for the IHI, MIRAI, VEGRAI and FRAI classifications comply with the RQIS PES (DWS, 2014) classification of Category C conditions for this section of the Blyde River. The overall Integrated EcoStatus Category for the BRN1 site complies with the RQIS PES (DWS, 2014) classification and due to the sensitivity of the system, any further impact must be avoided.

Key Drivers of System Change and Business Case

- Possible cumulative impacts on the water quality as a result of potential upstream and surrounding forestry activities. Some run-off from the hard road surface may potentially contribute to the increased EC observed at this point in relation to the BUS site upstream. However, water quality parameters indicate no impact on pH or DO at the time of assessment, with increases in EC potentially related to the current illegal artisanal mining activities or historic mining in the area. This needs to be closely monitored in future given the high sensitivity of the system;
- Possible cumulative impacts on the water quality (notably elevated EC in relation to the BUS site upstream of this point) as a result of upstream mining and forestry activities is not clearly reflected in either the fish or macro-invertebrate assessment results, indicating any potential impact on the aquatic biota at the time of assessment is likely limited;
- An impact on water quality and an impact on aquatic biota as a result of sediment loading are deemed possible future threats in some areas, due to past mining activities. This needs to be monitored should the proposed project proceed.

Table 14: Results of the Aquatic Ecological Assessment at Site BMS1 (Located downstream of the BUS site, below the mine's site office on the Blyde River adjacent to the Beta Mine study area) during the October 2018, March 2019 and January 2020 assessments.

Site BMS1

Figure 15: Downstream view of the BMS1 site at the time of the January 2020 assessment

Algal proliferation	Isolated algae observed in the Jan 2020 assessment, while no algae was observed in either the Oct 2018 or Mar 2019 assessments.
Depth profiles	The site was dominated by a slow shallow run over cobble and stones. Faster riffles and rapids present downstream.
Flow condition	Flow conditions during the October 2018 and March 2019 assessment periods were regarded as moderate to slow, while moderate to fast flows were observed in the January 2020 assessment.
Riparian zone characteristics	The riparian zone was dominated by grasses, shrubs and trees. Both banks well covered with limited indication of erosion.
Water clarity and odour	Water was very clear with no odours observed for all three assessment periods.

***In situ* physico-chemical water quality**

	Oct 2018	Mar 2019	Jan 2020	DWS (2018)	
pH	7.45	8.24	7.99	**pH**	5.9 – 8.8
EC (mS/m)	95.1	5.3	15.0	**EC (mS/m)**	≤ 30
DO (mg/ℓ)	8.69	4.67	8.77	**DO (mg/ℓ)**	≥ 8.0
DO (% sat)	108.8	57.2	109.4		
Temp (℃)	19.1	18.7	19.40		

Seasonal variations in water quality (% var from October 2018)

	Mar 2019	Jan 2020
pH	+10.6	+7.2
EC (mS/m)	-94.4	-84.2
DO (mg/ℓ)	-46.3	+0.9

Index of Habitat Integrity

	Oct 2018	Mar 2019	Jan 2020
Instream IHI	85.9 (Category B)	86.5 (Category B)	86.2 (Category B)
Riparian IHI	83.8 (Category B)	84.0 (Category B)	84.0 (Category B)

Riparian Vegetation Response Assessment Index (VEGRAI score)

Oct 2018	Mar 2019	Jan 2020
78.9 (Category B/C)	78.9 (Category B/C)	77.8 (Category B/C)

Comment:

- The pH values complied with the recommended range as defined by the Department of Water and Sanitation (DWS, 2018) for all three assessments. No adverse effects on the aquatic ecology in terms of altered pH was thus deemed likely;
- EC complies with the DWS (2018) recommendation (< 30 mS/m). Some variability in the EC was observed at this point. Although no adverse effects on the aquatic ecology was observed, it is recommended that should the proposed project proceed, that this trend be monitored as this site serves as a reference site for the other Blyde River sites;
- DO saturation was considered as adequate in supporting a diverse and sensitive aquatic community as it complied with the > 8 mg/ℓ concentration recommendation (DWS, 2018) in both the Oct 2018 and Jan 2020 assessment periods. As for site BUS, lower measured DO concentration results observed during the Mar 2019 assessment can potentially be attributed to probe malfunction as all DO measurements were lower during the second assessment);
- Overall, any adverse effects on the biota specific water quality of the site as a result of the upstream forestry and historic mining activities is considered limited, yet the sensitivity of this system needs to be continually monitored to manage any potential adverse effects to the water quality.

Aquatic macro-invertebrate community integrity

	Oct 2018	Mar 2019	Jan 2020
SASS5 score	145	186	187
Number of Taxa	21	31	29
ASPT score	6.9	6.0	6.42
IHAS score	88 (Excellent)	92 (Excellent)	96 (Excellent)

Seasonal variations in aquatic macro-invertebrate community integrity (% var from October 2018)

	Mar 2019	Jan 2020
SASS5 score	+28.3	+29.5
ASPT score	-13.0	-6.5
IHAS score	+4.5	+9.1

Fish Community Assessment (FRAI score)

Oct 2019	Mar 2019	Jan 2020
98.1 (Category A)	99.0 (Category A)	52.3 (Category D, automated) 99.1 (Category A, adjusted)
Enteromius neefi (LC)		*Enteromius neefi* (LC) *Enteromius anoplus* (LC) *Enteromius. viviparus* (LC)

Macro-invertebrate Response Assessment Index (MIRAI score)

Oct 2018	Mar 2019	Jan 2020
75.5 (Category C)	77.5 (Category C)	85.3 (Category B)

Comment:

- The integrity of the macro-invertebrate assemblage improved from a Category C classification in Oct 2018 and Mar 2019 to a Category B classification during the Jan 2020 assessment according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability was regarded as excellent at the time of all three assessments, with a presence of a diversity of habitat and flow types, thus being ideally suited to supporting a diverse and sensitive aquatic macro-invertebrate assemblage;
- The instream and riparian zones were regarded as unmodified to largely natural with limited signs of sedimentation in the instream zones and some evidence of alien vegetation encroachment in the riparian zone;
- The fish community integrity (FRAI) at the site was regarded as unmodified with an adjusted classification of a Category A assigned at the time of all three assessments based on suitable water quality and habitat conditions at the site;
- Overall, the EcoStatus Categories for the IHI, MIRAI, VEGRAI and FRAI classifications comply with the RQIS PES (DWS, 2014) classification of Category C conditions for this upstream section of the Blyde River. The overall Integrated EcoStatus Category for the BMS1 site complies with the RQIS PES (DWS, 2014) classification and due to the sensitivity of the system, any further impact must be avoided.

Key Drivers of System Change and Business Case

<table>
<tr><td colspan="4">SITE ECOSTATUS CATEGORY</td><td rowspan="4">➢ Possible cumulative impacts on the water quality as a result of potential upstream and surrounding forestry activities as well as potential seepage from the adjacent waste rock dump. However, this is not clearly reflected in either the water quality, fish or macro-invertebrate assessment results, indicating any potential impact at the time of assessment is likely limited;
➢ Possible cumulative impacts on the water quality as a result of upstream mining and forestry activities is not clearly reflected in either the fish or macro-invertebrate assessment results, indicating any potential impact on the aquatic biota at the time of assessment is likely limited;
➢ An impact on water quality and an impact on aquatic biota as a result of sediment loading are deemed possible future threats in some areas, due to past mining activities and the emerging threat of illegal artisanal mining activities along sections of the Blyde River. It is considered vitial that uncontrolled illegal artisanal mining activities be properly policed and prohibited;
In conclusion: Presence of diverse flow conditions and good water quality are considered important ecological variables (exemplified by presence of sensitive taxa such as Psephenidae, Heptageniidae and Perlidae). Given the sensitivity of the system and the overall integrated ecological category of largely natural, maintaining system integrity is considered critical in this ecologically important watercourse.</td></tr>
<tr><td></td><td>Oct 2018</td><td>Mar 2019</td><td>Jan 2020</td></tr>
<tr><td>MIRAI
Instream IHI
Riparian IHI
VEGRAI
FRAI</td><td>Category C
Category B
Category B
Category B/C
Category A</td><td>Category C
Category B
Category B
Category B/C
Category A</td><td>Category B
Category B
Category B
Category B/C
Category A</td></tr>
<tr><td>Integrated Ecological Category</td><td>81.9% (Category B/C)</td><td>82.9% (Category B)</td><td>85.3% (Category B)</td></tr>
</table>

Table 15: Results of the Aquatic Ecological Assessment at Site BMS2 (Located downstream of the BMS1 site, downstream of the confluence of the Peach Tree Stream flowing adjacent to Iota Hill Opencast, Iota South WRD and Iota Pollution Control Dam (PCD) study areas) during the October 2018, March 2019 and January 2020 assessments.

Site BMS2

Figure 16: Downstream view of the BMS2 site at the time of the January 2020 assessment

Algal proliferation	No algae observed in any of the three assessments at this point
Depth profiles	The depth varied from very deep pools to shallow runs over stones and cobble. Shallow runs dominated the site in the Oct 2018 and Mar 2019 assessments, however, in the Jan 2020 assessment, moderately shallow and deep rapids were present.
Flow condition	Flow conditions during the October 2018 and March 2019 assessment periods were regarded as moderate to slow, while moderate to fast flows were observed in the January 2020 assessment.
Riparian zone characteristics	The riparian zone was dominated by grasses, shrubs and trees. Both banks well covered with limited indication of erosion.

***In situ* physico-chemical water quality**

	Oct 2018	Mar 2019	Jan 2020	DWS (2018)	
pH **EC (mS/m)** **DO (mg/ℓ)** **DO (% sat)** **Temp (℃)**	7.50 9.5 8.33 102.2 17.5	8.27 7.4 4.60 56.1 18.5	8.30 8.0 8.98 112.7 19.6	**pH** **EC (mS/m)** **DO (mg/ℓ)**	5.9 – 8.8 ≤ 30 ≥ 8.0

Seasonal variations in water quality (% var from October 2018)

	Mar 2019	Jan 2020
pH	+10.3	+10.7
EC (mS/m)	-22.1	-15.8
DO (mg/ℓ)	-44.8	+7.8

Index of Habitat Integrity

	Oct 2018	Mar 2019	Jan 2020
Instream IHI	84.8 (Category B)	82.0 (Category B)	80.8 (Category B/C)
Riparian IHI	84.3 (Category B)	79.6 (Category B/C)	79.56 (Category B/C)

Riparian Vegetation Response Assessment Index (VEGRAI score)

Oct 2018	Mar 2019	Jan 2020
78.9 (Category B/C)	78.9 (Category B/C)	77.8 (Category B/C)

Comment:

- The pH values complied with the recommended range as defined by the Department of Water and Sanitation (DWS, 2018) for all three assessments. No adverse effects on the aquatic ecology in terms of altered pH was thus deemed likely.
- EC complies with the DWS (2018) recommendation (< 30 mS/m). Some variability in the EC was observed at this point. Although no adverse effects on the aquatic ecology was observed, it is recommended that should the proposed project proceed, that this trend be monitored as this site serves as a reference site for the other Blyde River sites;
- DO saturation was considered as adequate in supporting a diverse and sensitive aquatic community as it complied with the > 8 mg/ℓ concentration recommendation (DWS, 2018) in both the Oct 2018 and Jan 2020 assessment periods. As for site BUS, lower measured DO concentration results observed during the Mar 2019 assessment can potentially be attributed to probe malfunction as all DO measurements were lower during the second assessment);
- Overall, any adverse effects on the biota specific water quality of the site as a result of the upstream forestry and historic mining activities is considered limited, yet the sensitivity of this system needs to be continually monitored to manage any potential adverse effects to the water quality.

Aquatic macro-invertebrate community integrity

	Oct 2018	Mar 2019	Jan 2020
SASS5 score	118	122	190
Number of Taxa	19	20	30
ASPT score	6.2	6.1	6.33
IHAS score	81 (Excellent)	76 (Excellent)	82 (Excellent)

Seasonal variations in aquatic macro-invertebrate community integrity (% var from October 2018)

	Mar 2019	Jan 2020
SASS5 score	+3.4	+61
ASPT score	-1.6	+1.6
IHAS score	+6.2	+1.2

Fish Community Assessment (FRAI score)

Oct 2019	Mar 2019	Jan 2020
90.0 (Category A)	99.0 (Category A)	61.5 (Category C/D, automated) 99.1 (Category A, adjusted)
No fish captured during the Oct 2018 and Mar 2019 assessments but based on historical data, expected species and suitable water quality and habitat conditions at this site, a Category A was assigned.		*Enteromius neefi* (LC) *Labeobarbus marequensis* (LC) Oncorhynchus mykiss (Alien)

Macro-invertebrate Response Assessment Index (MIRAI score)

Oct 2018	Mar 2019	Jan 2020
72.0 (Category C)	76.9 (Category C)	82.6 (Category B)

Comment:

- The integrity of the macro-invertebrate assemblage improved from a Category C classification in Oct 2018 and Mar 2019 to a Category B classification during the Jan 2020 assessment according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability was regarded as excellent at the time of all three assessments, with a presence of a diversity of habitat and flow types, thus being ideally suited to supporting a diverse and sensitive aquatic macro-invertebrate assemblage;
- The instream and riparian zones were regarded as moderately modified to largely natural with some signs of sedimentation in the instream zones and some evidence of alien vegetation encroachment in the riparian zones;
- The fish community integrity (FRAI) at the site was regarded as unmodified with an adjusted classification of a Category A assigned at the time of all three assessments based on suitable water quality and habitat conditions at the site;
- Overall, the EcoStatus Categories for the IHI, MIRAI, VEGRAI and FRAI classifications comply with the RQIS PES (DWS, 2014) classification of Category C conditions for this upstream section of the Blyde River. The overall Integrated EcoStatus Category for the BMS2 site complies with the

			RQIS PES (DWS, 2014) classification and due to the sensitivity of the system, any further impact must be avoided.
Water clarity and odour	Water was very clear with no odours observed for all three assessment periods.		

SITE ECOSTATUS CATEGORY				
	Oct 2018	**Mar 2019**	**Jan 2020**	**Key Drivers of System Change and Business Case**
MIRAI **Instream IHI** **Riparian IHI** **VEGRAI** **FRAI**	**Category C** **Category B** **Category B** **Category B/C** **Category A**	**Category C** **Category B** **Category B/C** **Category B/C** **Category A**	**Category B** **Category B/C** **Category B/C** **Category B/C** **Category A**	➢ Possible cumulative impacts on the water quality as a result of upstream mining and forestry activities, as well as the informal road crossing. However, this is not strongly reflected in either the water quality, fish or macro-invertebrate assessment results, indicating any potential impact is likely limited; ➢ The lack of aquatic vegetation habitat at this point may limit the occurrence of species with preferences for aquatic vegetation; ➢ An impact on water quality and an impact on aquatic biota as a result of sediment loading are deemed possible future threats in some areas, due to past mining activities. This needs to be monitored should the proposed mining project proceed.
Integrated Ecological Category	**78.7% (Category B/C)**	**80.6% (Category B/C)**	**84.5% (Category B)**	

Table 16: Results of the Aquatic Ecological Assessment at Site BRN2 (Adjacent to the Iota Pit WRD and PCD and downstream of site BMS2 and upstream of site BDS) during the January 2020 assessment.

Site BRN2

Figure 17: Downstream view of the BRN2 site at the time of the January 2020 assessment.

Algal proliferation	None observed
Depth profiles	Upstream of the road the site was dominated by a relatively deep run, flowing over an extensive sediment bank, downstream of the road the site was dominated by moderately shallow runs and rapids, with shallow pools in the backwaters.
Flow condition	The site was dominated by a slower deep run upstream and downstream the site was dominated by faster runs and isolated rapids.

***In situ* physico-chemical water quality**

		DWS (2018)	
pH	8.23	**pH**	5.9 – 8.8
EC (mS/m)	9.3	**EC (mS/m)**	≤ 30
DO (mg/ℓ)	7.48	**DO (mg/ℓ)**	≥ 8.0
DO (% sat)	95.9		
Temp (℃)	19.9		

Index of Habitat Integrity

Instream IHI	68.2 (Category C)
Riparian IHI	79.56 (Category B/C)

Riparian Vegetation Response Assessment Index

VEGRAI score	77.8 (Category B/C)

Comment:

- The pH value complied with the recommended range as defined by the (DWS, 2018);
- The EC fell within the DWS (2018) recommendation (< 30 mS/m) and was unlikely to limit the sensitivities of the aquatic assemblages likely to occur at this point;
- The DO saturation could be considered slightly low as measured DO concentrations were observed at 7.48 mg/ℓ, which was lower than the > 8 mg/ℓ concentration recommendation (DWS, 2018);
- Overall, adverse effects on the biota specific water quality of the site was regarded as good, however, the increased turbidity at this point and the slightly reduced DO, along with an extensive portion of sedimentation (> 80 m of the BRM2 site) was a cause for concern and impacts related to the upstream forestry and historical mining activities were not considered sufficient drivers of change at this point. Apon further investigation, approximately 120 m and 500 m, respectively, upstream of this point, extensive illegal artisanal mining activities were observed, with a number of excavations at both sites and a partial river diversion observed at the 500 m point (Figure 18 and Figure 19).

Aquatic macro-invertebrate community integrity

Invertebrate community assessment (SASS5 and IHAS)

SASS5 score	187
Number of Taxa	28
ASPT score	6.68
IHAS score	82 (Excellent)

Fish Community Assessment

FRAI score	59.6 (Category C/D, automated) 99.1 (Category A, adjusted)

Enteromius neefi (LC)
Enteromius viviparus (LC)
Enteromius paludinosis (LC)
Enteromius cf treurensis (CR)
Chiloglanis pretoriae (LC)

Macro-invertebrate Response Assessment Index

MIRAI score	86.5 (Category B)

Comment:

- The site was considered to be in a Category B condition according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability was regarded as excellent and likely to support a diverse and sensitive aquatic assemblage;
- The instream habitat integrity was regarded as moderately modified from natural conditions sue to the severe sedimentation observed at this point, which is likely to have smothered the natural instream stones and cobble habitat of this section of the Blyde River and resulted in bed modifications at this point. The riparian zone integrity was regarded as moderate to largely natural with some instream and marginal impacts related to the road crossing and the proliferation of alien and invasive species;
- The fish community integrity at the site was regarded as unmodified with an adjusted classification of Category A assigned. In the Jan 2020 assessment, the species *Enteromius cf treurensis* (Critically endangered according the IUCN Red List) was collected at this point, as well as the species *Chiloglanis pretoriae*, which is known for its requirement of clear and fast flowing water of good quality in cobble habitat. Should the illegal artisanal mining activities increase in magnitude, this could result in the loss of available habitat for this species and as a result, the loss of this species to the Blyde River. Similarly, should the proposed mining project proceed, special care would need to be taken to prevent impacts related to erosion and sedimentation, loss of water quality and alterations to the natural flow profiles of the Blyde River;
- Overall, the EcoStatus Category for the IHI, MIRAI, VEGRAI and FRAI classifications comply with the RQIS PES (DWS, 2014) classification of Category C conditions for this section of the Blyde River. The overall Integrated EcoStatus Category for the BRN2 site complies with the RQIS PES (DWS, 2014) classification and due to the sensitivity of the system, any further impact must be avoided.

Riparian zone characteristics	The riparian zone was dominated by grasses, shrubs and trees. Both banks well covered with limited indication of erosion.	
Water clarity and odour	Water was very turbid at this point with no odour	
SITE ECOSTATUS CATEGORY		
MIRAI **Instream IHI** **Riparian IHI** **VEGRAI** **FRAI**		**Category B** **Category C** **Category B/C** **Category B/C** **Category A**
Integrated Ecological Category		**86.9% (Category B)**

Key Drivers of System Change and Business Case

- Possible cumulative impacts on the water quality, sedimentation and the proliferation of alien and invasive species as a result of upstream and surrounding forestry activities, run-off from the hard road surface, and illegal artisanal mining activities observed upstream of this point may begin to affect the Ecostatus Category of the river at this point if suitable mitigation and control measures are not implemented. This needs to be closely monitored and managed in future given the high sensitivity of the system;
- An impact on water quality and an impact on aquatic biota as a result of sediment loading are deemed possible future threats along this section of the Blyde River. This needs to be carefully managed and monitored should the proposed project proceed;
- Special mention is made of water quality, habitat and flow requirements of the fish species observed along this portion of the Blyde River, including *Chiloglanis pretoriae* which was sampled in the January 2020 assessment.

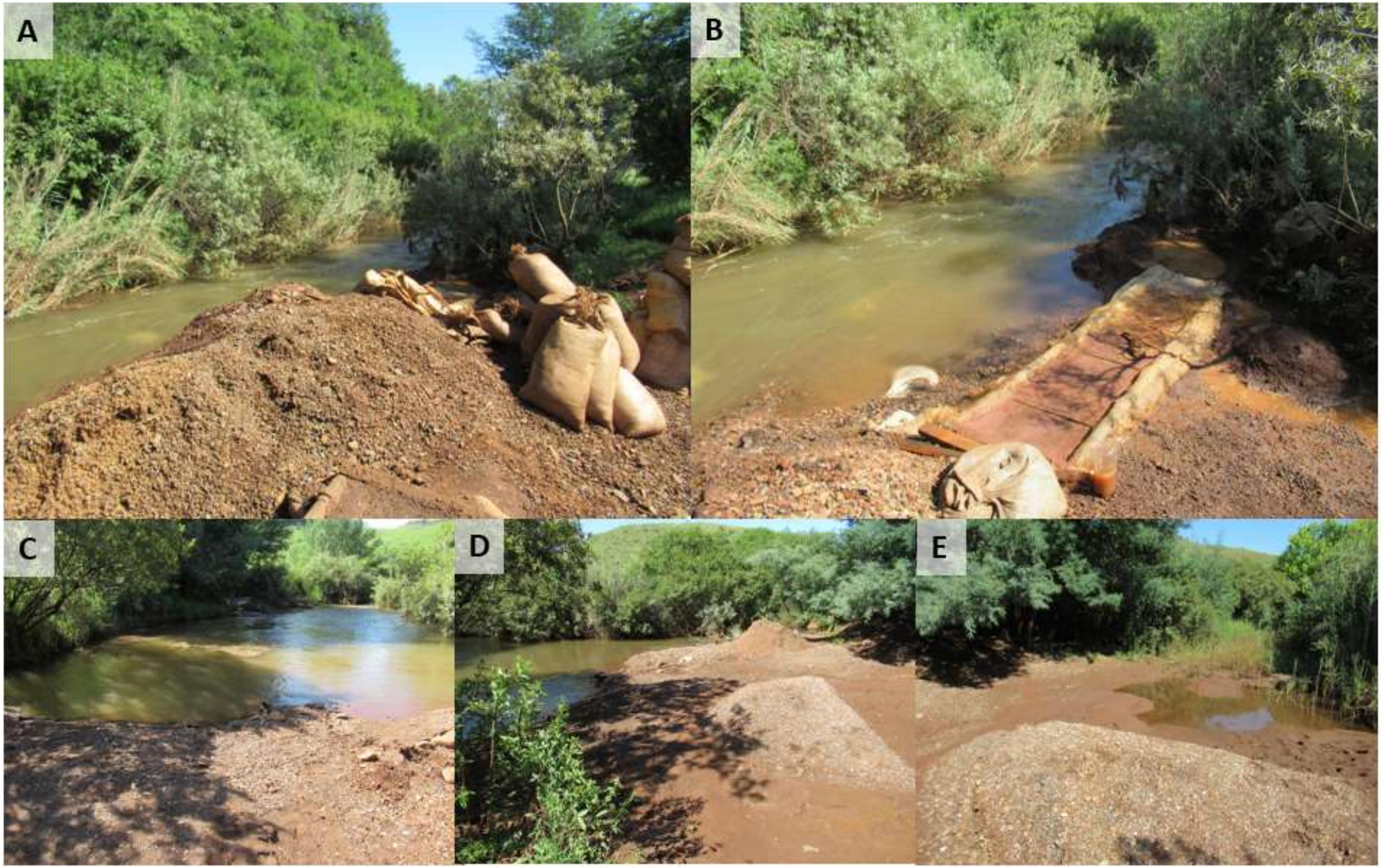


Figure 18: Illegal artisanal mining activities taking place upstream of site BRN2. A and B: washing of fines; C, D and E: partial diversion of the Blyde River.

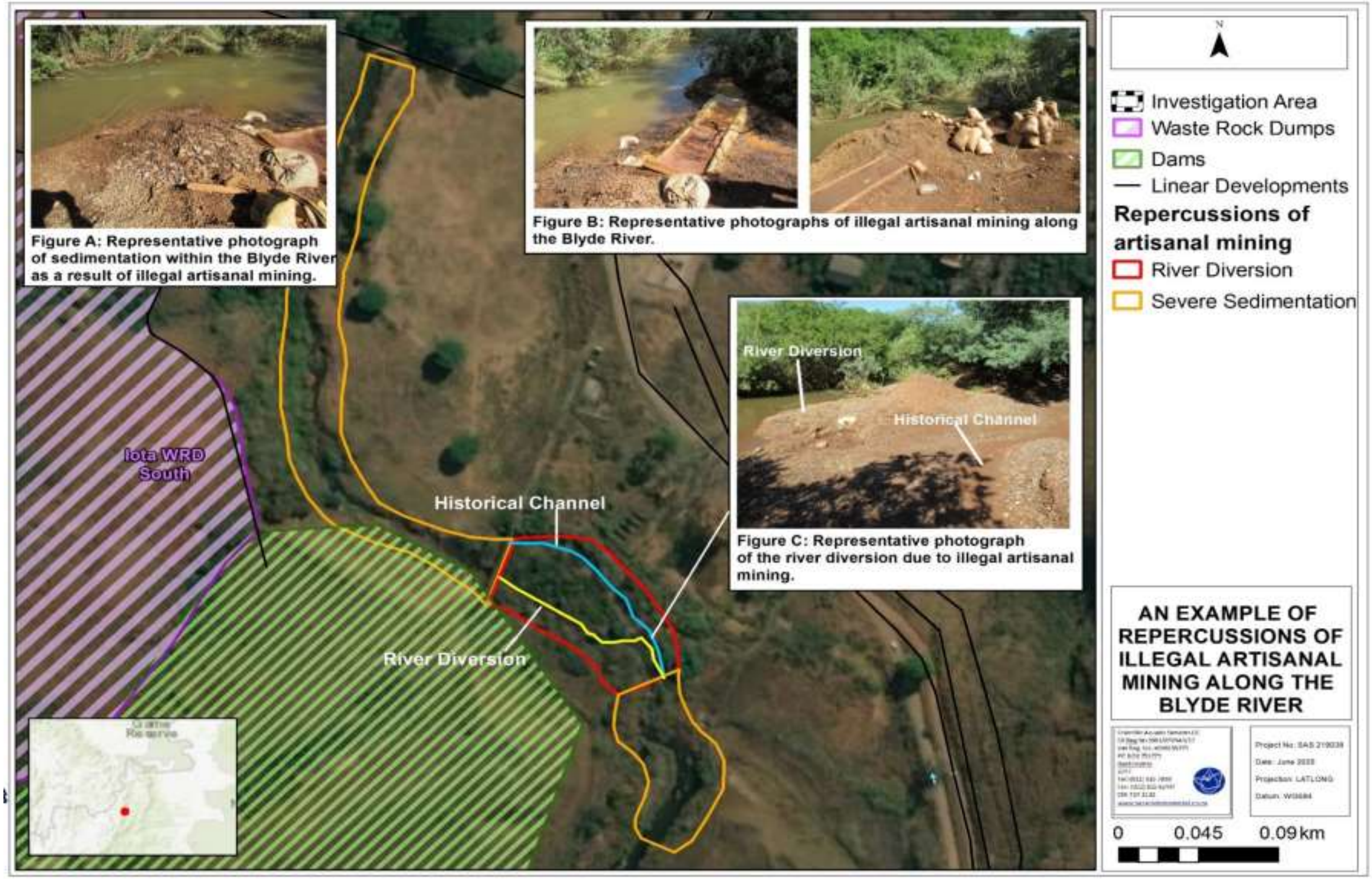


Figure 19: An example of the extent of the Blyde River currently impacted by the illegal artisanal mining activities observed at the time of the January 2020 assessment.

Table 17: Results of the Aquatic Ecological Assessment at Site BDS (Downstream site situated in the lower reaches of the Blyde River, downstream of Pilgrim's Caravan Park and Iota Hill Opencast study area) during the October 2018, March 2019 and the January 2020 assessment.

Site BDS

Figure 20: Downstream view of the BDS site at the time of the January 2020 assessment

Algal proliferation	Algae was observed in isolated clumps in the Oct 2018 and Mar 2019 assessment periods, during the Jan 2020 assessment, increased proloiferation of algae was observed on the rocks and cobbles.
Depth profiles	The site was dominated by moderately deep runs and slightly shallower rapids. Depth is generally about ½ m. The upstream reach consisted of shallower runs
Flow condition	Flow conditions during the October 2018 and March 2019 assessment periods were regarded as moderate to slow, fast runs and rapids dominated the site in the January 2020 assessment.
Riparian zone characteristics	The riparian zone was dominated by grasses, shrubs and trees. The right bank was severely eroded in some areas, while the left bank was relatively well vegetated.

***In situ* physico-chemical water quality**

	Oct 2018	Mar 2019	Jan 2020	DWS (2018)	
pH	7.93	8.62	8.28	**pH**	5.9 – 8.8
EC (mS/m)	14.9	11.2	8.5	**EC (mS/m)**	≤ 30
DO (mg/ℓ)	8.46	3.65	7.96	**DO (mg/ℓ)**	≥ 8.0
DO (% sat)	107.7	43.1	100.4		
Temp (℃)	19.1	17.8	19.9		

Seasonal variations in water quality (% var from October 2018)

	Mar 2019	Jan 2020
pH	+4.2	+4.4
EC (mS/m)	**-24.8**	**-43.0**
DO (mg/ℓ)	**-56.9**	-5.9

Index of Habitat Integrity

	Oct 2018	Mar 2019	Jan 2020
Instream IHI	80.8 (Category B/C)	79.5 (Category B/C)	82.8 (Category B)
Riparian IHI	80.0 (Category B/C)	80.0 (Category B/C)	80.03 (Category B/C)

Riparian Vegetation Response Assessment Index (VEGRAI score)

Oct 2018	Mar 2019	Jan 2020
78.9 (Category B/C)	78.9 (Category B/C)	77.8 (Category B/C)

Comment:

- The pH values complied with the recommended range as defined by the Department of Water and Sanitation (DWS, 2018) for all three assessments. No adverse effects on the aquatic ecology in terms of altered pH was thus deemed likely.
- EC complies with the DWS (2018) recommendation (< 30 mS/m), decreasing over time since the Oct 2018 no adverse effects on the aquatic ecology was observed, it is recommended that should the proposed project proceed, that this trend be monitored as this site serves as a reference site for the other Blyde River sites;
- DO saturation was considered variable over time with the DO in neither the Mar 2019 or Jan 2020 regarded as adequate in supporting a diverse and sensitive aquatic community falling below the > 8 mg/ℓ concentration recommendation (DWS, 2018), however, as for the upstream sites, the lower measured DO concentration results observed during the Mar 2019 assessment can potentially be attributed to probe malfunction as all DO measurements were lower during the second assessment;
- Sewage ingress was noted downstream of this point in the Oct 2018 assessment;
- Overall, in terms of water quality (specifically slight improvements in EC and some improvement in water clarity), some recovery of the system was observed, however, this improvement was not reflected in terms of habitat availability and the sensitivity and diversity of the aquatic macro-invertebrate community present.

Aquatic macro-invertebrate community integrity

	Oct 2018	Mar 2019	Jan 2020
SASS5 score	90	64	146
Number of Taxa	16	13	21
ASPT score	5.6	4.9	6.95
IHAS score	62 (Adequate)	62 (Adequate)	77 (Excellent)

Seasonal variations in aquatic macro-invertebrate community integrity (% var from October 2018)

	Mar 2019	Jan 2020
SASS5 score	**-28.9**	**+62.2**
ASPT score	-12.5	**+24.1**
IHAS score	0.0	**+24.2**

Fish Community Assessment (FRAI score)

Oct 2019	Mar 2019	Jan 2020
98.8 (Category A)	99.0 (Category A)	72.9 (Category C, automated) 99.1 (Category A, adjusted)
Enteromius neefi (LC)		*Enteromius neefi* (LC) *Enteromius viviparus* (LC) *Labeobarbus marequensis* (LC) *Chiloglanis pretoriae* (LC) Oncorhynchus mykiss (Alien)

Macro-invertebrate Response Assessment Index (MIRAI score)

Oct 2018	Mar 2019	Jan 2020
70.3 (Category C)	63.3 (Category C)	78.8 (Category B/C)

Comment:

- The integrity of the macro-invertebrate assemblage improved from a Category C classification in Oct 2018 and Mar 2019 to a Category B/C classification during the Jan 2020 assessment according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability was regarded as adequate in the Oct 2018 and Mar 2019 assessment periods, improving to excellent in the Jan 2020 assessment. The temporal improvement in macro-invertebrate integrity at this point in relation to the previous assessment is thus likely related to the improved habitat availability and suitability at this point;
- The instream integrity has shown significant recovery at this point in relation to the BRN2 site where the impacts of sedimentation related to the artisanal mining activities were observed. While some recovery related to the artisanal mining activities upstream of this was observed, the riparian zone has remained in a minimally to moderately modified condition likely due to the impacts of erosion observed at this point. to largely natural with some signs of sedimentation in the instream zones and some evidence of alien vegetation encroachment in the riparian zones;
- The fish community integrity (FRAI) at the site was regarded as unmodified with an adjusted classification of a Category A assigned at the time of all three assessments based on suitable water quality and habitat conditions at the site;

<table>
<tr><td></td><td></td><td colspan="3"></td><td>➢ Overall, the EcoStatus Categories for the IHI, MIRAI, VEGRAI and FRAI classifications comply with the RQIS PES (DWS, 2014) classification of Category C conditions for this section of the Blyde River. The overall Integrated EcoStatus Category for the BDS site complies with the RQIS PES (DWS, 2014) classification and due to the sensitivity of the system, any further impact must be avoided.</td></tr>
<tr><td colspan="2">Water clarity and odour</td><td colspan="2">Water was clear in both the oct 2018 and Mar 2019 assessments and discoloured in the January 2020 assessment, but in all three assessments, blanketing of benthos was noted. No odours were evident.</td><td colspan="2" rowspan="5">Key Drivers of System Change and Business Case
➢ Possible cumulative impacts on the water quality as a result of upstream historical and artisanal mining, and forestry activities, as well as the informal road crossing. However, in relation to the upstream BRN2 site, some recovery of the system was observed in terms of water quality. This spatial improvement in terms of water quality was not strongly reflected in either the habitat suitability or macro-invertebrate assessment results, with a slight decline noted in the integrity of the aquatic macro-invertebrate integrity at this point. Some impact related to the proliferation of algae and the blanketing of benthos is likely to have resulted in some limitations in habitat availability for colonization by macro-invertebrates;
➢ An impact on water quality and an impact on aquatic biota as a result of sediment loading are deemed possible future threats along this section of the Blyde River due to both historical mining and ongoing illegal artisanal mining activities. due to past mining activities. This needs to be monitored should the proposed mining project proceed;
➢ Special care should be taken to prevent impacts related to erosion and sedimentation, loss of water quality and alterations to the natural flow profiles of the Blyde River. Special mention is made of water quality, habitat, and flow requirements of the fish species observed along this portion of the Blyde River and upstream of this point, including Labeobarbus marequensis and Chiloglanis pretoriae which were sampled in the January 2020 assessment.</td></tr>
<tr><td colspan="4">SITE ECOSTATUS CATEGORY</td></tr>
<tr><td></td><td>Oct 2018</td><td>Mar 2019</td><td>Jan 2020</td></tr>
<tr><td>MIRAI
Instream IHI
Riparian IHI
VEGRAI
FRAI</td><td>Category C
Category B/C
Category B/C
Category B/C
Category A</td><td>Category C
Category B/C
Category B/C
Category B/C
Category A</td><td>Category B/C
Category B
Category B/C
Category B/C
Category A</td></tr>
<tr><td>Integrated Ecological Category</td><td>80.0% (Category B/C)</td><td>77.3% (Category C)</td><td>83.01 (Category B)</td></tr>
</table>

Table 18: Results of the Aquatic Ecological Assessment at Site BRN3 (Historical RHP monitoring site. Downstream of the study area and the Pilgrims Rest town and WWTW).

Site BRN3

Figure 21: Upstream view of the BRN3 site at the time of the January 2020 assessment.

Algal proliferation	Algal proliferation observed on rocks
Depth profiles	The river at this point was dominated by relatively deep pools (>1 m) and moderately shallow rapids and runs (approx.. ½ m)
Flow condition	The site was dominated by a slower deep pools and fast flowing rapids and runs.
Riparian zone characteristics	The riparian zone was dominated by grasses, shrubs and trees. Both banks well covered, but some severe erosion was noted on the left bank of the Blyde River at this point, with less severe erosion noted further downstream
Water clarity and odour	Water was very discoloured
SITE ECOSTATUS CATEGORY	

In situ **physico-chemical water quality**

		DWS (2018)	
pH	7.75	**pH**	5.9 – 8.8
EC (mS/m)	13.7	**EC (mS/m)**	≤ 30
DO (mg/ℓ)	8.24	**DO (mg/ℓ)**	≥ 8.0
DO (% sat)	101.0		
Temp (℃)	19.2		

Index of Habitat Integrity

Instream IHI	83.4 (Category B)
Riparian IHI	80.03 (Category B/C)

Riparian Vegetation Response Assessment Index

VEGRAI score	77.8 (Category B/C)

Comment:

- The pH value complied with the recommended range as defined by the (DWS, 2018);
- The EC fell within the DWS (2018) recommendation (< 30 mS/m) and was unlikely to limit the sensitivities of the aquatic assemblages likely to occur at this point;
- The DO saturation was considered adequate on comparison with the > 8 mg/ℓ concentration recommendation (DWS, 2018);
- Overall, no effects on the biota specific water quality due to altered water quality was deemed likely, however, impacts to water clarity may begin to impact visual feeder predatory fish and macro-invertebrate species. Cumulative impacts to both fish and macro-invertebrate assemblages appear to have improved at this point with improvements in habitat suitability and slightly reduced turbidity.

Aquatic macro-invertebrate community integrity

Invertebrate community assessment (SASS5 and IHAS)

SASS5 score	166
Number of Taxa	24
ASPT score	6.92
IHAS score	86 (Excellent)

Fish Community Assessment

FRAI score	79.5 (Category B/C, automated) 99.1 (Category A, adjusted)

Enteromius neefi (LC)
Enteromius viviparus (LC)
Enteromius paludinosis (LC)
Enteromius anoplus (LC)
Amphilius uranoscopus (LC)
Chiloglanis pretoriae (LC)
Labeobarbus marequensis (LC)
Oncorhynchus mykiss (Alien)

Macro-invertebrate Response Assessment Index

MIRAI score	80.8% (Category B/C)

Comment:

- The site was considered to be in a Category B/C condition according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability was regarded as excellent and likely to support a diverse and sensitive aquatic assemblage;
- The instream habitat integrity was regarded minimally modified as no impacts related to sedimentation were observed at this point. The riparian zone integrity was regarded as moderate to largely natural with impacts largely related to erosion at this point.
- The fish community integrity at the site was regarded as unmodified with an adjusted classification of Category A assigned.
- Overall, the EcoStatus Category for the IHI, MIRAI, VEGRAI and FRAI classifications comply with the RQIS PES (DWS, 2014) classification of Category C conditions for this section of the Blyde River. The overall Integrated EcoStatus Category for the BRN2 site complies with the RQIS PES (DWS, 2014) classification and due to the sensitivity of the system, any further impact must be avoided.

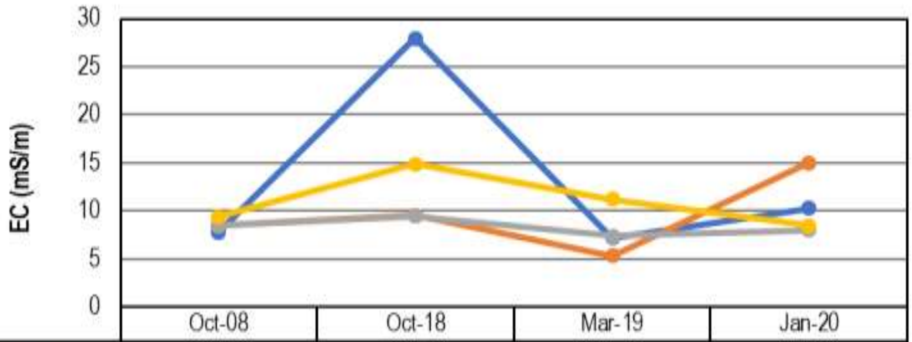
Key Drivers of System Change and Business Case

- The Blyde River at this point has shown recovery from the results observed at site BDS in terms of both macro-invertebrate and fish community integrity. No impacts related to sedimentation were observed at this point, however, some impact occurs in a downstream direction as increasing algal proliferation on the rocks was observed. Possible cumulative impacts on the water quality, erosion and sedimentation, and the proliferation of alien and invasive species as a result of upstream and surrounding forestry activities, run-off from the hard road surface, increasing urbaisation and the associated surface hardening, effluent releases from the Waste Water Treatment Works, and illegal artisanal mining activities observed upstream of this point may begin to affect the Ecostatus Category of the

MIRAI **Instream IHI** **Riparian IHI** **VEGRAI** **FRAI**	**Category B/C** **Category B** **Category B/C** **Category B/C** **Category A**	river further downstream of this point if suitable mitigation and control measures are not implemented on a catchment level. This needs to be closely monitored and managed in future given the high sensitivity of the system; ➢ Special care should be taken to prevent impacts related to erosion and sedimentation, loss of water quality and alterations to the natural flow profiles of the Blyde River. Special mention is made of water quality, habitat, and flow requirements of the fish species observed along this portion of the Blyde River and upstream of this point, including *Labeobarbus marequensis, Chiloglanis pretoriae* and *Amphilius uranoscopus*, which were sampled in the January 2020 assessment.
Integrated Ecological Category	**83.8 (Category B)**	

6.5.1 *Temporal Water Quality Comparison for the Blyde River sites (BUS, BMS1, BMS2 and BDS)*

For the purpose of the Blyde River sites assessed by SAS, temporal comparison of water quality was limited to the four biomonitoring sites which were sampled in all three field assessments (October 2018[4], March 2019, January 2020) as well as historical biomonitoring obtained in 2008[5]. The sites assessed for the purposes of this study were compared to the nearest site's data from the October 2008 study. These results serve to indicate the temporal change that has occurred in the Blyde River over time, however, due to the variations in site locality between the two studies, results should be interpreted with caution. Site BUS was compared to site S1[3], sites BMS1 and BMS2 were compared to site S2[3] and site BDS was compared to site S3[3].



	Oct-08	Oct-18	Mar-19	Jan-20
BUS	7,8	28	7,2	10,3
BMS1	8,5	9,51	5,3	15
BMS2	8,5	9,5	7,4	8
BDS	9,4	14,9	11,2	8,5

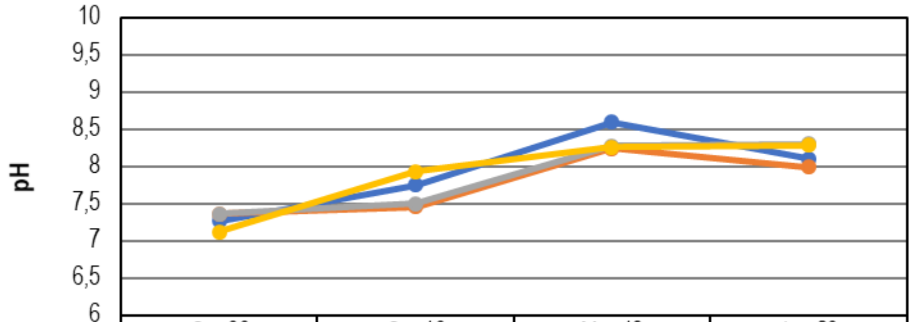
Figure 22: Temporal EC variation over time on this portion of the Blyde River in relation to data obtained in 2008.

- Since the baseline in October 2008, the EC has increased by 32.1% at site BUS and by 76.6% at site BMS1. These values exceed the TWQR as defined by DWAF, 1996 advocating no more than 15% seasonal change. However, the data suggests significant seasonal and localised short-term variability. Surrounding land-use activities related to historical mining and ongoing illegal artisanal mining activities, as well as forestry activities were observed as the potential drivers of change in EC in this portion of the Blyde River over time. It is important to note that no temporal data was collected for the sites assessed downstream of site BDS and further catchment-wide impacts will be discussed in terms of

[4] Scientific Aquatic Services (2018). Freshwater Resource and Aquatic Ecological Assessment as part of the Water Use Licensing Process for the Proposed Stonewall Mining Transvaal Gold Mining Estates (TGME) Mine Development Project, near Pilgrims Rest, Mpumalanga Province. MvB Consulting. November 2018.

[5] Scientific Aquatic Services (2008). Aquatic Ecological Study of the Blyde River in the vicinity of proposed Beta Mine expansion at the TGME Mine, Pilgrims Rest. GCS (Pty) Ltd. November 2008.

