mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

FINAL SCOPING REPORT

SASOL MINING (PTY) LTD

SHONDONI COLLIERY

DATE: OCTOBER 2020

DMRE REFERENCE NUMBER:

MINING RIGHT MP 30/5/1/2/3/2/1/138 MR

SUBMITTED FOR ENVIRONMENTAL AUTHORISATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

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FILE REFERENCE NUMBER	MP 30/5/1/2/3/2/1/138 MR

IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore, please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner (EAP) must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

OBJECTIVE OF THE SCOPING PROCESS

The objective of the scoping process is to, through a consultative process—

(a) identify the relevant policies and legislation relevant to the activity;
(b) motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
(c) identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking process;
(d) identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;
(e) identify the key issues to be addressed in the assessment phase;
(f) agree on the level of assessment to be undertaken, including the methodology to be applied, the expertise required as well as the extent of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site; and
(g) identify suitable measures to avoid, manage, or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

FINAL SCOPING REPORT

SASOL MINING (PTY) LTD – SHONDONI COLLIERY

OCTOBER 2020

Consulting

Purpose of Report

In order to facilitate the management of a decommissioning mine and an operational mine, Sasol Mining wants to separate the current approved 2011 integrated EMP report/ document into two separate management programmes. One for the Middelbult Colliery (decommissioning mine) and one for the Shondoni Colliery (operational mine). This project will focus on the operations of Shondoni Colliery and all the related current and proposed activities. Sasol Mining's Shondoni Colliery wishes to expand its operations to a new Block 8 North Reserve Area. This will require that four prospecting rights be included in the larger mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area. To ensure sufficient ventilation for the underground mine workings, four new ventilation shafts will be required in the north and north-west region of the Shondoni Colliery project area.

The proposed project requires Environmental Authorisation (EA) in terms of the provisions of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002; MPRDA), the National Environmental Management Act (Act No. 107 of 1998; NEMA) as well as the National Water Act (Act No. 36 of 1998; NWA). Based on the nature of the proposed activities at Shondoni Colliery, the necessary applications have to be supported *inter alia* by a Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process as provided for in the 2014 Environmental Impact Assessment (EIA) Regulations (GNR 982 of 04 December 2014), as amended.

In view of the fact that Shondoni Colliery operates as a mine, the administrative process is that of the "Single Environmental System" with the Department of Mineral Resources and Energy (DMRE) being the Competent Authority (CA) for the EA Application. The DMRE has developed Reporting Templates in support of the "Single Environmental System", (Scoping Report, Basic Assessment Report, Environmental Impact Assessment Report as well as Environmental Management Programme Report), with strict instructions and content requirements. The DMRE Templates essentially represent a summary by the Environmental Assessment Practitioner (EAP) of more comprehensive information and requires that supporting details be provided as Appendices to the DMRE Template Report.

Report Reference Numbers
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JMA Report: Prj6342
DMRE Ref: MP 30/5/1/2/3/2/1/138 MR

Report Status
Final

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LIST OF ABBREVIATIONS AND ACRONYMS