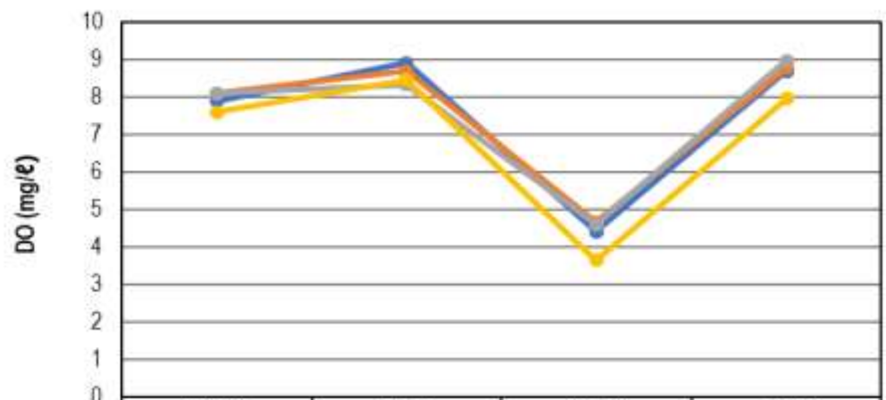
the spatial variations observed along the Blyde River in the January 2020 assessment in the sections that follow.



	Oct-08	Oct-18	Mar-19	Jan-20
BUS	7,26	7,75	8,59	8,1
BMS1	7,36	7,45	8,24	7,99
BMS2	7,36	7,5	8,27	8,3
BDS	7,12	7,93	8,26	8,28

Figure 23: Temporal pH variation over time on this portion of the Blyde River in relation to data obtained in 2008.

- A notable change was observed at each of the sites assessed between the October 2018 and the March 2019 assessment periods with the pH increasing by 10.8% at site BUS, 10.6% at site BMS1, 10.3% at site BMS2, and by 4.6% at site BDS. At sites BUS, BMS1 and BMS2, the increases of > 5% exceeds the TWQR as defined by DWAF, 1996. While a natural seasonal change is considered possible, impacts related to the surrounding forestry activities in terms of pH should be considered. Large variations in pH have the potential to result in impacts to the integrity of the aquatic assemblage of the Blyde River and monitoring of this parameter is thus considered essential.



	Oct-08	Oct-18	Mar-19	Jan-20
BUS	7,9	8,91	4,42	8,69
BMS1	8,1	8,69	4,67	8,77
BMS2	8,1	8,33	4,6	8,98
BDS	7,6	8,46	3,65	7,96

Figure 24: Temporal DO variation over time on this portion of the Blyde River in relation to data obtained in 2008.

- The DO levels were observed to be largely stable in the Blyde River over time with the exception of the DO values observed in the March 2019 assessment. Upon further investigation, it was found that the lower measured DO concentrations observed in the March 2019 assessment may likely have been attributed to probe malfunction as all DO measurements were lower during the March 2019 assessment[6].

Temporal variation of TGME's water quality monitoring points (as per Figure 25 and 26 overleaf):

- The long-term trend for conductivity (EC) at the S5 (BMS1 upstream) site is largely stable (Figure 25) but variable over time, ranging from 30.0 mS/m to 104.0 mS/m. At site S19 (BMS2 downstream), the long-term trend for EC (Figure 26) indicates a decreasing trend over time which is considered a positive change towards more natural conditions (≤ 30 mS/m), however, as with the S5 site, the EC is largely variable;
- The pH of both sites is relatively stable over the long-term as indicated by the trendlines in Figures 24 and 25. The pH of both sites largely complies with the DWS (2018) natural range (5.9 – 8.8);
- Long-term trends for temperature variation at both sites was considered normal considering diurnal cycles; and
- Continued regular monitoring of the TGME water quality monitoring sites is recommended to monitor any emerging impacts over time.

[6] Dissolved Oxygen probe malfunction was only identified after the field assessment in March 2019 and results therefore are not an accurate indication of the DO concentration and saturation.

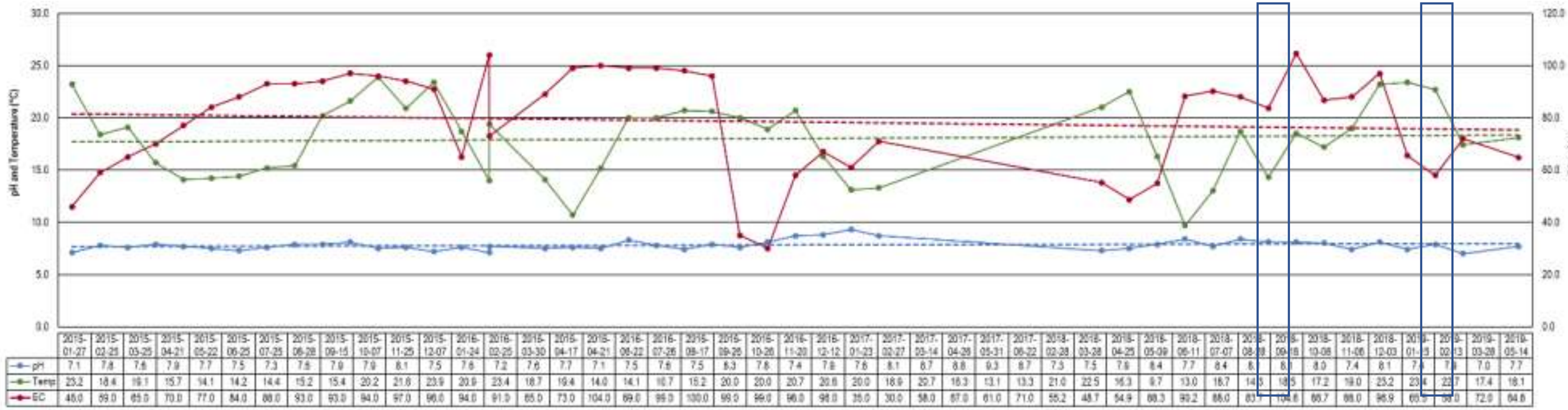


Figure 25: Temporal pH, temperature and EC variation at site S5 (BMS1) since January 2015 (adapted from TGME’s water quality monitoring data). Blue boxes indicate the time of SAS sampling in October 2018 and March 2019.

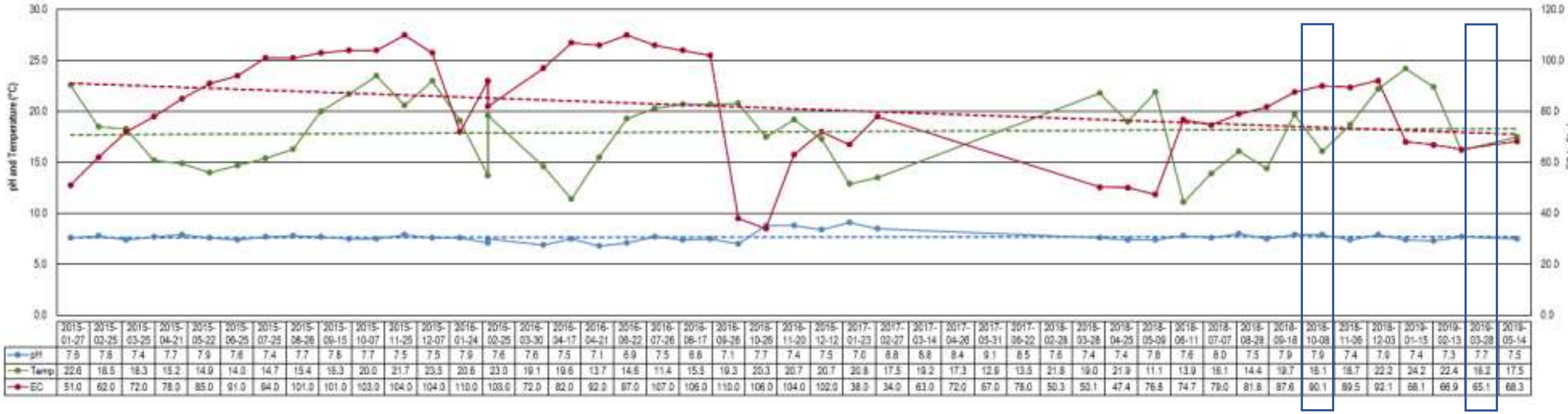
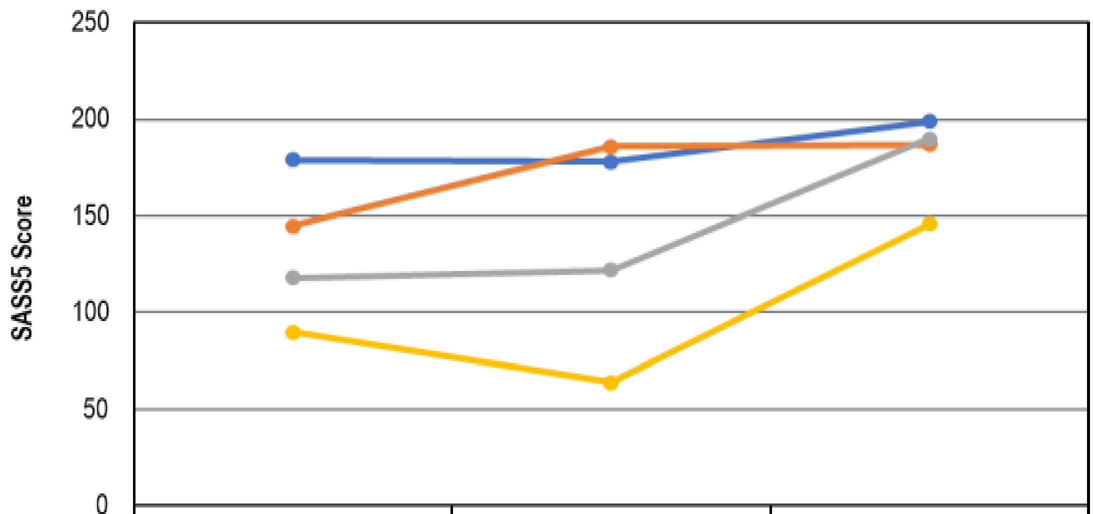


Figure 26: Temporal pH, temperature and EC variation at site S19 (BMS2) since January 2015 (adapted from TGME’s water quality monitoring data). Blue boxes indicate the time of SAS sampling in October 2018 and March 2019.

6.5.2 *Temporal Macro-invertebrate Community Integrity Comparison for the Blyde River sites*

For the purposes of monitoring temporal change of the macro-invertebrate assemblage along this portion of the Blyde River over time, comparison was limited to the four biomonitoring sites which were sampled in all three field assessments (October 2018[7], March 2019, January 2020), and the historical October 2018[8] results were not included. This is largely due to the reluctance to introduce spatial site-specific variations that may occur due to varying habitat compositions at each of the sites, which would then have the potential to skew the temporal results observed at each point.



	Oct-18	Mar-19	Jan-20
BUS	179	178	199
BMS1	145	186	187
BMS2	118	122	190
BDS	90	64	146

Figure 27: Temporal SASS5 variation observed on the Blyde River over time since the October 2018 assessment.

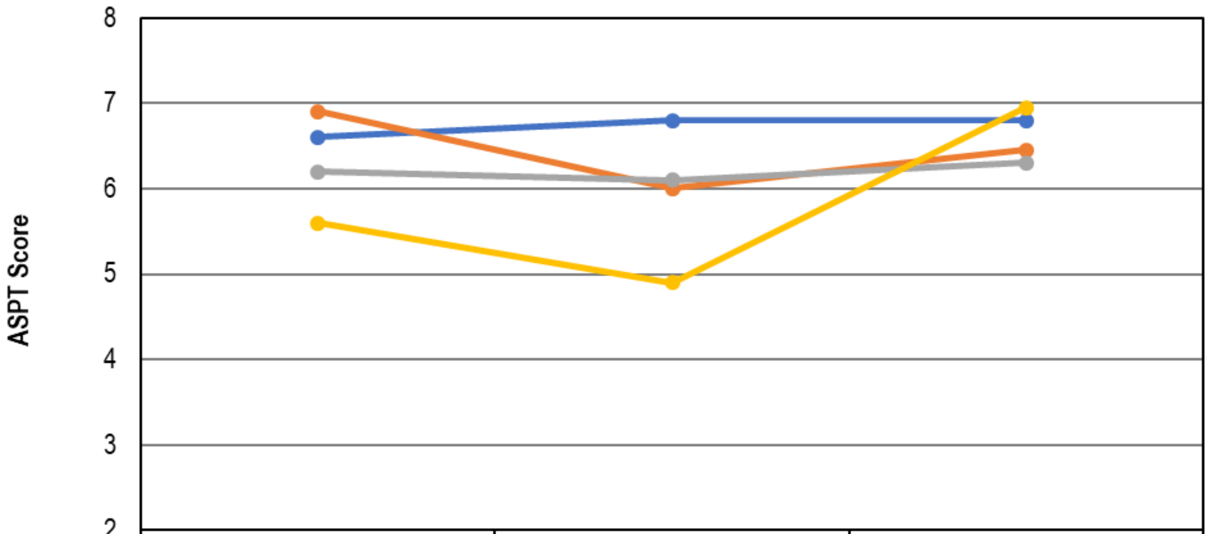
- The SASS5 score shows some seasonal variation with all the scores improved by 11.2% at site BUS, 29.0% at site BMS1, 61.0% at site BMS2 and 62.2% at site BDS in relation to the scores obtained in October 2018. Seasonal high and low flow variations in the macro-invertebrate assemblage are deemed natural, with diversity likely to improve during the high flow season as was observed in the January 2020 assessment. The SASS5 scores at sites BUS and BMS1 appear unaffected by

[7] Scientific Aquatic Services (2018). Freshwater Resource and Aquatic Ecological Assessment as part of the Water Use Licensing Process for the Proposed Stonewall Mining Transvaal Gold Mining Estates (TGME) Mine Development Project, near Pilgrims Rest, Mpumalanga Province. MvB Consulting. November 2018.

[8] Scientific Aquatic Services (2018). Freshwater Resource and Aquatic Ecological Assessment as part of the Water Use Licensing Process for the Proposed Stonewall Mining Transvaal Gold Mining Estates (TGME) Mine Development Project, near Pilgrims Rest, Mpumalanga Province. MvB Consulting. November 2018.

variations in the habitat suitability and habitat availability. Some change in this trend was observed in a downstream direction with decreasing SASS5 scores observed at sites BMS2 and site BDS. Further investigation indicated a correlation between compromised habitat integrity and the SASS5 scores obtained in a downstream direction.

- Illegal artisanal mining activities observed on the Blyde River at the time of the January 2020 assessment has resulted in severe sedimentation in some areas, and may potentially have contributed to blanketing of benthos and algal proliferation, which has begun to compromise the habitat integrity and water clarity of the Blyde River in a downstream direction.



	Oct-18	Mar-19	Jan-20
BUS	6,6	6,8	6,8
BMS1	6,9	6	6,45
BMS2	6,2	6,1	6,3
BDS	5,6	4,9	6,95

Figure 28: Temporal ASPT variation observed on the Blyde River over time since the October 2018 assessment.

- The ASPT scores observed over time at each of the sites were observed to be largely stable over time. The consistently lower ASPT scores observed at the downstream sites BMS2 and BDS (specifically during the October 2018 and March 2019 assessments) are indicative of long-term impacts in a downstream direction, with habitat availability and water clarity playing an important role in shaping the aquatic assemblages present.

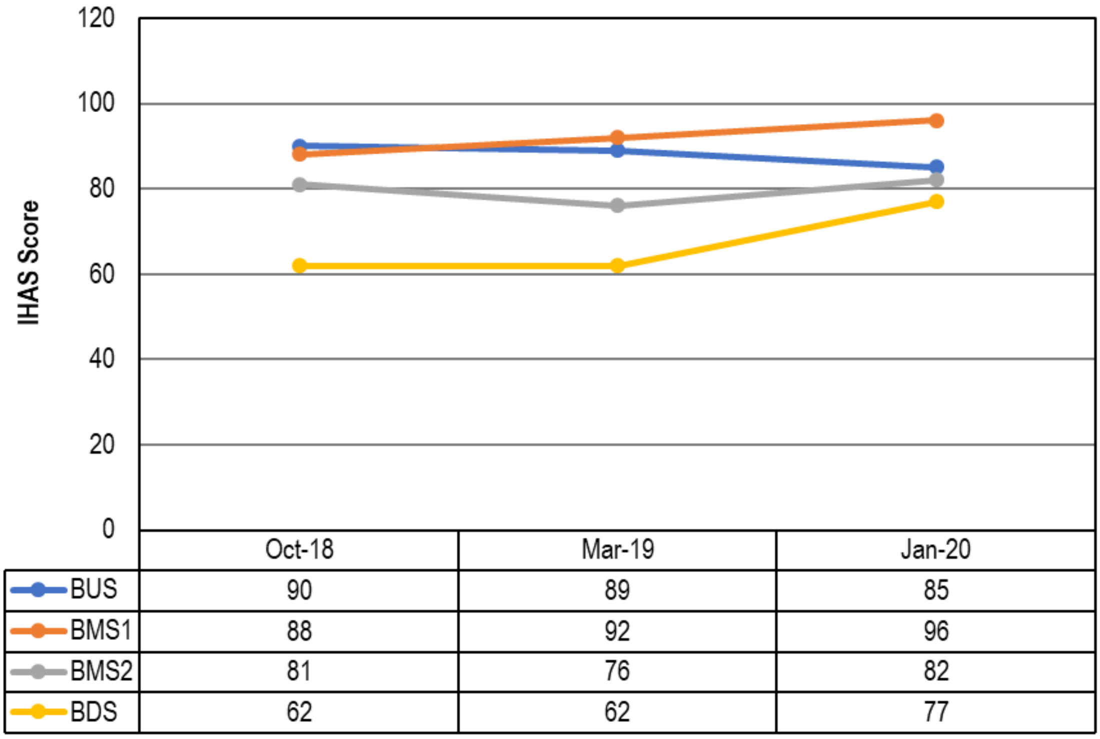
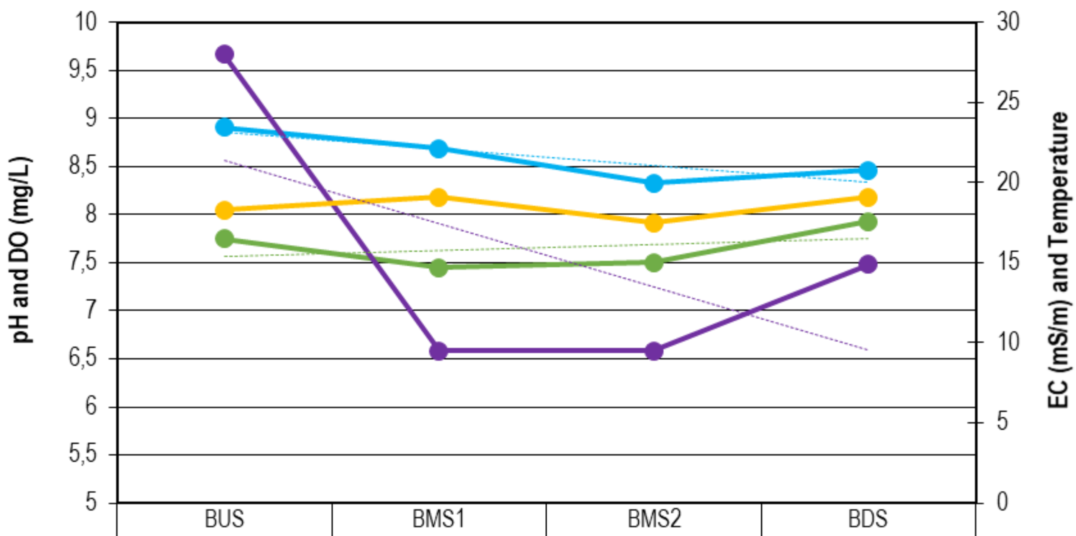


Figure 29: Temporal IHAS variation observed on the Blyde River over time since the October 2018 assessment.

- On consideration of seasonal variability in habitat suitability and availability, the variations in IHAS scores at each of the sites over time may be regarded as natural;
- However, it is important to note the general trend in decreasing habitat suitability in a downstream direction;
- These decreases, which were consistently observed over time since the October 2018 assessment, are indicative of impacts to the habitat integrity of the Blyde River over time due to the surrounding land-uses. These include ongoing illegal artisanal mining, forestry and the proliferation of alien and invasive species and other anthropogenic activities, which result in the alteration of the natural surface water runoff patterns to the river, resulting in and increased potential for incision and erosion of the river's natural banks.

6.5.3 *Spatial Water Quality Comparison for the Blyde River sites*

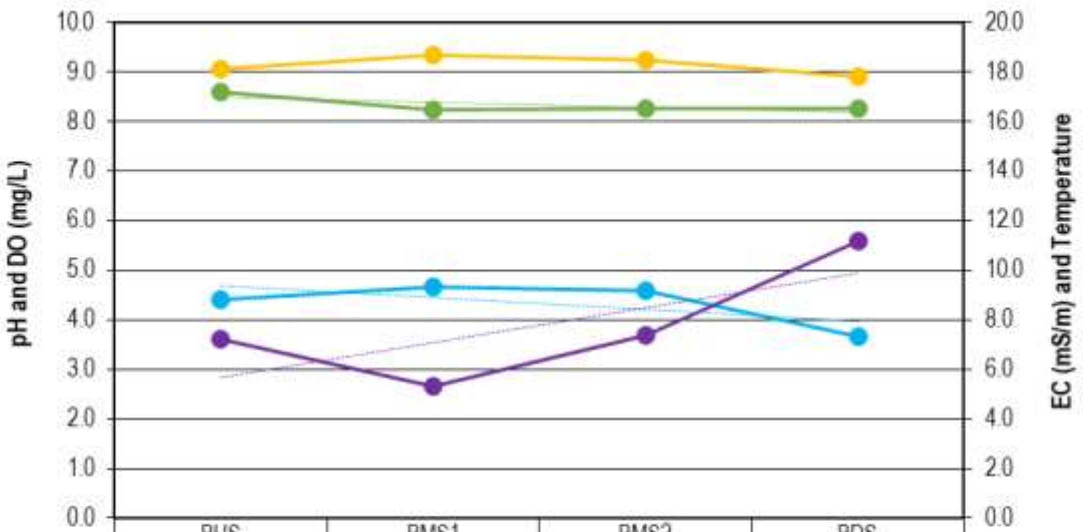
The spatial water quality comparisons were limited to sites BUS, BMS1, BMS2 and BDS for the October 2018 and March 2019 assessments, while sites BRN1, BRN2 and BRN3 were additionally assessed in the January 2020 assessment.



	BUS	BMS1	BMS2	BDS
pH	7,75	7,45	7,5	7,93
DO (mg/L)	8,91	8,69	8,33	8,46
EC (mS/m)	28	9,51	9,5	14,9
Temp (°C)	18,3	19,1	17,5	19,1

Figure 30: Spatial water quality variation in the October 2018 assessment.

- Spatially, the EC significantly decreased by 46.8% between the upstream and downstream sites [exceeding the TWQR (DWAF, 1996)] which is indicated by an overall decreasing trendline observed in Figure 29. Temporal comparisons also suggested short-term variability in EC;
- Spatially, pH increased by 2.3% in a downstream direction between the upstream site BUS and the downstream site BDS, as indicated by the overall increasing trendline (Figure 29). The pH decreased negligibly by 3.9% between site BUS and site BMS1, and decreased by 3.2% at site BMS2 when compared to the upstream site (BUS). These spatial changes complied with the TWQR (DWAF, 1996) and did not exceed the 5% variance range;
- The pH values at all four sites were considered natural and spatially, no impacts resulting from pH variations were deemed likely during the October 2018 assessment;
- The DO levels at all four sites were considered ideal for supporting diverse aquatic life and complied with the guidelines stipulated by the TWQR (DWAF, 1996), which stipulates that the dissolved oxygen level should fall between 80% and 120% saturation; and
- Temperatures may be considered natural for the season and time of day of the assessment (October 2018).

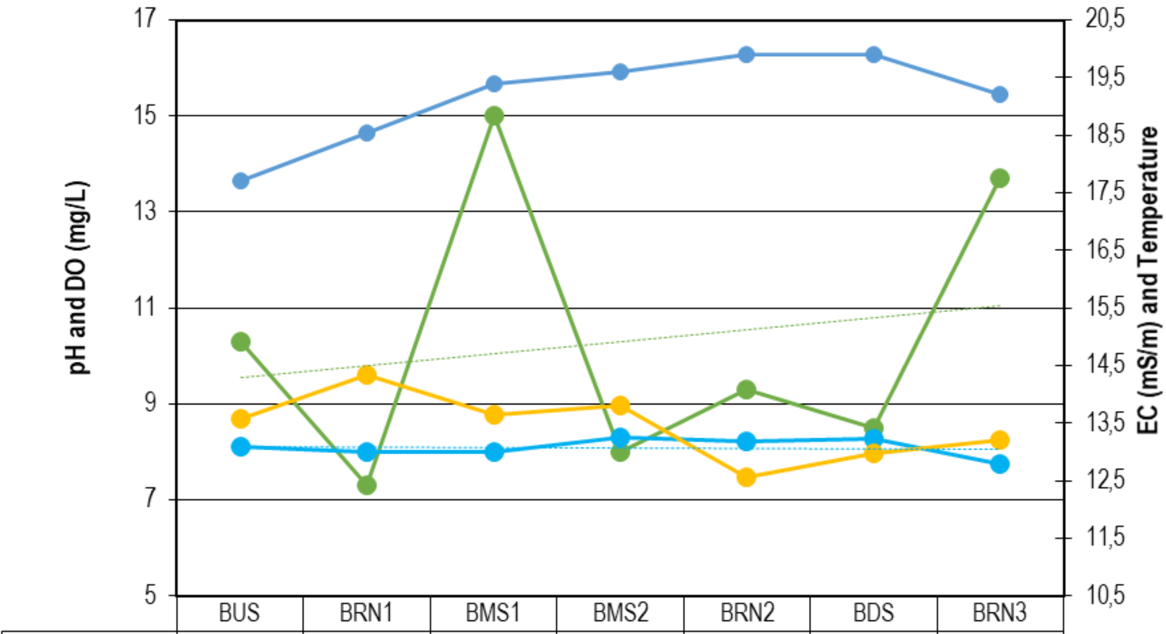


	BUS	BMS1	BMS2	BDS
pH	8.6	8.2	8.3	8.3
DO (mg/L)	4.4	4.7	4.6	3.7
EC (mS/m)	7.2	5.3	7.4	11.2
Temp (°C)	18.1	18.7	18.5	17.8

Figure 31: Spatial water quality variation in the March 2019 assessment.

- Spatially, the EC decreased significantly (> 15%) by 26.4% between site BUS and site BMS1 [which exceeds the Target Water Quality Requirement (TWQR) as defined by DWAF, 1996]. The EC increased insignificantly (< 15%) by 2.8% between site BUS and site BMS2, which complies with the TWQR (DWAF, 1996). Overall, the EC significantly increased by 55.6% between the upstream and downstream sites [exceeding the TWQR (DWAF, 1996)] which is indicated by an overall increasing trendline observed in Figure 30;
- This indicates that possible significant spatial impacts as a result of potential runoff/seepage associated with historic and current mining activities as well as potential anthropogenic activities associated with the town of Pilgrims Rest are likely at the time of the March 2019 assessment;
- Spatially, pH decreased by 3.8% in a downstream direction between the upstream site BUS and the downstream site BDS, as indicated by the overall decreasing trendline (Figure 30). The pH decreased negligibly by 4.1% between site BUS and site BMS1, and decreased by 3.7% at site BMS2 when compared to the upstream site (BUS). These spatial changes complied with the TWQR (DWAF, 1996) and did not exceed the 5% variance range;
- The pH values at all four sites can be considered as natural and spatially, no impacts resulting from pH variations are thus deemed likely at the time of the March 2019 assessment;

- The DO levels at all four sites were considered inadequate in supporting diverse aquatic life as stipulated by the guidelines of the TWQR (DWAF, 1996), which stipulates that the dissolved oxygen level should fall between 80% and 120% saturation. However, it was the opinion of the specialist that the low DO readings were likely a result of probe malfunction at the time of the March 2019 assessment as low DO readings were recorded from all four sites, despite adequate flow conditions conducive to high DO concentrations; and
- Temperatures were considered natural for the season and time of day of the assessment.



	BUS	BRN1	BMS1	BMS2	BRN2	BDS	BRN3
EC (mS/m)	10,3	7,3	15	8	9,3	8,5	13,7
pH	8,1	8	7,99	8,3	8,23	8,28	7,75
DO (mg/L)	8,69	9,6	8,77	8,98	7,48	7,96	8,24
Temp (°C)	17,7	18,53	19,4	19,6	19,9	19,9	19,2

Figure 32: Spatial water quality variation in the January 2020 assessment.

- The EC shows significant spatial variation along the length of the Blyde River. With an increase of 105.5% in EC observed at site BMS1 in relation to that observed at site BRN1. At site BMS2, the EC was found to have decreased once again by 46.7%. Overall, the EC significantly increased by 33.0% between the upstream BUS and downstream BRN3 sites, which is indicated by an overall increasing trendline observed in Figure 31. These changes exceed the TWQR (DWAF, 1996) and possible significant spatial impacts as a result of historical mining and ongoing artisanal mining activities, impacts related to forestry, the proliferation of alien and invasive species (resulting in altered runoff to the river), discharges and seepage related to sewage and the WWTW situated downstream of the town of Pilgrims Rest and increasing urbanisation were observed as likely to impact this portion of the Blyde River;

- Spatially, pH decreased by 4.3% in a downstream direction between the upstream site BUS and the downstream site BRN3, as indicated by the overall decreasing trendline (Figure 30). While the pH was regarded as somewhat variable along this section of the Blyde River, the pH values at all sites was considered as natural and spatially, no impacts resulting from pH variations were deemed likely;
- The DO levels at the downstream sites BRN2 and BDS were regarded as slightly low and did not comply with the > 8 mg/ℓ concentration recommendation (DWS, 2018). Some impact related to the illegal artisanal mining activities upstream of site BRN2 was suspected due to sedimentation and alteration associated with the natural flow profiles of the river due to the partial river diversion observed, however, the DO appeared to have recovered once again at the downstream site BRN3; and
- Temperatures were considered natural for the season and time of day of the assessment.

Ongoing monitoring of the Blyde River sites, with particular focus on EC and DO and the variability thereof, will need to continue to monitor existing trends and identify any emerging impacts.

6.5.4 *Spatial Macro-invertebrate Community Integrity Comparison for the Blyde River sites*

The spatial macro-invertabrate assemblage comparisons were limited to sites BUS, BMS1, BMS2 and BDS for the October 2018 and March 2019 assessments, while sites BRN1, BRN2 and BRN3 were additionally assessed in the January 2020 assessment.

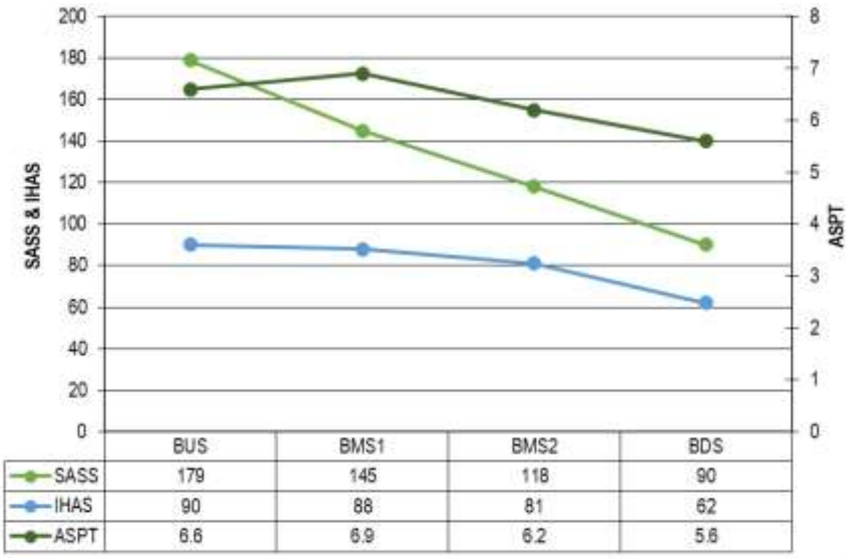


Figure 33: Spatial macro-invertebrate community integrity variation in the October 2018 assessment.

- The SASS5 data from the October 2018 assessment indicates that the aquatic macro-invertebrate community in this section of the Blyde River has suffered a marginal loss in integrity throughout the area in a downstream direction, when compared to the reference score for a pristine Northern Escarpment Mountain ecoregion stream;
- Spatially, between sites BUS and BMS1, the SASS5 score significantly (> 15%) decreased by 19.0%, the ASPT score increased by 4.5% and the habitat suitability only slightly decreased by 2.2%;
- Spatially, between sites BUS and BMS2, the SASS5 score significantly (> 15%) decreased by 34.1%, the ASPT score decreased by 6.1% and the habitat suitability decreased by 10.0%;
- Spatially, in a downstream direction between the upstream BUS site and the downstream BDS site, significant (> 15%) deterioration of the three aquatic macro-invertebrate indices is observed. The SASS5 score decreased by 49.7%, the ASPT score decreased by 15.2% and the habitat suitability decreased by 31.1%; and
- The decrease of macro-invertebrate community diversity is likely related to the decrease in habitat availability and sensitivity (of which ASPT is a measure) in a downstream direction, as well as the deterioration in habitat type variability at the downstream site in comparison to the upstream site (notably sedimentation observed at downstream site BDS).

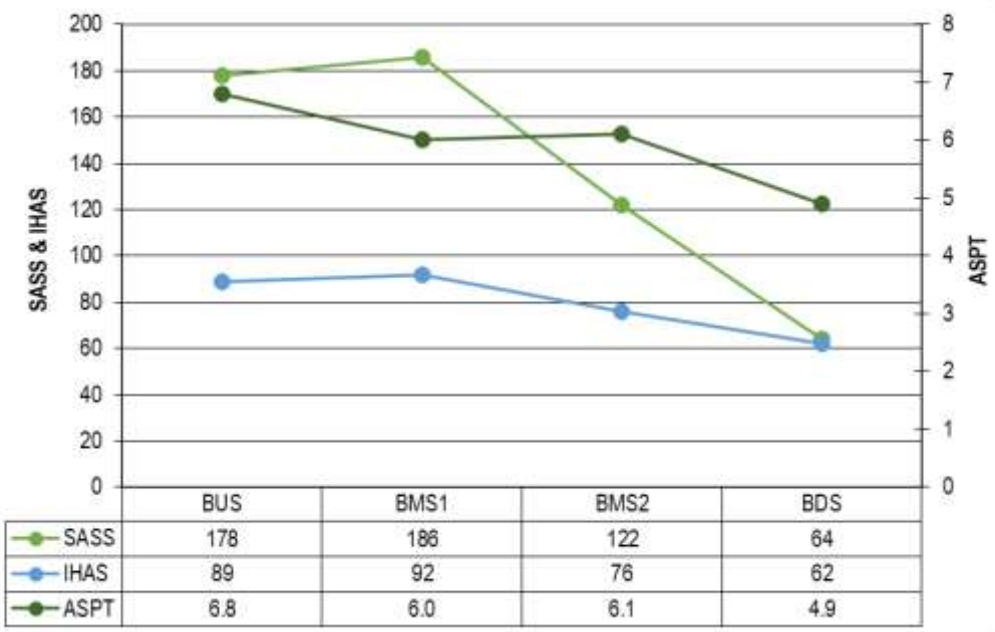


Figure 34: Spatial macro-invertebrate community integrity variation in the March 2019 assessment.

- The SASS5 data from the March 2019 assessment indicates that the aquatic macro-invertebrate community in this section of the Blyde River has suffered a minimal to marginal loss in integrity throughout the area in a downstream direction, when compared to the reference score for a pristine Northern Escarpment Mountain ecoregion stream;
- Spatially, between sites BUS and BMS1, the SASS5 score insignificantly (< 15%) increased by 4.5%, the ASPT score decreased by 11.8% and the habitat suitability only slightly increased by 3.4%;
- Spatially, between sites BUS and BMS2, the SASS5 score significantly (> 15%) decreased by 31.5%, the ASPT score decreased by 10.3% and the habitat suitability decreased by 14.6%;
- Spatially, in a downstream direction between the upstream BUS site and the downstream BDS site, significant (> 15%) deterioration of the three aquatic macro-invertebrate indices is observed. The SASS5 score decreased by 64.0%, the ASPT score decreased by 27.9% and the habitat suitability decreased by 30.3%; and
- The decrease of macro-invertebrate community diversity is likely related to the decrease in habitat availability and sensitivity (of which ASPT is a measure) in a downstream direction as well as the deterioration in habitat type variability at the downstream site in comparison to the upstream site.

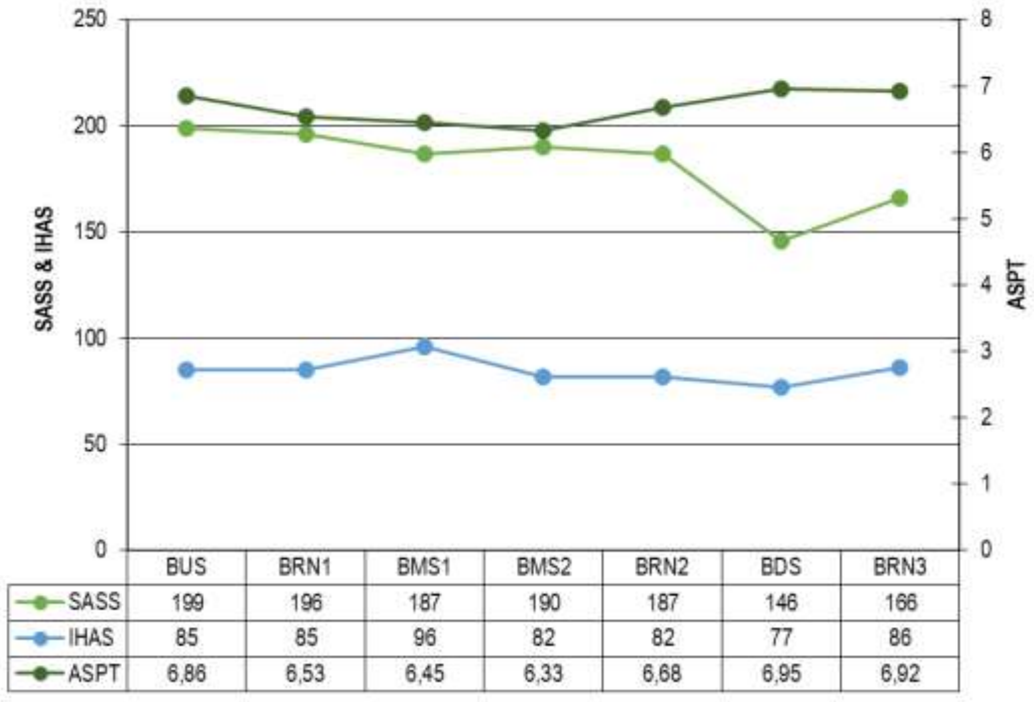


Figure 35: Spatial macro-invertebrate community integrity variation in the January 2020 assessment.

- The SASS5 data from the January 2020 assessment indicates that the aquatic macro-invertebrate community in this section of the Blyde River has suffered a minimal to marginal loss in integrity throughout the area in a downstream direction, when compared to the reference score for a pristine Northern Escarpment Mountain ecoregion stream;
- Spatially, between sites BUS and BRN3, the SASS5 score decreased by 16.6% (>15%), while no impact to the ASPT scores were observed;
- A 23.2% decline in SASS5 score was observed between sites BMS2 and BDS, serving as an indication that the majority of the impact was likely related to the illegal artisanal mining activities observed between sites BMS2 and BRN2;
- The 13.7% improvement in SASS5 score between sites BDS and BRN3, serves as an indication that despite impacts related to increasing urbanization, the ingress of sewage related to the Pilgrims Rest WWTW and the proliferation of alien and invasive species, some recovery in the aquatic assemblage of the Blyde River occurred;
- This data serves as an indication that at the time of the January 2020 assessment, the resilience of the Blyde River was such that the impact of the ongoing illegal artisanal mining activities could largely be absorbed, with some recovery of the aquatic assemblages further downstream. However, should the scale of impact increase, the cumulative land-use impacts would place the Blyde River under strain and a decline in Ecological Category would likely occur.

Ongoing monitoring of the sites along the Blyde River should be implemented so as to confirm any emerging trends and potential impacts.

6.5.5 *Summary of Temporal and Spatial Water Quality and Macro-invertebrate Comparison for the Blyde River sites*

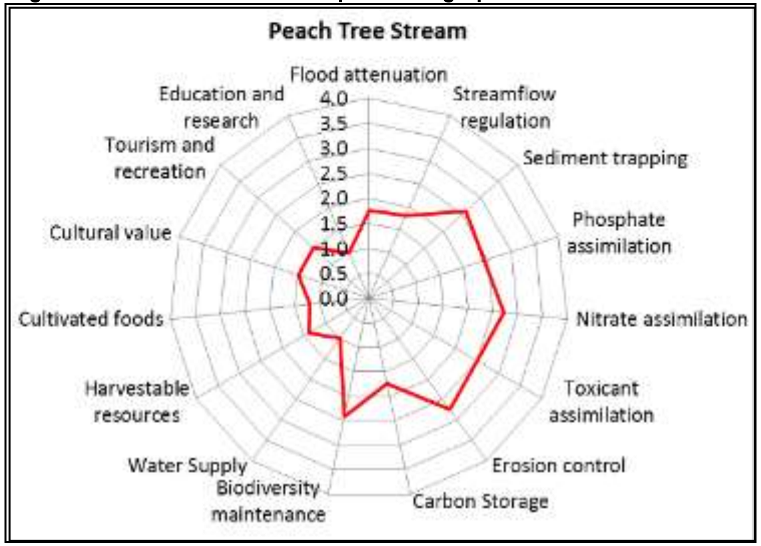
The temporal and spatial results of the study indicate that the integrity of the Blyde River, while still classified as an Ecological Category B along the entire portion of the Blyde River assessed, has begun to decline in a downstream direction. This decline may be largely related to the surrounding land-use activities, including forestry, illegal artisanal mining activities, seepage and runoff from historical mining areas, increasing urbanization and proliferation of alien and invasive species (resulting in altered surface runoff into the river), and the ingress of sewage related to the Pilgrims Rest WWTW. The illegal artisanal mining activities observed has resulted in severe sedimentation in some areas and may potentially have contributed to blanketing of benthos and algal proliferation, which has begun to compromise the habitat integrity and water clarity of the Blyde River in a downstream direction.

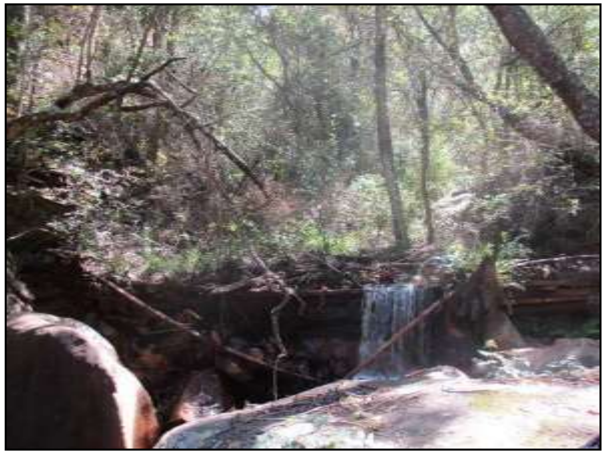
Land-use activities were largely to blame for the short-term variability in EC observed, as well as impacts to the habitat availability and suitability. However, with some recovery of the aquatic assemblages further downstream, it was concluded that the resilience of the Blyde River was such that the impact of the historical mining and ongoing illegal artisanal mining activities, forestry and altered surface runoff profiles could largely be absorbed, However, should the scale of impact increase, the cumulative land-use impacts would place the Blyde River under strain and a decline in Ecological Category would likely occur. **All efforts need to be made to prevent the proposed activities from impacting on the water quality and the integrity of the aquatic assemblage of this Class I, sensitive system. It is vitally important that the system be managed appropriately as a Class 1 water resource, as set out in "*Classes and Resource Quality Objectives of Water Resources for the Olifants Catchment.*" (DWS, 2018).**

6.6 The Peach Tree Stream

Table 19: Freshwater System Analysis summary of the assessment of the Peach Tree Stream (a tributary of the Blyde River located downgradient of the Iota Hill mining area) and a reach of an unnamed tributary thereof.

Ecological & socio-cultural service provision graph:





Photograph notes	Representative photographs of a section of the Peach Tree Stream, illustrating weirs within the system, which alter flow patterns as well as causing blockages (as debris accumulates against the weirs) during high flow periods.

PES and VEGRAI discussion	**IHI Riparian PES Category: B/C** **VEGRAI Category: C** The upper reaches of the system were inaccessible due to dense vegetation, terrain and personal safety concerns; however, these inaccessible areas are likely to be relatively ecologically intact. The lower reach of the system has, however, undergone modification, with specific mention of the presence of weirs, diversion canals (one of which is still in use) and encroachment of alien and indigenous invasive flora due to the historical mining-related disturbances which have occurred.
Ecoservice provision	**Intermediate** Whilst the ecological integrity of the system has been compromised to an extent, the system is still considered to provide moderate levels of ecological functioning, particularly in terms of sediment trapping and assimilation of nutrients. The latter is especially important as the system is downgradient of several historical mining adits, and observations during the site assessment indicate that decant from the historical mining activities may potentially be reaching the system. Due to the relatively remote locality of the system and connectivity to surrounding natural areas, the potential for

Watercourse characteristics:

a) Hydraulic regime

The hydraulic regime of the system has been historically impacted by the creation of two concrete canals, diverting water away from the original path. Whilst one of these canals was not visible due to overgrowth of vegetation, it was clear during the site assessment that it is still in use, whilst the other canal is in a state of disrepair and was dry at the time of assessment.

b) Water quality

Please refer to Table 19 below for a detailed analysis of the water quality within this system. Basic water quality parameters (pH, EC and DO) indicate that the water quality meets the RWQO of South Africa (DWA, 2011), with a pH of 7.90, EC of 10.6 mS/m, and DO saturation of 104.8%.

c) Geomorphology and sediment balance

Geomorphological processes have been marginally altered as a result of the construction of weirs in the lower reaches of the system, and it is expected that historical mining activities, specifically adits located upgradient of the system, as well as the proximity of the Waste Rock Dump associated with the Beta Mine area. These activities are likely to have contributed additional sediment to the system, which may in turn be transported into the Blyde River, especially since there are ongoing soil disturbances by informal miners in the vicinity (Pers. Comm. TGME Security Supervisor, October 2018).

	biodiversity support is also considered an important ecological service provisioned by the system.	
EIS discussion	**EIS Category: High** Although the ecological integrity of the system has been compromised to some extent, due to the intermediate levels of ecosystem services provisioned in particular those related to hydraulic functions, and the degree to which the system contributes to sustaining biodiversity in the vicinity, the Peach Tree Stream is considered to be of high Ecological Importance and Sensitivity.	**d) Habitat and biota** As far as could be ascertained during the site assessment, the vegetation communities in the upper reaches of the system are unlikely to have been significantly modified, although due to disturbances in the lower reaches, some encroachment by alien and/or indigenous floral species is expected. The lower reaches of the system have been transformed in terms of vegetation as a result of encroachment by indigenous invasive species. However, the dense vegetation provides suitable cover for various fauna which may utilise the stream as a migratory corridor, as well as providing breeding and foraging habitat.
REC/RMO and BAS Categories	**REC: Category B/C** **RMO: Maintain / Improve** **BAS: Category B/C** Further impacts to the system as a result of the proposed mining activities, in particular impaired water quality and sedimentation of the receiving environment must be prevented. It is possible that historical and current informal mining activities will have an impact on the system, particularly on water quality, and therefore it is recommended that efforts be made to prevent such impacts from occurring (i.e. improve the system) for example, by sealing old adits which may be decanting correctly. In addition, rehabilitation measures such as clearing of alien vegetation and correct management of the existing Waste Rock Dump will aid in improving the overall ecological condition. It is the opinion of the ecologists that the BAS is a Category B/C, should suitable mitigation and management of impacts, along with cogent, well-developed rehabilitation measures, be implemented.	**Possible significant impacts, business case, conclusion and mitigation requirements:** The Peach Tree Stream is located downgradient of the Iota mining areas therefore, strict adherence to mitigation measures, as contained in Section 8 of this report, will need to take place in order to prevent further degradation of the ecological integrity of the stream should the project be authorised. Key mitigation measures include those listed in Table 10 above for the Blyde River.

Table 20: Results of the Aquatic Ecological Assessment at Site PTS [Located on an unnamed tributary (locally known as Peach Tree Stream) of the Blyde River adjacent to the Iota Hill Opencast study area] during the October 2018 and the January 2020 assessment.

Site PTS

Figure 36: Downstream view of the PTS site at the time of the October 2018 assessment.

Algal proliferation	None observed in the October 2018 assessment, however, in the January 2020 assessment, isolated clumps of algae were observed.
Depth profiles	The depth varied from very deep pools to shallow runs over cobble and stones (downstream). Deep pools dominated the site.
Flow condition	Under the October 2018 flow was generally faster, however, in the January 2020 assessment, the stream was reduced to low slow flows.
Riparian zone characteristics	The riparian zone was dominated by shrubs and trees. Both banks well covered with limited indication of erosion.
Water clarity and odour	Water was very clear and no odours evident.

***In situ* physico-chemical water quality**

	Oct 2018	Jan 2020	DWS (2018)	
pH	7.90	8.21	**pH**	5.9 – 8.8
EC (mS/m)	10.6	10.9	**EC (mS/m)**	≤ 30
DO (mg/ℓ)	9.11	8.97	**DO (mg/ℓ)**	≥ 8.0
DO (% sat)	104.8	109.0		
Temp (℃)	14.8	17.8		

Seasonal variations in water quality (% var from October 2018)

pH	+3,9
EC (mS/m)	+2,8
DO (mg/ℓ)	-1,5

Index of Habitat Integrity

	Oct 2018	Jan 2020
Instream IHI	79.3 (Category B/C)	79.3 (Category B/C)
Riparian IHI	82.0 (Category B/C)	82.0 (Category B/C)

Riparian Vegetation Response Assessment Index (VEGRAI score)

Oct 2018	Jan 2020
74.8 (Category C)	70.2 (Category C)

Comment:

- The pH values complied with the recommended range as defined by the DWS (2018);
- The EC concentrations complied with the DWS (2018) recommendation (< 30 mS/m);
- The saturation of DO was considered as adequate in supporting a diverse and sensitive aquatic community as it complied with the > 8 mg/ℓ concentration (DWS 2018) during both assessments;
- Overall, any adverse effects on the biota specific water quality of the site as a result of upstream mining and forestry activities was considered to be limited at this point over time.

Aquatic macro-invertebrate community integrity

	Oct 2018	Jan 2020
SASS5 score	42	25
Number of Taxa	7	6
ASPT score	6.0	4.17
IHAS score	70 (Good)	82 (Excellent)

Seasonal variations in aquatic macro-invertebrate community integrity (% var from October 2018)

SASS5 score	**-40.48**
ASPT score	**-30.50**
IHAS score	**+17.14**

Fish Community Assessment (FRAI score)

Oct 2019	Jan 2020
90.0 (Category A)	90.0 (Category A)

Species Present: No fish captured at the time of the assessment but based on historical data, expected species and suitable water quality and habitat conditions at this site, a Category A was assigned.

Macro-invertebrate Response Assessment Index (MIRAI score)

Oct 2018	Jan 2020
69.3 (Category C)	47.5 (Category D)

Comment:

- The site deteriorated from a Category C condition in the October 2018 assessment to a Category D in the January 2020 assessment according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability can be regarded as good at the time of the October 2018 assessment, with a presence of relatively strong flowing water and aquatic vegetation and excellent at the time of the January 2020 assessment, despite the reduced flow obseved;
- The instream and riparian zones were regarded as largely natural to moderately modified. The riparian zone was unimpacted by erosion and sedimentation in the instream zone, slight potential impact from illegal mining activity upstream may be occurring;
- The fish community integrity (FRAI) at the site was regarded as unmodified with an anticipated classification of a Category A at the time of the assessment;
- Overall, the EcoStatus Category for the IHI, MIRAI, VEGRAI and FRAI classifications complied with the RQIS PES (DWS, 2014) classification of Category C conditions for this tributary of the Blyde River. However, the EcoStatus Category for the MIRAI classification did not comply with the RQIS PES (DWS, 2014) classification and further investigation as to any potential upstream impacts is recommended.

Key Drivers of System Change and Business Case

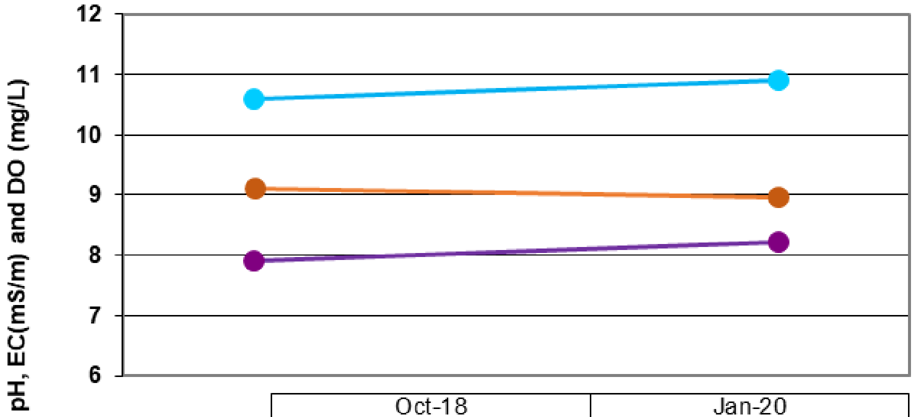
SITE ECOSTATUS CATEGORY		
	Oct 2018	**Jan 2020**
MIRAI **Instream IHI** **Riparian IHI** **VEGRAI** **FRAI**	**Category C** **Category B/C** **Category B/C** **Category C** **Category A**	**Category D** **Category B/C** **Category B/C** **Category C** **Category A**
Integrated Ecological Category	**76.1% (Category C)**	**65.72 (Category C)**

- Possible cumulative impacts on the water quality as a result of upstream illegal mining as well as forestry activities. However, this is not reflected in the water quality results or habitat integrity. Further investigation as to the potential source of impact, if any, is recommended, however, flow was deemed the key driver of seasonal change at this point;
- An impact on water quality and an impact on aquatic biota as a result of sediment loading are deemed possible future threats to this stream and this needs to be monitored;

In conclusion: presence of suitable flow conditions (runs also present downstream of sampling point) and good water quality are important ecological variables (exemplified by presence of sensitive taxa such as Leptophlebiidae which was sampled in the October 2018 assessment). The systems of the area are also sensitive to sedimentation and care needs to be taken not to exacerbate this impact. Given the sensitivity of the system and the overall integrated ecological category of C, maintaining system integrity is considered vital. Furthermore, it is deemed essential to manage impacts in line with the mitigation hierarchy as defined in the mining and biodiversity guidelines by, in order, avoiding, minimising, rehabilitating and, as a last resort, offsetting latent impacts on the biodiversity of the area.

6.6.1 *Temporal Water Quality and Macro-invertebrate Community Integrity Comparison for the Peach Tree Stream site*

The water quality and aquatic macro-invertebrate community integrity was assessed at the PTS site in both the October 2018 and the January 2020 assessments. The temporal variations are discussed below.



	Oct-18	Jan-20
pH	7,9	8,21
EC (mS/m)	10,6	10,9
DO (mg/ℓ)	9,11	8,97

Figure 37: Temporal water quality variation observed on the Peach Tree Stream since the October 2018 assessment.

- On comparison of the various water quality parameters assessed during each assessment. It was observed that despite the seasonal variation in flow, the water chemistry has remained largely stable, with negligible variations observed for pH, EC and DO since the October 2018 assessment.

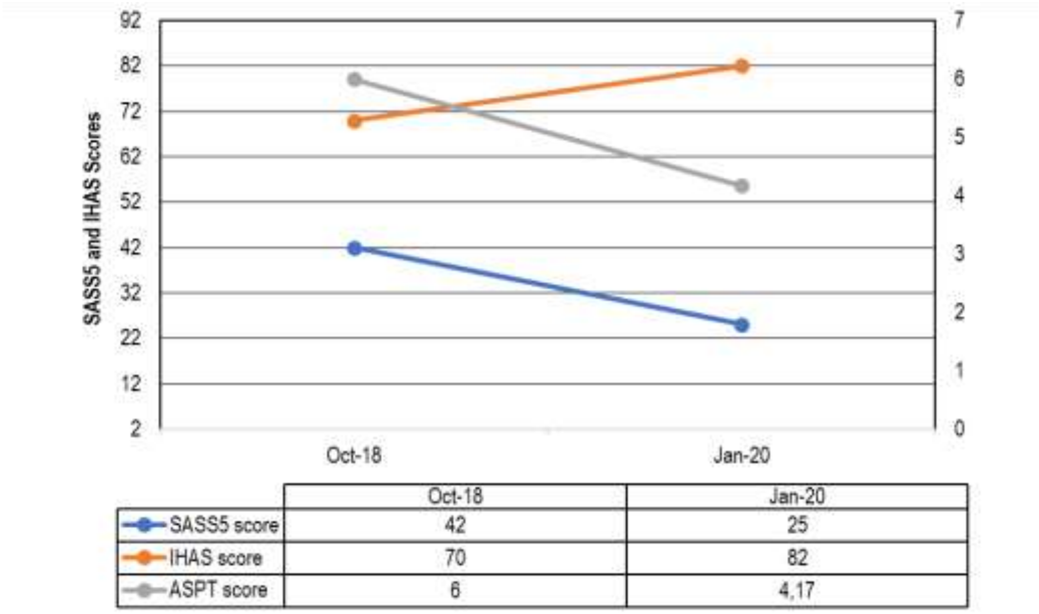
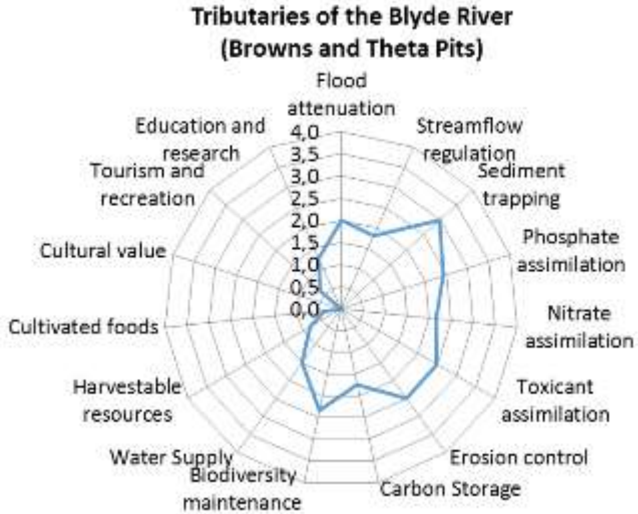


Figure 38: Temporal macro-invertebrate community integrity variation observed on the Peach Tree Stream since the October 2018 assessment.

- The SASS5 and ASPT scores each decreased significantly by 40.5% and by 30.5%, respectively. This despite the 17.4% improvement in habitat integrity observed;
- Since no indication of impact in terms of water quality was observed from the *in situ* water quality analysis, variations in flow were deemed the main driver of seasonal change in this system over time;
- It is important to note, however, the observation of isolated areas of algal proliferation, which may be an indicator of an increased incidence of elements such as nitrates, which may be related to forestry and illegal artisanal mining activities further upstream, despite the limited increase in the overall dissolved salt concentrations.

6.7 Unnamed Tributaries of the Blyde River

Table 21: Freshwater System Analysis summary of the assessment of the various ephemeral unnamed tributaries of the Blyde River associated with the Browns and Theta mining areas.

<table>
<tr>
<td colspan="2">Ecological & socio-cultural service provision graph:

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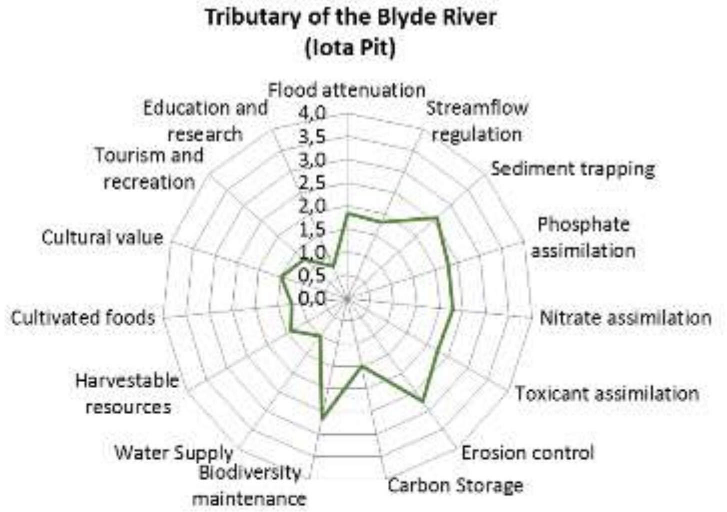
<tr>
<td rowspan="2">PES and VEGRAI discussion</td>
<td rowspan="2">IHI Riparian PES Category: B/C
The assessment was conducted towards the end of the dry season in October 2018, and it was apparent that veld fires had swept through some of the assessment sites in the months preceding the assessment. As the rainy season had not yet commenced, vegetation in the affected areas had not recovered, and therefore conditions were inferred from sites which had not been affected to the same degree. The majority of the ephemeral drainage systems associated with the Browns mining area are relatively inaccessible, therefore have undergone few modifications. However, removal of vegetation for forestry was apparent, particularly in the vicinity of Browns pit and south of the Theta pit area.</td>
<td>Photograph notes</td>
<td>Representative photographs of two of the ephemeral unnamed tributaries of the Blyde River in the vicinity of the Brown's mining area, illustrating the proximity of commercial forestry (left) to the systems, as well as the sparse cover at the time of the assessment (right).</td>
</tr>
<tr>
<td colspan="2">Watercourse characteristics:
a) Hydraulic regime
The hydraulic regime of these ephemeral systems has not been impacted significantly, although one system associated with the Browns Pit area has been impacted by impoundment in the lower reaches due to the historical Beta Mine Tailings Storage Facility (TSF). This has resulted in ponding between the TSF and the main access road to the mine offices, causing the artificial formation of wetland characteristics.</td>
</tr>
</table>

Ecoservice provision	**Intermediate** Provision of ecoservices is limited by the lack of water in these systems, however, the extent of vegetation cover within these systems does enable the provisioning of services such as assimilation of nutrients and toxicants, erosion control, sediment trapping, flood attenuation and to a lesser degree, carbon storage. Socio-cultural benefits are limited by the absence of water in the systems.	**b) Water quality** There was no surface water present within any of these systems at the time of the assessment (October 2018), therefore water quality parameters could not be ascertained. However, it is unlikely that water quality is significantly impaired due to the relatively remote locality of these systems and absence of activity in their respective catchments, with the exception of forestry and mining activities in the existing TGME operations area. **c) Geomorphology and sediment balance** Few changes to geomorphological processes could be discerned, although forestry activities – notably clearing of vegetation and regular usage of gravel access roads in close proximity to the drainage systems – is likely to result in additional sediment inputs. Some incision and erosion were observed in those areas where vegetation has been removed, however, it was not extensive at the time of the assessment.
EIS discussion	**EIS Category: Moderate** Although relatively ecologically intact, the Ecological Importance and Sensitivity of the system is deemed to be moderate, due to the decreased provision of ecological services, as well as the relatively small size of the systems and the impacts to the riparian zones. Nevertheless, as noted in the discussion around habitat and biota, they are nevertheless likely to support biodiversity in the surrounding areas.	**d) Habitat and biota** Although in a largely natural condition, these systems are comparatively small when compared to – for example, the Peach Tree Stream – and therefore their use by fauna as migratory corridors may be limited. Additionally, due to the ephemeral nature of these systems, breeding and foraging potential is limited particularly for water-dependent faunal species. Nevertheless, these systems provide good connectivity to surrounding natural areas and thus may be utilised by a number of faunal species for foraging and refugia on a seasonal basis.
REC /RMO / BAS Category	**REC: Category B** **RMO: Maintain** **BAS: Category B** As much as feasible, these systems should not be further impacted by the proposed mining activities. Thus, strict implementation of mitigation measures is required. Where necessary, depending on the locality of surface infrastructure, it is strongly recommended that provision be made for rehabilitation, particularly in the lower reaches of the systems which are more likely to be impacted by the mining activities.	**Possible significant impacts, business case, conclusion and mitigation requirements:** A portion (approximately 1.3ha) of one of the systems located on the eastern side of the proposed Browns Pit as well as the headwaters (approximately 1.5ha) of a small drainage system within the Theta/Browns WRD Option 1 may potentially be completely lost if the pit is to encroach into the drainage system, as depicted in the current layout. This will potentially result in loss of recharge (albeit seasonal) of the larger downstream system, namely the Blyde River, and it is therefore recommended that if possible, this loss be quantified by a suitably qualified hydrologist in order to ascertain the significance thereof on the larger system. Furthermore, the proposed terrace mining activities and the Theta /Browns WRD (both options) may result in increased sediment loading of the downstream system, due to loss of vegetation and ongoing soil disturbances throughout the life of mine. These activities will need to be strictly mitigated during the life of the project and rehabilitation measures implemented during closure in order to minimise the significance of ongoing latent and cumulative impacts. Please refer to Section 8 of this report for applicable mitigation measures.

Table 22: Freshwater System Analysis summary of the assessment of the unnamed tributary of the Blyde River associated with the Iota Hill mining area.

Ecological & socio-cultural service provision graph:



PES and VEGRAI discussion	**IHI Riparian PES Category: C** The upper reach of this system was inaccessible due to safety concerns, however, that reach is likely to be relatively unimpacted due to the inaccessibility. The lower reach has historically been impacted by agricultural activities, and currently is subjected to trampling by domestic livestock and harvesting of wood (*Acacia mearnsii*) most likely for domestic purposes. Areas of bank incision and erosion were observed, and in some sections was considered severe.	**Photograph notes**	Representative photographs of two points along the ephemeral drainage line located to the east of the Iota WRD Option 1, illustrating encroachment of alien vegetation, and felling thereof, most likely for domestic purposes, since this area is in close proximity to a small informal settlement.
		Watercourse characteristics: **a) Hydraulic regime** As an ephemeral system, it is not anticipated that the hydraulic regime has been significantly altered, except potentially by blockages caused by excess sediment or felled trees within the channel.	
Ecoservice Provision	**Intermediate** Although ephemeral, and although there is a moderately high degree of alien invasive vegetation in the marginal and non-marginal zones, this drainage system nevertheless provides intermediate levels of ecoservices, with mention of biodiversity maintenance, sediment trapping, flood attenuation and assimilation of excess nutrients and toxicants. Whilst the system currently does not provide a high degree of socio-cultural services due to the decreased ecological integrity, it holds potential for some educational and tourism activities (if correct interventions and rehabilitation were to take place).	**b) Water quality** No surface water was present within the system at the time of the assessment in October 2018; therefore, water quality parameters could not be assessed. Given the proximity of a small informal settlement however is it anticipated that water quality, when present, may be impaired as a result of domestic effluent. This is unlikely to be significant, however. **c) Geomorphology and sediment balance** Impacts to geomorphological processes include bank incision and erosion, likely to contribute to increased sedimentation of the system. An informal gravel road runs adjacent to the drainage line, traversing it in the lower reach of the system, approximately 130m before it confluences with the Blyde River.	

EIS discussion	**EIS Category: Moderate** The drainage system located east and downgradient of the Iota Hill mining area is considered to be of moderate ecological importance, largely due to the decreased ecological integrity. The connectivity of the upper reaches of the system to natural areas increases the likelihood of utilisation by fauna; however, the proximity of anthropogenic influences in the lower reach may negatively influence this.	**d) Habitat and biota** Habitat within the upper reaches of the systems comprises indigenous riparian forest, with little to no occurrence of invasive floral species. Although partially accessible, the terrain, remote locality and restricted access in terms of landowner permission means that human activity in the vicinity of these systems is limited; therefore providing ideal conditions (in combination with the good ecological integrity of the system) for breeding and foraging by a variety of fauna, as well as providing excellent faunal migratory corridors as there is good canopy cover.
REC/RMO/BAS Category	**REC: Category C** **RMO: Maintain** **BAS: Category C** This system was found to be moderately modified, with particular mention of the extent of alien floral invasion and bank incision. Nevertheless, with the implementation of appropriate rehabilitation measures, it is conceivable that this system could be improved. Therefore, it is strongly recommended that no further impacts as a result of the proposed mining activities should be permitted.	**Possible significant impacts, business case, conclusion and mitigation requirements:** Whilst the Iota Pit mining area is unlikely to have a direct impact on this system (as in, no infrastructure will directly encroach on the drainage system), it is nevertheless located downgradient of and approximately 120m from the Iota Pit WRD Option 1. Indirect impacts on this system may in turn have an effect on the Blyde River. Therefore, should the development be approved and proceed, very strict adherence to mitigation measures as provided in Section 8 must take place. Key mitigation measures are similar to those mentioned in Table 11 for the Blyde River.
*During the site assessment conducted in March 2019, a small, ephemeral drainage line conveying surface water was identified within the south-east portion of the Iota WRD Option 1. This system was characterised as a Preferential Surface Flow Path (PSFP) and was therefore not assessed as a watercourse with riparian characteristics; however, due to the encroachment on the PSFP by the WRD, it was delineated and included in the delineation map above. Since it flows into the Blyde River, impacts to this PSFP could have a negative impact on the Blyde River, therefore, development within this PSFP is not supported unless clear separation of clean and dirty water areas is possible and that the area can be rehabilitated to become free draining and it can be ensured that the re-instated drainage will not lead to pollution of downgradient resources.		

6.8 The Pilgrims Creek

The Pilgrim's Creek is not situated within 500 m of any of the proposed infrastructure. The stream confluences with the Blyde River downstream of site BDS and is situated downgradient (to the north) of the proposed project infrastructure (with specific mention of the Theta Pit (east of the Theta Main Pit), the Theta Main Pit and the Wishbone WRD). Due to the sensitivity of the aquatic resources situated in the vicinity of the proposed project area, and the potential for impacts to be expressed on the Pilgrims Creek an assessment of the instream ecological integrity of the Pilgrims Creek was deemed necessary.

Table 23: Results of the Aquatic Ecological Assessment at Site PCN1 (Upstream of any potential impact related to the proposed project infrastructure).

Site PCN1	

Figure 39: Upstream view of the PCN1 site at the time of the January 2020 assessment.

Algal proliferation	None observed
Depth profiles	The river at this point was dominated by relatively deep and shallow pools (>1 m) and moderately shallow runs (< ½ m)
Flow condition	The site was dominated by a still deep and shallow pools and slow flowing runs.

In situ physico-chemical water quality		DWS (2018)	
pH	8.0	**pH**	5.9 – 8.8
EC (mS/m)	24.1	**EC (mS/m)**	≤ 30
DO (mg/ℓ)	6.5	**DO (mg/ℓ)**	≥ 8.0
DO (% sat)	81.6		
Temp (°C)	18.3		

Index of Habitat Integrity	
Instream IHI	79.1 (Category B/C)
Riparian IHI	76.39 (Category C)

Riparian Vegetation Response Assessment Index	
VEGRAI score	70.0 (Category C)

Comment:

- The pH value complied with the recommended range as defined by the DWS (2018) recommendation;
- The EC fell within the DWS (2018) recommendation (< 30 mS/m) and was unlikely to limit the sensitivities of the aquatic assemblages likely to occur at this point;
- The DO saturation was considered inadequate on comparison with the > 8 mg/ℓ concentration recommendation (DWS, 2018). This was likely due to the low flows observed at this point as well as the large amount of aquatic vegetation and isolated areas of filamentous algal proliferation observed;
- Overall, biota specific water quality was deemed fair, but low DO concentrations and lack of stronger flows were likely to limit some more sensitive taxa that could occur at this point.

Aquatic macro-invertebrate community integrity	
Invertebrate community assessment (SASS5 and IHAS)	
SASS5 score	92
Number of Taxa	19
ASPT score	4.84
IHAS score	80 (Excellent)

Fish Community Assessment	
FRAI score	54.9 (Category D, automated) 99.5 (Category A, adjusted)
Enteromius neefi (LC) *Enteromius viviparus* (LC) *Enteromius anoplus* (LC) *Enteromius motebensis* (NT)	

Macro-invertebrate Response Assessment Index	
MIRAI score	56.6% (Category D)

Comment:

- The site was considered to be in a Category D condition according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability was regarded as excellent, due to the presence of extensive aquatic vegetation;
- The instream habitat integrity was regarded minimally to moderately modified due to the road crossing as altered flow profiles, while the riparian zone integrity was regarded as moderately modified due to the proliferation of alien and invasive species;
- The fish community integrity at the site was regarded as unmodified with an adjusted classification of Category A assigned.
- Overall, the EcoStatus Category for the IHI, MIRAI, VEGRAI and FRAI classifications comply with the RQIS PES (DWS, 2014) classification of Category C conditions for a tributary in this section of the Blyde River catchment, however, the EcoStatus Category for the MIRAI classification did not comply with the RQIS PES (DWS, 2014) classification and further investigation as to any potential upstream impacts is recommended.

Riparian zone characteristics	The riparian zone was dominated by grasses, shrubs and trees. Both banks well covered.
Water clarity and odour	Water was clear and no odour was noted.
SITE ECOSTATUS CATEGORY	
MIRAI **Instream IHI** **Riparian IHI** **VEGRAI** **FRAI**	**Category D** **Category B/C** **Category C** **Category C** **Category A**
Integrated Ecological Category	**71.38% (Category C)**

Key Drivers of System Change and Business Case

- This portion of the Pilgrims Creek has been impacted as a result of historical and ongoing mining activities, the adjacent road, numerous road crossings and the proliferation of alien and invasive species
- The elevated EC concentration in relation the those observed on the Blyde River as well as the Peach Tree Stream serves as an indication that cumulative impacts affect the Pilgrims Creek prior to any potential impact from the proposed mining activities;
- Care should be taken to prevent impacts related to seepage, erosion and sedimentation, loss of water quality and further alterations to the natural flow profiles of this stream. Especially on consideration of the *Enteromius motebensis,* which was observed at this point in the January 2020 assessment, and which has been classified as Near Threatened according to the IUCN Red List.

Table 24: Results of the Aquatic Ecological Assessment at Site PCN2 (Downstream of any potential impact related to the proposed project infrastructure and upstream of the confluence with the Blyde River).

Site PCN2

Figure 40: Upstream view of the PCN2 site at the time of the January 2020 assessment.

Algal proliferation	None observed
Depth profiles	The river at this point was dominated by shallow pools and very shallow runs (< ½ m).
Flow condition	The site was dominated by a still pools and slow runs.

***In situ* physico-chemical water quality**

		DWS (2018)	
pH **EC (mS/m)** **DO (mg/ℓ)** **DO (% sat)** **Temp (℃)**	7.98 27.5 6.84 85.6 20.1	**pH** **EC (mS/m)** **DO (mg/ℓ)**	5.9 – 8.8 ≤ 30 ≥ 8.0

Spatial variations in water quality (% var from site PCN1)

pH **EC (mS/m)** **DO (mg/ℓ)**	-0,25 +14,11 +5,23

Index of Habitat Integrity

Instream IHI **Riparian IHI**	77.2 (Category B/C) 76.39 (Category C)

Riparian Vegetation Response Assessment Index

VEGRAI score	70.0 (Category C)

Comment:

- The pH value complied with the recommended range as defined by the DWS (2018) recommendation;
- The EC fell within the DWS (2018) recommendation (< 30 mS/m) and was unlikely to limit the sensitivities of the aquatic assemblages likely to occur at this point;
- The DO saturation was considered inadequate on comparison with the > 8 mg/ℓ concentration recommendation (DWS, 2018). This was likely due to the low flows observed at this point as well as the large amount of aquatic vegetation and isolated areas of filamentous algal proliferation observed;
- Overall, biota specific water quality was deemed fair, but low DO concentrations and lack of stronger flows were likely to limit some more sensitive taxa that could occur at this point.

Aquatic macro-invertebrate community integrity

Invertebrate community assessment (SASS5 and IHAS)

SASS5 score **Number of Taxa** **ASPT score** **IHAS score**	145 27 5.37 84 (Excellent)

Spatial variations in aquatic macro-invertebrate community integrity (% var from site PCN1)

SASS5 score **ASPT score** **IHAS score**	+57.61 +10.95 +5

Fish Community Assessment

FRAI score	56.4 (Category D, automated) 99.5 (Category A, adjusted)

Enteromius neefi (LC)
Enteromius viviparus (LC)
Enteromius anoplus (LC)
Labeobarbus marequensis (LC)

Macro-invertebrate Response Assessment Index

MIRAI score	69.9% (Category C)

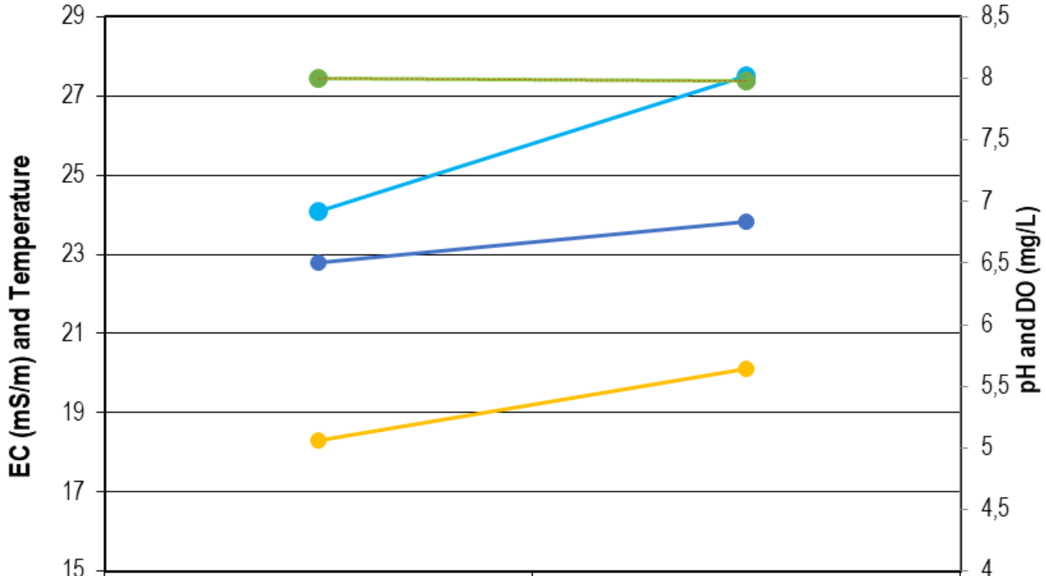
Comment:

- The site was considered to be in a Category C condition according to the MIRAI EcoStatus tool;
- The macro-invertebrate habitat suitability was regarded as excellent, due to the presence of extensive aquatic vegetation;
- The instream habitat integrity was regarded minimally to moderately modified due to the road crossing and altered flow profiles, while the riparian zone integrity was regarded as moderately modified due to the proliferation of alien and invasive species;
- The fish community integrity at the site was regarded as unmodified with an adjusted classification of Category A assigned.
- Overall, the EcoStatus Category for the IHI, MIRAI, VEGRAI and FRAI classifications comply with the RQIS PES (DWS, 2014)

<table>
<tr><td></td><td></td><td></td><td>classification of Category C conditions for a tributary in this section of the Blyde River catchment.</td></tr>
<tr><td>Riparian zone characteristics</td><td>The riparian zone was dominated by grasses, shrubs and trees. Both banks well covered.</td><td colspan="2" rowspan="5">Key Drivers of System Change and Business Case
➢ Some improvement in the aquatic ecological integrity was observed at this point in relation to the upstream PCN1 site. Sensitive fish species observed at this point include the Labeobarbus marequensis. A number of sensitive macro-invertebrate species were sampled, including Leptophlebiidae, Psephenidae, Helodidae and Philopotamidae.
➢ Special care should be taken to prevent impacts related to erosion and sedimentation, loss of water quality and further alterations to the natural flow profiles of this stream.</td></tr>
<tr><td>Water clarity and odour</td><td>Water was clear and no odour was noted.</td></tr>
<tr><td colspan="2">SITE ECOSTATUS CATEGORY</td></tr>
<tr><td>MIRAI
Instream IHI
Riparian IHI
VEGRAI
FRAI</td><td>Category D
Category B/C
Category C
Category C
Category A</td></tr>
<tr><td>Integrated Ecological Category</td><td>71.38% (Category C)</td></tr>
</table>

6.8.1 *Temporal Water Quality and Macro-invertebrate Community Integrity Comparison for the Peach Tree Stream site*

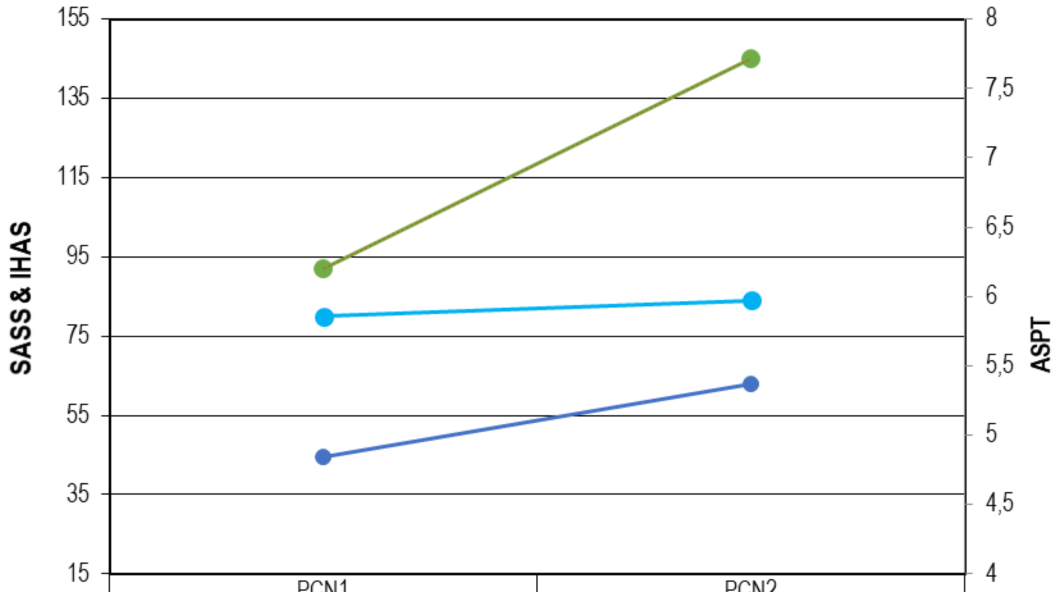
The water quality and aquatic macro-invertebrate community integrity was assessed at both an upstream and a downstream site along the Pilgrims Creek during the January 2020 assessment. The spatial variations are discussed below.



	PCN1	PCN2
EC (mS/m)	24,1	27,5
Temp (℃)	18,3	20,1
pH	8	7,98
DO (mg/ℓ)	6,5	6,84

Figure 41: Spatial variation of the water quality observed on the Pilgrims Creek during the January 2020 assessment.

- The EC increased by 14.1%, which falls within the TWQR for aquatic ecosystems as advocated by DWAF (1996);
- pH decreased by 0.25% which complies with the < 5% spatial change as advocated by the DWAF (1996) TWQR for aquatic ecosystems;
- DO increased by 5.2% which may be regarded as a positive change; and
- Temperature at both sites could be regarded as normal for the time of day and the time of year when sampling took place.
- Overall, the water quality of the Pilgrims Creek appeared to improve in a downstream direction and no impact on the potential aquatic assemblage was deemed likely.



	PCN1	PCN2
SASS5	92	145
IHAS	80	84
ASPT	4,84	5,37

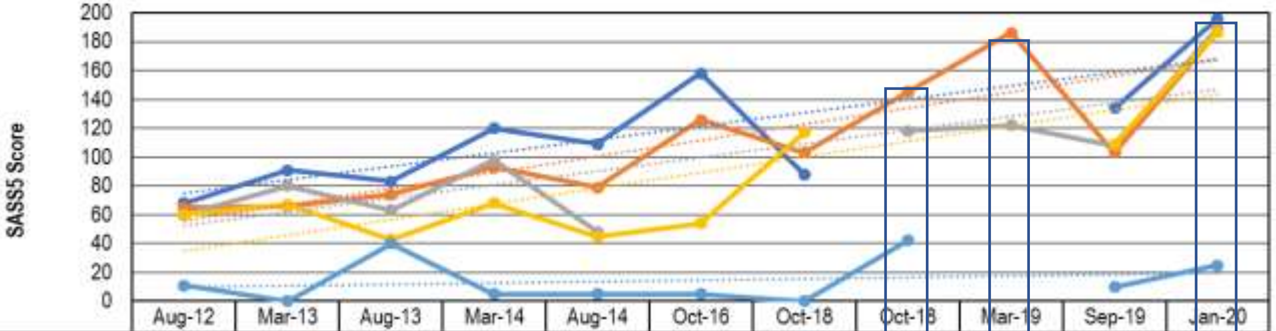
Figure 42: Spatial variation of macro-invertebrate community integrity observed on the Pilgrims Creek during the January 2020 assessment.

- The SASS5 score increased significantly by 57.6% and the ASPT score increased by 11.0%. Habitat suitability and availability for macro-invertebrates increased by 5.0%;
- The improvement in macro-invertebrate diversity and sensitivity correlates with both the improved water quality as well as the improved habitat availability at the downstream site;
- Any future impact associate with the proposed mine infrastructure would be expressed at this point, however, due to this point's proximity to the town of Pilgrims Rest, and increasing impacts related to the surrounding land-use activities, some cumulative impacts may become evident at this point over time.

6.9 Historical Temporal Biomonitoring Data

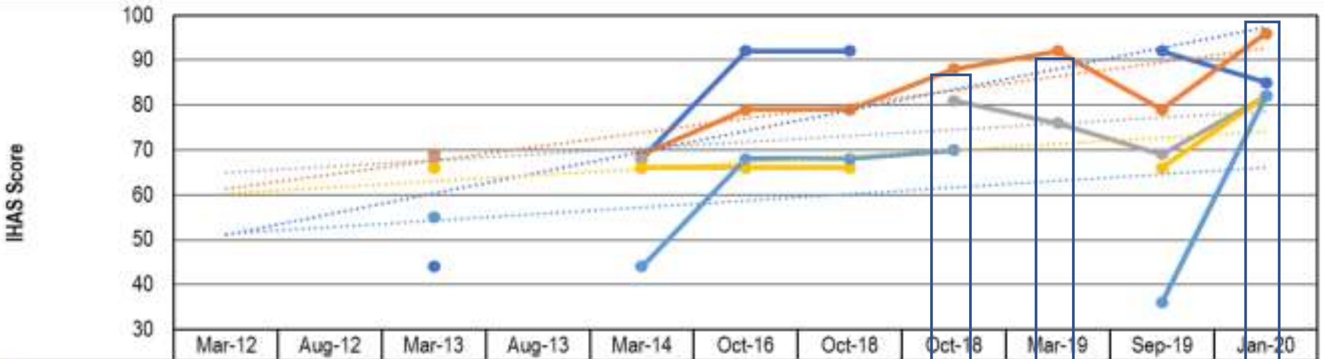
TGME appointed an external specialist to conduct biomonitoring activities on the Blyde River and the Peach Tree Stream since 2012. The historical data combined with the relevant comparative sites assessed by SAS for the purposes of this study are presented in the figures below.

It is deemed likely that variances in sampling technique and effort may have resulted in variations in the results observed between the different assessors.



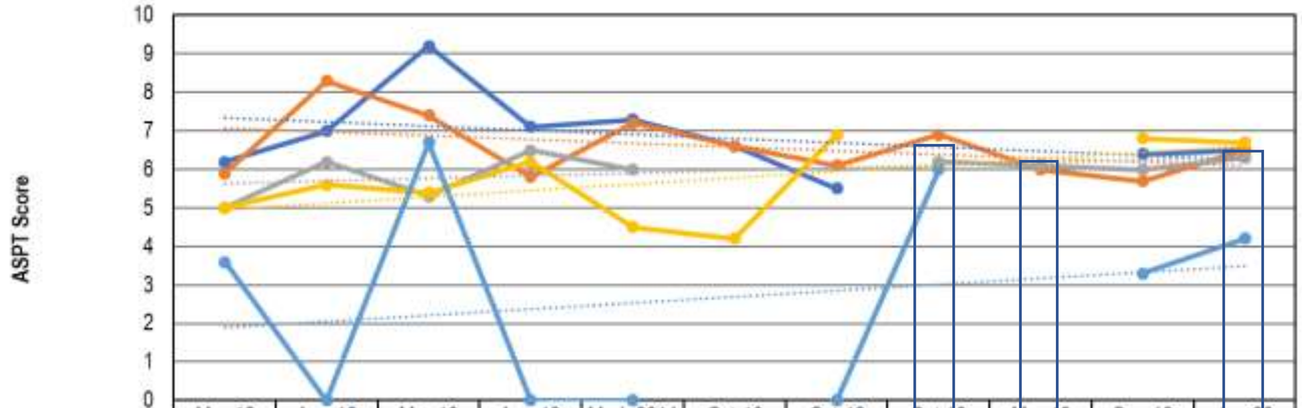
	Aug-12	Mar-13	Aug-13	Mar-14	Aug-14	Oct-16	Oct-18	Oct-18	Mar-19	Sep-19	Jan-20
1 P (BRN1)	68	91	83	120	109	158	88			134	196
BM 1 B (BMS1)	65	66	74	93	79	126	103	145	186	103	187
BM 1 BP (BMS2)	60	80	63	98	48			118	122	108	190
BM 2 BP (BRN2)	60	67	43	68	45	54	117			109	187
1 B (PTS)	11	0	40	5	5	5	0	42		10	25

Figure 43: Temporal SASS5 biomonitoring data (Africa Enviro & Biology, 2013, 2014, 2016, 2018 and 2019). Blue boxes indicate the SAS SASS5 biomonitoring results for the October 2018, March 2019 and January 2020 assessments.



	Mar-12	Aug-12	Mar-13	Aug-13	Mar-14	Oct-16	Oct-18	Oct-18	Mar-19	Sep-19	Jan-20
1 P (BRN1)			44		68	92	92			92	85
BM 1 B (BMS1)			69		69	79	79	88	92	79	96
BM 1 BP (BMS2)			68		68			81	76	69	82
BM 2 BP (BRN2)			66		66	66	66			66	82
1 B (PTS)			55		44	68	68	70		36	82

Figure 44: Temporal IHAS biomonitoring data (Africa Enviro & Biology, 2013, 2014, 2016, 2018 and 2019). Blue boxes indicate the SAS IHAS biomonitoring results for the October 2018, March 2019 and January 2020 assessments.



	Mar-12	Aug-12	Mar-13	Aug-13	Marh 2014	Oct-16	Oct-18	Oct-18	Mar-19	Sep-19	Jan-20
1 P (BRN1)	6,2	7	9,2	7,1	7,3	6,6	5,5			6,4	6,5
BM 1 B (BMS1)	5,9	8,3	7,4	5,8	7,2	6,6	6,1	6,9	6	5,7	6,5
BM 1 BP (BMS2)	5	6,2	5,3	6,5	6			6,2	6,1	6	6,3
BM 2 BP (BRN2)	5	5,6	5,4	6,2	4,5	4,2	6,9			6,8	6,7
1 B (PTS)	3,6	0	6,7	0	0		0	6		3,3	4,2

Figure 45: Temporal ASPT biomonitoring data (Africa Enviro & Biology, 2013, 2014, 2016, 2018 and 2019). Blue boxes indicate the SAS ASPT biomonitoring results for the October 2018, March 2019 and January 2020 assessments.