ABA	:	Acid Base Accounting
AEL	:	Atmospheric Emission Licence
AMD	:	Acid Mine Drainage
AQMS	:	Air Quality Monitoring Station
BAR	:	Basic Assessment Report
CA	:	Competent Authority
CBA	:	Critical Biodiversity Areas
CM	:	Continuous Miner
CV	:	Curriculum Vitae
DEA	:	Department of Environmental Affairs
DEFF	:	Department of Environment, Forestry and Fisheries
DMRE	:	Department of Mineral Resources and Energy
DWS	:	Department of Water and Sanitation
EA	:	Environmental Authorisation
EAP	:	Environmental Assessment Practitioner
EAPASA	:	Environmental Assessment Practitioners Association of South Africa
EIA	:	Environmental Impact Assessment
EIAR	:	Environmental Impact Assessment Report
EIS	:	Ecological Importance and Sensitivity
EMP	:	Environmental Management Plan
EMPR	:	Environmental Management Programme Report
ESA	:	Ecological Support Areas
GHG	:	Greenhouse Gas
GMM	:	Govan Mbeki Municipality
GN	:	Government Notice
GNR	:	Government Notice Report
ha	:	hectare
HIA	:	Heritage Impact Assessment
HGM	:	Hydro Geomorphic
HPC	:	Heterotrophic Plate Count
I&AP's	:	Interested and Affected Parties
IBA	:	Important Bird Area
IHAS	:	Integrated Habitat Assessment System
IHI	:	Index of Habitat Integrity
IWWMP	:	Integrated Water and Waste Management Plan
km	:	kilometer
kV	:	kilovolt
l/s	:	litre per second
LHD	:	Laud Haul Dumper
m	:	meter
mbgl	:	meters below ground level
mg/l	:	milligram per litre
mm	:	millimeter
m^3	:	cubic meter
MAE	:	Mean Annual Evaporation
mamsl	:	meter above mean sea level
MAP	:	Mean Annual Precipitation
MAR	:	Mean Annual Runoff
MBSP	:	Mpumalanga Biodiversity Sector Plan
MIRAI	:	Macroinvertebrate Response Assessment Index
MPRDA	:	Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)

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m/s	:	meter per second
MTPA	:	Mpumalanga Tourism and Parks Authority
MVA	:	Mega-Volt Ampere
MWP	:	Mining Work Programme
NAAQS	:	South African National Ambient Air Quality Standard
NAEIS	:	National Atmospheric Emission Inventory System
NAG	:	Net Acid Generation
NEMA	:	National Environmental Management Act (Act No. 107 of 1998)
NEMWA	:	National Environmental Management: Waste Act (Act No. 59 of 2008)
NFEPA	:	National Freshwater Ecosystem Priority Areas
NWA	:	National Water Act (Act No. 36 of 1998)
PES	:	Present Ecological State
ROM	:	Run of Mine
SABAP	:	South African Bird Atlas Project
SACNASP	:	South African Council for Natural Scientific Professions
SAHRA	:	South African Heritage Resources Agency
SANBI	:	South African National Biodiversity Institute
SANS	:	South African National Standard
SASS5	:	South African Scoring System
SAWB	:	South African Weather Bureau
SAWQ	:	South African Water Quality
SCC	:	Species of Conservational Concern
SCS	:	Sasol Coal Supply
SDF	:	Spatial Development Framework
SEI	:	Site Ecological Importance
S&EIR	:	Scoping and Environmental Impact Reporting
SEP	:	Stakeholder Engagement Process
SLP	:	Social and Labour Plan
SSO	:	Sasol Synfuels Operations
STP	:	Sewage Treatment Plant
TDS	:	Total Dissolved Solids
TOC	:	Total Organic Carbons
VIA	:	Visual Impact Assessment
VOC	:	Volatile Organic Compound
WCS	:	Wetland Consulting Services
WGS	:	World Geodetic System
WHO	:	World Health Organisation
WMA	:	Water Management Area
WML	:	Waste Management Licence
WR	:	Water Resources
WRC	:	Water Research Commission
WUL	:	Water Use Licence
XRD	:	X-Ray Diffraction

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EXECUTIVE SUMMARY

Sasol Mining (Pty) Ltd operates several underground coal mines in the Secunda area, known as the Secunda Complex, in the Mpumalanga Province.

Middelbult Colliery which represents one of the underground mines became operational in 1981 and during its existence, Middelbult Colliery has gone through several expansions. These expansions consisted of several reserve blocks being added to the mining right area as well as the construction of several man and material shaft complexes and the associated mining and other infrastructure to ensure access to these exploitable coal reserves.

Since its inception, Middelbult Colliery obtained two Environmental Management Programmes (EMPr's) approved in terms of the provisions of the former Minerals Act (Act No. 50 of 1991). The first which was approved during 2002, authorised the underground mining of the Middelbult Reserve, and four man and material shaft complexes namely, Main Shaft, North Shaft, West Shaft and North-West Shaft. Both the North Shaft as well as North West Shaft have since been decommissioned and rehabilitated.