6.10 Fish Community Integrity

The fish community integrity of the Blyde River and its associated tributaries, including the Peach Tree Stream and the Pilgrims Creek was assessed on a site by site basis. However, fish are known to migrate along a linear reach and therefore the FRAI index was applied to all the sites to determine the integrity of the fish assemblages associated with the entire focus area. On application of the index, the Blyde River reach assessed achieved an Ecological Category B (minimally modified), and the reach assessed on the Pilgrims Creek, which confluences with the Blyde River, achieved an Ecological Category C (Moderately modified). A number of the sensitive species observed, including *Labeobarbus marequensis, Chiloglanis pretoriae* and *Amphilius uranoscopus* require clean, clear, fast-flowing and well oxygenated water over good cobble and stone habitat for their survival. It is therefore deemed imperative that the river is maintained in an ecologically appropriate condition in support of the Resource Management Objectives for the system and that impacts related to sedimentation and loss of water quality integrity be mitigated as far as possible.

The table below provides a full list of the species observed in the Blyde River and the Pilgrims Creek within and in the vicinity of the proposed project area.

Table 25: Fish species observed within and in the vicinity of the proposed project area.

Scientific Name	Common Name	River/stream	Conservation Status	Photo
Amphilius uranoscopus	Common/Stargazer Mountain Catfish	Blyde	LC	
Chiloglanis pretoriae	Shortspine Suckermouth	Blyde	LC	
Enteromius anoplus	Chubbyhead Barb	Blyde/Pilgrims Creek	LC	

Scientific Name	Common Name	River/stream	Conservation Status	Photo
Enteromius motebensis	Marico Barb	Pilgrims Creek	NT	
Enteromius neefi	Sidespot Barb	Blyde/Pilgrims Creek	LC	
Enteromius paludinosis	Straightfin Barb	Blyde/Pilgrims Creek	LC	
Enteromius cf treurensis	Treur River Barb	Blyde	CR	
Enteromius viviparus	Bowstripe Barb	Blyde/Pilgrims Creek	LC	
Labeobarbus marequensis	Lowveld Largescale Yellowfish	Blyde/Pilgrims Creek	LC	

Scientific Name	Common Name	River/stream	Conservation Status	Photo
Oncorhynchus mykiss	Rainbow Trout	Blyde	Alien	

LC = Least Concern; NT = Near Threatened; CR = Critically Endangered

Enteromius cf treurensis (CR) and *Enteromius motebensis* (NT), which were sampled at the time of the January 2020 assessment are both fish species with limited distributions, and impacts to this portion of the Blyde River and its tributaries, may result in significant losses to the cumulative populations of these species.

Should the proposed project proceed, it is considered essential that the further decline of these fish species is managed, through the employment of focussed measures around conservation and rehabilitation targeted at the biology of these species. A conservation initiative should be employed as part of the biodiversity offset/compensation initiative, with well-defined targeted management practices to:

- maintain the integrity of the aquatic resources of the area;
- prevent further losses of these species, and
- enhance recovery of both the *Enteromius treurensis* and the *Enteromius motebensis* within the affected reaches of the Blyde River and its associated tributaries on completion of the proposed project, with a focus on the conservation of genetic diversity.

Habitat management (including riparian and bankside habitat), habitat development and maintenance, as well as research data management and monitoring are deemed critical components to address as part of the initiative.

The creation of an aquatic biodiversity management area or biosphere reserve should be considered, whereby the primary goal is to protect the aquatic biodiversity in a given area. This can be achieved by sterilising the Treur River from further development and ensuring that careful catchment management of this system is applied. Further to this, active monitoring and research should be facilitated through the implementation of an ongoing biomonitoring programme, as well as tertiary academic scholarship programmes related to the maintenance of the ecological integrity of the Blyde River and Treur River and/or initiatives such as conservation aquaculture and species relocations.

Finally, ongoing restoration and management initiatives should be employed to continually contribute to the improvement of the instream and riparian habitat and water quality for the duration of the proposed project and into the closure phases to mitigate and limit impacts as far as possible.

6.11 Aquatic Ecological Importance and Sensitivity Assessment

The Ecological Importance and Sensitivity (EIS) method (DWAF, 1999) was applied to the Blyde River and the Peach Tree Stream in order to ascertain the current sensitivity and importance of the system (as per Figure 47). The results of the assessment are presented in the tables below:

Table 26: Results of the EIS assessment for the Blyde River within the study area.

Biotic Determinants	Score
Rare and endangered biota	4
Unique biota	3
Intolerant biota	4
Species/taxon richness	2
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	4
Refuge value of habitat type	2
Sensitivity of habitat to flow changes	4
Sensitivity of flow-related water quality changes	3
Migration route/corridor for instream and riparian biota	3
Nature Reserves, Natural Heritage sites, Natural areas, PNEs	3
RATINGS	**3.2**
EIS CATEGORY	**Very High**

The Ecological Importance and Sensitivity Assessment analysis of the Blyde River provided a score of 3.2 which is regarded as **extremely important and sensitive**. The high importance and sensitivity of the stream is mainly as a result of the presence of intolerant biota, namely, Blepharoceridae, Heptageniidae, Chlorocyphidae, Helodidae, and Psephenidae. The diversity of aquatic habitat types as well as the sensitivity of the habitat to flow changes also added to the high importance and sensitivity rating. The biota in this system have a preference for rocky and gravely substrate in clear fast flowing water thus indicating that the system is sensitive to changes in the total suspended solids. In order for the sensitivity score to remain high, it is vital and of the utmost importance that sedimentation and sediment loading of this system when mining activities commence is prevented. The system is considered unique on a national scale based on its biodiversity and habitat diversity. The Blyde River's water quality is generally excellent and dilutes the relatively poorer water in the Olifants River generated by impacts from mining industry and human settlement in the catchment.

Furthermore, the river systems in this area (specifically the Blyde River and Treur River – the latter is not within the study areas but is a tributary of the Blyde River) are important for threatened fish species *Amphilius natalensis* (DD), *Amphilius* sp. *'natalensis* cf. *treur'* (DD), as well as the vulnerable *Pseudagrion newtoni* ("Harlequin sprite" damselfly), and amphibian species (*Hadromophryne natalensis* – Vulnerable in Mpumalanga).

Table 27: Results of the EIS assessment for the Peach Tree Stream within the study area.

Biotic Determinants	Score
Rare and endangered biota	2
Unique biota	2
Intolerant biota	3
Species/taxon richness	2
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	3
Refuge value of habitat type	2
Sensitivity of habitat to flow changes	4
Sensitivity of flow-related water quality changes	3
Migration route/corridor for instream and riparian biota	1
Nature Reserves, Natural Heritage sites, Natural areas, PNEs	3
RATINGS	**2.5**
EIS CATEGORY	**High**

The Ecological Importance and Sensitivity Assessment analysis of the Peach Tree Stream provided a score of 2.5, which is regarded as **highly important and sensitive**. The high importance and sensitivity of the stream is mainly as a result of the diversity of aquatic habitats, sensitivity of biota to flow and water quality changes, as well as the possible presence of intolerant biota*.* The system is considered important in terms of conservation with a National Heritage Site present in the catchment area. This river is considered unique on a national and international level based on unique biodiversity.

Due to the importance of these two systems and the potential impact posed by the proposed mining activities (see Section 8 for detailed risk assessment) it is essential that special attention be paid to protecting these aquatic resources and the biota present. This is further emphasised by the Class I status of the Upper Blyde River in which the classification indicates high environmental protection and minimal utilisation (DWS, 2016).

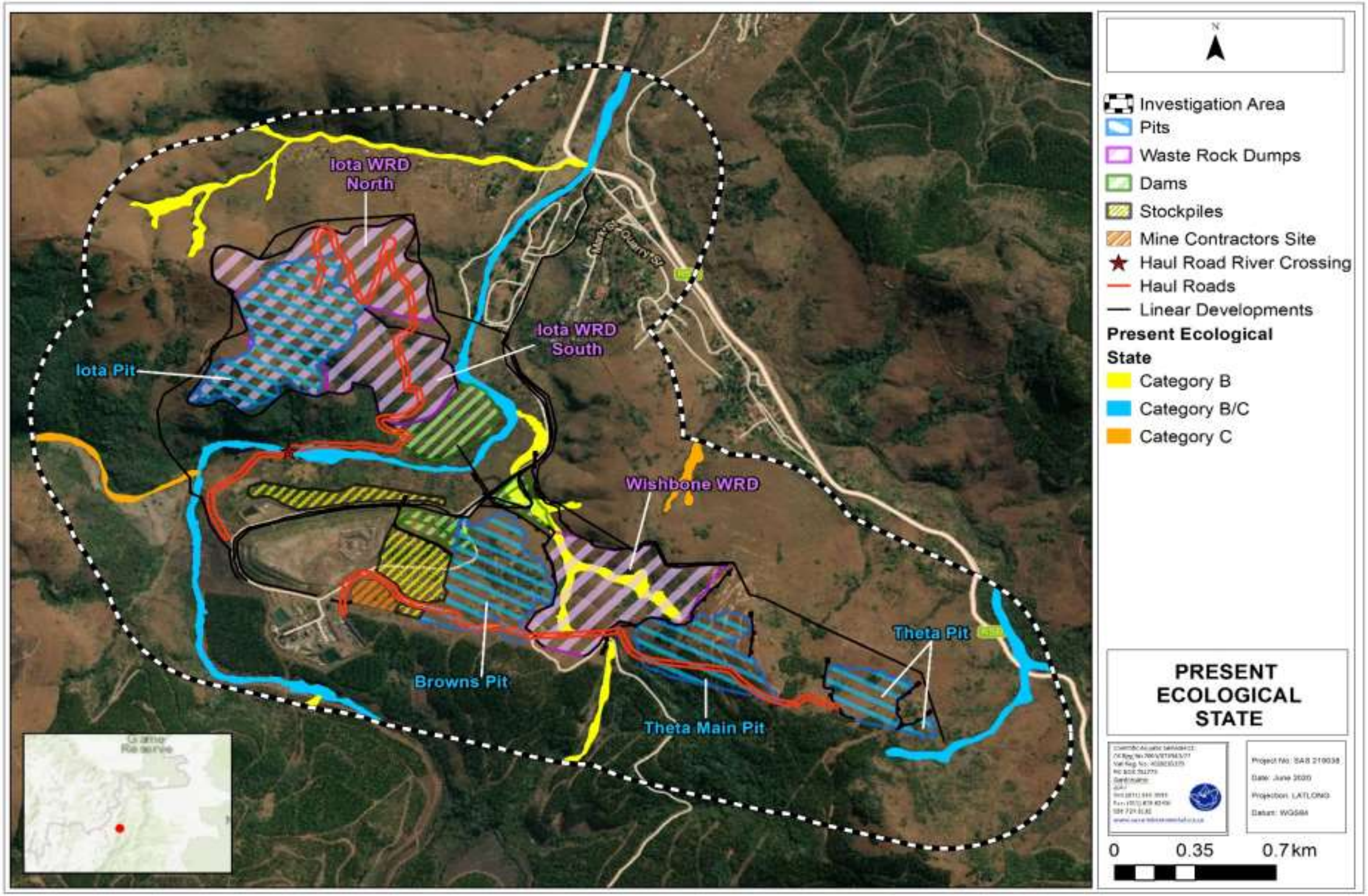


Figure 46: Conceptual illustration of the PES categories applicable to the watercourses associated with the various proposed mining areas.

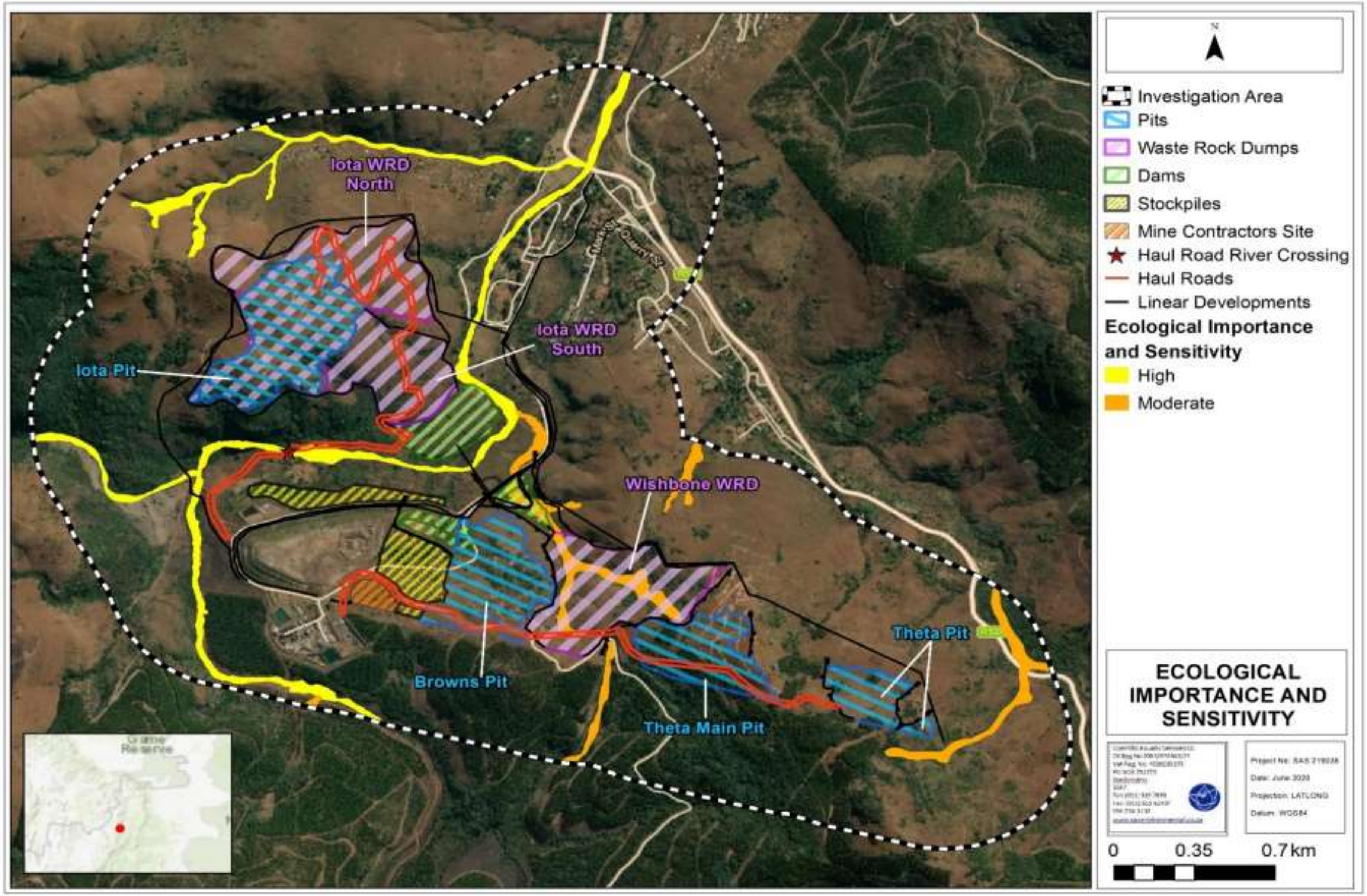


Figure 47: Conceptual illustration of the EIS categories applicable to the watercourses associated with the various proposed mining areas.

7 SENSITIVITY MAPPING

7.1 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 as "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 watercourse 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 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 28: Articles of Legislation and the relevant zones of regulation applicable to each article, and national and provincial buffer guidelines.

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA)	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 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 500 m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.
Government Notice 704 as published in the Government Gazette Vol 408 No 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);	For all activities within a watercourse or within 100m of a watercourse
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations, 2014, as amended.	32m from the edge of a watercourse

Buffer guidelines according to the National Freshwater Ecosystem Priority Areas (NFEPA) Implementation Manual (2011) and the Mpumalanga Biodiversity Sector Plan (MBSP) Handbook (2014)	
NFEPA (2011) and MBSP Handbook (2014)	Although these are not legislated zones of regulation the recommended buffer for the Blyde River, in accordance with both guidelines, is 1000m (1km).

Watercourses with their associated zones of regulation, in terms of GN704 and GN509 of the National Water Act, 1998 (Act No 36 of 1998) as well as the National Environmental Management Act, 1998 (Act No. 107 of 1998) are depicted in Figures 48, 49, 50 and 51 below. The recommended buffer in terms of NFEPA (2011) and the MBSP Handbook (2014) are depicted in Figure 48. These maps (in particular those depicting the legislated Zones of Regulation) must be considered during the planning phase to ensure that all relevant infrastructure is optimally located without encroaching on freshwater habitat and is appropriately authorised.

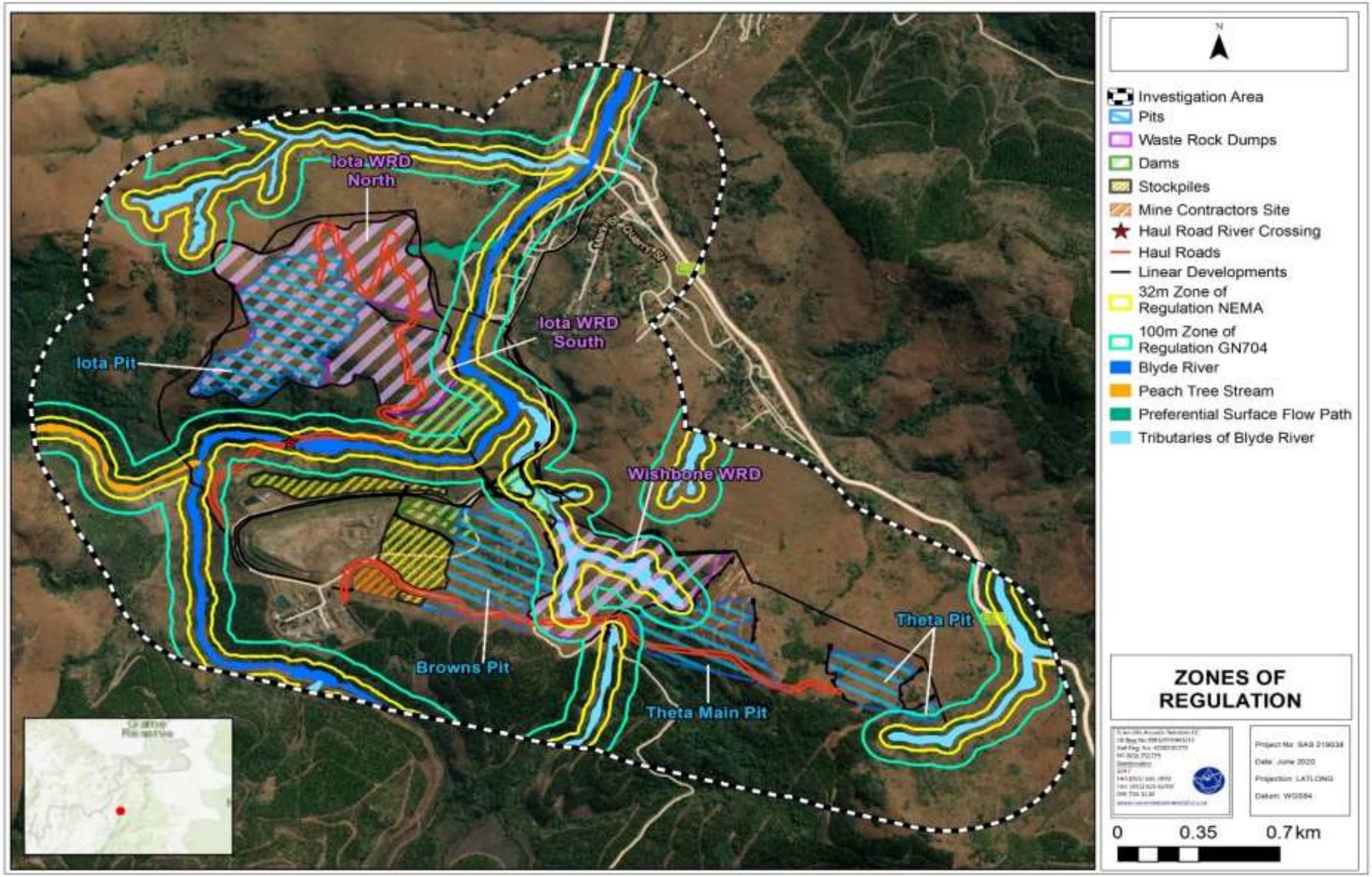


Figure 48: Conceptual presentation of the zones of regulation in terms of NEMA, and GN704 as it relates to the National Water Act, 1998, (Act No. 36 of 1998, in relation to the various study areas and watercourse delineations.

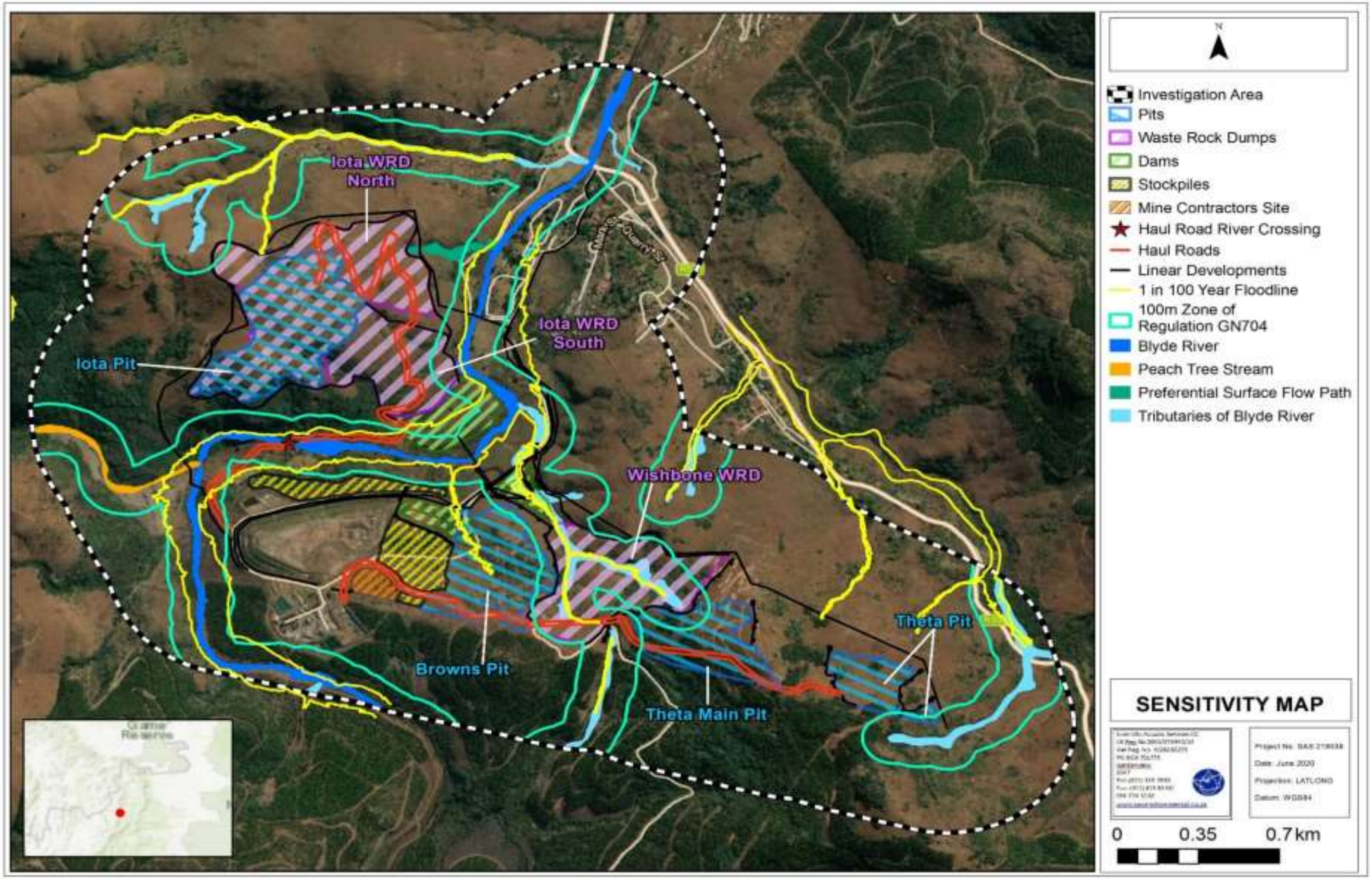


Figure 49: Conceptual presentation of the zones of regulation in terms of GN509 as it relates to the National Water Act, 1998, (Act No. 36 of 1998), in relation to the various study areas and watercourse delineations.

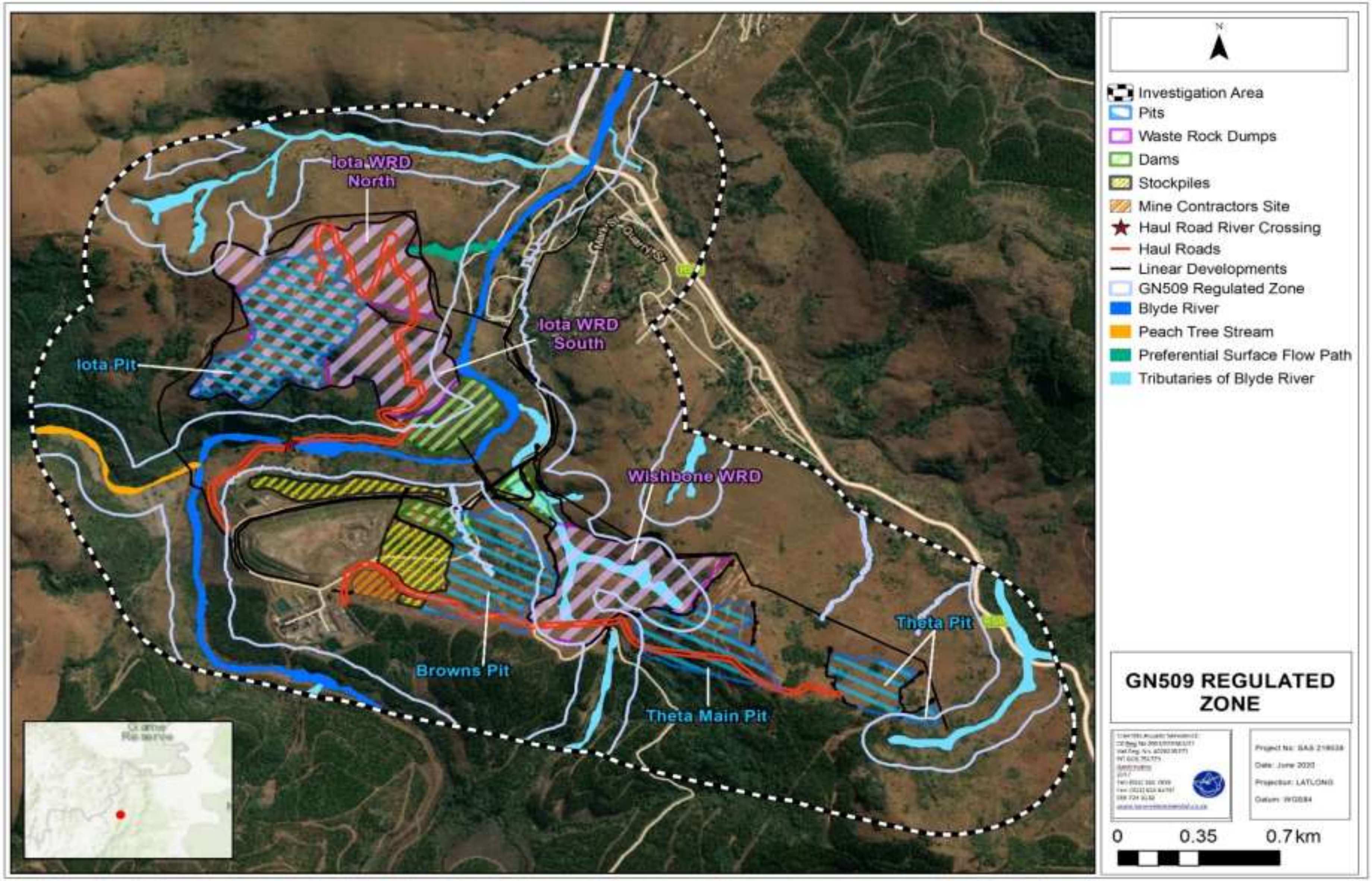


Figure 50: Conceptual presentation of the zone of regulation (combined 100m and available floodlines) applicable to the watercourses in terms of GN509 as it relates to the National Water Act, 1998, (Act No. 36 of 1998).

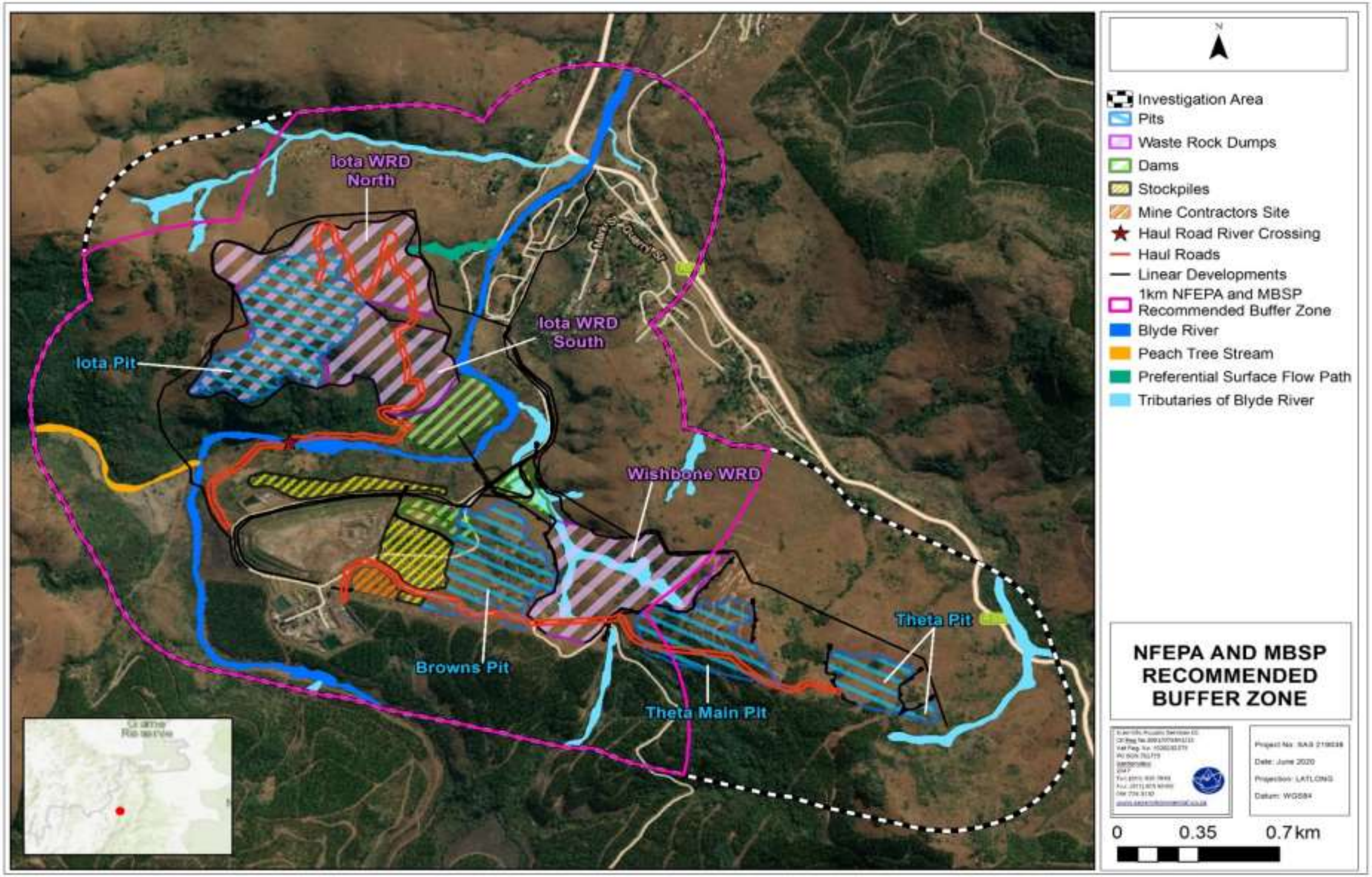


Figure 51: Conceptual presentation of the 1000m buffer zone around the Blyde River as recommended by NFEPA (2011) and the MBSP Handbook (2014) in relation to the various study areas.

8 RISK ASSESSMENT

Following the freshwater and aquatic ecological assessments of the various drainage systems in the study areas and surrounding investigation areas, the DWS Risk Assessment Matrix (2016) as outlined in Section 1.2 (detailed methodology contained in Appendix D), was applied with the aim of quantifying the significance of perceived risks to the receiving environment. Specifically, the risk assessment aimed to ascertain the significance of perceived impacts on the flow regime, physical, chemical, geomorphological, habitat and biota of the freshwater resources associated with the various study areas. As noted in Section 1.3, the risk assessment was applied assuming that the mitigation measures provided in this report are applied, i.e. the risk significance ratings contained in this report are *post-mitigation*.

In addition, essential mitigation measures which must be implemented to minimise the perceived impacts are presented here, including standard "best practice" and good housekeeping applicable to activities of this nature, which much be implemented in conjunction with the activity specific mitigation measures.

As noted in Section 1.3, the risk assessment was undertaken based on the layout provided at the time of this assessment and the specialist's experience with projects of a similar nature, and assuming a "worst case" scenario as contemplated in the NEMA which advocates the application of the precautionary principle when undertaking environmental studies.

8.1 Impact identification and assessment

Common to all study areas are construction related activities that will be undertaken, including the removal of topsoil and clearing of vegetation in preparation for construction of surface infrastructure (which will include support infrastructure such as employee change rooms, workshops and storage areas). The construction of these facilities may potentially lead to destruction or alteration of habitat, in turn leading to loss or alteration of ecological structure and indirect impacts on freshwater resources. Clearing of vegetation prior to construction, and ongoing disturbances to vegetation during operational activities will result in exposed soils. This, combined with the steep slopes, will, in turn, increase the risk of erosion and potentially sedimentation of downgradient watercourses. Impacts on the watercourses will potentially lead to a loss of migratory routes for faunal species, impacts to water quality, and loss of recharge to downstream reaches. These activities, if not effectively mitigated, may result in long term to permanent impacts on portions of watercourses which are directly affected (for example within the headwaters of a smaller tributary which will be impacted by the "Wishbone WRD and Wishbone PCD"), and potentially extend to downstream/downgradient areas (numerous watercourses are located downgradient of the various study areas but particularly the Blyde River and Peach Tree Stream). Significant potential impacts in the vicinity of the Iota South WRD and Iota PCD, directly adjacent to the Blyde River are additional considerations and areas that require extensive mitigation.

Operational activities may result in the contamination of soils and groundwater with specific mention of increased salt loads and contamination by specific Chemical Pollutants of Concern (CPC's), possibly leading to contamination of surface water within the watercourses associated with the various study areas, in turn potentially leading to the alteration or loss of habitat for floral and faunal species associated with these freshwater areas.

From a hydropedological point of view, no significant impact from the proposed mining project [on the watercourses] is foreseen due to the dominance of shallow responsive soils which are event driven. No interflow soils were identified within the study area, thus contribution of vadose zone to the freshwater resources is limited. Although impact is anticipated to be low, if mitigation measures are carefully implemented and recommendations are considered, the impact significance can be further reduced to ensure that there is a minimised net loss of catchment yield to the watercourses of the region.

Activities which are likely to negatively affect the watercourses associated with the various study areas include, but are not limited to, the following:

- Placement of infrastructure (including the Wishbone WRD, the Wishbone PCD (located on a tributary of the Blyde River), the Iota WRD south, and the Iota PCD situated adjacent to the Blyde River, road crossings and fences) within preferential surface water flow paths and watercourses with riparian vegetation;
- Stripping (vegetation clearance) of mining areas and disturbances to soils prior to construction of infrastructure and ongoing disturbances to soils during the operational phase;
- Potential destruction of watercourse habitat during construction and operational activities;

- Construction of hard standing areas that increase runoff volumes, including roads, buildings and paved areas;
- Canalisation of run-off may potentially lead to the creation of supercritical flows, which would lead to erosion and incision of drainage systems affected. Furthermore, the mobilised sediment would lead to sedimentation in the receiving environment which in turn would affect habitat integrity and aquatic biota. This is particularly significant in the case of the perennial rivers in the region since the biota of these systems are particularly reliant on clear fast flowing water flowing over a rocky and or gravel substrate, clear of fine sediment for foraging breeding and cover. Furthermore, the fish community of the systems are reliant on the availability of deeper refugia which can become silted up if the catchment is excessively disturbed and not appropriately managed;
- Discharge and/or spills and seepage from mining surface infrastructure;
- Construction of clean and dirty water separation areas leading to a loss of catchment yield; and
- Build-up of contaminants in sediments leading to the creation of a sediment sink and chronic source of potential water contamination.

The watercourses located within, and downgradient of the proposed mining activities remain at risk due to the proposed activities. Additionally, should any rehabilitation of historical mining areas be undertaken prior to or concurrently with the proposed mining activities, care must be taken during the rehabilitation process to ensure that further impacts on the watercourses do not occur as a result.

The points below summarise the aspects, in addition to the results of the freshwater field assessment that, were considered when evaluating the potential impact:

- When undertaking the impact assessment, the principles enshrined in the relevant South African legislation and advocated by the DEA *et al* (2013), the precautionary principle was followed and a “worst case scenario” was considered where applicable, based on the layout provided (e.g. where the Wishbone WRD and its associated PCD) is placed over the headwaters of a drainage line). However, it is acknowledged that the project footprint has been refined and optimised in order to minimise and reduce impact significance on the receiving environment;

- It is important to note that in line with the methodology, the DWS Risk Assessment Matrix (2016) is applied assuming that recommended mitigation measures are implemented, i.e. the impact significance presented is ***post-mitigation***;
- Due to the scoring method of the DWS Risk Assessment Matrix (2016), not all variables factor in the sensitivity of the watercourse, although activities occurring within a watercourse are scored at the highest possible severity rating (5). Therefore, some impacts may be perceived as 'moderate' significance although the true significance thereof may in reality by higher;
- The perceived impacts of the various activities on the ecology of the receiving watercourses took into consideration the chronological order in which the activities will occur, if deemed applicable;
- It is essential that throughout the life of mine and beyond closure that downstream impacts are managed, mitigated and minimised in such a way as to meet the Resource Quality Objectives for the receiving watercourses and in particular the Blyde River;
- The presence of the Critically Endangered *Enteromius cf treurensis* observed in the Blyde River within the proposed project area, as well as the Near Threatened *Enteromius motebensis* observed in the Pilgrims Creek downgradient of the proposed project area was considered; and
- Due to the economic value of the targeted geological resources, total avoidance of impacts on the freshwater resources may not be the most appropriate solution when considering the principles of Integrated Environmental Management; however, with the implementation of well-planned, cogent mitigation measures, impacts can be mitigated and minimised albeit not avoided and the risk removed completely. In addition, in order to optimise the economic potential of the mined resource, continuous mining is preferred in order to ensure that ore abstraction takes place as efficiently as possible and that ore recovery is optimised, in order to limit the duration of impacts on the watercourses.

The results of the impact assessment are summarised in the table below (see Appendix G for detailed assessment). It should be noted that in the interests of presenting a concise, user-friendly summary of the risk assessment as well as of the mitigation measures, only key mitigation measures are contained in Table 27 whilst all mitigation measures considered essential for a project of this nature are presented in Table 28.

Table 29: Summary of the results of the impact assessment applied to the various study areas.

No.	Phases	Activity	Aspect	Impact	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	PES AND EIS OF WATERCOURSE
1	Pre-construction planning	Planning of proposed surface infrastructure layout and proposed open pit mining areas.	The location of infrastructure (most signifcantly the Wishbone WRD, the Iota South WRD and the PCDs, as well as various road crossings, powerline crossings and pump columns etc) occur directly within watercourses (especially in the case of linear infrastructure which traverse several drainage systems) and within the 32m or 100m zones of regulation according to the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Government Notice (GN) 704 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).	* Loss of catchment yield and surface water recharge, potential creation of seepage (from the WRD) within the active drainage systems which can lead to a loss of general loss of aquatic and riparian biodiversity as well as SCCs, impaired water quality, loss of instream habitat integrity and overall EcoStatus as well as impacts to aquatic resources further downstream of the proposed mining activity.	17	204	H	70	Ensure that as far as possible all infrastructure is placed outside of aquatic resources. In particular, mention is made of the need to not encroach on the Blyde River and Peach Tree Stream and to protect these two systems from the impact of adjacent mining; It must be ensured that the design and construction of all infrastructure prevents failure; In addition, very clear separation of clean and dirty water areas must be included in the design of the mine in such a way as to ensure the mine is fully compliant with Regulation GN704; and Refer to Table 27; Aspect 1 and 2 for detailed mitigation measures.	N/A	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.
2	Construction	Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.	Topsoil removal and creation of temporary stockpiles.	* Increased risk of transportation of sediment from exposed soils in stormwater runoff, leading to increased turbidity of surface water, sedimentation of watercourses and changing the characteristics of the stream beds, smothering of	16	144	M	70	Prior to bulk earthworks the entire clean and dirty water management system must be developed to ensure that all "dirty water" areas can be managed as they are created; and Refer to Table 28; Aspect 1, 4 and 6 for detailed mitigation measures.	N/A	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor

3		Clearing of vegetation in proximity to the drainage systems for contractor laydown areas and construction of surface infrastructure, including preparation of open pits (outside of drainage lines).	Establishment of laydown areas, site clearing, removal of vegetation and associated disturbances to soils.	vegetation and/or altered vegetation composition, smothering of benthic taxa and/or destruction of suitable macro-invertebrate and fish habitats; * Excavation and denuding activities will alter the natural runoff and flow regime of the area. Altered flow regime may lead to destruction of suitable macro-invertebrate and fish habitat; * Loss of riparian areas due to the disturbance of the activity; * Alteration of the chemical	17	170	H	70	Refer to Table 27; Aspect 1, 2, 3 and 7 for detailed mitigation measures.		planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.

3a		Clearing of vegetation within the drainage systems in preparation for construction of various linear developments; loss of vegetation within the drainage line directly impacted by the Wishbone WRD and PCDs.		properties of the river as a result of vegetation removal and deforestation; * Exposure of soils, leading to increased runoff and erosion, and thus increased sedimentation of the river; * Increased sedimentation of the river, leading to smothering of benthos, loss of rheophilic taxa, diverse biotopes and potentially altering surface water quality; * Increased hardened surfaces and compacted soils thus altering the pattern, timing and distribution of recharge which affects the watercourses within the zone of influence; * Loss of foraging and breeding habitat [or hampering access to such suitable habitat (loss of connectivity)] and faunal migratory corridors; and * Proliferation of alien vegetation as a result of disturbances.	17	170	H	70			
4		Construction of additional access and haul roads, resurfacing of existing roads and refurbishment of existing buildings.	Altered drainage patterns due to increased impermeable surfaces. Installation of culverts/pipes as part of the construction of stream crossings.	* Increased water inputs to watercourses, altering flow patterns and wetting patterns leading to further changes to vegetation and aquatic biota communities; * Contaminants from roads (e.g. oil spills) contained in runoff causing	17	93,5	M	70	Refer to Table 27; Aspect 1, 3, 4 and 5 for detailed mitigation measures.		

				pollution to surface water within freshwater resources with resulting potential direct impact on aquatic biota; * Possible incision and sedimentation of freshwater resources due to increased water velocity (direct impact on biota in terms of smothering and indirect impact in terms of habitat destruction).							
5	Construction	Construction of surface infrastructure (e.g. additional mine offices, ablutions, stormwater management systems, etc.).	Risk of contaminated stormwater runoff (e.g. hydrocarbons, sediment, originating from impermeable surfaces).	* Possible contamination of the associated watercourses downstream of the surface structures (water quality impact with associated direct impact on aquatic biota); * Possible erosion/incision of the drainage systems adjacent to surface infrastructure due to concentration of stormwater runoff *Erosion and sedimentation risk with associated impact on aquatic biota and suitable habitat).	**17**	**119**	**M**	**70**	Refer to Table 27; Aspect 1, 4, 5 and 6 for detailed mitigation measures.	**N/A**	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.
			Stockpiling of topsoil and overburden, earthworks, movement of vehicles within lower reaches of drainage systems.	* Sediment-laden runoff entering riparian habitat leading to altered water quality, and changes to aquatic habitat; and * Altered drainage/flow regimes, leading to altered runoff patterns and formation of preferential flow paths.	**17**	**170**	**H**	**70**			
			Potential disposal of hazardous and non-hazardous materials in riverine areas.	* Altered water quality, possible changes to flow patterns as a result of blockages caused by solid waste/rubble.	**8**	**24**	**L**	**70**	No waste may be disposed of within any riverine habitat, and that all waste be removed to an appropriate disposal facility; and Refer to Table 27; Aspect 1, 3 and 5 for detailed mitigation measures.		
5a		Construction of surface infrastructure within drainage systems:	As for Activity 5 above.	As for Activity 5 above.	**17**	**170**	**H**	**70**			

		Wishbone WRD, PCDs, linear developments including but not limited to haul and access roads, perimeter fence, diversion trench and so forth.									
6		Opening of pits by means of dozer ripping (strip mining method).	Excavations will lead to denuding of landscape, thus increasing the risk of increased sediment loads entering the watercourses.	Potential sedimentation of watercourses, leading to altered channel competency, altered vegetation community structures, blanketing of benthos and loss of rheophilic taxa and suitable habitat.	17	93,5	M	70	Strict adherence to the requirements of GN704 as it relates to the NWA in order to prevent contamination of salts and CPC's to the freshwater and aquatic systems; and Refer to Table 27; Aspect 1, 3 and 4 for detailed mitigation measures.		
7	Operations	Alteration of the local hydrological regime due to potentially poorly managed stormwater and compaction of soils and increased extent of impermeable surfaces.	Altered drainage patterns, potentially leading to the formation of preferential flow paths and/or concentrated flows.	* Erosion of terrestrial areas as preferential flow paths are formed in the landscape, resulting in sedimentation of watercourses, leading to altered channel competency, altered vegetation community structures, blanketing of benthos and loss of rheophilic taxa and suitable habitat.	17	144,5	M	70	Refer to Table 27; Aspect 4 for detailed mitigation measures.	N/A	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.
8		Presence of clean and dirty separation infrastructure upstream of surface infrastructure; Presence of diversion trench around perimeter fence.	Loss of catchment yield due to stormwater containment.	* Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the watercourses; * Reduction in volume of water entering the watercourses, leading to loss of recharge (and thus desiccation) of downstream system; and * Altered vegetation communities due to moisture stress.	16	124	M	70	Pollution prevention through infrastructure design, in order to prevent, eliminate and/or control potential groundwater pollution plumes, in accordance with any recommendations made in geohydrological specialist study; and Refer to Table 27; Aspect 1 and 4 for detailed mitigation measures.		
9		Deposition of tailings, waste rock, general operations of the mine, with special mention of the Wishbone WRD, Wishbone PCD, Iota WRD South and Iota PCD	Possible pollution of surface water as result of seepage/runoff from proposed infrastructure (e.g. water treatment facilities, ROM stockpiles, PCD, WRD, TSF and workshop/fuel storage areas). Potential groundwater pollution, leading to plumes, which may affect watercourses downstream of the surface infrastructure.	* Possible contamination of surface and ground water, leading to impaired water quality and salination of soils within riparian areas; * Sedimentation of watercourses could lead to altered water quality, altered channel integrity and altered vegetation community structures; and * Changes to vegetation growth due	15	180	H	70	No dirty water (as defined by GN704 as it relates to the NWA) is to be released into the receiving environment; Special attention needs to be paid to the use of the existing TSF and the lining thereof according to the specifications of the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008); Water treatment facilities to be implemented		

			Increased risk of sediment transport in surface runoff from surface infrastructure to watercourses, leading to altered water quality and sedimentation of freshwater systems.	to increased nutrients as a result of altered groundwater properties.	18	126	M	70	prior to the commencement of activities and to be maintained throughout the LOM to the minimum specifications of GN704 as it relates to the NWA; and Refer to Table 27; Aspect 1, 4 and 6 for detailed mitigation measures.		
10		Continued dozer ripping (strip mining method) of pits.	Excavations will lead to denuding of landscape, thus increasing the risk of increased sediment loads entering the watercourses.	Potential sedimentation of watercourses, leading to altered channel competency, altered vegetation community structures, blanketing of benthos and loss of rheophilic taxa and suitable habitat.	19	90,25	M	70	Refer to Table 27; Aspect 1 and 4 for detailed mitigation measures.		
11	Closure and latent impacts	Decommissioning / removal of surface infrastructure.	Compacted soils, latent impacts of vegetation losses.	* Increased runoff volumes and formation of preferential surface flow paths as a result of compacted soils and unvegetated areas, leading to increased sedimentation, erosion, and increased water inputs to downgradient aquatic systems (watercourses); * Proliferation of alien vegetation due to disturbances, which will impact natural flow regimes; and * Potential visual scars, affecting aesthetic features and faunal habitat.	18	130,5	M	70	Ensure that soils are replaced in the correct layers, ripped and re-reprofiled post-closure, and that vegetation is restored to a point where succession will lead to the same conditions as the pre-mining state as a minimum; Rehabilitation measures must be implemented. Implementation must be overseen by a suitably qualified Environmental Site Officer (ESO) with freshwater experience and the ESO must sign off the rehabilitation before the relevant contractors leave site; Minimum of ten years' post-closure monitoring to be undertaken; and Refer to Table 27; Aspect 4, 7 and 8 for detailed mitigation measures.	N/A	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.

8.2 Project specific mitigation measures

Based on the findings of the freshwater resource assessment, several recommendations are made to minimise the impact on the freshwater ecology of the area, should the proposed mining project proceed, as outlined in Table 30 below. These must be implemented in conjunction with those stipulated in Table 28 above. In addition to these mitigation measures an emergency protocol as specified under paragraph 6 (1) (vi) of GN509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) must be developed and retained on site at all times (refer to Appendix E).

Table 30: Essential mitigation measures developed for the TGME mining project.

Aspect	Mitigation measures	Mitigation measures applicable to Impact No.s (Table 29)
8. Project footprint, infrastructure design and general construction phase	➢ All activities should adhere to the requirement of GN704 of the National Water Act, 1998 (Act No 36 of 1998) (NWA); ➢ During the planning phase, the location of access roads should take into consideration the sensitivity maps provided in Section 7.1 of this report, and wherever possible, access roads should not be planned adjacent to, or traversing, any watercourse. Should it be essential that access roads cross over any watercourse, this should be planned at existing crossing points or points of existing disturbance within the river and/or riparian zone; ➢ As far as possible no development of any geographically variable infrastructure should take place within 100m of the Blyde River, its tributaries, or any other delineated freshwater resource in line with regulation GN704 of the National Water Act as far as possible, while ensuring that mining is done safely and to optimise resource abstraction as far as possible without causing irreversible harm to the watercourses of the region; ➢ All road crossings over watercourses must be kept to the bare minimum and are adequately designed to prevent impacts on habitat, instream flow, pattern and timing of water and water quality. ➢ All mining infrastructure must remain out of the riparian zones and associated zones of regulation in line with the requirements of GN704 and GN509 of the NWA. Any mining infrastructure within the applicable zones of regulation in terms of GN704 and GN509 must be appropriately authorised; ➢ Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of clean water runoff areas and catchment yield and the concomitant recharge of streams in the area; ➢ Design of infrastructure should be environmentally and structurally sound and all possible precautions taken to prevent contamination of surface and resources present; ➢ No dirty water runoff must be permitted to reach the watercourses, in line with GN704 as it relates to the NWA and appropriate clean and dirty water separation and stormwater management controls must be developed as the first part of the construction activities of each project/mining unit; ➢ It is deemed essential that the mine be designed in such a way as to ensure that decant is prevented for the life of the proposed mining activities and beyond closure unless measures to treat decant to background water qualities can be ensured until the quality of the decant naturally returns to these background levels;	Impacts 1, 2, 3, 4, 5, 6, 8, 9 and 10.

Aspect	Mitigation measures	Mitigation measures applicable to Impact No.s (Table 29)
	➢ Water quality, with special mention of pH and dissolved salts need to be managed, and monitored in order to ensure that reasonable water quality occurs downstream of the mined areas to allow for the on-going survival of a riparian and aquatic community in line with the REC and RMO, and in support of Resource Quality Objectives for the major watercourses of the region and most notably the Blyde River; ➢ Mine design and planning must ensure that connectivity of the freshwater resources is maintained; ➢ All proposed haul and access roads, fences and any additional linear infrastructure (e.g. PCD pump columns and Eskom power supply) must cross the watercourses at the narrowest point and at a 90-degree angles. As much as possible, existing access roads and river crossings must be utilised (if necessary, upgraded) to minimise further disturbances to the watercourses; ➢ The substrate characteristics of the watercourse and instream connectivity must be maintained; ➢ Obstruction of flow should not take place or should only occur for very short periods, if absolutely essential; ➢ Restrict construction of clean and dirty water systems and within watercourses (e.g. Wishbone WRD and bridge crossings) to the drier winter months to avoid sedimentation of the watercourses in the vicinity of the proposed mining project; ➢ Vehicles to be serviced at the contractor laydown area and all refueling is to take place outside of the watercourses and applicable setback zones; and ➢ Sanitation services must be provided for construction personnel, whereby at least one portable toilet will be provided per ten personnel and will be emptied regularly.	
9. Access control	➢ During any further exploration activities or the construction phase no vehicles must be allowed to indiscriminately drive through the watercourses and vehicles must remain on designated roadways; ➢ New crossings of the watercourses should be avoided. If new crossings are required, the substrate conditions of the watercourses and stream connectivity must be maintained; ➢ Permit only essential construction personnel beyond approved construction areas; and ➢ All areas of increased ecological sensitivity (i.e. the watercourses and areas which are important in terms of recharge) must be designated as "No-Go" areas and be off limits to all unauthorised vehicles and personnel during all phases of the proposed mining project.	Impacts 3, 4, 5 and 6 General operational / maintenance activities.
10. Hydrological drivers and consumption management	➢ If decant will occur, all water is to be treated to background water quality values prior to release into the receiving environment; and ➢ Measures to contain and reuse as much water as possible within the mine process water system must be sought, and very strict control of water consumption must take place. Detailed monitoring must be implemented and maintained to ensure that all water usage is continuously optimised; ➢ No dirty water runoff must be permitted to reach the riverine resources during the entire life of mine, and clean and dirty water management systems must be put in place to prevent the contaminated runoff (suspended solids and salts and water with low pH) from entering the receiving aquatic environment. Clean and dirty water runoff systems must be constructed before construction of any other infrastructure takes place; ➢ Any dirty water runoff containment facilities must remain outside of the defined riparian areas and their buffers (setback zones / zones of regulation) as a measure to minimise the impact on the receiving environment; ➢ Strict control of sewage water treatment must take place and the sewage system must form part of the mine's closed process water system;	Impacts 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11.

Aspect	Mitigation measures	Mitigation measures applicable to Impact No.s (Table 29)
	➢ All dirty water containment structures must be designed to contain a minimum storm event of a 24 hour 1 in 50 year flood event; ➢ All pollution control facilities must be managed in such a way as to ensure that storage and surge capacity is available if a rainfall event occurs; ➢ Special attention needs to be paid to the use of the disposal of tailings generated and the lining of the facilities to be used according to the specifications of the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008); ➢ All storage facilities (WRD, PCD, stockpiles) to be lined with appropriate liners to prevent seepage; ➢ Adequate stormwater management must be incorporated into the design of the proposed mining project in order to prevent erosion and the associated sedimentation of the riparian and instream areas. In this regard special mention is made of: • Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed; • Runoff from paved surfaces should be slowed down by the strategic placement of berms; and • All overburden stockpiles and waste stockpiles must have berms and/catchment paddocks at their toe to contain runoff from the facilities. ➢ The use of 'green' stormwater management techniques such as vegetated swales, constructed wetlands (attenuation ponds), and permeable paving (where practical, e.g. in parking areas) is strongly recommended. Such methods will assist in polishing stormwater runoff, thus minimising potential pollution of the receiving aquatic environment; ➢ Stormwater trenches/berms must be constructed, and water contained therein may be recycled and utilised within the mine water circuit (dust suppression), or pumped to a Pollution Control facility for evaporation; and ➢ Monitor all potentially affected drainage systems for changes in riparian vegetation structure related to water stress should variation in the vegetation be observed.	
11. Waste and contamination management	➢ No material may be dumped, disposed of or stockpiled within any of the watercourses in the vicinity of the proposed mining project. If any spills occur, they must be immediately cleaned up; and ➢ No dirty water (as defined by GN704) is to be released into the receiving environment.	Impacts 4, 5, and 11.
12. Geomorphological drivers and habitat management	➢ All areas affected by construction or decommissioning activities must be rehabilitated upon closure of the mining expansion. All contaminated soils must be removed and disposed of at an appropriate facility. Affected areas must be reshaped to be free draining and reseeded with indigenous grasses should take place as required; ➢ Ensure that all stockpiles are well managed and have measures such as berms and protection with hessian sheets or silt traps as deemed applicable by the project engineers implemented to prevent erosion, sedimentation and eutrophication (Reno mattresses, gabions, re-vegetation etc.), which may lead to transformation of riparian and/or aquatic habitat and lead to impaired water quality; ➢ All erosion noted within any study area must be remedied immediately and included as part of an ongoing rehabilitation plan; ➢ Strict supervision of all construction activities to ensure that edge effects are minimised and that development remains within the approved footprint; ➢ During the construction and operational phases of the proposed TGME mining expansion, erosion berms should be installed to prevent the formation of erosion gullies as a result of the formation of any preferential surface flow paths, and the possible sedimentation of the assessed sites and surrounding freshwater systems; and ➢ The following points serve to guide the placement of erosion berms when implementing erosion control: • Where the track has slope of less than 2%, berms every 50m should be installed;	Impacts 2, 3, 4, 5, 9 and 11.

Aspect		Mitigation measures	Mitigation measures applicable to Impact No.s (Table 29)
		• Where the track slopes between 2% and 10%, berms every 25m should be installed; • Where the track slopes between 10%-15%, berms every 20m should be installed; • Where the track has slope greater than 15%, berms every 10m should be installed.	
13.	**Vegetation**	➢ Implement alien vegetation control program within freshwater resource areas with special mention of water loving tree species. Throughout the life of mine measures to control alien vegetation must be implemented and specific attention to riverine features should be paid; ➢ Limit footprint of vegetation clearing to what is essential; ➢ Retain as much indigenous vegetation as possible; and ➢ Rehabilitation and re-vegetation of disturbed areas immediately after construction.	Impacts 3, 4, 10 and 11 Ongoing throughout LOM.
14.	**Closure**	➢ The following recommendations must be considered in conjunction with the recommendations of the geohydrologist. The geohydrologist recommendations must take precedence over the recommendations presented below: • Strict monitoring throughout LOM and post-closure is required in order to ensure the health and functioning of watercourses is retained and monitoring data must be proactively utilised to identify any possible pollutants entering the system. • Drilling of groundwater monitoring boreholes to monitor water levels and quality as the groundwater rebounds. ➢ Demolition footprint must be clearly demarcated and no related activities, including the movement of vehicles, must be permitted to occur outside of the footprint area; ➢ All related waste and rubble must be removed from site and disposed of according to relevant SABS standards. No waste must be permitted to enter watercourses; ➢ Edge effects such as erosion must be monitored and managed as recommended during construction and operational phases; ➢ All areas affected by stockpiling during the operational phase of the mine must be rehabilitated and stabilised using cladding or a suitable grass mix to prevent sedimentation of the watercourses in the area; ➢ Rehabilitation must ensure that riparian structure and function are reinstated in such a way as to ensure the ongoing functionality of the larger drainage systems at pre-mining levels; ➢ All areas must be resloped and an appropriate layer of topsoil reapplied and where necessary and reseeded with indigenous grasses; ➢ It is critical that ongoing monitoring of alien vegetation is maintained post-closure, as proliferation of alien vegetation in the demolition areas is expected; and ➢ Ongoing watercourse (riparian) and aquatic biomonitoring must take place throughout the closure phase of the mine and must continue into the post closure phase for a period of at least ten years to define latent impacts that need to be mitigated.	Impact 10 and 11.

8.3 Watercourse monitoring

The following monitoring recommendations are intended to be implemented throughout all phases of the proposed mining development:

- Any areas where active erosion is observed must be rehabilitated and a system of berms and swales must be utilised to slow movement of water;
- Riparian resources need to be monitored using the wetland assessment protocols as defined below unless updated and/or more appropriate methods are developed in future:
  - PES according to the IHI method (Kleynhans, 2008) (refer to Section 2.3 for the method) as applicable;
  - Riparian zonation monitoring to determine whether impacts on base flow levels are occurring;
  - Water quality monitoring as part of the mine’s water quality monitoring program; and
  - Monitoring of the riparian vegetation assemblage, in particular alien vegetation. Where applicable, VEGRAI should be used as part of the monitoring process.
- Ongoing monitoring of the trends in ecological integrity of the assessed sites in the vicinity of the existing and proposed TGME mining facilities is deemed essential, in order to monitor the impacts of the mining activities of these very sensitive and ecologically important systems. Aquatic biomonitoring must take place on a bi-annual basis by a SA RHP Accredited assessor, in order to identify any emerging issues in the receiving environment using the following indices in the assessment:
  - Habitat assessments using IHAS (6 monthly) and the IHIA (annually);
  - Aquatic macro-invertebrates using SASS5 and the MIRAI EcoStatus tool (6 monthly);
  - Fish community integrity using the FRAI EcoStatus tool (Annually in summer); and
  - Diatoms and the application of the SPI index (6 monthly).
- Close monitoring of water quality (surface water, groundwater and process water) must take place. Monitoring of water quality must take place monthly, during which time basic parameters such as pH, Dissolved Oxygen (DO) and Electrical Conductivity (EC) are measured;
- Should EC or pH values reach an undesirable level, suitable mitigation measures must be implemented;

- Sediment monitoring at selected sites along the Blyde River should take place concurrently with the aquatic biomonitoring to monitor pollution levels in sediments over time;
- Toxicity testing of the mine's process water facilities, the groundwater and surface water resources must take place concurrently with the biomonitoring program, in order to monitor the toxicological risk of the process water system to the receiving environment and in particular the groundwater resources. These ongoing toxicological tests must be compared to baseline data to monitor and manage any emerging impacts over time. Tests must include the following test organisms as a minimum:
  - *Vibrio fischeri*;
  - *Poecilia reticulata*; and
  - *Daphnia pulex*.
- Should emergency discharge from any process water system be required, definitive toxicological testing according to the Direct Estimation of Ecological Effect Potential (DEEEP) protocol must take place, in order to define safe discharge volumes and ensure sufficient dilution;
- Results of future assessments must be compared spatially and temporally to the results of this study (specifically, Sections 6.3.1 – 6.3.6). If it is observed through biomonitoring information that significant negative changes are taking place in ecological integrity (Change of Class), it should be taken as an indication that the system is suffering stress and mitigatory actions should be identified and where possible, implemented; and
- Biomonitoring results very strongly rely on the competency level of the assessor. All future biomonitoring studies must be undertaken by an accredited assessor and it would be preferable to utilise the same assessor in subsequent studies in order to allow for more accurate comparison of data over time.

8.4 Possible Latent Impacts

Even with extensive mitigation, latent impacts on the receiving freshwater environment are deemed highly likely. The following points highlight the key latent impacts that have been identified:

- Reduced availability of refugia for aquatic and wetland biota;
- Loss of riparian habitat;
- Altered riparian and wetland vegetation structures with specific mention of increased abundance and diversity of alien invasive species;
- Eroded and incised portions streams are unlikely to be rehabilitated;

- Silted up refuge pools are unlikely to be naturally rehabilitated and are unlikely to be rehabilitated by the mine and loss of refugia in the system is deemed likely;
- Loss of water quality within a sensitive catchment and loss of clean water to the downstream freshwater resources, including the already impacted Olifants River, which depends on the input of clean water from the Blyde River for dilution of the poor water quality in the system;
- Loss of ecoservice provision;
- Loss of some sensitive species that are less tolerant of water quality changes is likely, with special mention of the fish species observed such as the *Chiloglanis pretoriae* and *Amphilius uranoscopus*, which are species that require clear, fast-flowing and well oxygenated water with suitable cobble habitat for survival; and
- Loss of rare and critically endangered biota such as the Treur River Barb (*Enteromius cf treurensis*), which is endemic to this region, and the near threatened Marico Barb (*Enteromius motebensis),* which were both sampled during the January 2020 assessment, as well as the Natal Mountain Catfish - *Amphilius natalensis* (DD), *Amphilius* sp. *'natalensis* cf. *treur'* (DD), the vulnerable *Pseudagrion newtoni* ("Harlequin sprite" damselfly), and amphibian species (*Hadromophryne natalensis* – Vulnerable in Mpumalanga) (IUCN, 2016).

8.5 Cumulative impacts

The proposed TGME Theta mining project is located in an area where commercial forestry, agricultural activities, peri-urban settlements and tourism facilities to a lesser degree, place a strain on freshwater resources present. Cumulative impacts as a result of these land uses results in loss or diversion of surface water, and associated loss of catchment yield, as well as potential impacts on water quality (e.g. informal discharge of domestic effluent into the Blyde River from informal settlements and from the Pilgrims Rest WWTW) . Historical mining and agricultural activities have resulted in alterations to and losses of sensitive wetland, aquatic and riparian habitat, contributing to loss of aquatic biodiversity and placing additional pressure on faunal species reliant on this habitat for breeding, foraging and migration routes. This too, applies to the rare and endangered biota that are endemic to the region such as the critically endangered Treur River Barb (*Enteromius treurensis*) as well as the Natal Mountain Catfish (*Amphilius natalensis* (DD)), *Amphilius* sp. *'natalensis* cf. *treur'* (DD), the vulnerable *Pseudagrion newtoni* ("Harlequin sprite" damselfly), and amphibian species (*Hadromophryne natalensis* – Vulnerable in Mpumalanga) (IUCN, 2016).

At the time of the assessment, water quality was considered very good within the study area and immediately downstream thereof, and within acceptable standards (however, temporal and spatial variation in EC and potential temporal variation in DO was noted and should be monitored in future); however, the proposed TGME mining project has the potential to contribute to impaired water quality as a result of contaminated runoff from the impermeable surfaces associated with the surface infrastructure. The results of the geohydrological study (MVB Consulting, 2019) indicate that decant is not expected to occur during the life of the project. These impacts can mostly be managed, but if done so inadequately or not at all, the proposed TGME project may contribute to cumulative impacts on the freshwater resources within the Pilgrims Rest area, leading to a localized loss of freshwater resources and freshwater resource integrity. Whilst this may potentially contribute to impacts on the ecological integrity of downstream watercourses, the extent of impact is not expected to reach tourism hotspots such as Bourke's Luck Potholes and further downstream than this, due to the distance involved.

It should however be noted that the proposed TGME Theta project is a "pilot" project, and may be the catalyst for extensive open cast gold mining within the greater Pilgrims Rest area. Thus, whilst the cumulative impacts associated with the proposed Theta project are not expected to be extensive, the cumulative impacts associated with future mining activities in the catchment, should such projects come to fruition, may have a regional and potentially provincial influence on freshwater resources.

8.6 "No-Go" Alternative

The following section presents the outcome and discussion of anticipated impacts on the freshwater and aquatic ecology, based on several scenarios surrounding the No-go alternative vs if the Theta Project is authorised. Assessing the No-go Alternative, or the scenario of a project not going ahead, requires that all possible scenarios be taken into account, including the implications of not authorising the project. For the Theta Project, four scenarios were identified, and their anticipated impacts on the freshwater and aquatic ecology for the focus area and larger region (where applicable), were assessed below:

- No-go with no management from relevant stakeholders;
- No-go with management from relevant stakeholders;
- Authorised mining in an ideal scenario; and
- Authorised mining practically achievable.

Discussion: No-go Alternative

The Blyde River and its tributaries are subject to several ongoing threats and the immediate threat of loss of water quality, habitat and biodiversity if the No-go Alternative is pursued. These threats include but are not limited to the illegal artisanal mining activities observed along the length of the Blyde River at the time of the January 2020 assessment, seepage and impacts to the EC of the river due to historical mining activities and historical mining infrastructures, ongoing forestry activities and the proliferation of alien and invasive species, which have resulted in changes to the surface water runoff patterns and flow regimes of the river, cumulative impacts related to increasing urbanisation such as surface hardening and the creation and treatment of sewage. This is not to say that the ongoing land use activities which currently threaten the Blyde River will be solved should the proposed mining activities be approved.

Both the development of the proposed mine as well as the threat of illegal artisanal mining activities have the potential to result in an influx of people to the area, which has the potential to escalate urbanisation and impacts to the surrounding landscape, which in turn, has the potential to further impact the instream integrity of the Blyde River.

The presence of several critically endangered and near threatened species inclusive of the Trear River Barb (*Enteromius cf treurensis*) (CR) and the Marico Barb (*Enteromius motebensis*) (NT), as well as several other fish species requiring clear, fast flowing and well oxygenated rivers with good cobble and stones habitat for their survival are of critical concern. The Treur River Barb (*Enteromius treurensis),* is not a migratory fish and is isolated to a single population in the upper reaches of the Blyde River and its tributary the Treur River. However, with the No-go Alternative, the existing threats to biodiversity remain. The alien Rainbow Trout (*Oncorhynchus mykiss*) was sampled along the length of this section of the Blyde River and preys on the Treur River Barb (*Enteromius treurensis*) and poses a threat to the natural populations present. To prevent negative impacts on the freshwater and aquatic resources, there would need to be agreement from all relevant stakeholders to manage the current risks posed by illegal mining and the proliferation of alien and invasive species. For example, controlling illegal mining activities will assist in the prevention of altered habitat and the associated sedimentation of the river and would allow for recovery of water clarity and quality of the Blyde River as well as ensuring the long-term health of both instream and riparian habitat within the focus area and downstream. This scenario would be the choice alternative as the threat to the biota, habitat and water quality of the Blyde River, should the proposed mining project proceed, is regarded as high in terms of the freshwater and aquatic ecological integrity. However, this is not deemed likely as the required resources are unlikely to be made available.

Pursuing the no-go alternative will most likely result in an influx of uncontrolled illegal artisanal miners to the area (i.e. no management from government) and the relatively small-scale activities observed along the Blyde River, which included washing of fines and a partial river diversion, would likely increase exponentially. Should the Theta Project not be approved, the necessary funding and resources required to control illegal miners will not be available, resulting in the ongoing pollution and sedimentation of the Blyde River and tributaries. Immediate impacts will include habitat being directly destroyed or fragmented by modifying riverbanks, channelizing and diverting flows, creating ponds, and through increased erosion, turbidity and sediment composition. The anticipated long-term impacts include the ongoing degradation and die-back of riparian habitat, severe sedimentation and loss of habitat of the downstream aquatic resources and loss of water clarity and quality, with significant impacts on downstream instream and riparian habitat also anticipated.

The current state of alien and invasive species within the proposed project area and beyond already poses an unacceptable risk to the local biodiversity. Of increased concern is the presence of wattle and gum species along the freshwater resources. For example, wattle spreads quickly and invades stream banks where it clogs rivers and causes soil erosion. Without adequate resources, managing the existing, vast population of the alien and invasive species associated with the proposed project area will not yield positive results.

Discussion:

The proposed project, if authorised, has the likelihood of resulting in the loss of not only near threatened and critically endangered species to this portion of the Blyde River and potentially further downstream, but also has the potential to compromise the water quality of the Blyde River and impact downstream users of this important resource. The impacts will be especially significant with regards to the activities associated with the Iota Pit, Iota WRDs, Wishbone WRD and Theta Pits. The creation of dirty water and the release of treated mine effluent and other pollutants to the freshwater resources are likely to result in the following:

- A gradual deterioration of the overall EcoStatus Category of the Blyde River and poses the risk that the river may no longer comply with the RQIS PES (DWS, 2014) classification of Category C conditions for this section of the Blyde River over time;
- Impact on the water quality and the integrity of the aquatic assemblage of this Class I, sensitive system; and
- That the Blyde River is thus unlikely to be managed appropriately as a Class 1 water resource, as set out in “Classes and Resource Quality Objectives of Water Resources for the Olifants Catchment.” (DWS, 2018).

The greatest future threat to the freshwater resources of this region is the ongoing, unmanaged and uncontrolled illegal artisanal mining activities. The greatest current threats are associated with the surrounding land-uses such as forestry, the ongoing spread of alien and invasive species, increasing urbanisation and the influx of people to the area without appropriate water supply and treatment of waste (thus making use of the river to service their basic domestic needs such as washing and sanitation). The financial requirements to control and manage the existing, vast population of alien and invasive species in the area, supply of municipal services to the surrounding communities, and the policing and management of illegal artisanal miners is undoubtably high and will realistically only be adequately managed should the project be approved and once the mine is in operation.

With authorisation comes the inclusion of mitigation measures that the mine would be obligated to implement, adhere to and be audited on. Strict control of mining activities, along with sound engineering designs, where no mine-related activities result in pollution or sedimentation of the Blyde River and downstream habitat, should be the goal. However, accidental discharge or spills are always a possibility, and this emphasises the necessity for strict adherence to cogent, well-conceived and ecologically sensitive mitigation measures along with readily available emergency action plans (discharge, fires, spillages etc.). Even isolated failures and incidents to comply with and manage the appropriate mitigation measures have the potential to completely destroy isolated fish populations such as the Trear River Barb (*Enteromius treurensis*). Once in operation, and as resources become available, the mine will be able to implement the necessary security measures to control illegal mining activities. This will have an immediate positive impact on the water quality of the Blyde with the subsequent long-term improvement of riparian habitat.

Large mining operations can have greater potential for impact than small-scale artisanal mining, but they also have a greater capacity to minimise damage where artisanal mining practises rarely take responsibility for environmental damage.

Table 30 below presents a summary of the assessment of each future land use alternative.

Table 31: Results of the impacts assessed associated with the various mining scenarios.

NO GO ALTERNATIVE VS MINING								
Proposed Activities	**Status of Impact**	**Extent**	**Duration**	**Probability**	**Intensity**	**Magnitude**	**Significance**	**IMPACT DESCRIPTION**
No-go with no management from relevant stakeholders	N	4	5	5	-4	**-18**	**High-**	Anticipated impacts on freshwater and aquatic ecology include: - Influx of artisanal miners and people to the area with insufficient and/or inadequate municipal infrastructure resulting in increased urbanisation and increased surface water runoff and resulting erosion and incision of the river banks; - Ongoing illegal artisanal mining resulting in sedimentation of the instream habitat, loss of riparian habitat and impaired water quality, which has the potential to result in loss of sensitive aquatic species. Ongoing proliferation of alien and invasive species along the Blyde River and its tributaries resulting in the loss of riparian habitat and altered surface water runoff patterns (causing erosion and incision);
No-go with management from relevant stakeholders	P	3	2	2	5	**12**	**High+**	Anticipated impacts on freshwater and aquatic ecology include: - Maintenance of biodiversity and no direct loss of threatened ecosystems: habitat, biota and water quality; - Control of alien and invasive species; - Control of illegal artisanal miners; - Protection of the Blyde River; - Preservation of water quality and habitat for water supply to downstream users; - Long-term benefit to local and regional biodiversity targets; and - Riparian habitat improved with control of illegal mining activities.
Authorised mining in an ideal scenario	N	1	2	3	-3	**-6**	**Low-**	Anticipated impacts on freshwater and aquatic ecology include: - Influx of artisanal miners and people to the area with insufficient municipal infrastructure resulting in increased urbanisation and increased surface water runoff and resulting erosion and incision of the river banks; - Potential loss of critically endangered species (with special mention of *Enteromius treurensis*), potential impacts to water quality, potential loss of habitat as a result of sedimentation - Ongoing, adequate control of illegal mining with subsequent recovery of sedimented river areas and water clarity impacted by illegal mining activities.
Authorised mining practically achievable	N	3	3	3	-3	**-12**	**High-**	Anticipated impacts on freshwater and aquatic ecology include: - Influx of job-seekers to the area with insufficient municipal infrastructure resulting in increased urbanisation and increased surface water runoff and resulting erosion and incision of the river banks; - Downgradient and downstream freshwater and aquatic resources to be impacted by accidental spills, discharges, sedimentation and erosion – though these will be managed by readily available emergency action plans; - Potential loss of critically endangered species (with special mention of *Enteromius treurensis*), potential impacts to water quality, potential loss of habitat as a result of sedimentation though the likelihood and severity may be mitigated to a certain extent; and - Illegal mining to continue, to a lesser extent and post closure, with some impacts on the Blyde River and its associated instream and riparian habitat still possible.

N = Negative; P = Positive; Extent, Duration, Probability, Intensity and Magnitude were rated as per the impact assessment method employed for the Faunal and Floral Specialist studies (STS, 2020)

9 CONCLUSION AND REASONED OPINION

Numerous watercourses, including the highly sensitive Blyde River, the Peach Tree Stream, the Pilgrims Creek, as well as numerous smaller ephemeral drainage lines with riparian vegetation draining into the Blyde River, were identified within and in the vicinity of the three study areas, i.e. Browns Pit, Theta Pit, and Iota Pit. These watercourses were assessed in order to define their ecological condition, importance and sensitivity, and provisioning of goods and services (i.e. ecological functioning and socio-cultural benefits).

The various watercourses were found to be of high ecological importance and sensitivity, ecologically important and sensitive, and to provide intermediate to moderately high levels of various ecological services such as biodiversity maintenance (especially in the upper reaches of systems[with special mention of the Blyde River] where disturbances were fewer), flood attenuation, assimilation of nutrients and toxicants and streamflow regulation. As a result of the increased ecological integrity and the degree to which ecoservices are provisioned, all systems were deemed to be of moderate to high ecological importance and sensitivity.

The aquatic assemblages of the various rivers and streams assessed (i.e. the Blyde River, the Peach Tree Stream and the Pilgrims Creek) of the assessed sites can be defined as being extremely sensitive to water quality changes as well as changes in flow regimes, with these two parameters also considered to be the most important ecological parameters in the Blyde River system (affected by both natural seasonal variation as well as existing anthropogenic impact) with more significant influence from the changes in flow regime. Two species of concern, the Treur River Barb (*Enteromius cf treurensis*) (Critically Endangered) and the Marico Barb (*Entromius motebensis)* (Near Threatened) were observed within and in the vicinity of the proposed project during the January 2020 assessment. Special mention is made of the Treur River Barb, which is isolated to a single population in the upper reaches of the Blyde River catchment.

The temporal and spatial results of the aquatic ecological assessment indicate that the integrity of the Blyde River, while still largely classified overall as an Ecological Category B along the entire portion of the Blyde River assessed, has begun to decline in a downstream direction over time. This decline may be largely related to the surrounding land-use activities, including forestry, illegal artisanal mining activities, seepage and runoff from historical mining areas, increasing urbanization and proliferation of alien and invasive species (resulting in altered surface runoff into the river), and the ingress of sewage related to the Pilgrims Rest

WWTW. The illegal artisanal mining activities observed has resulted in severe sedimentation in some areas and may potentially have contributed to blanketing of benthos and algal proliferation in a downstream direction, which has begun to compromise the habitat integrity and water clarity of the Blyde River in a downstream direction.

Land-use activities were largely to blame for the short-term variability in EC observed, as well as impacts to the habitat availability and suitability. However, with some recovery of the aquatic assemblages further downstream (site BRN3), it was concluded that the resilience of the Blyde River was such that the impact of the historical mining and ongoing illegal artisanal mining activities, forestry and altered surface runoff profiles still have the potential to be absorbed. However, should the scale of impact increase, the cumulative land-use impacts would place the Blyde River under significant strain and a decline in Ecological Category would be inevitable. **According to the "*Classes and Resource Quality Objectives of Water Resources for the Olifants Catchment"* (DWS, 2018), all efforts need to be made to prevent the proposed activities from impacting on the water quality and the integrity of the aquatic assemblage of this Class I, sensitive system.**

It is therefore considered critical that should the proposed mining project be authorised, very strict adherence to cogent, well-developed mitigation measures must take place throughout the life of the project, with specific mention of planning, separation of clean and dirty water, management of potential decant, dewatering and sedimentation of the receiving environment as well as, during closure, rehabilitation of affected areas.

Due to the likelihood that certain aspects of the proposed TGME mining project may potentially have significantly high impacts on the receiving environment, extensive mitigation must be applied during the construction and operational phases of the project to ensure that no impact takes place beyond the surface infrastructure footprint. In this regard particular mention is made of the management of surface water and the dirty water area of the mine footprint. Strict monitoring throughout the life of the mine and post-closure would be required to ensure the ecological integrity and functioning of the freshwater resources is retained in this sensitive drainage area, and monitoring data must be utilised to proactively manage any identified emerging issues.

Thus, it is strongly recommended that during the planning phase, the delineations of the freshwater resources and their applicable zones of regulation be utilised in order to reposition and optimise the layout of surface infrastructure, wherever possible, with the aim of minimising encroachment on freshwater resources and maintaining a suitable buffer from the Blyde River to prevent impacts as far as possible. Further to this, it is strongly recommended that a suitably qualified freshwater ecologist must form part of the project management team to monitor and guide the construction, operational, rehabilitation and closure objectives of the mine.

It is important to note that it is unlikely that should impacts to the Blyde River and its associated tributaries occur, that the river would have the potential to be restored to its original ecological state. Post-closure seepage and decant is likely to impact the water quality of the Blyde River into perpetuity and it is likely that a number of the sensitive species observed during the seasonal studies carried out may be lost.

Based on the above, it is clear that certain aspects of the proposed project have the potential to impact upon the receiving freshwater environment throughout the life cycle of the project and into the post-closure phase of the proposed project without the responsible implementation of the mitigation hierarchy and exceptionally strict implementation of well-developed, cogent mitigation measures throughout all phases of the proposed project, some of which are highlighted in this report. Strong consideration must be given to comments from all other specialists who have prepared work for this Water Use License application.

The objective of the freshwater system analysis and aquatic ecological assessment was to provide sufficient information on the ecology of the area, together with other studies on the physical and socio-cultural environment, in order for the Environmental Assessment Practitioner (EAP) and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. The needs for conservation as well as the risks to other spheres of the physical and socio-cultural environment need to be compared and considered along with the need to ensure economic development of the country. It is the opinion of the ecologists that this study provides the relevant information required in order to implement IEM and to ensure that the best long-term use of the resources within the TGME project area will be made in support of the principle of sustainable development.

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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, at their discretion, 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

The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)	The environment and the health and well-being of people are safeguarded under the *Constitution of the Republic of South Africa,* 1996 (Act No. 108 of 1996) by way of Section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive realisation of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with Section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA)	The National Environmental Management Act, 1998 (Act No. 107 of 1998 (NEMA)) and the associated Regulations as amended in 2018, 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 Environmental Management: Biodiversity Act (2004) (Act 10 of 2004) (NEMBA)	**Ecosystems that are threatened or in need of protection** (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection. *(b)* An MEC for environmental affairs in a province may, by notice in *the Gazette,* publish a provincial list of ecosystems in the province that are threatened and in need of protection. (2) The following categories of ecosystems may be listed in terms of subsection (1): *(a)* critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation; *(b)* endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems; (c) vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and *(d)* protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs *(a), (b)* or (c).
National Water Act, 1998 (Act No. 36 of 1998) (NWA)	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).
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA)	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 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.
Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)	These regulations, forming part of the National Water Act, 1998 (Act No. 36 of 1998), 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. Mining projects must comply with Regulation GN 704 of the National Water Act (1998) (Act 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 (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.
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)	The obtaining of a New Order Mining Right (NOMR) is governed by the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). The MPRDA requires the applicant to apply to the Department of Mineral Rsoures (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).

APPENDIX C – Methods of Assessment

The sections below describe the methodology used to assess the riparian and aquatic ecological integrity of the five sites selected on the Blyde River and Peach Tree Stream as well as the various unnamed tributaries of each, based on water quality, instream and riparian habitat condition and biological impacts and integrity (as applicable, methodology used during field assessments were dependent on availability of surface water and watercourse classification).

FRESHWATER ECOSYSTEM ASSESSMENT METHODOLOGIES:

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 features present or in close proximity of the proposed study area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

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 study area.

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 associated with the study area.

Classification System for Wetlands and other Aquatic Ecosystems in South Africa
The freshwater features encountered within the proposed study 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[9] (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;
- **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.

[9] 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.

- **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).

1. 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”.[10] 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 C3: 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

Freshwater Resource 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

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

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 C4) of the wetland system being assessed.

Table C4: 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

2. Recommended Management Objective (RMO) and Recommended Ecological Category (REC) Determination

"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" (DWA, 1999).

The RMO (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the freshwater resource (sections above), with the objective of either maintaining, or improving the ecological integrity of the freshwater resource in order to ensure continued ecological functionality.

Table C5: Recommended management objectives (RMO) for water resources based on PES & EIS scores.

			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
PES	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain

	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

*PES Categories E and F are considered ecologically unacceptable (Malan and Day, 2012) and therefore, should a freshwater resource fall into one of these PES categories, a REC class D is allocated by default, as the minimum acceptable PES category.

A freshwater resource may receive the same class for the REC as the PES if the freshwater resource 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 resource.

Table C6: Description of Recommended Ecological Category (REC) classes.

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

Freshwater Resource 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).

AQUATIC ECOLOGICAL ASSESSMENT METHODOLOGIES:

Visual Assessment

Each site was investigated in order to identify visible impacts on the site, with specific reference to impacts from surrounding activities. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the system, were identified by observing conditions and relating them to professional experience. Photographs of each site were taken to provide visual indications of the conditions at the time of assessment. Factors which were noted in the site specific visual assessments included the following:

- Stream morphology;

- Instream and riparian habitat diversity;
- Stream continuity;
- Erosion potential;
- Depth flow and substrate characteristics;
- Signs of physical disturbance of the area; and
- Other life forms reliant on aquatic ecosystems.

Physico Chemical Water Quality Data

On-site testing of biota specific water quality parameters including pH, Electrical Conductivity (EC), dissolved oxygen concentration (DO) and temperature. The results aid in the interpretation of the data obtained by the biomonitoring. Results are discussed against the guideline water quality values for aquatic ecosystems (DWAF 1996 vol. 7) as well as the Resource Water Quality Objectives (RWQO) of South Africa (DWA, 2011). Although the DWAF (1996) guideline water quality percentage change values pertain to temporal comparisons, it will also be applied to spatial comparisons for the purpose of this report, as no suitable alternative is currently available. As the Blyde River forms part of the Olifants River system, the Department of Water and Sanitation (DWS) guideline recommendations from 2018 were also considered.

General 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 C7 below.

Table C7: 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

The Riparian Vegetation Response Assessment Index (VEGRAI)

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 (Kleynhans *et al.*, 2007b). 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).

Riparian vegetation is described in the National Water Act (NWA; Act 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.

Table C8: 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

Habitat for aquatic macro-invertebrates

The Integrated Habitat Assessment System (IHAS) was applied according to the protocol of McMillan (1998). This index was used to determine specific habitat suitability for aquatic macro-invertebrates as well as to aid in the interpretation of the results of the South African Scoring System version 5 (SASS5) scores. However, according to a study conducted within the Mpumalanga and Western Cape regions, the IHAS method does not produce reliable scores with regard to the suitability of habitat at sampling sites for aquatic macro-invertebrates (Ollis *et al*., 2006). Furthermore, the performance of the IHAS seems to vary between geomorphologic zones and between biotope groups (Ollis *et al*., 2006). It has, however; become clear that IHAS requires further validation and testing, although the basic data remains of value (Thirion, 2007).

Table C9: IHAS Scores and their corresponding description of overall condition (quality and quantity) of available aquatic macro-invertebrate habitat (McMillan, 1998)

IHAS Score (%)	Description
>75	Excellent
65 – 74	Good
55 – 64	Adequate / Fair
<55	Poor

Aquatic Macro-Invertebrates: South African Scoring System version 5 (SASS5)

Aquatic macro-invertebrates were sampled using the qualitative kick sampling method called SASS5 (South African Scoring System version 5) (Dickens and Graham, 2002). The SASS5 method has been specifically designed to comply with international accreditation protocols.

This method is based on the British Biological Monitoring Working Party (BMWP) method and has been adapted for South African conditions by Dr. F. M. Chutter (1998).
The assessment was undertaken according to the protocol, as defined by Dickens & Graham (2002). All work was undertaken by an accredited SASS5 practitioner.
The SASS5 method was designed to incorporate all available biotypes at a given site and to provide an indication of the integrity of the of the aquatic macro-invertebrate community through recording the presence of various macro-invertebrate families at each site, as well as consideration of abundance of various populations, community diversity and community sensitivity. Each taxon is allocated a score according to its level of tolerance to river health degradation (Dallas 2007).

This method relies on churning up the substrate with your feet and sweeping a finely meshed SASS net, with a pore size of 1000 micron mounted on a 300 mm square frame, over the churned-up area several times. In stony bottomed flowing water biotopes (rapids, riffles, runs, etc.) the net downstream of the assessor and the area immediately upstream of the net is disturbed by kicking the stones over and against each other to dislodge benthic invertebrates. The net was also swept under the edge of marginal and aquatic vegetation to cover from 1-2 meters. Identification of the organisms was made to family level (Thirion *et al*., 1995; Dickens & Graham, 2002; Gerber & Gabriel, 2002).

Interpretation of the results of biological monitoring depends, to a certain extent, on interpretation of site-specific conditions (Thirion *et.al*, 1995). In the context of this investigation it would be best not to use SASS5 scores in isolation, but rather in comparison with relevant habitat scores. The reason for this is that some sites have a less desirable habitat or fewer biotopes than others do. In other words, a low SASS5 score is not necessarily regarded as poor in conjunction with a low habitat score. Also, a high SASS5 score, in conjunction with a low habitat score, can be regarded as better than a high SASS5 score in conjunction with a high habitat score. A low SASS5 score, together with a high habitat score, would be indicative of poor conditions. The IHAS Index is valuable in helping to interpret SASS5 scores and the effects of habitat variation on aquatic macro-invertebrate community integrity.

Classification of the system took place by comparing the present community status to reference conditions (Dallas 2007), which reflect the best conditions that can be expected in rivers and streams within a specific area and also reflect natural variation over time.

Aquatic Macro-Invertebrates: Macro-invertebrate Response Assessment Index (MIRAI)
The four major components of a stream system that determine productivity, with particular reference to aquatic organisms, are flow regime, physical habitat structure, water quality and energy inputs. An interplay between these factors (particularly habitat and availability of food sources) result in the discontinuous, patchy distribution pattern of aquatic macro-invertebrate populations. As such aquatic invertebrates shall respond to habitat changes (i.e. changes in driver conditions).

To relate drivers to such changes in habitat and aquatic invertebrate condition, two key elements are required. Firstly, habitat preferences and requirements for each taxa present should be obtained. As such reference conditions can be established against which any response to drivers can be measured. Secondly, habitat features should be evaluated in terms of suitability and the requirements mentioned in the first point. As a result, expected and actual patterns can be evaluated to achieve an EcoStatus Category rating.

Based on the three key requirements, the MIRAI provides an approach to deriving and interpreting aquatic invertebrate response to driver changes. The index has been applied to the sites following methodology described by Thirion (2007). Aquatic macro-invertebrates expected at each point were derived both from the Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database, as well as habitat, flow and water parameters (Thirion, 2007).

Fish biota: Fish Response Assessment Index (FRAI)
The FRAI (Kleynhans, 2007) is based on the premise that "drivers" (environmental conditions) may cause fish stress which shall then manifest as changes in fish species assemblage. The index employs preferences and intolerances of the reference fish assemblage, as well as the response of the actual (present) fish assemblage to particular drivers to indicate a change from reference conditions. Intolerances and preferences are divided into metric groups relating to preferences and requirements of individual species.
This allows cause-effect relationships to be understood, i.e. between drivers and responses of the fish assemblage to changes in drivers. These metric groups are subsequently ranked, rated and finally integrated as a fish Ecological Category.
The fish community of each site was sampled for a period of twenty minutes by means of a battery-operated electro-fishing device. Fish species identified were compared to those expected to be present at the sites, which were compiled from a literature survey from Skelton (2001) and the Reference Frequency of Occurrence of Fish Species in South Africa (Kleynhans, *et al*., 2007c). Fish expected to occur in the system is summarised in Section 4.2.2. Comparisons between upstream and downstream points were made where applicable.

Aquatic Ecological Importance and Sensitivity (EIS) Method of assessment (DWAF, 1999)
The EIS method considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table C10). The median of the resultant score is calculated to derive the EIS category (Table C11).

Table C10: Definition of the four-point scale used to assess biotic and habitat determinants presumed to indicate either importance or sensitivity

Four point scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)

Table C11: Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General Description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Aquatic EcoStatus Integration Tool

The Ecological Category was determined for each driver component, separately. However, the individual metrics of all the driver components are assessed in a combined fashion that allows some comparison between metrics of all drivers. This facilitates deriving the cause-and-effect relationships that are required in the interpretation and assessment of particular biological responses. The biological responses are assessed separately, but the resulting fish and macro-invertebrate Ecological Categories were integrated to provide an indication of the instream Ecological Category. The integration of the riparian vegetation Ecological Category and the instream Ecological Category provides the EcoStatus (Kleynhans and Louw, 2007).

Rating (Scoring)

A six-point rating system was followed, where metrics of the drivers and biological responses were scored in terms of the degree to which they have changed compared to the natural or close-to-natural reference:

0 = No discernible change from reference/close to reference
1 = Small modification from reference
2 = Moderate modification from reference
3 = Large modification from reference
4 = Serious modification from reference
5 = Extreme modification from reference

These qualitative ratings are expert knowledge-based and are assessed by the relevant expert in a particular speciality.

Ranking and Weighting

The principle of following a ranking-weighting approach is that not all driver or biological response metrics have the same relative ecological significance in all types of rivers. That is, a particular metric may be seriously modified but it may be of relatively low significance in terms of the functioning and integrity of the river. Thus, the ranking-weighting process is done separately from the rating and should not be influenced by it.

Ranking was done as follows:
The metric of the component (driver or biological response) that was considered to be most important in influencing the Ecological Category of the component if it changed was ranked as 1.

Weighting was done as follows:
The metric (or metric-group, cf. above) with a rank of 1 was awarded a weight of 100%. The weight of the metric with a rank of 2 was considered relative to its importance when compared to the metric with a rank = 1, and this can be any percentage lower than 100%. Usually expert knowledge limits the resolution to 10% and sometimes 5%. Where all metrics (or metric-groups) are ranked as 1, they will all receive a weight of 100%.

Calculation of ECs for components
The calculation of the Ecological Categories of drivers and biological responses was done by totalling the weighted scores and expressing this as a percentage of the maximum. This value indicates the percentage change away from the expected reference and must be subtracted from 100 to arrive at the percentage value that represents the Ecological Category. This value was used to place the Ecological Category of the component in a particular category that ranges from A to F (Table C12).

Table C12 Generic ecological categories for EcoStatus components (Kleynhans and Louw, 2007).

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

EcoStatus Integration
The biological responses are considered to provide the best indication of the EcoStatus of the river because they integrate the effect of the driver components (Kleynhans and Louw, 2007).

The steps in deriving the EcoStatus are:

- Criteria that provides an indication of the relative indicator value of the two instream biological groups, fish and invertebrates, was considered. These criteria were used to weight the relative importance of these two groups as indicators of instream health. The Ecological Categories of the two biological groups were proportioned according to these weights and combined to provide the instream Ecological Category;
- The Vegetation Response Assessment Index (VEGRAI) was used to obtain the riparian vegetation Ecological Category;
- The riparian vegetation Ecological Category and the instream Ecological Category were integrated based on a proportioning of weights according to the availability of high confidence information;
- This provides the EcoStatus of the river.

APPENDIX D – Risk Assessment Methodology

The identified impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructures that are possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[11]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the table below. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[2].

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation. The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

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[1] *The definition has been aligned with that used in the ISO 14001 Standard.*

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

Table D1: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table D2: Spatial Scale (How big is the area that the aspect is impacting on)

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table D3: Duration (How long does the aspect impact on the resource quality)

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

Table D4: Frequency of the activity (How often do you do the specific activity)

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table D5: The frequency of the incident or impact (How often does the activity impact on the resource quality)

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table D6: Legal issues (How is the activity governed by legislation)

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table D7: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource)

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table D8: Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.
A low risk class must be obtained for all activities to be considered for a GA		

Table D9: Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develop or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for prospecting activities and decommissioning and rehabilitation;
- If applicable, transboundary or global effects were assessed;
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

Mitigation measure development

According to the DEA *et al.,* (2013) "Rich biodiversity underpins the diverse ecosystems that deliver ecosystem services that are of benefit to people, including the provision of basic services and goods such as clean air, water, food, medicine and fibre; as well as more complex services that regulate and mitigate our climate, protect people and other life forms from natural disaster and provide people with a rich heritage of nature-based cultural traditions. Intact ecological infrastructure contributes significant savings through, for example, the regulation of natural hazards such as storm surges and flooding by which is attenuated by wetlands".

According to the DEA *et al.,* (2013) Ecosystem services can be divided into 4 main categories:

- Provisioning services are the harvestable goods or products obtained from ecosystems such as food, timber, fibre, medicine, and fresh water;
- Cultural services are the non-material benefits such as heritage landscapes and seascapes, recreation, ecotourism, spiritual values and aesthetic enjoyment;
- Regulating services are the benefits obtained from an ecosystem's control of natural processes, such as climate, disease, erosion, water flows, and pollination, as well as protection from natural hazards; and
- Supporting services are the natural processes such as nutrient cycling, soil formation and primary production that maintain the other services.

Loss of biodiversity puts aspects of the economy, wellbeing and quality of life at risk, and reduces socio-economic options for future generations. This is of particular concern for the poor in rural areas who have limited assets and are more dependent on common property resources for their livelihoods.

The importance of maintaining biodiversity and intact ecosystems for ensuring on-going provision of ecosystem services, and the consequences of ecosystem change for human well-being, were detailed in a global assessment entitled the Millennium Ecosystem Assessment (MEA, 2005), which established a scientific basis for the need for action to enhance management and conservation of biodiversity.

Sustainable development is enshrined in South Africa's Constitution and laws. The need to sustain biodiversity is directly or indirectly referred to in a number of Acts, not least the National Environmental Management: Biodiversity Act (No. 10 of 2004) (hereafter referred to as the Biodiversity Act), and is fundamental to the notion of sustainable development. In addition, International guidelines and commitments as well as national policies and strategies are important in creating a shared vision for sustainable development in South Africa (DEA *et al.,* 2013).

The primary environmental objective of the Mineral and Petroleum Resources Development Act (MPRDA) is to give effect to the environmental right contained in the South African Constitution. Furthermore, Section 37(2) of the MPRDA states that "any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of prospecting and mining projects in order to ensure that exploitation of mineral resources serves present and future generations".

Pressures on biodiversity are numerous and increasing. According to the DEA *et al.,* (2013) Loss of natural habitat is the single biggest cause of biodiversity loss in South Africa and much of the world. The most severe transformation of habitat arises from the direct conversion of natural habitat for human requirements, including[12]:

- Cultivation and grazing activities;
- Rural and urban development;
- Industrial and mining activities, and
- Infrastructure development.

Impacts on biodiversity can largely take place in four ways (DEA *et al.,* 2013):

- **Direct impacts:** are impacts directly related to the project including project aspects such as site clearing, water abstraction and discharge of water from riverine resources;
- **Indirect impacts:** are impacts associated with a project that may occur within the zone of influence in a project such as surrounding terrestrial areas and downstream areas on water courses;
- **Induced impacts:** are impacts directly attributable to the project but are expected to occur due to the activities of the project. Factors included here are urban sprawl and the development of associated industries; and
- **Cumulative impacts:** can be defined as the sum of the impact of a project as well as the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity resources. Examples include numerous mining operations within the same drainage catchment or numerous residential developments within the same habitat for faunal or floral species.

Given the limited resources available for biodiversity management and conservation, as well as the need for development, efforts to conserve biodiversity need to be strategic, focused and supportive of sustainable development. This is a fundamental principle underpinning South Africa's approach to the management and conservation of its biodiversity and has resulted the definition of a clear mitigation strategy for biodiversity impacts.

'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other land use. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.

The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DEA *et al.,* 2013):

[12] Limpopo Province Environment Outlook. A Report on the State of the Environment, 2002. Chapter 4.

- **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases if impacts are expected to be too high the "no project" option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
- **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;
- **Rehabilitate impact:** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation can however not be considered as the primary mitigation tool as even with significant resources and effort rehabilitation that usually does not lead to adequate replication of the diversity and complexity of the natural system. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project. Practical rehabilitation should consist of the following phases in best practice:
  - **Structural rehabilitation** which includes physical rehabilitation of areas by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long terms sustainable ecological structure;
  - **Functional rehabilitation** which focuses on ensuring that the ecological functionality of the ecological resources on the study area supports the intended post closure land use. In this regard special mention is made of the need to ensure the continued functioning and integrity of wetland and riverine areas throughout and after the rehabilitation phase;
  - **Biodiversity reinstatement** which focuses on ensuring that a reasonable level of biodiversity is re-instated to a level that supports the local post closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community of community suitable for supporting the intended post closure land use; and
  - **Species reinstatement** which focuses on the re-introduction of any ecologically important species which may be important for socio-cultural reasons, ecosystem functioning reasons and for conservation reasons. Species re-instatement need only occur if deemed necessary.
- **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of *very high significance* and when residual impacts are considered to be of *very high significance*, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have *medium to high significance*, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.[13]

In light of the above discussion the following points present the key concepts considered in the development of mitigation measures for the proposed development.

- Mitigation and performance improvement measures and actions that address the risks and impacts[14] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.

[13] Provincial Guideline on Biodiversity Offsets, Western Cape, 2007.
[14] Mitigation measures should address both positive and negative impacts

- Desired outcomes are defined, and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, with estimates of the resources (including human resource and training requirements) and responsibilities for implementation wherever possible.

Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through to construction and operation.

APPENDIX E – Risk Assessment Mitigation Measures

Good Housekeeping

The following essential mitigation measures are considered to be standard best practice measures applicable to activities of this nature, and must be implemented during the life of the mining operation and associated facilities, in conjunction with those stipulated in the project specific risk assessment, which define the mitigatory measures specific to the minimisation of impacts on the aquatic resources within the study areas.

Activities footprint

- The footprint of all activity areas should remain as small as possible and not encroach into the watercourse features except where absolutely essential or where authorised activities are to take place. It must be ensured that the watercourses is off-limits to non-essential personnel;
- Access to the remainder of the freshwater feature should be prohibited to prevent compaction of soils, loss of vegetation and increased erosion;
- A specified area for washing, cutting, etc. must be allocated outside of the delineated watercourses and associated riparian zones and adequate measures should be taken to prevent contamination of any surfaces in this area as well as in the watercourse, which may contribute to sedimentation and degradation of water quality at this point;
- Appropriate sanitary facilities must be provided for the life of the construction and all waste removed to an appropriate waste facility, and;
- No fires should be permitted in or near the riparian areas.

Freshwater habitat

- Flow continuity within the watercourses must be maintained as far as possible. It is considered essential therefore that disturbances within the watercourses must be minimised as far as possible;
- All areas where soils are exposed or destabilised need to be stabilised taking into account the following:
  - As far as possible soft engineering and earthworks should be used, with special mention of re-sloping of banks, revegetation of banks and stabilisation using products such as hessian sheets and socks; and
  - Hard engineering techniques should only be implemented in areas where engineering and hydraulic constraints require such interventions. In particular mention is made of gabions, reno mattresses and reinforced walls; and
- The duration of impacts on the watercourses should be minimised as far as possible by ensuring that the duration of time in which flow alteration will take place is minimised;
- Permit only essential construction personnel within 100m of all watercourses and associated riparian zones;
- Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the development;

Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas, and these species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, and has to be controlled;
- Removal of the alien and weed species encountered within the study area must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 and Section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998)). Removal of species should take place throughout the life of the facility;
- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas should be kept as small as possible when removing alien plant species; and

- No vehicles should be allowed to drive through the watercourses during the eradication of alien and weed species.

Soils

- All soils compacted as a result of the mining activities as well as maintenance activities should be ripped and profiled; and
- A monitoring plan for the operational phase of the project should be implemented to prevent erosion and incision.

General

- All vehicles must be regularly inspected for leaks;
- Re-fueling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage;
- All hazardous chemicals must be stored on specified surfaces;
- All spills must be immediately cleaned up and treated accordingly;
- Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate waste facility;
- No indiscriminate disposal of waste must be permitted.

APPENDIX F – Emergency Protocol as specified under paragraph 6 (1) (vi) of GN509 as it relates to the NWA.

Purpose of the "Emergency Protocol"
The purpose of this protocol is to set out the process to be followed and actions to be taken by any person to provide assurance to the DWS in ensuring emergency incidents and situations can be responded to, while at the same time ensuring compliance to the requirements of the National Water Act. Failure to comply to these requirements will be dealt with in terms of section 19 or 20 of the National Water Act (NWA) (Act 36 of 1998).
The agreement relates to situations where any person or entity is required to immediately respond by taking necessary action to an emergency situation or incident. It is noted that this does not include routine or planned maintenance or to deal with poor project planning. Emergency Protocol: This "Emergency Protocol" spells out what protocol needs to be followed to remedy "emergency situations and incidents ". In terms of Section 67 of the National
Water Act" Dispensing with certain requirements of Act" the NWA states the following:

(1) In an emergency situation, or in cases of extreme urgency involving the safety of humans or property or the protection of a water resource or the environment, the Minister may
  (a) dispense with the requirements of this Act relating to prior publication or to obtaining and considering public comment before any instrument contemplated in section 158(1) is made or issued;
  (b) dispense with notice periods or time limits required by or under this Act;
  (c) authorise a water management institution to dispense with
  (i) the requirements of this Act relating to prior publication or to obtaining and considering public comment before any instrument is made or issued; and
  (ii) notice periods or time limits required by or under this Act.

(2) Anything done under subsection (1)
  (a) must be withdrawn or repealed within a maximum period of years after the emergency situation or the urgency ceases to exist; and
  (b) must be mentioned in the Minister's annual report to Parliament."

(3) An incident is an event that requires immediate attention that might lead to potential disruption of service delivery.

Examples include the following:
Replacement of stolen or vandalised or damaged underground cables or, overhead power lines, burst pipelines, flooded or damaged bridges and for related infrastructure, the replacement of /or repairs to damaged infrastructure.
Described below is the process to be followed and definitions. Process to respond to an Emergency that has a water use implication in terms of section 21 water uses of the NWA. Definitions:

Emergency incident and situations as defined in this notice read together with section 20 and 67 of the NWA.
Protocol to be followed:
Any person that must attend to an emergency must notify the regional office or CMA about the emergency immediately and provide all required documents to the relevant region(s) within 1 month thereafter according to the specified protocol in this document. Should the incident take place over a weekend or pubic holiday (outside DWS working hours), the documents can be forwarded to DWS and receipt be followed -up on the day after the weekend or holiday.

1) Relevant DWS regional office to be notified about the emergency incident or situation (hereafter referred to as an Emergency) by means of an email and or 24 hour hotline of DWS. The document emailed must as a minimum contain the following information:
  a. Date of occurrence of the emergency;
  b. Date at which any person became aware of the emergency;
  c. Nature of emergency;
  d. A motivation and definition of the emergency;
  e. Description, location and receiving environment sensitivity of the emergency;
  f. Description of short, medium and long term actions, environmental management and rehabilitation, and emergency plan required to be taken to respond to the emergency;
  g. Date(s) when the actions will be taken (or have taken place);

h. Contract details of responsible persons.

2) The following is a list of the required information that must be submitted to the relevant CMA or regional office of DWS within 1 month following the Emergency response to enable the regional office or CMA to determine whether the activities qualifies for a GA in terms of this Notice or whether a post facto licence will be required.

Tabulated list of information required to be submitted within a maximum of 1 month after the occurrence of the "Emergency"

Table of Contents **List of Appendices** **List of Maps** **List of Tables** **1. DESCRIPTION OF Emergency situation, location, date, etc.** 1.1. Motivation that situation was an emergency **2. EMERGENCY RESPONSE PROGRAMME** **3. METHODOLOGY FOLLOWED** **4. ENVIRONMENTAL MANAGEMENT STRATEGY** 4.1 Description of risks to resource quality and mitigation measures implemented to reduce risks (This report must be based on the Risk Matrix to be completed by SACNASP registered Professional). 4.2. Environmental Impact Management + rehabilitation plan (what, where, when, who, how) 4.3. Monitoring and Review Strategy **5. RESPONSIBILITIES AND PRESCRIBED OCCUPATIONS** **6. DECLARATIONS** 6.1. Design Engineer 6.2. Site Manager 6.3. Environmental **Practitioner / Environmental Control Officer (contact person)** **LIST OF APPENDICES** **APPENDIX A: DESIGN /CONSTRUCTION DRAWINGS** **APPENDIX B: ENVIRONMENTAL MANAGEMENT PLAN** **LIST OF MAPS** Map 1: Site location Map 2: Location of watercourses affected **LIST OF TABLES** Table 1: Schedule of Crossings Table 2: Programme (Start and Completion dates) Table 3: Risk Rating Matric (Impacts and Significance Ratings) Table 4: Mitigation Measures Table 5: Rehabilitation Measures Table 6: Stormwater Management Plan Table 7: Monitoring and Review Measures

Compliance to this Emergency Protocol does not absolve any person from complying to the requirements of any other laws and associated regulations.

APPENDIX G – Detailed Risk Assessment

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: Stephen van Steden Reg no. 400134/05

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity																		
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	PES AND EIS OF WATERCOURSE
1	Pre-construction planning	Planning of proposed surface infrastructure layout and proposed open pit mining areas.	The location of infrastructure (most signifcantly the Wishbone WRD, the Iota South WRD and the PCDs, as well as various road crossings, powerline crossings and pump columns etc) occur directly within watercourses (especially in the case of linear infrastructure which traverse several drainage systems) and within the 32m or 100m zones of regulation according to the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Government Notice (GN) 704 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).	* Loss of catchment yield and surface water recharge, potential creation of seepage (from the WRD) within the active drainage systems which can lead to a loss of general loss of aquatic and riparian biodiversity as well as SCCs, impaired water quality, loss of instream habitat integrity and overall EcoStatus as well as impacts to aquatic resources further downstream of the proposed mining activity.	5	5	5	5	5	2	5	12	5	5	5	2	17	204	H	70	Ensure that as far as possible all infrastructure is placed outside of aquatic resources. In particular, mention is made of the need to not encroach on the Blyde River and Peach Tree Stream and to protect these two systems from the impact of adjacent mining; It must be ensured that the design and construction of all infrastructure prevents failure; In addition, very clear separation of clean and dirty water areas must be included in the design of the mine in such a way as to ensure the mine is fully compliant with Regulation GN704; and Refer to Table 27; Aspect 1 and 2 for detailed mitigation measures.	N/A	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.

2	Construction	Removal of topsoil from project footprint, and stockpiling thereof for rehabilitation.	Topsoil removal and creation of temporary stockpiles.	* Increased risk of transportation of sediment from exposed soils in stormwater runoff, leading to increased turbidity of surface water, sedimentation of watercourses and changing the characteristics of the stream beds, smothering of vegetation and/or altered vegetation composition, smothering of benthic taxa and/or destruction of suitable macro-invertebrate and fish habitats; * Excavation and denuding activities will alter the natural runoff and flow regime of the area. Altered flow regime may lead to destruction of suitable macro-invertebrate and fish habitat; * Loss of riparian areas due to the disturbance of the activity; * Alteration of the chemical properties of the river as a result of vegetation removal and deforestation; * Exposure of soils, leading to increased runoff and erosion, and thus increased sedimentation of the river; * Increased sedimentation of the river, leading to smothering of benthos, loss of rheophilic taxa, diverse biotopes and potentially altering surface water quality; * Increased hardened surfaces and compacted soils thus altering the pattern, timing and distribution of recharge which affects the watercourses within the zone of influence; * Loss of foraging and breeding habitat [or hampering access to such suitable habitat (loss of connectivity)] and faunal migratory corridors; and * Proliferation of alien vegetation as a result of disturbances.	5	5	5	5	5	2	2	9	5	5	5	1	16	144	M	70	Prior to bulk earthworks the entire clean and dirty water management system must be developed to ensure that all "dirty water" areas can be managed as they are created; and Refer to Table 28; Aspect 1, 4 and 6 for detailed mitigation measures.	N/A	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.
3		Clearing of vegetation in proximity to the drainage systems for contractor laydown areas and construction of surface infrastructure, including preparation of open pits (outside of drainage lines).	Establishment of laydown areas, site clearing, removal of vegetation and associated disturbances to soils.		5	5	5	5	5	3	2	10	5	5	5	2	17	170	H	70	Refer to Table 27; Aspect 1, 2, 3 and 7 for detailed mitigation measures.		
3a		Clearing of vegetation within the drainage systems in preparation for construction of various linear developments; loss of vegetation within the drainage line directly impacted by the Wishbone WRD and PCDs.			5	5	5	5	5	3	2	10	5	5	5	2	17	170	H	70			
4		Construction of additional access and haul roads, resurfacing of existing roads and refurbishment of existing buildings.	Altered drainage patterns due to increased impermeable surfaces. Installation of culverts/pipes as part of the construction of stream crossings.	* Increased water inputs to watercourses, altering flow patterns and wetting patterns leading to further changes to vegetation and aquatic biota communities; * Contaminants from roads (e.g. oil spills) contained in runoff causing pollution to surface water within freshwater resources with resulting potential direct impact on aquatic biota; * Possible incision and sedimentation of freshwater resources due to increased water velocity (direct impact on biota in terms of smothering and indirect impact in terms of habitat destruction).	3	1	3	3	2,5	1	2	5,5	5	5	5	2	17	93,5	M	70	Refer to Table 27; Aspect 1, 3, 4 and 5 for detailed mitigation measures.		

5	Construction	Construction of surface infrastructure (e.g. additional mine offices, ablutions, stormwater management systems, etc.).	Risk of contaminated stormwater runoff (e.g. hydrocarbons, sediment, originating from impermeable surfaces).	* Possible contamination of the associated watercourses downstream of the surface structures (water quality impact with associated direct impact on aquatic biota); * Possible erosion/incision of the drainage systems adjacent to surface infrastructure due to concentration of stormwater runoff *Erosion and sedimentation risk with associated impact on aquatic biota and suitable habitat).	2	2	2	2	2	2	3	7	5	5	5	2	17	119	M	70	Refer to Table 27; Aspect 1, 4, 5 and 6 for detailed mitigation measures.	N/A	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.
			Stockpiling of topsoil and overburden, earthworks, movement of vehicles within lower reaches of drainage systems.	* Sediment-laden runoff entering riparian habitat leading to altered water quality, and changes to aquatic habitat; and * Altered drainage/flow regimes, leading to altered runoff patterns and formation of preferential flow paths.	5	5	5	5	5	2	3	10	5	5	5	2	17	170	H	70			
			Potential disposal of hazardous and non-hazardous materials in riverine areas.	* Altered water quality, possible changes to flow patterns as a result of blockages caused by solid waste/rubble.	1	1	1	1	1	1	1	3	1	1	5	1	8	24	L	70	No waste may be disposed of within any riverine habitat, and that all waste be removed to an appropriate disposal facility; and Refer to Table 27; Aspect 1, 3 and 5 for detailed mitigation measures.		
5a		Construction of surface infrastructure within drainage systems: Wishbone WRD, PCDs, linear developments including but not limited to haul and access roads, perimeter fence, diversion trench and so forth.	As for Activity 5 above.	As for Activity 5 above.	5	5	5	5	5	2	3	10	5	5	5	2	17	170	H	70			
6		Opening of pits by means of dozer ripping (strip mining method).	Excavations will lead to denuding of landscape, thus increasing the risk of increased sediment loads entering the watercourses.	Potential sedimentation of watercourses, leading to altered channel competency, altered vegetation community structures, blanketing of benthos and loss of rheophilic taxa and suitable habitat.	3	2	3	2	2,5	1	2	5,5	5	5	5	2	17	93,5	M	70	Strict adherence to the requirements of GN704 as it relates to the NWA in order to prevent contamination of salts and CPC's to the freshwater and aquatic systems; and Refer to Table 27; Aspect 1, 3 and 4 for detailed mitigation measures.		

7	**Operations**	Alteration of the local hydrological regime due to potentially poorly managed stormwater and compaction of soils and increased extent of impermeable surfaces.	Altered drainage patterns, potentially leading to the formation of preferential flow paths and/or concentrated flows.	* Erosion of terrestrial areas as preferential flow paths are formed in the landscape, resulting in sedimentation of watercourses, leading to altered channel competency, altered vegetation community structures, blanketing of benthos and loss of rheophilic taxa and suitable habitat.	**2**	**2**	**3**	**3**	**2,5**	**2**	**4**	**8,5**	**5**	**5**	**5**	**2**	**17**	**144,5**	**M**	**70**	Refer to Table 27; Aspect 4 for detailed mitigation measures.		
8		Presence of clean and dirty separation infrastructure upstream of surface infrastructure; Presence of diversion trench around perimeter fence.	Loss of catchment yield due to stormwater containment.	* Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the watercourses; * Reduction in volume of water entering the watercourses, leading to loss of recharge (and thus desiccation) of downstream system; and * Altered vegetation communities due to moisture stress.	**2**	**2**	**1**	**2**	**1,75**	**2**	**4**	**7,75**	**5**	**3**	**5**	**3**	**16**	**124**	**M**	**70**	Pollution prevention through infrastructure design, in order to prevent, eliminate and/or control potential groundwater pollution plumes, in accordance with any recommendations made in geohydrological specialist study; and Refer to Table 27; Aspect 1 and 4 for detailed mitigation measures.		
9		Deposition of tailings, waste rock, general operations of the mine.	Possible pollution of surface water as result of seepage/runoff from proposed infrastructure (e.g. water treatment facilities, ROM stockpiles, PCD, WRD, TSF and workshop/fuel storage areas). Potential groundwater pollution, leading to plumes, which may affect watercourses downstream of the surface infrastructure.	* Possible contamination of surface and ground water, leading to impaired water quality and salination of soils within riparian areas; * Sedimentation of watercourses could lead to altered water quality, altered channel integrity and altered vegetation community structures; and * Changes to vegetation growth due to increased nutrients as a result of altered groundwater properties.	**5**	**5**	**5**	**5**	**5**	**2**	**5**	**12**	**5**	**5**	**5**	**0**	**15**	**180**	**H**	**70**	No dirty water (as defined by GN704 as it relates to the NWA) is to be released into the receiving environment; Special attention needs to be paid to the use of the existing TSF and the lining thereof according to the specifications of the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008); Water treatment facilities to be implemented prior to the commencement of activities and to be maintained throughout the LOM to the minimum specifications of GN704 as it relates to the NWA; and Refer to Table 27; Aspect 1, 4 and 6 for detailed mitigation measures.	**N/A**	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.
			Increased risk of sediment transport in surface runoff from surface infrastructure to watercourses, leading to altered water quality and sedimentation of freshwater systems.		2	2	2	2	**2**	2	3	**7**	5	5	5	3	**18**	**126**	**M**	70			
10		Continued dozer ripping (strip mining method) of pits.	Excavations will lead to denuding of landscape, thus increasing the risk of increased sediment loads entering the watercourses.	Potential sedimentation of watercourses, leading to altered channel competency, altered vegetation community structures, blanketing of benthos and loss of rheophilic taxa and suitable habitat.	**3**	**3**	**3**	**2**	**2,75**	**1**	**1**	**4,75**	**5**	**5**	**5**	**4**	**19**	**90,25**	**M**	**70**	Refer to Table 27; Aspect 1 and 4 for detailed mitigation measures.		
11	**Closure and latent impacts**	Decommissioning / removal of surface infrastructure.	Compacted soils, latent impacts of vegetation losses.	* Increased runoff volumes and formation of preferential surface flow paths as a result of compacted soils and unvegetated areas, leading to increased sedimentation, erosion, and increased water inputs to downgradient aquatic systems (watercourses); * Proliferation of alien vegetation due to disturbances, which will impact natural flow regimes; and * Potential visual scars, affecting aesthetic features and faunal habitat.	**2**	**3**	**2**	**2**	**2,25**	**3**	**2**	**7,25**	**5**	**5**	**5**	**3**	**18**	**130,5**	**M**	**70**	Ensure that soils are replaced in the correct layers, ripped and re-reprofiled post-closure, and that vegetation is restored to a point where succession will lead to the same conditions as the pre-mining state as a minimum; Rehabilitation measures must be implemented. Implementation must be overseen by a suitably qualified Environmental Site Officer (ESO) with freshwater experience and the ESO must sign off the rehabilitation before the relevant contractors leave site; Minimum of ten years' post-closure monitoring to be undertaken; and Refer to Table 27; Aspect 4, 7 and 8 for detailed mitigation measures.	**N/A**	All watercourses currently deemed to be of high ecological importance and ecological sensitivity, with the PES varying from largely natural to largely modified sections with more modified sections occurring at lower elevations nearer to historical mining operations. Potential poor planning, and/or failure to implement the required mitigation measures, will lead to decreased EcoStatus/PES and EIS.

APPENDIX H – Hydropedological Opinion

Scientific Aquatic Services
Applying science to the real world

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Attention: Mr M Biljon

TECHNICAL MEMORANDUM

OPINION ON THE IMPORTANCE OF HYDROPEDOLOGICAL PROCESSESS IN DRIVING THE HYDROLOGICAL PROCESSES OF THE WATER COURSES ASSOCIATED WITH THE TGME MINE DEVELOPMENT PROJECT: AMENDMENT TO MR83 TO INCLUDE THE THETA HILL, BROWNS HILL AND IOTA HILL NEAR PILGRIM'S REST, MPUMALANGA PROVINCE, SOUTH AFRICA

Scientific Aquatic Services (SAS) was requested to provide a hydropedological opinion as part of the Water Use Licence Application (WULA) process for the Transvaal Gold Mining Estate (TGME) Mine Development Project to include Theta Hill, Browns Hill and Iota Hill.

The footprint area falls within the Thaba Chweu Local Municipality and is located on Portion (Pnt) 42 of the Farm Ponieskrans 543KT (owned by Public Works), which forms part of five farm portions making up the existing Mining Right Area. The footprint area is situated immediately southwest of Pilgrim's rest, a provincial heritage site, with the R533 running along the northern and eastern sides of the footprint area, Refer to Figure A and B.

STUDY OBJECTIVES

In support of the above, a hydropedological opinion and impact statement considering the mining and related activities impacts on water courses was requested, indicating how the proposed mining development could affect the Present Ecological State of the water courses and propose mitigation thereof as deemed necessary.

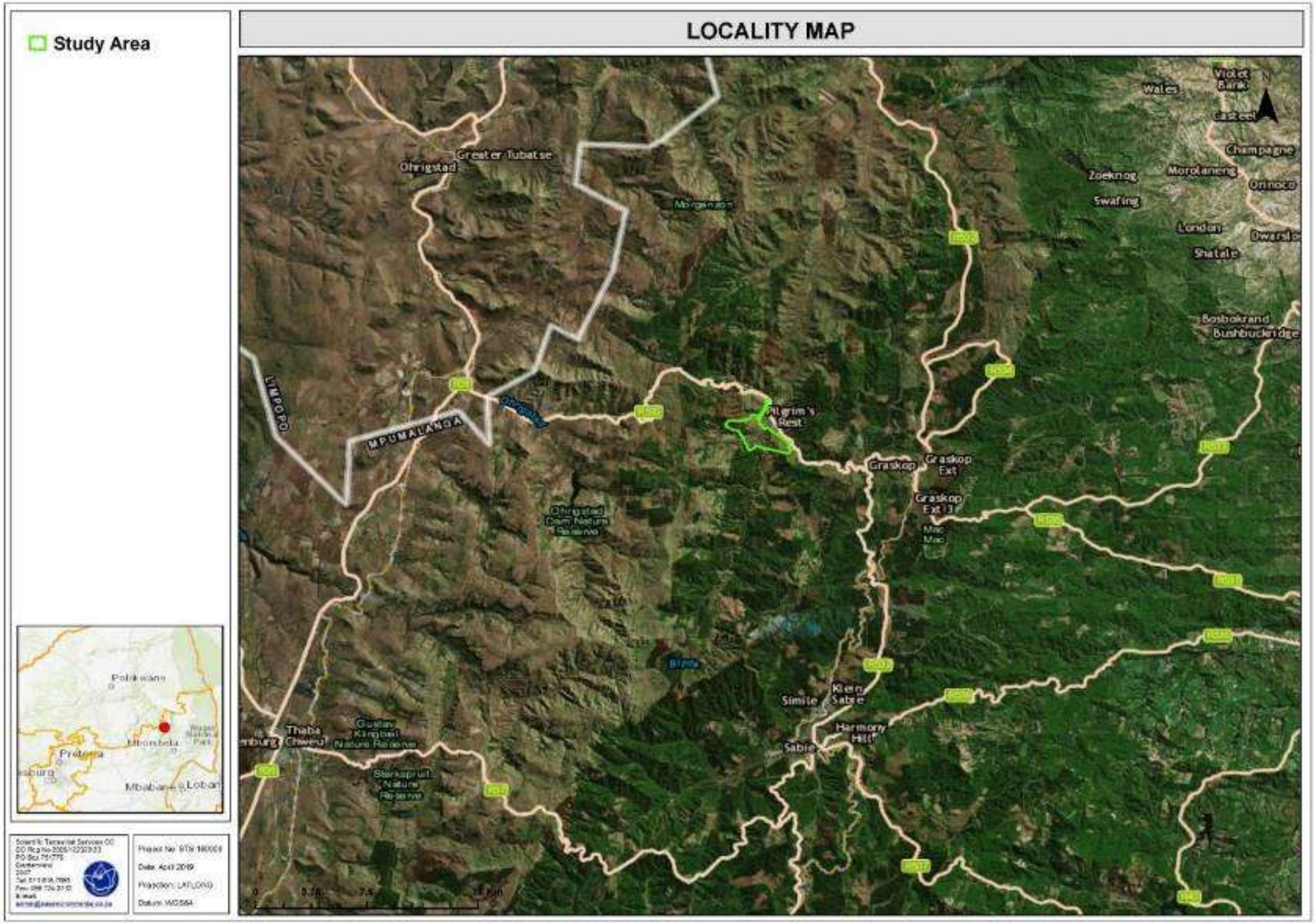

Figure A: Digital satellite image depicting the study area in relation to surrounding areas.

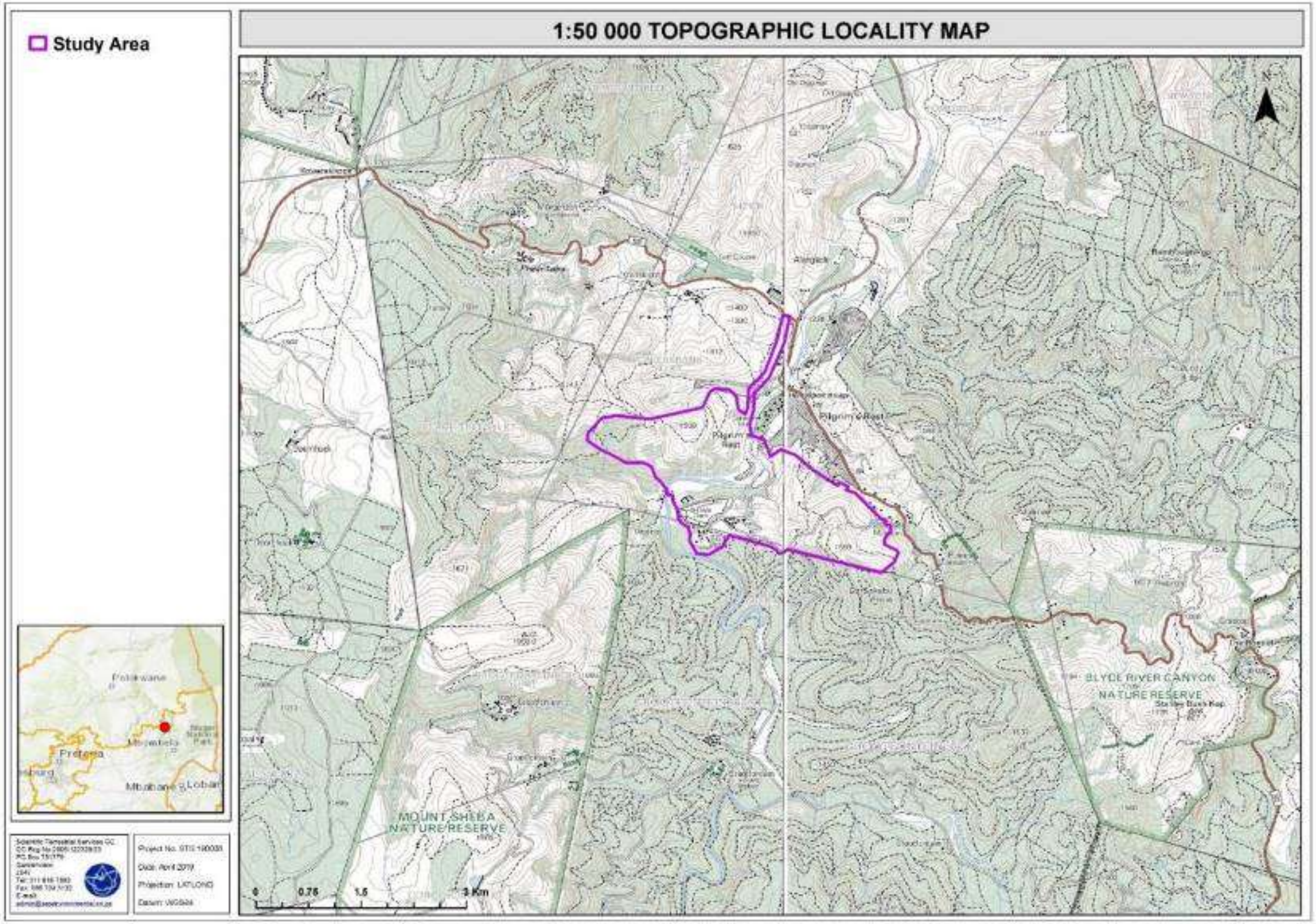

Figure B: Location of the footprint area depicted on a 1:50 000 topographical map in relation to surrounding area

PROJECT DESCRIPTION

Stonewall Mining has identified the need to amend one of its current mining rights (83MR), to include the proposed Theta Hill, Browns Hill and Iota Hill surface mining projects. Stonewall Mining is in the process of applying for an Environmental Authorisation, in support of the mining right amendment application.

The proposed project envisages undertaking surface mining operations at three locations, known as Theta Hill, Browns Hill and Iota Hill, with an anticipated Life of Mine (LoM) of 5 years. The proposed mining development includes (Figure C):

- Three proposed Open Pits, i.e. Theta Pit (18.5 ha), Iota Pit (19.4 ha) and Browns Pit (18.2 ha) – making use of Modified Terrace Mining to a depth of 90 m;
  - Both the Iota and Theta Pits will be concurrently backfilled. The Browns Pit will not be backfilled as it is likely that this Pit will form part of later expansion. Thus, the impact from the Browns Pit, and a portion of the Browns Waste Rock Dump (WRD), will be permanent.
- Several WRDs. As part of the operational activities, two options are proposed for the locations of the associated WRDs at both Theta Hill and Iota Hill projects;
- Three proposed stockpiles, including a Run of Mine (ROM) stockpile (1.27 ha), Strategic Ore stockpile (4.43 ha) and a Topsoil stockpile (5.27 ha);
- Berms, Diversion trenches and Catchment trenches associated with each Pit;
- Pollution Control Dams (PCDs) – eight proposed PCDs ranging in size between approximately 0.1 – 0.4 ha;
- Settling Dam (0.47 ha);
- Low level river crossing; and
- Linear developments:
  - Project access road (2.66 km) and Haul Roads (width of 16 m);
  - Pump columns (3.57 km);
  - Eskom 22 kV Supply Line (2.13 km);
  - 6.6 kV Overhead Line - Existing Power Supply (1.33 km) and New Supply Line (6.27 km).

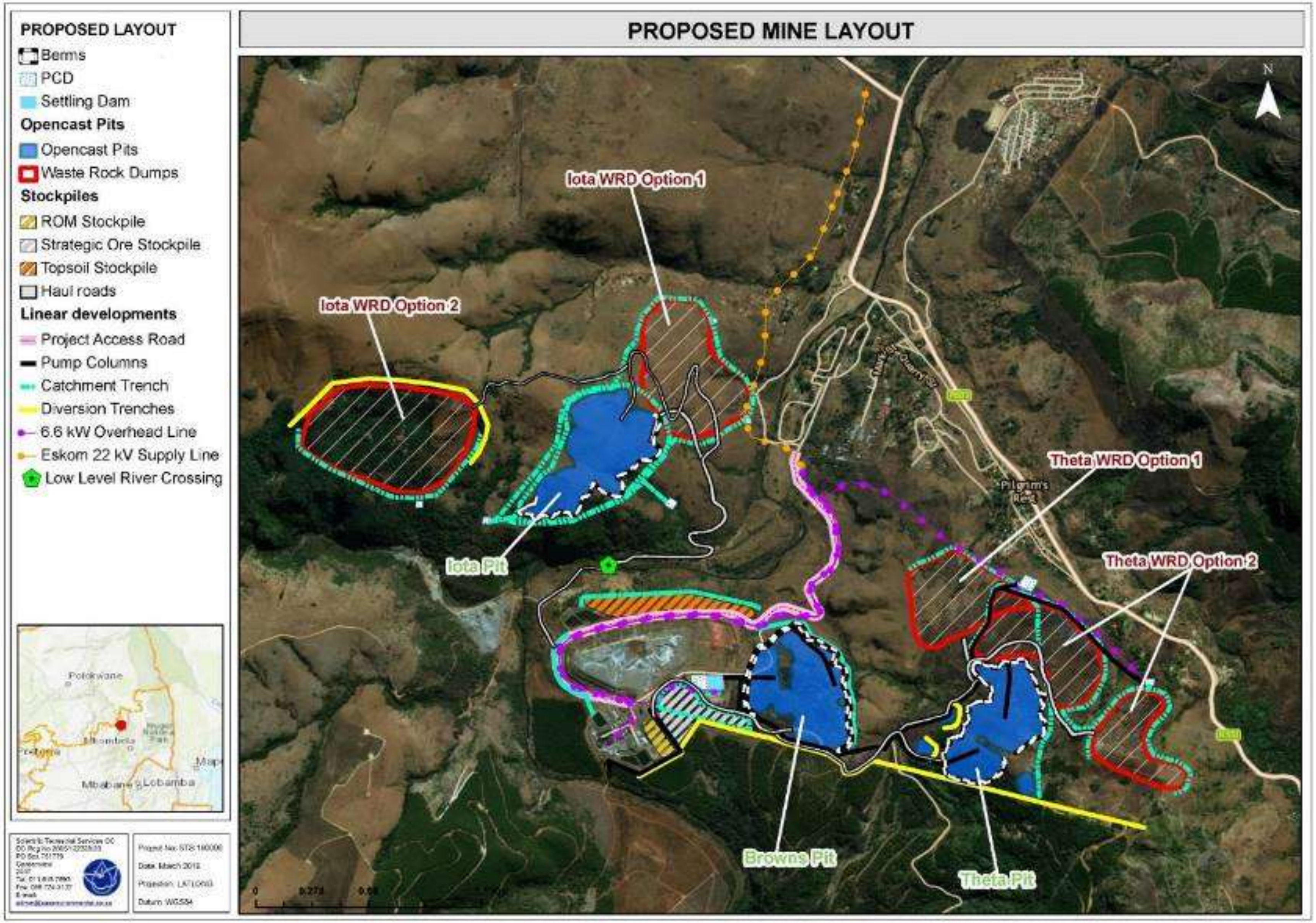

Figure C: The proposed mine layout for the proposed 83MR Theta Hill amendment application

RECHARGE OF WATER COURSES

Typically, there are four primary water course recharge mechanisms, and these include:

1. precipitation (rainfall-direct recharge);
2. surface flow (runoff);
3. subsurface flow (interflow) through the unsaturated zone of the surrounding soils; as well as
4. groundwater discharge.

The study area as well as surrounding areas are characterised by lithic soils known as Mispah and Glenrosa soil forms, as presented in Figure E. From a hydropedological point of view these soils are referred to as shallow responsive soils which means these soils 'respond' quickly to rain events and typically generate overland flow due to lack of storage capacity attributed to their shallow nature. Refer to Figure D. The surrounding soils are therefore not considered significant hydropedological drivers of the surrounding water courses, however surface water hydrology is considered one of the most significant drivers. The outcomes of the surface water hydrology study should therefore be strongly considered in this regard and strict control of the mine water balance and surface water controls should take place as guided by Regulation GN704 of 1999. Ground water studies should also be consulted in order to understand if whether they are important for recharging the water courses associated with the study area although based on the understanding of the author, based on discussion with the project team, the importance of geohydrological processes, within the proposed mining areas, in driving the hydrological processes of the Blyde River and its tributaries is negligible. Figure F below gives an insight of the topographical setting of the study area and surroundings. It should be noted that the vadose zone of the surrounding soils is very shallow due to the dominance of very shallow soils.

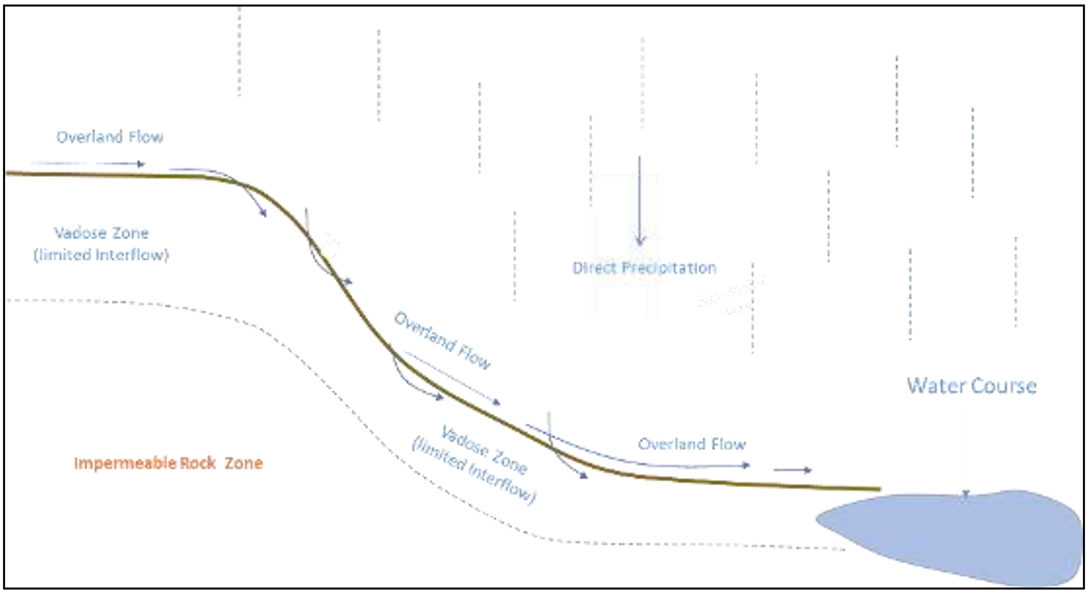

Figure D: Conceptual recharge mechanism of the water courses associated with the study area

Figure E: Images depicting the shallow lithic soils of Mispah and Glenrosa occurring within the study area

Figure F: Images depicting the land scape associated the study area and surroundings.

HYDROPEDOLOGICAL IMPLICATIONS

The study area is characterised by several drainage systems, which were identified as tributaries of the Blyde River and Peach Tree stream, with Theta Hill also associated with the headwaters of an unnamed tributary of the Blyde River. These drainage systems are event driven, and overland flow as well as direct precipitation (rainfall) are the main drivers of these drainage systems, with limited contribution from the vadose zone. Based on the specialist's interpretation of the existing data and understanding of the recharge mechanism of water courses, the water courses associated with the study area are largely driven by precipitation and surface runoff from the large catchment area upstream.

CONCLUSION

From a hydropedological point of view, no significant impact from the proposed mining project is foreseen due to the dominance of shallow responsive soils which are event driven. No interflow soils were identified within the study area, thus contribution of vadose zone to the freshwater resources is limited. Although impact is anticipated to be low, if mitigation measures are carefully implemented and recommendations are considered, the impact significance can be further reduced to ensure that there is a minimised net loss of catchment yield to the watercourses of the region.

Key mitigation measures include:

- Strict control of the mine water balance and surface water controls should take place as guided by Regulation GN704 of 1999;
- A clean and dirty water separation system must be constructed around the pit areas, in line with GN 704. However the extent of the mining operations and hence the "dirty water area" must be kept to the absolute minimum to reduce the volume of surface runoff water captured in the process water system and thus lost to the receiving environment to minimize the loss of clean water recharge of the watercourses in the area;
- Concurrent rehabilitation should strongly be considered to ensure that the duration that any pit or extent thereof is left unrehabilitated is minimised;
- The duration of impact on the receiving environment must be kept to the minimum and post closure the area should be managed as a free draining area which does not lead to contamination of the watercourses in the area;
- Although the soils within the study area are predominantly shallow (less than 30cm at most), it is still imperative to separate the topsoil (soft material) from the parent rock (hard material) to ensure that there is available material which can be used for plant growth during rehabilitation; and
- Topsoil stockpile height should be restricted to that which can deposited without additional traversing by construction equipment. A Maximum height of 2-3 m is therefore proposed, and the stockpile should be treated with appropriate temporary soil stabilisation methods.

We trust we have interpreted your requirements correctly. Please do not hesitate to contact us if there are aspects of our proposal that you would like to discuss further.

Yours Faithfully,

Digital Documentation Not Signed for Security Purposes
Stephen van Staden

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APPENDIX I – Results of Freshwater Field Investigation

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

Table I1: Presentation of the results of the VEGRAI assessments of the assessed reach of the Blyde River.

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	80.0	50.0	3.3	1.0	100.0
NON MARGINAL	77.0	28.9	0.0	2.0	60.0
	2.0				160.0
LEVEL 3 VEGRAI (%)				78.9	
VEGRAI EC				**B/C**	
AVERAGE CONFIDENCE				1.7	

Table I2: Presentation of the results of the VEGRAI assessment of Peach Tree Stream.

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	77.0	48.1	3.3	1.0	100.0
NON MARGINAL	71.1	26.7	0.0	2.0	60.0
	2.0				160.0
LEVEL 3 VEGRAI (%)				74.8	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				1.7	

Table I3: Presentation of the results of the PES (IHI) assessment of the various ephemeral unnamed tributaries of the Blyde River associated with the Browns and Theta pit areas.

RIPARIAN IHI	
Base Flows	-1.0
Zero Flows	0.0
Moderate Floods	0.0
Large Floods	0.0
HYDROLOGY RATING	**0.3**
Substrate Exposure (marginal)	1.0
Substrate Exposure (non-marginal)	1.0
Invasive Alien Vegetation (marginal)	1.0
Invasive Alien Vegetation (non-marginal)	1.5
Erosion (marginal)	1.5
Erosion (non-marginal)	1.5
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.5
Marginal	1.5
Non-marginal	1.5
BANK STRUCTURE RATING	**1.5**
Longitudinal Connectivity	1.0
Lateral Connectivity	2.0
CONNECTIVITY RATING	**1.3**
RIPARIAN IHI %	**79.0**
RIPARIAN IHI EC	**B/C**
RIPARIAN CONFIDENCE	**2.0**

Table I4: Presentation of the results of the PES (IHI) assessment of the unnamed tributary of the Blyde River associated with the Iota pit area.

RIPARIAN IHI	
Base Flows	-1,0
Zero Flows	0,0
Moderate Floods	0,0
Large Floods	0,0
HYDROLOGY RATING	0,3
Substrate Exposure (marginal)	3,0
Substrate Exposure (non-marginal)	3,0
Invasive Alien Vegetation (marginal)	3,0
Invasive Alien Vegetation (non-marginal)	3,0
Erosion (marginal)	3,0
Erosion (non-marginal)	3,0
Physico-Chemical (marginal)	0,5
Physico-Chemical (non-marginal)	0,5
Marginal	3,0
Non-marginal	3,0
BANK STRUCTURE RATING	3,0
Longitudinal Connectivity	1,0
Lateral Connectivity	2,0
CONNECTIVITY RATING	1,3
RIPARIAN IHI %	65,6
RIPARIAN IHI EC	C
RIPARIAN CONFIDENCE	2,7

Table I5: Presentation of the results of the Ecoservices assessments for all freshwater resources assessed.

Ecosystem service	Blyde	Tribs Blyde (Browns & Theta Pits)	Tribs Blyde (Iota)	Peach Tree Stream
Flood attenuation	2,3	2,0	1,8	1,8
Streamflow regulation	2,0	1,8	1,8	1,6
Sediment trapping	2,6	3,0	2,6	2,6
Phosphate assimilation	2,6	2,4	2,3	2,4
Nitrate assimilation	2,6	2,1	2,3	2,6
Toxicant assimilation	2,8	2,5	2,3	2,4
Erosion control	2,6	2,5	2,8	2,8
Carbon Storage	2,0	1,8	1,5	1,5
Biodiversity maintenance	3,0	2,3	2,7	2,4
Water Supply	1,7	1,5	1,0	0,8
Harvestable resources	0,8	0,8	1,4	1,4
Cultivated foods	0,4	0,4	1,2	1,2
Cultural value	1,5	0,0	1,5	1,5
Tourism and recreation	2,8	0,6	1,3	1,5
Education and research	3,3	1,3	0,8	1,0
SUM	**32,7**	**25,0**	**27,1**	**27,4**
Average score	**2,2**	**1,7**	**1,8**	**1,8**
Rating	**Moderately high**	**Intermediate**	**Intermediate**	**Intermediate**

Table I6: Presentation of the results of the EIS assessments for all freshwater resources assessed.

FRESHWATER FEATURE:	Blyde	Tribs Blyde River (Beta, Browns & Theta Hill)	Trib Blyde River (Iota Hill)	Peach Tree Stream	
Ecological Importance and Sensitivity	Score (0-4)				Confidence (1-5)
Biodiversity support	A (average)				**Average**
	3,00	2,00	1,00	2,00	
Presence of Red Data species	3	2	1	2	4
Populations of unique species	3	1	1	1	4
Migration/breeding/feeding sites	3	3	1	3	4
Landscape scale	B (average)				
	2,40	1,60	1,40	2,20	
Protection status of the wetland	3	3	1	3	4
Protection status of the vegetation type	1	1	1	1	4
Regional context of the ecological integrity	3	2	2	3	4
Size and rarity of the wetland type/s present	3	1	1	2	4
Diversity of habitat types	2	1	2	2	4
Sensitivity of the wetland	C (average)				
	2,00	1,00	1,00	1,67	
Sensitivity to changes in floods	2	1	1	1	3
Sensitivity to changes in low flows/dry season	2	1	1	2	3
Sensitivity to changes in water quality	2	1	1	2	3
ECOLOGICAL IMPORTANCE & SENSITIVITY (max of A,B or C)	**A**	**A**	**B**	**B**	**3,7**
	High	**Moderate**	**Moderate**	**High**	

Hydro-Functional Importance			Score (0-4)				Confidence
Regulating & supporting benefits	**Flood attenuation**		2	2	2	2	4
	Streamflow regulation		2	2	2	2	4
	Water Quality Enhancement	*Sediment trapping*	3	3	2	3	4
		Phosphate assimilation	3	2	2	2	4
		Nitrate assimilation	3	2	2	3	4
		Toxicant assimilation	3	3	2	2	4
		Erosion control	3	3	3	3	4
	Carbon storage		2	2	2	2	3
HYDRO-FUNCTIONAL IMPORTANCE (average score)			3	2	2	2	4

Direct Human Benefits		Score (0-4)				Confidence
Subsistence benefits	*Water for human use*	2	1	1	1	4
	Harvestable resources	1	1	1	1	4
	Cultivated foods	0	0	1	1	4
Cultural benefits	*Cultural heritage*	2	0	1	1	4
	Tourism and recreation	3	0	1	1	4
	Education and research	3	1	1	1	4
DIRECT HUMAN BENEFITS (average score)		1,83	0,50	1,00	1,00	4,00

APPENDIX J – IHAS Scoresheets

Site BUS (October 2018)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)						
River Name: BLYDE RIVER						
Site Name: BUS	**Date**: 01.10.2018					
SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	**>5**
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	**>10**	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	**4-5**	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	**2-20**	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	**51-75**	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	**2**	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			22		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	**2**	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	**none**	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	**pool**		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	**1-25**	26-50	51-75	>75
	Vegetation Score (max 15):				10	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	**>1**	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	**under**	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	**under**	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	**0-½**	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			**all****	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	**none**
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		**corr**		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				19	
	HABITAT TOTAL (MAX 55):				51	
STREAM CONDITION	**0**	**1**	**2**	**3**	**4**	**5**
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	**3mix**
Average width of stream: (in meters)		>10	>5-10	<1	1-2	**>2-5**
Average depth of stream: (in meters)	>2	>1-2	1	**>½-1**	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	**med**		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		**clear**
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		**none**
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	**mix**	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	**other**		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	**>95**		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	**>95**		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX					39
	TOTAL IHAS SCORE (%):				90	

Site BUS (March 2019)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: BLYDE RIVER
Site Name: BUS
Date: 27.03.2019

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	**>5**
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	**>10**	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	**4-5**	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	**2-20**	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	**>75**	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	**2**	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			23		
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	**>1-2**	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	**>1**		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		**run**	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	**26-50**	51-75	>75
	Vegetation Score (max 15):				11	
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	**1**	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	**under**	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	**under**	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	**0-½**	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	**none**	some			all**	
Algae present: ('1-2m^2 = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m^2	rocks	1-2m^2	<1m^2	isol	**none**
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		**corr**		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				14	
	HABITAT TOTAL (MAX 55):				48	

STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	**3mix**
Average width of stream: (in meters)		>10	>5-10	<1	1-2	**>2-5**
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	**½**	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		**mix**
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		**clear**
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		**none**
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	**mix**	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	**trees**	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	**>95**		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	**>95**		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX					41
	TOTAL IHAS SCORE (%):				89	

Site BMS1 (October 2018)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)						
River Name: BLYDE RIVER						
Site Name: BMS1	**Date**: 01.10.2018					
SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	**>3-5**	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	**>10**	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	**4-5**	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	**2-20**	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	**51-75**	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	**2**	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			20		
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	**2**	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	**>1**		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		**mix**
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	**51-75**	>75
	Vegetation Score (max 15):				15	
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	**>1**	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	**under**	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	**under**	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	**>½****		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	**none**	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	**isol**	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		**corr**		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				16	
	HABITAT TOTAL (MAX 55):				51	
STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	**3mix**
Average width of stream: (in meters)		>10	>5-10	<1	1-2	**>2-5**
Average depth of stream: (in meters)	>2	>1-2	1	**>½-1**	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	**med**		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		**clear**
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		**none**
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	**mix**	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	**other**		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	**81-95**	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	**81-95**	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX				37	
	TOTAL IHAS SCORE (%):				88	

Site BMS1 (March 2019)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)						
River Name: BLYDE RIVER						
Site Name: BMS1	**Date**: 26.03.2019					
SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			21		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
	Vegetation Score (max 15):				13	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				19	
	HABITAT TOTAL (MAX 55):				53	
STREAM CONDITION	**0**	**1**	**2**	**3**	**4**	**5**
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX					39
	TOTAL IHAS SCORE (%):				92	

Site BMS2 (October 2018)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)						
River Name: BLYDE RIVER						
Site Name: BMS2	**Date**: 02.10.2018					
SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	**>3-5**	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	**>5-10**	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	**4-5**	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	**11-20**	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	**51-75**	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	**2**	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			19		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	**>½-1**	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	**0-½**	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		**mix**
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	**26-50**	51-75	>75
	Vegetation Score (max 15):				11	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	**1**	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	**0-½**	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	**0-½**	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	**>½****		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	**none**	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	**rocks**	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		**corr**		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				14	
	HABITAT TOTAL (MAX 55):				44	
STREAM CONDITION	**0**	**1**	**2**	**3**	**4**	**5**
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	**3mix**
Average width of stream: (in meters)		>10	**>5-10**	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	**½**	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	**med**		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		**clear**
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		**none**
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	**mix**	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	**other**		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	**>95**		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	**>95**		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX 45):				37	
	TOTAL IHAS SCORE (%):				81	

Site BMS2 (March 2019)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)						
River Name: BLYDE RIVER						
Site Name: BMS2	**Date**: 26.03.2019					
SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			20		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
	Vegetation Score (max 15):				9	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m²' = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	$>2m^2$	rocks	$1\text{-}2m^2$	$<1m^2$	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				14	
	HABITAT TOTAL (MAX 55):				43	
STREAM CONDITION	**0**	**1**	**2**	**3**	**4**	**5**
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX				33	
	TOTAL IHAS SCORE (%):				76	

Site BDS (October 2018)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: BLYDE RIVER
Site Name: BDS
Date: 02.10.2018

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	**none**	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	**>10**	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	**4-5**	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	**2-20**	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	**51-75**	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	**2**	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
SIC Score (max 20):				14		
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	**0-½**	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	**>1**		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		**run**	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	**26-50**	51-75	>75
Vegetation Score (max 15):					9	
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	**1**	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	**under**	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	**½**	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	**0-½**	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	**none**	some			all**	
Algae present: ('1-2m^2 = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m^2	rocks	1-2m^2	<1m^2	**isol**	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		**corr**		over
(** NOTE: you must still fill in the SIC section)						
Other Habitat Score (max 20):					15	
HABITAT TOTAL (MAX 55):					38	

STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		**run**	rapid	2mix	3mix
Average width of stream: (in meters)		>10	**>5-10**	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	**>½-1**	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	**slow**	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		**clear**
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	**other**		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	**mix**	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	**other**		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	**81-95**	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	**81-95**	>95		
(*** NOTE: if more than one option, choose the lowest)						
STREAM CONDITIONS TOTAL (MAX					24	
TOTAL IHAS SCORE (%):					62	

Site BDS (March 2019)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)						
River Name: BLYDE RIVER						
Site Name: BDS	**Date**: 27.03.2019					
SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	**none**	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	**>5-10**	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	**2-3**	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	**11-20**	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	**0-25**	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	**2**	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			12		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	**2**	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	**>1**		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		**run**	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	**51-75**	>75
	Vegetation Score (max 15):				13	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	**0-½**	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	**under**	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	**>½**	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	**none**	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	**none**	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m^2	**rocks**	1-2m^2	<1m^2	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		**corr**		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				10	
	HABITAT TOTAL (MAX 55):				35	
STREAM CONDITION	**0**	**1**	**2**	**3**	**4**	**5**
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		**run**	rapid	2mix	3mix
Average width of stream: (in meters)		>10	**>5-10**	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	**>½-1**	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	**slow**	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		**clear**
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	**other**		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	**mix**	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	**other**		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	**81-95**	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	**81-95**	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX					27
	TOTAL IHAS SCORE (%):				62	

Site PTS (October 2018)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: UNNAMED TRIB
Site Name: PEACH TREE STREAM
Date: 01.10.2018

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	**>1-2**	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	**>2-5**	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	**2-3**	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	**11-20**	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	**26-50**	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	**>1-2**	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):	13				
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	**>½-1**	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	**0-½**	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		**mix**
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	**26-50**	51-75	>75
	Vegetation Score (max 15):	11				
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	**0-½**	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	**under**	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	**>½**	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	**0-½**	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	**none**	some			all**	
Algae present: ('1-2m^2 = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m^2	**rocks**	1-2m^2	<1m^2	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		**corr**		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):	11				
	HABITAT TOTAL (MAX 55):	35				

STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	**2mix**	3mix
Average width of stream: (in meters)		>10	>5-10	<1	**1-2**	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	**>½-1**	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	**slow**	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		**clear**
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		**none**
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	**mix**	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	**other**		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	**>95**		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	**>95**		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX 45):	35				
	TOTAL IHAS SCORE (%):	70				

Site- 010/011(January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: BLYDE
Site Name: 010/011
Date: 29-01-2020

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
SIC Score (max 20):	15					
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
Vegetation Score (max 15):	15					
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
Other Habitat Score (max 20):	13					
HABITAT TOTAL (MAX 55):	43					
STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
STREAM CONDITIONS TOTAL (MAX 45):	39					
TOTAL IHAS SCORE (%):	82					

Site DS (January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: BLYDE
Site Name: 019 - RHP DS SITE
Date: 31-01-2020

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			19		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
	Vegetation Score (max 15):				15	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				10	
	HABITAT TOTAL (MAX 55):				44	

STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX					42

Site BDS (January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: BLYDE						
Site Name: BDS	**Date: 30-01-2020**					
SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			10		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
	Vegetation Score (max 15):				15	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m^2 = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m^2	rocks	1-2m^2	<1m^2	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				10	
	HABITAT TOTAL (MAX 55):				35	
STREAM CONDITION	**0**	**1**	**2**	**3**	**4**	**5**
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX				42	
	TOTAL IHAS SCORE (%):				77	

Site BMS 2 (January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: BLYDE						
Site Name: BMS2	Date: 29-01-2020					
SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			16		
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
	Vegetation Score (max 15):				13	
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				11	
	HABITAT TOTAL (MAX 55):				40	
STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX 42				42	
	TOTAL IHAS SCORE (%):				82	

Site BUS (January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: BLYDE
Site Name: BUS
Date: 29-01-2020

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
SIC Score (max 20):				16		
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
Vegetation Score (max 15):					14	
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
Other Habitat Score (max 20):					9	
HABITAT TOTAL (MAX 55):					39	
STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
STREAM CONDITIONS TOTAL (MAX 45):					43	
TOTAL IHAS SCORE (%):					82	

Site O12 (January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)						
River Name: PILGRAMS CREEK						
Site Name: O12	Date: 30-01-2020					
SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			14		
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
	Vegetation Score (max 15):				15	
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				14	
	HABITAT TOTAL (MAX 55):				43	
STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX 45):				37	
	TOTAL IHAS SCORE (%):				80	

Site C12- DS (January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: PILGRAMS CREEK
Site Name: C15-DS SITE
Date: 30-01-2020

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
SIC Score (max 20):	14					

VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
Vegetation Score (max 15):	15					

OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
Other Habitat Score (max 20):	13					
HABITAT TOTAL (MAX 55):	42					

STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
STREAM CONDITIONS TOTAL (MAX 42	42					
TOTAL IHAS SCORE (%):	84					

Site 002-(January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: PEACH TREE						
Site Name: 002	Date:					
SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			18		
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
	Vegetation Score (max 15):				9	
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				12	
	HABITAT TOTAL (MAX 55):				39	
STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX 45):				43	
	TOTAL IHAS SCORE (%):				82	

Site 005-(January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)						
River Name: BLYDE						
Site Name: 005	**Date: 28-01-2020**					
SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			20		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
	Vegetation Score (max 15):				15	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				15	
	HABITAT TOTAL (MAX 55):				50	
STREAM CONDITION	**0**	**1**	**2**	**3**	**4**	**5**
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX				44	
	TOTAL IHAS SCORE (%):				94	

Site 001-BP 11 (January 2020)

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)						
River Name: BLYDE						
Site Name: OO9 (BP 11)	Date: 29-01-2020					
SAMPLING HABITAT	**0**	**1**	**2**	**3**	**4**	**5**
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			17		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none	0	1-25	26-50	51-75	>75
	Vegetation Score (max 15):				14	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				10	
	HABITAT TOTAL (MAX 55):				41	
STREAM CONDITION	**0**	**1**	**2**	**3**	**4**	**5**
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>2	>1-2	1	>½-1	½	<½
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	flood	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX 44				44	
	TOTAL IHAS SCORE (%):				85	

APPENDIX K – SASS5 Scoresheets

Site BUS (October 2018)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET																	
DATE: 01.10.2018	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**				
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10	A		A
E: °	**TURBELLARIA**	3		1		1	Corixidae*	3			B	B	Blepharoceridae	15			
SITE CODE: BUS	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5			A
RIVER: BLYDE RIVER	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2		A	A
SITE DESCRIPTION: U/S ALT.	Leeches	3					Naucoridae*	7		1		1	Culicidae*	1		1	
WEATHER CONDITION: CLEAR & HOT	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10		A	
TEMP: 18.3°C	Amphipoda	13					Notonectidae*	3					Empididae	6			
pH: 7.75	Potamonautidae*	3	A		A	A	Pleidae*	4					Ephydridae	3			
DO: 8.91mg/l / 109.2 %	Atyidae	8					Veliidae/M..veliidae*	5		A		A	Muscidae	1			
Cond: 28.0 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1			
BIOTOPES SAMPLED:	**HYDRACARINA**	8			1	1	Cordalidae	8					Simuliidae	5	A	A	
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1			
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5			
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5			
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**				
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4					Ancylidae	6	A		
M VEG OOC: DOM SP:	Baetidae 2 sp	6	B				Hydropsychidae 2 sp	6			A		Bulininae*	3			
GRAVEL:	Baetidae >2 sp	12		B	B	B	Hydropsychidae >2 sp	12	A			B	Hydrobiidae*	3			
SAND:	Caenidae	6			B	B	Philopotamidae	10					Lymnaeidae*	3			
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3			
HAND PICKING/VISUAL OBS:	Heptageniidae	13	B			B	Psychomyiidae/Xiphocen.	8					Planorbidae*	3		1	
FLOW: MED	Leptophlebiidae	9	B		A	B	**CASED CADDIS:**						Thiaridae*	3			
TURBIDITY: NONE	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5			
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**				
FORESTRY	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5			
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3			
	Tricorythidae	9	B			B	Hydrosalpingidae SWC	15					Unionidae	6			
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		105	67	89
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		A	A	B	**NO OF TAXA:**		13	13	14
BRIDGE	Chlorocyphidae	10	A			A	Petrothrincidae SWC	11					**ASPT:**		8	5.2	6
	Chlorolestidae	8					Pisuliidae	10					**IHAS**:	90%			
	Coenagrionidae	4		A		A	Sericostomatidae SWC	13					**OTHER BIOTA**:				
	Lestidae	8					**COLEOPTERA:**						TADPOLES				
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:				
	Protoneuridae	8					Elmidae/Dryopidae*	8					GOOF SIC & SOOC				
	Zygoptera juvs.	6					Gyrinidae*	5		A	B	B	MIN VEG (AQ. & MARG)				
	Aeshnidae	8	A			A	Halipidae*	5					GSM UNDER				
	Corduliidae	8					Helodidae	12					* = airbreathers				
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					SWC = South Western Cape T = Tropical				
	Libellulidae	4	A	A	A	B	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical				
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock				
	Pyralidae	12					Psephenidae	10	A		A	B	1=1, A=2-10, B=10-100, C=100-1000, D=>1000				

TOT	
Athericidae	A
Blepharoceridae	
Ceratopogonidae	A
Chironomidae	B
Culicidae*	1
Dixidae*	A
Empididae	
Ephydridae	
Muscidae	
Psychodidae	
Simuliidae	B
Syrphidae*	
Tabanidae	
Tipulidae	
GASTROPODA	
Ancylidae	A
Bulininae*	
Hydrobiidae*	
Lymnaeidae*	
Physidae*	
Planorbidae*	1
Thiaridae*	
Viviparidae* ST	
PELECYPODA	
Corbiculidae	
Sphaeriidae	
Unionidae	
SASS SCORE:	179
NO OF TAXA:	27
ASPT:	6.6

Site BUS (March 2019)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET																		
DATE: 27.03.2019	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10			1	1
E: °	**TURBELLARIA**	3					Corixidae*	3			B	B	Blepharoceridae	15				
SITE CODE: **BUS**	**ANNELIDA:**						Gerridae*	5		A		A	Ceratopogonidae	5			1	1
RIVER: BLYDE RIVER	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2	B	A	B	B
SITE DESCRIPTION: U/S	Leeches	3					Naucoridae*	7		1		1	Culicidae*	1				
WEATHER CONDITION: RAIN & OVERCAST	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 18.1°C	Amphipoda	13					Notonectidae*	3		A		A	Empididae	6				
pH: 8.59	Potamonautidae*	3	A	A	A	B	Pleidae*	4					Ephydridae	3				
DO: 4.42 mg/l / 52.7 %	Atyidae	8					Veliidae/M..veliidae*	5		A		A	Muscidae	1				
Cond: 7.2 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8			1	1	Cordalidae	8					Simuliidae	5				
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12			1	1	Dipseudopsidae	10					Tipulidae	5	A		A	A
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4					Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6	A			A	Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B	B	B	B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	B	B	B	B	Philopotamidae	10			1	1	Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	A			A	Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW: MED	Leptophlebiidae	9	B		A	B	**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY: NONE	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
FORESTRY	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	B		A	B	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		95	80	116	178
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6					**NO OF TAXA:**		14	14	17	26
BRIDGE	Chlorocyphidae	10		1		1	Petrothrincidae SWC	11					**ASPT:**		6.8	5.7	6.8	6.8
	Chlorolestidae	8					Pisuliidae	10					**IHAS**:		89%			
	Coenagrionidae	4	A	A	B	B	Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**						TADPOLES & SPIDERS					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:					
	Protoneuridae	8					Elmidae/Dryopidae*	8	1			1	GOOD SIC & SOOC					
	Zygoptera juvs.	6					Gyrinidae*	5		B		B	GOOD AQ. VEG (LIM MARG. VEG.)					
	Aeshnidae	8	A	A	A	B	Halipidae*	5					GSM UNDER					
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6	A	A	B	B	Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4	A	1	B	B	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site BMS1 (October 2018)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET																		
DATE: 01.10.2018	**TAXON**		S	VG	GSM	TOT	**TAXON**		S	VG	GSM	TOT	**TAXON**		S	VG	GSM	TOT
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10	A			A
E:°	**TURBELLARIA**	3	1			1	Corixidae*	3					Blepharoceridae	15				
SITE CODE: BMS1	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5				
RIVER: BLYDE RIVER	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2	A			A
SITE DESCRIPTION: M/S ALT.	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION: CLEAR & HOT	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 19.1°C	Amphipoda	13					Notonectidae*	3					Empididae	6				
pH: 7.45	Potamonautidae*	3					Pleidae*	4		A		A	Ephydridae	3				
DO: 8.69 mg/l / 108.8 %	Atyidae	8					Veliidae/M..veliidae*	5					Muscidae	1				
Cond: 95.1mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5	A			A
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4	A			A	Ancylidae	6	A		A	A
M VEG OOC: DOM SP:	Baetidae 2 sp	6		B	B		Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B			C	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6			B	B	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	1			1	Psychomyiidae/Xiphocen.	8					Planorbidae*	3		A		A
FLOW: MED	Leptophlebiidae	9			A	A	**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY: NONE	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
FORESTRY	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	B	B		B	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		92	37	59	145
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6	A	A		B	**NO OF TAXA:**		13	7	7	21
BRIDGE	Chlorocyphidae	10			A	A	Petrothrincidae SWC	11					**ASPT:**		7	5.3	8	6.9
D/S OF MINE OFFICE	Chlorolestidae	8					Pisuliidae	10					**IHAS**:		88%			
	Coenagrionidae	4	A			A	Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**						TADPOLES					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:					
	Protoneuridae	8					Elmidae/Dryopidae*	8					GOOF SIC & SOOC					
	Zygoptera juvs.	6					Gyrinidae*	5		1		1	MIN VEG (AQ. & MARG)					
	Aeshnidae	8	A			A	Halipidae*	5					GSM UNDER					
	Corduliidae	8					Helodidae	12			1	1	* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4		1		1	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	A		1	A	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site BMS1 (March 2019)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET																	
DATE: 26.03.2019	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10	1			1
E:°	**TURBELLARIA**	3	B			B	Corixidae*	3		B	B	B	Blepharoceridae	15				
SITE CODE: **BMS1**	**ANNELIDA:**						Gerridae*	5		A		A	Ceratopogonidae	5	A			A
RIVER: BLYDE RIVER	Oligochaeta	1	B			B	Hydrometridae*	6					Chironomidae	2	B		A	B
SITE DESCRIPTION: M/S	Leeches	3					Naucoridae*	7			1	1	Culicidae*	1		B		B
WEATHER CONDITION: OVERCAST & RAIN	**CRUSTACEA:**						Nepidae*	3		1		1	Dixidae*	10				
TEMP: 18.7°C	Amphipoda	13					Notonectidae*	3		A		A	Empididae	6				
pH: 8.24	Potamonautidae*	3	B	A		B	Pleidae*	4					Ephydridae	3				
DO: 4.67 mg/l / 57.2 %	Atyidae	8					Veliidae/M..veliidae*	5		B	A	B	Muscidae	1				
Cond: 5.3 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5	B			B
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5			A	A
BEDROCK:	Perlidae	12	1			1	Dipseudopsidae	10					Tipulidae	5	A			A
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4					Ancylidae	6	A			A
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6	B			B	Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B	B	B	C	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	B	A		B	Philopotamidae	10	B		B	B	Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	B			B	Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW: MED	Leptophlebiidae	9	B	A		B	**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY: NONE	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
FORESTRY	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
TAILINGS STORAGE ADJACENT	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	B		A	B	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		139	77	57	186
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		A		A	**NO OF TAXA:**		20	15	9	31
BRIDGE	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		7.0	5.1	6.3	6.0
D/S OF MINE OFFICE	Chlorolestidae	8					Pisuliidae	10					**IHAS**:		92%			
CATTLE DRINKING	Coenagrionidae	4		B		B	Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**						TADPOLES & DAPHNIA					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5		L1		1	**COMMENTS**:					
	Protoneuridae	8					Elmidae/Dryopidae*	8					ALL BIOTOPES GOOD					
	Zygoptera juvs.	6					Gyrinidae*	5					4 x FISH (PHOTOS) [278.7s]					
	Aeshnidae	8	B	B		B	Halipidae*	5										
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4	B	A	1	B	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	B			B	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site BMS2 (October 2018)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 02.10.2018	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	PORIFERA	5					HEMIPTERA:						DIPTERA:					
S:°	COELENTERATA	1					Belostomatidae*	3					Athericidae	10	A			A
E: °	TURBELLARIA	3	A			A	Corixidae*	3		1		1	Blepharoceridae	15				
SITE CODE: BMS2	ANNELIDA:						Gerridae*	5					Ceratopogonidae	5				
RIVER: BLYDE RIVER	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2	A			A
SITE DESCRIPTION: M/S OS	Leeches	3					Naucoridae*	7					Culicidae*	1		A		A
WEATHER CONDITION: CLEAR & HOT	CRUSTACEA:						Nepidae*	3					Dixidae*	10				
TEMP: 17.5°C	Amphipoda	13					Notonectidae*	3					Empididae	6				
pH: 7.50	Potamonautidae*	3					Pleidae*	4	1	A		A	Ephydridae	3				
DO: 8.33 mg/l / 102.2 %	Atyidae	8					Veliidae/M..veliidae*	5					Muscidae	1				
Cond: 9.5 mS/m	Palaemonidae	10					MEGALOPTERA:						Psychodidae	1				
BIOTOPES SAMPLED:	HYDRACARINA	8					Cordalidae	8					Simuliidae	5	B	A		B
SIC: TIME: minutes	PLECOPTERA:						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					TRICHOPTERA						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	EPHEMEROPTERA						Ecnomidae	8					GASTROPODA					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4	1			1	Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6	B				Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12		B		B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	B	1		B	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW: MED	Leptophlebiidae	9	B			B	CASED CADDIS:						Thiaridae*	3				
TURBIDITY: NONE	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					PELECYPODA					
FORESTRY	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
CATTLE WATERING & GRAZING	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					SASS SCORE:		67	72	5	118
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		A		A	NO OF TAXA:		11	12	1	19
INFORMAL ROAD CROSSING	Chlorocyphidae	10	1			1	Petrothrincidae SWC	11					ASPT:		6	6.0	5	6.2
CATTLE WATERING / TRAMP	Chlorolestidae	8					Pisuliidae	10					IHAS:		81%			
	Coenagrionidae	4		A		A	Sericostomatidae SWC	13					OTHER BIOTA:					
	Lestidae	8					COLEOPTERA:						TADPOLES					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					COMMENTS:					
	Protoneuridae	8					Elmidae/Dryopidae*	8					GOOD SIC & SOOC					
	Zygoptera juvs.	6					Gyrinidae*	5		A	A	B	SOME MARG VEG.					
	Aeshnidae	8	A			A	Halipidae*	5					GSM UNDER					
	Corduliidae	8					Helodidae	12		1		1	* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4		1		1	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10		1		1	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site BMS2 (March 2019)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET																		
DATE: 26.03.2019	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E: °	**TURBELLARIA**	3	A			A	Corixidae*	3					Blepharoceridae	15				
SITE CODE: **BMS2**	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5		1		1
RIVER: BLYDE RIVER	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2		B	A	B
SITE DESCRIPTION: M/S	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION: OVERCAST	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 18.5°C	Amphipoda	13					Notonectidae*	3					Empididae	6				
pH: 8.27	Potamonautidae*	3	A			A	Pleidae*	4					Ephydridae	3				
DO: 4.60 mg/l / 56.1%	Atyidae	8					Veliidae/M..veliidae*	5					Muscidae	1				
Cond: 7.4 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5				
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5	A		A	A
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4	1	1		A	Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B	B	A	B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	B	B		B	Philopotamidae	10		1		1	Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3		A		A
FLOW: MED	Leptophlebiidae	9	B			B	**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY: NONE	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
FORESTRY	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
CATTLE WATERING & GRAZING	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9		1		1	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		82	76	35	122
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		1		1	**NO OF TAXA:**		13	12	5	20
INFORMAL ROAD CROSSING	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		6.3	6.3	7.0	6.1
CATTLE WATERING / TRAMP	Chlorolestidae	8					Pisuliidae	10					**IHAS**:	76%				
STONES PLACED INSTREAM FOR	Coenagrionidae	4	1			1	Sericostomatidae SWC	13					**OTHER BIOTA**:					
CROSSING AND DISTURB. FLOW	Lestidae	8					**COLEOPTERA:**						TADPOLES - NO FISH CAUGHT [169.8s]					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:					
	Protoneuridae	8					Elmidae/Dryopidae*	8					ROCK DISTURBANCE - STONES DOM.					
	Zygoptera juvs.	6					Gyrinidae*	5		L A		A	LIM. MARG. VEG - NO AQ. VEG					
	Aeshnidae	8	A			A	Halipidae*	5					GSM UNDER					
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6	A		A	B	Hydraenidae*	8	A			A	SWC = South Western Cape T = Tropical					
	Libellulidae	4	A	1		A	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	A	1	A	B	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site BDS (October 2018)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET																		
DATE: 02.10.2018	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10	1			1
E: °	**TURBELLARIA**	3					Corixidae*	3					Blepharoceridae	15				
SITE CODE: BDS	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5				
RIVER: BLYDE RIVER	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2	B	A		B
SITE DESCRIPTION: D/S OS	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION: CLEAR & HOT	**CRUSTACEA:**						Nepidae*	3		1		1	Dixidae*	10		A		A
TEMP: 19.1°C	Amphipoda	13					Notonectidae*	3		1		1	Empididae	6				
pH: 7.93	Potamonautidae*	3	1	A		A	Pleidae*	4					Ephydridae	3				
DO: 8.46 mg/l / 107.7 %	Atyidae	8					Veliidae/M..veliidae*	5		A		A	Muscidae	1				
Cond: 14.9 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5				
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4					Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6	A				Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12		B		B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6		B		B	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3		A		A
FLOW: V SLOW	Leptophlebiidae	9					**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY: NONE	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
CATTLE	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
RECREATIONAL / FISHING	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		27	74	5	90
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		A		A	**NO OF TAXA:**		5	14	1	16
BRIDGE	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		5	5.3	5	5.6
D/S PANNING	Chlorolestidae	8					Pisuliidae	10					**IHAS**:	62%				
	Coenagrionidae	4		B		B	Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**						TADPOLES & B. NEEFI X 16					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:					
SEWAGE INGRESS DS OF SITE	Protoneuridae	8					Elmidae/Dryopidae*	8					GOOD AQ & MARG VEG					
	Zygoptera juvs.	6					Gyrinidae*	5		A	A	A	GSM = MUD					
	Aeshnidae	8		A		A	Halipidae*	5					GSM & STONES - COMBINED					
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6	B			B	Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4		A		A	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site BDS (March 2019)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET																		
DATE: 27.03.2019	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E: °	**TURBELLARIA**	3					Corixidae*	3			**B**	**B**	Blepharoceridae	15				
SITE CODE: **BDS**	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5				
RIVER: BLYDE RIVER	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2			**A**	**A**
SITE DESCRIPTION: D/S	Leeches	3					Naucoridae*	7					Culicidae*	1		**A**		**A**
WEATHER CONDITION: OVERCAST	**CRUSTACEA:**						Nepidae*	3		**1**	**1**	**A**	Dixidae*	10				
TEMP: 17.8°C	Amphipoda	13					Notonectidae*	3					Empididae	6				
pH: 8.62	Potamonautidae*	3		**1**		**1**	Pleidae*	4					Ephydridae	3				
DO: 3.65 mg/l / 43.1%	Atyidae	8					Veliidae/M..veliidae*	5	**1**	**B**		**B**	Muscidae	1				
Cond: 11.2 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5				
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4					Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	**A**	**B**	**A**	**B**	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	**1**			**1**	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW: SLOW	Leptophlebiidae	9					**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY: NONE	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
CATTLE	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
RECREATIONAL / FISHING	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		29	42	31	64
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		**1**		**1**	**NO OF TAXA:**		4	8	6	13
BRIDGE	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		7.3	5.3	5.2	4.9
D/S PANNING	Chlorolestidae	8					Pisuliidae	10					**IHAS**:	62%				
	Coenagrionidae	4		**1**		**1**	Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**						TADPOLES & FISH x 11 (PHOTOS) [211.8s]					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:					
SEWAGE INGRESS DS OF SITE	Protoneuridae	8					Elmidae/Dryopidae*	8					GOOD AQ & MARG VEG					
PETROL LAYER ON SURFACE	Zygoptera juvs.	6					Gyrinidae*	5					GSM = MUD					
PETROL SMELL ONCE DISTURBED	Aeshnidae	8		**A**		**A**	Halipidae*	5			**1**	**1**	STONES LIM. COVERED IN SUBSTRATE					
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6	**1**		**1**	**A**	Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4					Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site PTS (October 2018)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET																		
DATE: 01.10.2018	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E: °	**TURBELLARIA**	3					Corixidae*	3					Blepharoceridae	15				
SITE CODE: PTS (PEACH TREE STREAM)	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5				
RIVER: UNNAMED TRIB	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2	1	A	1	B
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION: CLEAR & HOT	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 14.8°C	Amphipoda	13					Notonectidae*	3					Empididae	6				
pH: 7.90	Potamonautidae*	3					Pleidae*	4					Ephydridae	3				
DO: 9.11mg/l / 104.8 %	Atyidae	8					Veliidae/M..veliidae*	5	1			1	Muscidae	1				
Cond: 10.6 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5				
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4			1		Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6		1		A	Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12					Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6					Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW: SLOW	Leptophlebiidae	9					**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY: NONE	Oligoneuridae	15		A		A	Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
ILLEGAL MINING	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
MOUNTAIN STREAM	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		16	37	11	42
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6					**NO OF TAXA:**		4	6	3	7
HISTORIC MINING	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		4	6.2	4	6.0
	Chlorolestidae	8					Pisuliidae	10					**IHAS**:		62%			
	Coenagrionidae	4					Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**											
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5		1		1	**COMMENTS**:					
SIGNS OF MINING NUTRIENTS	Protoneuridae	8					Elmidae/Dryopidae*	8					GSM DOM = MUD					
	Zygoptera juvs.	6					Gyrinidae*	5	1	B	1	B	MARG VEG = BRAKEN FERNS					
	Aeshnidae	8					Halipidae*	5					STONES - WATERFALL (ELEVATED)					
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4	1	1		A	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- 010/011(January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 2-01-2020	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10	1		1	A
E: °	**TURBELLARIA**	3					Corixidae*	3		A		A	Blepharoceridae	15				
SITE CODE:010/011	**ANNELIDA:**						Gerridae*	5		A		A	Ceratopogonidae	5				
RIVER: BLYDE	Oligochaeta	1			1	1	Hydrometridae*	6					Chironomidae	2	A	A		B
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7		A		A	Culicidae*	1				
WEATHER CONDITION:	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 19,90 °C	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 8,23	Potamonautidae*	3	A			A	Pleidae*	4					Ephydridae	3				
DO: 95,9% 7,48 mg/l	Atyidae	8					Veliidae/M..veliidae*	5		A		A	Muscidae	1				
Cond: 93 mS/ TDS 62mg/l	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5	B	A		B
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5	A			A
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4		1		1	Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6			B		Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12		B		B	Hydropsychidae >2 sp	12	B			B	Hydrobiidae*	3				
SAND:	Caenidae	6	1	1	A	A	Philopotamidae	10	1			1	Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	A			A	Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9	A			A	**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	A			A	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		107	86	47	187
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6			A	A	**NO OF TAXA:**		14	15	8	28
	Chlorocyphidae	10		A		A	Petrothrincidae SWC	11					**ASPT:**		7,64	5,73	5,88	6,68
	Chlorolestidae	8					Pisuliidae	10					**IHAS**:		82%			
	Coenagrionidae	4		A		A	Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**						2 X ROCK CATLET 4X BARH WITH IPOTS IN A LINE					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5		1		1	**COMMENTS**:**36X BRBE WITH SMALL SPO**					
	Protoneuridae	8					Elmidae/Dryopidae*	8			A	A						
	Zygoptera juvs.	6					Gyrinidae*	5										
	Aeshnidae	8	A	B		B	Halipidae*	5										
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6		1	B	B	Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4		A	1	A	Hydrophilidae*	5	1			1	VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	A			A	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- 019 DS (January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 31-01-2020	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	PORIFERA	5					HEMIPTERA:						DIPTERA:					
S:°	COELENTERATA	1					Belostomatidae*	3					Athericidae	10				
E: °	TURBELLARIA	3	A			A	Corixidae*	3					Blepharoceridae	15				
SITE CODE:019 - RHP DS SITE	ANNELIDA:						Gerridae*	5		A		A	Ceratopogonidae	5				
RIVER: BLYDE	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2		1		1
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7		B		B	Culicidae*	1				
WEATHER CONDITION:	CRUSTACEA:						Nepidae*	3					Dixidae*	10				
TEMP: 19,20 °C	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 7,75	Potamonautidae*	3	1	1	1	A	Pleidae*	4					Ephydridae	3				
DO: 8,24 mg/l 101,0%	Atyidae	8					Veliidae/M..veliidae*	5	A			A	Muscidae	1				
Cond: 137 mS/m TDS 87mg/l	Palaemonidae	10					MEGALOPTERA:						Psychodidae	1				
BIOTOPES SAMPLED:	HYDRACARINA	8	1		1	A	Cordalidae	8					Simuliidae	5		1	1	A
SIC: TIME: minutes	PLECOPTERA:						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					TRICHOPTERA						Tabanidae	5	A		1	A
BEDROCK:	Perlidae	12	A			A	Dipseudopsidae	10					Tipulidae	5	1		1	A
AQUATIC VEG: DOM SP:	EPHEMEROPTERA						Ecnomidae	8					GASTROPODA					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4					Ancylidae	6	1			1
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B	1		B	Hydropsychidae >2 sp	12	B			B	Hydrobiidae*	3				
SAND:	Caenidae	6	A	A	A	B	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	1			1	Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9	A	1		A	CASED CADDIS:						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					PELECYPODA					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	B			B	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					SASS SCORE:		137	73	48	166
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		A		A	NO OF TAXA:		18	12	8	24
	Chlorocyphidae	10					Petrothrincidae SWC	11					ASPT:		7,61	6,08	6,00	6,92
	Chlorolestidae	8					Pisuliidae	10					IHAS:	86%				
	Coenagrionidae	4		B		B	Sericostomatidae SWC	13					OTHER BIOTA:					
	Lestidae	8					COLEOPTERA:						YELLOW FISH X12 (2XSO) SQUEKERS X2					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					COMMENTS:					
	Protoneuridae	8					Elmidae/Dryopidae*	8					TROUT X5 , BARD X40					
	Zygoptera juvs.	6					Gyrinidae*	5										
	Aeshnidae	8	A	B		B	Halipidae*	5										
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6	1	1	B	B	Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4					Hydrophilidae*	5	1			1	VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	A		1	A	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- BDS(January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 30-01-2020	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	PORIFERA	5					HEMIPTERA:						DIPTERA:					
S:°	COELENTERATA	1					Belostomatidae*	3					Athericidae	10				
E: °	TURBELLARIA	3					Corixidae*	3					Blepharoceridae	15				
SITE CODE:BDS	ANNELIDA:						Gerridae*	5					Ceratopogonidae	5				
RIVER: BLYDE	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2	A			A
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7		A	1	A	Culicidae*	1				
WEATHER CONDITION:	CRUSTACEA:						Nepidae*	3					Dixidae*	10				
TEMP: 19,90 °C	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 8,28	Potamonautidae*	3		A	A	A	Pleidae*	4					Ephydridae	3				
DO: 100,4% 7,96 mg/l	Atyidae	8					Veliidae/M..veliidae*	5		B		B	Muscidae	1				
Cond: 85USKM mS/m TDS 57 mg/l	Palaemonidae	10					MEGALOPTERA:						Psychodidae	1				
BIOTOPES SAMPLED:	HYDRACARINA	8	1			1	Cordalidae	8					Simuliidae	5	A	B		B
SIC: TIME: minutes	PLECOPTERA:						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					TRICHOPTERA						Tabanidae	5	A			A
BEDROCK:	Perlidae	12	1			1	Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	EPHEMEROPTERA						Ecnomidae	8					GASTROPODA					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4					Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6	A		A	A	Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B	B		B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6			A	A	Philopotamidae	10	1			1	Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	A			A	Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9					CASED CADDIS:						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					PELECYPODA					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	B			B	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					SASS SCORE:		110	41	39	146
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6	A		A	A	NO OF TAXA:		14	7	7	21
	Chlorocyphidae	10					Petrothrincidae SWC	11					ASPT:		7,86	5,86	5,57	6,95
	Chlorolestidae	8					Pisuliidae	10					IHAS:	77%				
	Coenagrionidae	4		A		A	Sericostomatidae SWC	13					OTHER BIOTA:					
	Lestidae	8					COLEOPTERA:											
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					COMMENTS:					
	Protoneuridae	8					Elmidae/Dryopidae*	8	1			1						
	Zygoptera juvs.	6					Gyrinidae*	5		B	1	B						
	Aeshnidae	8					Halipidae*	5										
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6			A	A	Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4	A			A	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	A			A	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- BMS 2 (January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 2-01-2020	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E: °	**TURBELLARIA**	3	**A**			**A**	Corixidae*	3			**A**	**A**	Blepharoceridae	15				
SITE CODE:BMS 2	**ANNELIDA:**						Gerridae*	5		**1**		**1**	Ceratopogonidae	5		**A**		**A**
RIVER: BLYDE	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2		**B**		**B**
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7		**A**		**A**	Culicidae*	1		**1**		**1**
WEATHER CONDITION:	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 19,60 °C	Amphipoda	13					Notonectidae*	3		**1**		**1**	Empididae	6				
Ph: 8,30	Potamonautidae*	3	**A**	**1**		**A**	Pleidae*	4					Ephydridae	3				
DO:8,98 mg/l 112,7%	Atyidae	8					Veliidae/M..veliidae*	5		**1**	**1**	**A**	Muscidae	1				
Cond: 80 mS/m TDS 51mg/l	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8		**1**		**1**	Cordalidae	8					Simuliidae	5	**B**	**B**		**B**
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4			**A**		Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6	**B**			**B**	Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12		**B**	**B**	**B**	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	**A**	**A**		**B**	Philopotamidae	10	**1**			**1**	Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13			**1**	**1**	Psychomyiidae/Xiphocen.	8					Planorbidae*	3		**1**		**1**
FLOW:	Leptophlebiidae	9			**A**	**A**	**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	**B**	**1**		**B**	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		71	105	78	190
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6	**A**			**A**	**NO OF TAXA:**		11	18	10	30
	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		6,45	5,83	7,80	6,33
	Chlorolestidae	8		**1**		**1**	Pisuliidae	10					**IHAS**:	82%				
	Coenagrionidae	4					Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8		**B**		**B**	**COLEOPTERA:**						TADPOLES 1X SMALL MOUTH YELLOW 1X TROUT					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:					
	Protoneuridae	8	**B**			**B**	Elmidae/Dryopidae*	8										
	Zygoptera juvs.	6			**1**	**1**	Gyrinidae*	5		**B**		**B**						
	Aeshnidae	8			**A**	**A**	Halipidae*	5										
	Corduliidae	8			**1**	**1**	Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4					Hydrophilidae*	5	**1**			**1**	VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	**A**	**A**	**1**	**B**	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- BUS(January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET																		
DATE: 29-01-2020	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E: °	**TURBELLARIA**	3	**A**			**A**	Corixidae*	3		**A**		**A**	Blepharoceridae	15	**1**			**1**
SITE CODE: BUS	**ANNELIDA:**						Gerridae*	5		**A**		**A**	Ceratopogonidae	5				
RIVER: BLYDE	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2	**B**			**B**
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7		**A**		**A**	Culicidae*	1				
WEATHER CONDITION:	**CRUSTACEA:**						Nepidae*	3		**1**		**1**	Dixidae*	10				
TEMP: 17,70 °C	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 8,10	Potamonautidae*	3	**A**			**A**	Pleidae*	4					Ephydridae	3				
DO: 8,69 mg/l 105,4%	Atyidae	8					Veliidae/M..veliidae*	5		**A**	**1**	**A**	Muscidae	1				
Cond: 103 mS/m TDS 68 mg/l	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8			**A**	**A**	Cordalidae	8					Simuliidae	5	**A**	**1**		**A**
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5			**1**	**1**
BEDROCK:	Perlidae	12	**A**			**A**	Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4					Ancylidae	6	**1**			**1**
M VEG OOC: DOM SP:	Baetidae 2 sp	6			**A**		Hydropsychidae 2 sp	6	**A**			**A**	Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	**B**	**B**		**B**	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	**A**		**A**	**B**	Philopotamidae	10	**1**			**1**	Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	**A**			**A**	Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9	**A**			**A**	**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	**A**			**A**	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		129	84	36	191
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		**A**		**A**	**NO OF TAXA:**		16	14	6	28
	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		8,06	6,00	6,00	6,82
	Chlorolestidae	8					Pisuliidae	10					**IHAS**:	82%				
	Coenagrionidae	4		**A**		**A**	Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**						7 X BARBUS SP					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:					
	Protoneuridae	8					Elmidae/Dryopidae*	8	**A**	**1**		**A**						
	Zygoptera juvs.	6					Gyrinidae*	5		**A**		**A**						
	Aeshnidae	8					Halipidae*	5										
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6		**1**	**B**	**B**	Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4					Hydrophilidae*	5		**1**		**1**	VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	**A**	**1**		**A**	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- 012 (January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 30-01-2020	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E: °	**TURBELLARIA**	3	**1**		**A**	**A**	Corixidae*	3			**A**	**A**	Blepharoceridae	15				
SITE CODE: O12	**ANNELIDA:**						Gerridae*	5		**A**		**A**	Ceratopogonidae	5	**1**			**1**
RIVER: PILGRAMS CREEK	Oligochaeta	1			**A**	**A**	Hydrometridae*	6					Chironomidae	2	**A**	**A**	**A**	**B**
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7		**A**		**A**	Culicidae*	1				
WEATHER CONDITION:	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 18,30°C	Amphipoda	13					Notonectidae*	3		**B**		**B**	Empididae	6				
Ph: 08,00	Potamonautidae*	3	**1**			**1**	Pleidae*	4					Ephydridae	3				
DO: 81,6% 6,50 mg/l	Atyidae	8					Veliidae/M..veliidae*	5		**B**		**B**	Muscidae	1				
Cond: 241US mS/m TDS 159 mg/l	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1		**A**		**A**
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5			**A**	**A**
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4					Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6	**B**		**A**		Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12		**B**		**B**	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	**B**	**1**	**1**	**B**	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9					**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		29	68	46	92
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		**1**		**1**	**NO OF TAXA:**		7	12	10	19
	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		4,14	5,67	4,60	4,84
	Chlorolestidae	8		**1**	**1**	**A**	Pisuliidae	10					**IHAS**:		80%			
	Coenagrionidae	4	**A**		**A**	**A**	Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**						4 X GLODNBARTS B. ANO 9 X BANDED BARB CO					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:					
	Protoneuridae	8					Elmidae/Dryopidae*	8					SEE PICS					
	Zygoptera juvs.	6					Gyrinidae*	5		**B**		**B**						
	Aeshnidae	8		**A**	**1**	**A**	Halipidae*	5										
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4					Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- 015 DS (January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 30-01-2020	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3		A	A	A	Athericidae	10				
E: °	**TURBELLARIA**	3	A			A	Corixidae*	3	1	B		B	Blepharoceridae	15				
SITE CODE:015- DS SITE	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5	A			A
RIVER: PILGRAMS CREEK	Oligochaeta	1			1	1	Hydrometridae*	6					Chironomidae	2	A		A	B
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION:	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 20,10 °C	Amphipoda	13					Notonectidae*	3		A		A	Empididae	6				
Ph: 7,98	Potamonautidae*	3	A		1	A	Pleidae*	4					Ephydridae	3				
DO: 85,6% 6,84mg/l	Atyidae	8					Veliidae/M..veliidae*	5		A	1	A	Muscidae	1				
Cond: 275 US mS/M tds 183mg/L	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1	1			1
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5	B			B
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5	A			A
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4		A		A	Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B	B		B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	B	1	1	B	Philopotamidae	10	1			1	Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9	A			A	**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		104	83	43	145
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6	A	A		B	**NO OF TAXA:**		17	15	10	27
	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		6,12	5,53	4,30	5,37
	Chlorolestidae	8					Pisuliidae	10					**IHAS**:		84%			
	Coenagrionidae	4	A	A	A	B	Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**						1x yellow +25 barb					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5		1		1	**COMMENTS**:					
	Protoneuridae	8					Elmidae/Dryopidae*	8					4x neefi ?					
	Zygoptera juvs.	6					Gyrinidae*	5		B	A	B						
	Aeshnidae	8	B	1	1	B	Halipidae*	5										
	Corduliidae	8					Helodidae	12	1			1	* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6			A	A	Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4		A		A	Hydrophilidae*	5		1		1	VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	A	1		A	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- 002 (January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE:	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**	**TAXON**		**S**	**VG**	**GSM**	**TOT**
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E: °	**TURBELLARIA**	3					Corixidae*	3					Blepharoceridae	15				
SITE CODE:OO2	**ANNELIDA:**						Gerridae*	5		1		1	Ceratopogonidae	5				
RIVER: PEACH TREE	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2		A	A	B
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION:	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 17,80 °C	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 8,21	Potamonautidae*	3					Pleidae*	4					Ephydridae	3				
DO: 08,97 mg/l 109,0%	Atyidae	8					Veliidae/M..veliidae*	5	1	A	B	B	Muscidae	1				
Cond:109 mS/m TDS 78mg/l	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5				
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4			A	A	Hydropsychidae 1sp	4					Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12					Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6					Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW: MODERATE	Leptophlebiidae	9					**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		10	21	20	25
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6					**NO OF TAXA:**		2	5	5	6
	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		5,00	4,20	4,00	4,17
	Chlorolestidae	8					Pisuliidae	10					**IHAS**:		82%			
	Coenagrionidae	4					Sericostomatidae SWC	13					**OTHER BIOTA**:					
	Lestidae	8					**COLEOPTERA:**											
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS**:					
	Protoneuridae	8					Elmidae/Dryopidae*	8										
	Zygoptera juvs.	6					Gyrinidae*	5	B	B	B	C						
	Aeshnidae	8					Halipidae*	5										
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4		A	1	A	Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- 005 (January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 28-01-2020	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	PORIFERA	5					HEMIPTERA:						DIPTERA:					
S:°	COELENTERATA	1					Belostomatidae*	3					Athericidae	10			1	1
E:°	TURBELLARIA	3	A			A	Corixidae*	3			A	A	Blepharoceridae	15				
SITE CODE:OO5	ANNELIDA:						Gerridae*	5		B		B	Ceratopogonidae	5			A	A
RIVER: BLYDE	Oligochaeta	1	1		1	A	Hydrometridae*	6					Chironomidae	2		B		B
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7		A		A	Culicidae*	1				
WEATHER CONDITION:	CRUSTACEA:						Nepidae*	3		1		1	Dixidae*	10				
TEMP: 19,40 °C	Amphipoda	13					Notonectidae*	3		A	B	B	Empididae	6				
Ph: 07,99	Potamonautidae*	3	B	A	1	B	Pleidae*	4					Ephydridae	3				
DO: 109,4% 8,77 mg/l	Atyidae	8					Veliidae/M..veliidae*	5		A		A	Muscidae	1				
Cond: 150 mS/m	Palaemonidae	10					MEGALOPTERA:						Psychodidae	1				
BIOTOPES SAMPLED:	HYDRACARINA	8		1		1	Cordalidae	8					Simuliidae	5		B		B
SIC: TIME: minutes	PLECOPTERA:						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					TRICHOPTERA						Tabanidae	5				
BEDROCK:	Perlidae	12	A			A	Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	EPHEMEROPTERA						Ecnomidae	8					GASTROPODA					
M VEG IC: DOM SP:	Baetidae 1sp	4			A		Hydropsychidae 1sp	4					Ancylidae	6	1			1
M VEG OOC: DOM SP:	Baetidae 2 sp	6		B			Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B			B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6		A		A	Philopotamidae	10			1	1	Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	A			A	Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9	A			A	CASED CADDIS:						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					PELECYPODA					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	A			A	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					SASS SCORE:		94	76	61	187
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		B	1	B	NO OF TAXA:		12	15	11	29
	Chlorocyphidae	10					Petrothrincidae SWC	11					ASPT:		7,83	5,07	5,55	6,45
	Chlorolestidae	8					Pisuliidae	10					IHAS:	94%				
	Coenagrionidae	4		A		A	Sericostomatidae SWC	13					OTHER BIOTA:					
	Lestidae	8					COLEOPTERA:											
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					COMMENTS:					
	Protoneuridae	8					Elmidae/Dryopidae*	8										
	Zygoptera juvs.	6					Gyrinidae*	5		A		A						
	Aeshnidae	8	B	1		B	Halipidae*	5										
	Corduliidae	8					Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6			A	A	Hydraenidae*	8	1			1	SWC = South Western Cape T = Tropical					
	Libellulidae	4					Hydrophilidae*	5					VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	A		A	B	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Site- 009 BO011(January 2020)

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 29-01-2020	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	PORIFERA	5					HEMIPTERA:						DIPTERA:					
S:°	COELENTERATA	1					Belostomatidae*	3			1	1	Athericidae	10			1	1
E:°	TURBELLARIA	3	A		1	A	Corixidae*	3		A		A	Blepharoceridae	15				
SITE CODE: 009 (BP011)	ANNELIDA:						Gerridae*	5		B		B	Ceratopogonidae	5		1		1
RIVER: BLYDE	Oligochaeta	1	A	1		A	Hydrometridae*	6					Chironomidae	2	B		1	B
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7		A	1	A	Culicidae*	1				
WEATHER CONDITION:	CRUSTACEA:						Nepidae*	3					Dixidae*	10				
TEMP: 15,53°C	Amphipoda	13					Notonectidae*	3					Empididae	6				
8	Potamonautidae*	3	A	1		A	Pleidae*	4		1		1	Ephydridae	3				
DO: 9,60 mg/l 118,0%	Atyidae	8					Veliidae/M..veliidae*	5		A		A	Muscidae	1				
Cond: 73 mS/m TDS 44 mg/l	Palaemonidae	10					MEGALOPTERA:						Psychodidae	1				
BIOTOPES SAMPLED:	HYDRACARINA	8	1		A	A	Cordalidae	8					Simuliidae	5	A		1	A
SIC: TIME: minutes	PLECOPTERA:						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					TRICHOPTERA						Tabanidae	5				
BEDROCK:	Perlidae	12	A			A	Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	EPHEMEROPTERA						Ecnomidae	8					GASTROPODA					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4	A			A	Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B	B	B	B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	A	A	A	B	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	B			B	Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9	A			A	CASED CADDIS:						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					PELECYPODA					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					SASS SCORE:		117	72	94	196
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6			A	A	NO OF TAXA:		17	13	14	30
	Chlorocyphidae	10	1			1	Petrothrincidae SWC	11					ASPT:		6,88	5,54	6,71	6,53
	Chlorolestidae	8		B	1	B	Pisuliidae	10			1	1	IHAS:		85%			
	Coenagrionidae	4					Sericostomatidae SWC	13					OTHER BIOTA:					
	Lestidae	8					COLEOPTERA:						BARBUS SP L X12 B.PAU X3					
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					COMMENTS:					
	Protoneuridae	8					Elmidae/Dryopidae*	8										
	Zygoptera juvs.	6					Gyrinidae*	5		A		A						
	Aeshnidae	8	B	B		B	Halipidae*	5										
	Corduliidae	8			1	1	Helodidae	12					* = airbreathers					
OTHER OBSERVATIONS:	Gomphidae	6	1		1	A	Hydraenidae*	8					SWC = South Western Cape T = Tropical					
	Libellulidae	4					Hydrophilidae*	5	1			1	VG = all vegetation ST = Sub-tropical					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud S = Stone & rock					
	Pyralidae	12					Psephenidae	10	A			A	1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

APPENDIX L – IHI Scoresheets

Site BUS (October 2018)

INSTREAM IHI	MRU
Base Flows	-1.0
Zero Flows	0.5
Floods	0.0
HYDROLOGY RATING	0.6
pH	0.5
Salts	0.5
Nutrients	0.5
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.0
Toxics	0.5
PC RATING	0.5
Sediment	0.5
Benthic Growth	0.5
BED RATING	0.5
Marginal	0.5
Non-marginal	0.5
BANK RATING	0.5
Longitudinal Connectivity	0.5
Lateral Connectivity	0.5
CONNECTIVITY RATING	0.5
INSTREAM IHI %	89.6
INSTREAM IHI EC	A/B
INSTREAM CONFIDENCE	2.0

RIPARIAN IHI	MRU
Base Flows	-1.0
Zero Flows	-1.0
Moderate Floods	0.5
Large Floods	0.0
HYDROLOGY RATING	0.7
Substrate Exposure (marginal)	0.5
Substrate Exposure (non-marginal)	0.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	0.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.0
Marginal	0.5
Non-marginal	1.0
BANK STRUCTURE RATING	0.7
Longitudinal Connectivity	0.5
Lateral Connectivity	1.0
CONNECTIVITY RATING	0.5
RIPARIAN IHI %	86.5
RIPARIAN IHI EC	B
RIPARIAN CONFIDENCE	2.0

Site BMS1 (October 2018)

INSTREAM IHI	MRU
Base Flows	-1.0
Zero Flows	0.5
Floods	0.0
HYDROLOGY RATING	0.6
pH	1.0
Salts	1.5
Nutrients	0.5
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.0
Toxics	0.5
PC RATING	1.0
Sediment	1.0
Benthic Growth	0.5
BED RATING	0.8
Marginal	0.5
Non-marginal	0.5
BANK RATING	0.5
Longitudinal Connectivity	0.5
Lateral Connectivity	1.0
CONNECTIVITY RATING	0.5
INSTREAM IHI %	85.9
INSTREAM IHI EC	B
INSTREAM CONFIDENCE	2.0

RIPARIAN IHI	MRU
Base Flows	-1.0
Zero Flows	-1.0
Moderate Floods	0.5
Large Floods	0.0
HYDROLOGY RATING	0.7
Substrate Exposure (marginal)	0.5
Substrate Exposure (non-marginal)	0.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	0.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	1.0
Physico-Chemical (non-marginal)	0.0
Marginal	1.0
Non-marginal	1.0
BANK STRUCTURE RATING	1.0
Longitudinal Connectivity	0.5
Lateral Connectivity	1.0
CONNECTIVITY RATING	0.5
RIPARIAN IHI %	83.8
RIPARIAN IHI EC	B
RIPARIAN CONFIDENCE	2.0

Site BMS2 (October 2018)

INSTREAM IHI	MRU
Base Flows	-1.0
Zero Flows	0.5
Floods	0.0
HYDROLOGY RATING	**0.6**
pH	1.0
Salts	1.5
Nutrients	0.5
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.0
Toxics	0.5
PC RATING	**0.7**
Sediment	1.0
Benthic Growth	1.0
BED RATING	**1.0**
Marginal	0.5
Non-marginal	0.5
BANK RATING	**0.5**
Longitudinal Connectivity	1.0
Lateral Connectivity	1.0
CONNECTIVITY RATING	**1.0**
INSTREAM IHI %	**84.8**
INSTREAM IHI EC	**B**
INSTREAM CONFIDENCE	**2.0**

RIPARIAN IHI	MRU
Base Flows	-1.0
Zero Flows	-1.0
Moderate Floods	0.5
Large Floods	0.0
HYDROLOGY RATING	**0.7**
Substrate Exposure (marginal)	0.5
Substrate Exposure (non-marginal)	0.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	0.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.5
Marginal	0.5
Non-marginal	1.0
BANK STRUCTURE RATING	**0.7**
Longitudinal Connectivity	1.0
Lateral Connectivity	1.5
CONNECTIVITY RATING	**1.0**
RIPARIAN IHI %	**84.3**
RIPARIAN IHI EC	**B**
RIPARIAN CONFIDENCE	**2.0**

Site BDS (October 2018)

INSTREAM IHI	MRU
Base Flows	-1.0
Zero Flows	0.5
Floods	0.0
HYDROLOGY RATING	**0.6**
pH	1.0
Salts	1.5
Nutrients	0.5
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.0
Toxics	0.5
PC RATING	**1.0**
Sediment	1.5
Benthic Growth	1.0
BED RATING	**1.3**
Marginal	1.0
Non-marginal	1.0
BANK RATING	**1.0**
Longitudinal Connectivity	1.0
Lateral Connectivity	1.5
CONNECTIVITY RATING	**1.0**
INSTREAM IHI %	**80.8**
INSTREAM IHI EC	**B/C**
INSTREAM CONFIDENCE	**2.0**

RIPARIAN IHI	MRU
Base Flows	-1.0
Zero Flows	-1.0
Moderate Floods	0.5
Large Floods	0.0
HYDROLOGY RATING	**0.7**
Substrate Exposure (marginal)	0.5
Substrate Exposure (non-marginal)	0.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	0.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.5
Marginal	0.5
Non-marginal	1.0
BANK STRUCTURE RATING	**0.7**
Longitudinal Connectivity	2.0
Lateral Connectivity	2.0
CONNECTIVITY RATING	**2.0**
RIPARIAN IHI %	**80.0**
RIPARIAN IHI EC	**B/C**
RIPARIAN CONFIDENCE	**2.0**

Site PTS (October 2018)

	MRU
INSTREAM IHI	
Base Flows	-1.0
Zero Flows	0.5
Floods	0.0
HYDROLOGY RATING	**0.6**
pH	0.5
Salts	0.0
Nutrients	0.5
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.5
Toxics	0.0
PC RATING	**0.5**
Sediment	2.0
Benthic Growth	1.5
BED RATING	**1.8**
Marginal	2.0
Non-marginal	1.5
BANK RATING	**1.8**
Longitudinal Connectivity	1.0
Lateral Connectivity	1.0
CONNECTIVITY RATING	**1.0**
INSTREAM IHI %	**79.3**
INSTREAM IHI EC	**B/C**
INSTREAM CONFIDENCE	**2.0**

	MRU
RIPARIAN IHI	
Base Flows	-1.0
Zero Flows	-1.0
Moderate Floods	0.5
Large Floods	0.0
HYDROLOGY RATING	**0.7**
Substrate Exposure (marginal)	0.5
Substrate Exposure (non-marginal)	0.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	0.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	1.0
Physico-Chemical (non-marginal)	0.5
Marginal	1.0
Non-marginal	1.0
BANK STRUCTURE RATING	**1.0**
Longitudinal Connectivity	1.0
Lateral Connectivity	0.5
CONNECTIVITY RATING	**1.0**
RIPARIAN IHI %	**82.0**
RIPARIAN IHI EC	**B/C**
RIPARIAN CONFIDENCE	**2.0**

Site BUS (March 2019)

	MRU
INSTREAM IHI	
Base Flows	-1.0
Zero Flows	0.5
Floods	0.0
HYDROLOGY RATING	**0.6**
pH	0.5
Salts	0.5
Nutrients	0.5
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.0
Toxics	0.5
PC RATING	**0.5**
Sediment	0.5
Benthic Growth	0.5
BED RATING	**0.5**
Marginal	0.5
Non-marginal	0.5
BANK RATING	**0.5**
Longitudinal Connectivity	0.5
Lateral Connectivity	0.5
CONNECTIVITY RATING	**0.5**
INSTREAM IHI %	**89.6**
INSTREAM IHI EC	**A/B**
INSTREAM CONFIDENCE	**2.0**

	MRU
RIPARIAN IHI	
Base Flows	-1.0
Zero Flows	-1.0
Moderate Floods	0.5
Large Floods	0.0
HYDROLOGY RATING	**0.7**
Substrate Exposure (marginal)	0.5
Substrate Exposure (non-marginal)	0.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	0.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.0
Marginal	0.5
Non-marginal	1.0
BANK STRUCTURE RATING	**0.7**
Longitudinal Connectivity	0.5
Lateral Connectivity	1.5
CONNECTIVITY RATING	**0.6**
RIPARIAN IHI %	**86.3**
RIPARIAN IHI EC	**B**
RIPARIAN CONFIDENCE	**2.0**

Site BMS1 (March 2019)

INSTREAM IHI	MRU
Base Flows	-1.0
Zero Flows	0.5
Floods	0.0
HYDROLOGY RATING	**0.6**
pH	1.0
Salts	1.5
Nutrients	0.5
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.0
Toxics	0.5
PC RATING	**0.9**
Sediment	1.0
Benthic Growth	0.5
BED RATING	**0.8**
Marginal	0.5
Non-marginal	0.5
BANK RATING	**0.5**
Longitudinal Connectivity	0.5
Lateral Connectivity	0.5
CONNECTIVITY RATING	**0.5**
INSTREAM IHI %	**86.5**
INSTREAM IHI EC	**B**
INSTREAM CONFIDENCE	**2.0**

RIPARIAN IHI	MRU
Base Flows	-1.0
Zero Flows	-1.0
Moderate Floods	0.5
Large Floods	0.0
HYDROLOGY RATING	**0.7**
Substrate Exposure (marginal)	0.5
Substrate Exposure (non-marginal)	0.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	0.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	1.0
Physico-Chemical (non-marginal)	0.0
Marginal	1.0
Non-marginal	1.0
BANK STRUCTURE RATING	**1.0**
Longitudinal Connectivity	0.5
Lateral Connectivity	0.5
CONNECTIVITY RATING	**0.5**
RIPARIAN IHI %	**84.0**
RIPARIAN IHI EC	**B**
RIPARIAN CONFIDENCE	**2.0**

Site BMS2 (March 2019)

INSTREAM IHI	MRU
Base Flows	-1.0
Zero Flows	0.5
Floods	0.0
HYDROLOGY RATING	**0.6**
pH	1.0
Salts	1.5
Nutrients	0.5
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.0
Toxics	0.5
PC RATING	**0.8**
Sediment	1.0
Benthic Growth	1.0
BED RATING	**1.0**
Marginal	1.0
Non-marginal	0.5
BANK RATING	**0.8**
Longitudinal Connectivity	1.5
Lateral Connectivity	1.5
CONNECTIVITY RATING	**1.5**
INSTREAM IHI %	**82.0**
INSTREAM IHI EC	**B**
INSTREAM CONFIDENCE	**2.0**

RIPARIAN IHI	MRU
Base Flows	-1.0
Zero Flows	-1.0
Moderate Floods	0.5
Large Floods	0.0
HYDROLOGY RATING	**0.7**
Substrate Exposure (marginal)	0.5
Substrate Exposure (non-marginal)	0.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	0.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.5
Marginal	1.0
Non-marginal	1.0
BANK STRUCTURE RATING	**1.0**
Longitudinal Connectivity	1.5
Lateral Connectivity	1.5
CONNECTIVITY RATING	**1.5**
RIPARIAN IHI %	**79.6**
RIPARIAN IHI EC	**B/C**
RIPARIAN CONFIDENCE	**2.0**

Site BDS (March 2019)

INSTREAM IHI	MRU
Base Flows	-1.0
Zero Flows	0.5
Floods	0.0
HYDROLOGY RATING	**0.6**
pH	1.0
Salts	1.5
Nutrients	0.5
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.0
Toxics	0.5
PC RATING	**1.0**
Sediment	2.0
Benthic Growth	1.0
BED RATING	**1.6**
Marginal	1.0
Non-marginal	1.0
BANK RATING	**1.0**
Longitudinal Connectivity	1.0
Lateral Connectivity	1.5
CONNECTIVITY RATING	**1.0**
INSTREAM IHI %	**79.5**
INSTREAM IHI EC	**B/C**
INSTREAM CONFIDENCE	**2.0**

RIPARIAN IHI	MRU
Base Flows	-1.0
Zero Flows	-1.0
Moderate Floods	0.5
Large Floods	0.0
HYDROLOGY RATING	**0.7**
Substrate Exposure (marginal)	0.5
Substrate Exposure (non-marginal)	0.5
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	0.0
Erosion (non-marginal)	0.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.5
Marginal	0.5
Non-marginal	1.0
BANK STRUCTURE RATING	**0.7**
Longitudinal Connectivity	2.0
Lateral Connectivity	2.0
CONNECTIVITY RATING	**2.0**
RIPARIAN IHI %	**80.0**
RIPARIAN IHI EC	**B/C**
RIPARIAN CONFIDENCE	**2.0**

APPENDIX M – Comments and Responses

FRESHWATER SYSTEMS

COMMENT	ISSUE / RISK RAISED	RESPONSE
The issue of wetlands must be addressed and proper mitigation measures must be specified (MTPA)	Mitigation measures for wetlands	The freshwater study for the site concluded that there are no wetlands on site. Please refer to Section 6.1, 6.3 and Appendix H. Mitigation measures for watercourses identified within the 83MR application area are provided. Please refer to Section 8.2 and Section 8.3 for mitigation measures and monitoring recommendations respectively.
A Wetland and Riparian area are linked to that area. This needs to be delineated (AWARD)	Delineation of Wetland and Riparian area	All watercourses meeting the ecological definition of a watercourse as contained in the National Water Act, 1998 (Act No. 36 of 1998) were delineated. Please refer to Section 6.3.
Wetland specialist study will not be undertaken during the EIA phase, which is concerning as all rivers have an associated riparian zone which should be assessed (K2C) (DWS – also commented on wetland)	Timing of wetland specialist study	A watercourse ecological assessment was undertaken during early spring (October) 2018. Existing aquatic biomonitoring and water quality data was used to improve temporal discussions of the data.
It is an important catchment providing in numerous human needs. The cumulative impacts on the catchment must be thoroughly investigated, considering the other mining activities that have been approved. These include other activities of TGME, as well as those of other mining companies (Lientjie Cohen: MTPA)	Catchment Management Approach	A cumulative impact statement is provided. Please refer to Section 8.5.
A catchment approach is critical (AWARD)	Catchment Management Approach	Comment Noted. Catchment considerations were included in the study.
The MBSP freshwater biodiversity assessment indicates the presence of a CBA River that needs to be delineated with a 1000 m buffer, according to the MBSP Handbook (MTPA)	Delineation of buffer zones	Noted. Please refer to Section 7.
Open-pit mining within ESA: SWSAs (Strategic Water Source Area (SWSA) is not a supported land use (MTPA)	Status of SWSA	Noted. Please refer to Section 4.
Reference to the National Strategic Water Source Areas (SWSAs) for surface water and groundwater and their importance to be addressed in the reports. (Lientjie Cohen: MTPA)	National Strategic Water Source Areas to be noted in reports	Comment noted. Please refer to Section 4.

COMMENT	ISSUE / RISK RAISED	RESPONSE
The area is actually a no-go area as it is a strategic water source area (AWARD)	Status of Strategic Water Source Area	Strategic Water Source Areas are not specifically legally protected although it is acknowledged that they are sensitive and important areas. Please refer to Section 4.
Request MTPA: Ongoing chemical and biological monitoring of the CBA River, including emergency mitigation plans	Monitoring / Emergency mitigation plans	Please refer to Section 8.2 for mitigation measures. Please refer to Section 8.3 for monitoring recommendations.
The Blyde River system must be managed as a Class 1 water resource, (minimal development and highly protected to ensure the delivery of water and ecosystems goods and services to downstream catchments). Mining is therefore a direct threat to the unique and high aquatic biodiversity and ecosystem functioning of the Blyde River. (Lientjie Cohen: MTPA) Therefore it is also critical to have clear and specific mitigation measures (AWARD) This means that the catchment should be managed in a manner that protects and preserves its ecological integrity (AWARD) (Sanparks)	Status of Blyde River and classification Specific detailed Mitigation measures	Noted. Please refer to Section 5.2.2 for the Resource Quality Objectives. Please refer to Section 8.2 for mitigation measures. Please refer to Section 8.3 for monitoring recommendations.
The proposed project can negatively impact on the water quality and quantity from the top of the Blyde River to the Olifants River up to the Kruger National Park (AWARD) The Blyde River system is one of the last remaining tributaries which provide a buffering service to the already water stressed and water quality compromised lower Olifants River (AWARD) South Africa is bound by transboundary responsibilities when it comes to its shared water basins	Catchment impact / mitigation	Please refer to Section 6.5.5 for information pertaining to historical and current water quality. Please refer to Section 8.3 for monitoring recommendations. Please refer to Section 8.5 for the cumulative impact statement.
Concern over the cumulative impact of all the proposed developments received so far for the Blyde River catchment area (Lientjie Cohen: MTPA)	Cumulative impacts on catchment	Please refer to Section 8.5.
Reduced water quality in the Blyde River will impact the Hoedspruit farming area which is nearly fully dependent on water from the Blyde River for irrigation (AWARD)	Impact on catchment and farming	Please refer to Section 8.5.
The Blyde River, which flows through the project area is also listed as high priority in terms of the National Freshwater Ecosystem Priority Areas assessment (NFEPA, 2011 – K2C).	Status of Blyde River system	Noted, please refer to Section 4.
Due consideration also needs to be given to the fact that any contaminated water will affect a vast area, (EWT)	Impact on catchment	Please refer to Section 8.5.
Water quality impacts could potentially have impacts on the aquatic biodiversity of the Blyde River (SANPARKS)	Impact on catchment & aquatic biodiversity	Please refer to Section 8.5.

WATER USE / WULA

COMMENT	ISSUE / RISK	RESPONSE
Can the existing TGME monitoring points also be considered to be used in future? (Lientjie Cohen: MTPA) - There is a drainage line north east of Pilgrim's Rest. This should be included as monitoring point. Only four (4) aquatic monitoring points in the Blyde River were identified, none in the tributaries	Monitoring points	Please refer to Section 6 and specficially 6.5.3 for temporal water quality comparisons.
From an environmental position, the test is thus then that the highest possible monitoring standards are set at the highest risk level (AWARD)	Monitoring standards	Please refer to Section 8.3
The management of siltation from prospecting roads. Mitigation through silt traps	Siltation & Silt traps	Please refer to Section 8.2.
From a water catchment perspective, the upper Blyde River catchment presents a case for sound control of land-use and hence water flow and quality of the river system.	Water catchment area vs land use	Comment noted
The mine has to honour the scientific buffers in terms of infrastructure especially the location of the waste rock (DWS – Piet Ackerman)	Infrastructure and buffer zones	The proposed mine layout has been revised to avoid sensitive watercourses and drainage systems as far as possible. Please refer to Section 2.
Pits and waste rock dumps must be removed from watercourses (DWS – Piet Ackerman)	Location of pits and WRD	The proposed mine layout has been revised to avoid sensitive watercourses and drainage systems as far as possible. Please refer to Section 2.
A Hydropedological overview must be submitted and losses motivated (DWS – Piet Ackerman)	Hydropedology	A hydropedological opinion was provided. Please refer to Section 6.3 and Appendix H.
The PES, EIS, REC of watercourses must be determined	Watercourses	This was undertaken. Please refer to Section 6.
Clean stormwater drains must be designed as natural as possible using rocks, topsoil and vegetation (DWS)	Stormwater drains	Noted. Please refer to Section 8.2.
A monitoring and Audit Plan must be submitted with a dedicated section on aquatic monitoring in the river (DWS)	Monitoring and Audit Plan	Please refer to Section 8.3 for monitoring requirements.
There must be no sediment that could run into the Blyde River. Mitigation is very important for these pits. (Mpho Ntshagovhe: DWS)	Sediment and management	Mitigation recommendations to manage sediment are provided. Please refer to Section 8.2.

GEOHYDROLOGY

Include some kind of water monitoring, both upstream and downstream from the proposed site, to monitor dangerous chemicals that may result from the mine, to prove that there is no pollution entering the water as the proposed development site (EWT)	Water Monitoring	Please refer to Section 8.3

EIA PROCESS / GENERAL ENVIRONMENTAL

COMMENT	ISSUE / RISK	RESPONSE
Spatial scope of this EIA = continued inadequate attention to the potential downstream impacts of inappropriate mining developments on the Blyde River, and its multitude of downstream users and dependent economic activities	Downstream impacts	Please refer to Section 8.5.
The extent of the mining applications in this part of the Mpumalanga Escarpment is of concern and the EIA will need to thoroughly investigate the cumulative impacts from a biodiversity and catchment perspective (K2C)	Biodiversity Catchment	Please refer to Section 8.5.

INFORMATION REQUIREMENTS

COMMENT	ISSUE / RISK	RESPONSE
Historical surface water and groundwater monitoring data of all monitoring sites with all relevant parameters as specified in the 83 MR EMP, Integrated Waste and Water Management Plans, Water Use Licences and any other compliance related monitoring programmes must be presented in the draft EIA report and made available to I&APs (Lientjie Cohen: MTPA)		Please refer to Section 6.5.5.

QUESTION NOT DIRECTLY RELATED TO 83 MR APPLICATION

COMMENT	ISSUE / RISK	RESPONSE
The existing tailings dam is in disrepair, with the liners pulling away and what appears to be salts leaching out into the surrounding soils.	Existing tailings dam	This is noted as a concern in the Risk Assessment and recommended that measures must be taken to address this. Please refer to Section 8.1.

APPENDIX N – 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)
Kelly Dyamond	MSc (Zoology: Aquatic Health) (University of Johannesburg)

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, 2007		
Postal code:	1401	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		

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

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Signature of the Specialist

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist with focus on Freshwater Ecology
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust and emerald Management Trust

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;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member pf the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications	
MSc (Environmental Management) (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for wetland Assessment short course Rhodes University	2016

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leone
Central Africa – Democratic Republic of the Congo

PROJECT EXPERIENCE (Over 2500 projects executed with varying degrees of involvement)

1 Mining Coal, Chrome, PGM's, Mineral Sands, Gold, Phosphate, river sand, clay, fluorspar
2 Linear developments
3 Energy Transmission, telecommunication, pipelines, roads
4 Minerals beneficiation
5 Renewable energy (wind and solar)
6 Commercial development
7 Residential development
8 Agriculture
9 Industrial/chemical

REFERENCES

Terry Calmeyer (Former Chairperson of IAIA SA)
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Marietjie Eksteen
Managing Director: Jacana Environmental
Tel: 015 291 4015

Yours faithfully

STEPHEN VAN STADEN

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

South African Wetland Society

Gauteng Wetland Forum

EDUCATION

Qualifications

N.Dip Nature Conservation (UNISA)	2017
Wetland Management: Introduction and Delineation (University of the Free State)	2018
Tools for Wetland Assessment (Rhodes University)	2017
Wetland Rehabilitation (University of the Free State)	2015

COUNTRIES OF WORK EXPERIENCE

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

Zimbabwe, Zambia

SELECTED PROJECT EXAMPLES

Wetland Assessments

- Baseline Aquatic and Freshwater Assessment as part of the Environmental Assessment and Authorisation Process for the N11 Ring Road, Mokopane, Limpopo Province.
- Freshwater Resource Ecological Assessment as part of the Water Use License Application Requirements for the Proposed Upgrades to the Klippan Pump Station Near Welkom, Free State Province.
- Freshwater Resource Ecological Assessment as part of the Water Use License Application Requirements for the Proposed Urania-Bronville 11kv and 132kv Powerline Corridor Near Welkom, Free State Province.
- Freshwater Assessment for the Proposed Rietrug, Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Rietrug Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.
- Freshwater Assessment for the Proposed Sutherland 2 Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Sutherland 2 Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.
- Freshwater Assessment for the Proposed Sutherland Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Sutherland Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.

• Freshwater resource delineation and ecological assessment as part of the proposed expansion of the Kudumane Mining Project, Northern Cape Province. • Freshwater assessment as part of the environmental assessment and authorisation process for associate electrical infrastructure and a proposed pipeline for the Rooipunt Solar Thermal Power Park Project near Upington, Northern Cape. • Present Ecological State of the Wetlands Report: Jukskei and Klip River Catchments: Monitoring and Managing the Ecological State of the Wetlands in the City of Johannesburg Metropolitan Area. • Wetland assessment as part of the environmental assessment and authorisation process for the proposed Leandra underground coal mine. • Freshwater ecological assessment as part of the water use licence application process for the proposed waste rock dump expansion for Impala Platinum Mine in Rustenburg, North-West Province. • Wetland assessment as part of the water use licence application process for the Marula Platinum Mine, Limpopo Province. • 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 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 proposed water management process at the Assmang Chrome Machadodorp Works, Mpumalanga. • Wetland ecological assessment as part of the Section 24G application process for the Temba Water Purification Plant.
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 • Freshwater Resource Rehabilitation and Management Plan as part of the Environmental Authorisation Process for the Proposed Urania-Bronville 11kv and 132kv Powerline Corridor Near Welkom, Free State Province. • Rehabilitation Plan as part of the Water Use License Application Requirements for the Proposed Upgrade of the Thabazimbi Wastewater Treatment Works (WWTW) Sewer Line, Limpopo Province. • 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 province. • Weekly specialist Environmental Control Officer (ECO) function for the monitoring of emergency desilting and rehabilitation of existing stormwater retention dams on ERF 836 Kosmosdal ext 1, and portion 5 of ERF 115 Kosmosdal ext 4, near Centurion, Gauteng Province.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF KELLY DYAMOND

PERSONAL DETAILS

Position in Company	Junior Field Biologist with specific focus on Aquatic and Wetland Ecology
Date of Birth	8th April 1991
Nationality	South African
Languages	English
Joined SAS	2017

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Accredited River Health practitioner by the South African River Health Program (RHP)
SASAqS Member (South African Society of Aquatic Scientists)

EDUCATION

Qualifications	
MSc Aquatic Health (University of Johannesburg)	2017
BSc Zoology (Hons) (University of Johannesburg)	2014
BSc Zoology and Environmental Management (University of Johannesburg)	2010

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, Kwa-Zulu Natal

SELECTED PROJECT EXAMPLES

Aquatic Biomonitoring

- Aquatic biomonitoring programs for Entra Paper Mill.
- Aquatic biomonitoring programs for Bokoni Platinum Mine.
- Aquatic biomonitoring programs for Dangote Cement Delmas Plant.
- Aquatic biomonitoring programs for Glencore Wonderkop Smelter and Rustenburg Smelter.
- Aquatic biomonitoring programs for NECSA Pelindaba Complex.
- Aquatic biomonitoring programs for Pilanesburg Platinum Mine and Sedibelo Mine.
- Aquatic biomonitoring programs for Rhovan Mine.
- Aquatic biomonitoring programs for Assmang Chrome Machadodorp Works.
- Aquatic biomonitoring programs for Assmang Manganese Cato Ridge Works.
- Aquatic biomonitoring programs for Bakubung Platinum Mine.
- Aquatic biomonitoring programs for Hernic Ferrochrome Mine.
- Aquatic biomonitoring programs for Nkomati Mine.
- Aquatic biomonitoring programs for Transvaal Gold Mining Estate.

Water Quality and Toxicity Monitoring

- Annual and Quarterly Water Monitoring and Management for the Enstra Paper Mill.
- Toxicological monitoring programs for Dangote Cement Delmas Plant.
- Toxicological monitoring programs for NECSA Pelindaba Complex.
- Toxicological monitoring programs for Pilanesburg Platinum Mine and Sedibelo Mine.
- Toxicological monitoring for Rhovan Mine.
- Toxicological monitoring for Assmang Chrome Machadodorp Works.
- Toxicological monitoring for Assmang Manganese Cato Ridge Works.
- Toxicological monitoring for Bakubung Platinum Mine.
- Toxicological monitoring for Hernic Ferrochrome Mine.
- Toxicological monitoring for Nkomati Mine.