The second was an EMPr Addendum, approved during 2003 which included the underground mining of the Block 8 Reserve (both the No. 2 Coal Seam and the No. 4 Coal Seam) as well as an additional man and material shaft complex known as the Simunye Shaft (previously referred to as the Ithemba Lethu Shaft).

During 2011, another EMPr Addendum was applied for to combine all the previous work done at Middelbult Colliery into one single integrated document which represented the overall comprehensive EMPr for Middelbult (Shondoni Block 8) Colliery.

This EMPr included all the historic shaft complexes as well as an additional man and material shaft referred to as the Shondoni Shaft, conveyors and underground mining operations, but in compliance with the requirements of both the subsequent Mineral and Petroleum Resources Development Act (Act No. 28 of 2002; MPRDA) as well as National Environmental Management Act (Act No. 107 of 1998; NEMA).

The Middelbult coal reserve has largely been depleted and this mine will soon enter its decommissioning phase. It is foreseen that this mine will be out of operation within the next 4 years. To ensure sustainable reserve utilisation, Sasol Mining's Shondoni Colliery wishes to expand its operations to a new Block 8 North Reserve Area. This will require that four prospecting rights be included in the larger mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area.

Consequently, in order to facilitate the management of a decommissioning mine and an operational mine, Sasol Mining wants to separate the current approved 2011 integrated EMPr into two separate management programmes. One for the Middelbult Colliery (decommissioning mine) and one for the Shondoni Colliery (operational mine).

This project will focus on the operations of the Shondoni Colliery and all the related current and proposed activities. Proposed activities include the underground mining associated with the new Block 8 North Reserve Area as well as four new additional ventilation shafts. To ensure sufficient ventilation for the underground mine workings, these shafts are required in the north, north-western region of the Shondoni Colliery EMP boundary area.

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The proposed project requires Environmental Authorisation (EA) in terms of the provisions of the MPRDA, NEMA and the National Water Act (Act No. 36 of 1998; NWA). Based on the nature of the proposed activities at Shondoni Colliery, the necessary applications have to be supported by *inter alia* a Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process as provided for in the 2014 Environmental Impact Assessment (EIA) Regulations (GNR 982 of 04 December 2014), as amended.

During the Scoping Phase of this project, a formal and comprehensive Stakeholder Engagement Process (SEP) Programme was initiated, which included consultation with the Competent Authority (CA), compilation of a Draft Scoping Report, a Public Meeting during which the project, new proposed activities as well as the Draft Scoping Report was discussed with identified and registered Interested and Affected Parties (I&AP's) and a Review Period of 30 days during which the CA and I&AP's could review and comment on the Draft Scoping Report.

Issues and Concerns raised during the Public Meeting or the Review Period were captured, considered and incorporated into the project. A formal Issues and Response Register was compiled within which the Environmental Assessment Practitioner (EAP) formally responded to issues and concerns raised and it is provided in this Final Scoping Report.

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1. INTRODUCTION AND TERMS OF REFERENCE

Sasol Mining (Pty) Ltd (hereafter referred to as Sasol Mining) operates several underground coal mines in the Secunda area, known as the Secunda Complex, in the Mpumalanga Province.

Middelbult Colliery which represents one of the underground mines became operational in 1981 and during its existence, Middelbult Colliery has gone through several expansions. These expansions consisted of several reserve blocks being added to the mining right area as well as the construction of several man and material shaft complexes and the associated mining and other infrastructure to ensure access to these exploitable coal reserves (see Figure 1(a)).

Since its inception, Middelbult Colliery obtained two Environmental Management Programmes (EMPr's) approved in terms of the provisions of the former Minerals Act (Act No. 50 of 1991). The first which was approved during 2002, authorised the underground mining of the Middelbult Reserve, and four man and material shaft complexes namely, Main Shaft, North Shaft, West Shaft and North-West Shaft. Both the North Shaft as well as North West Shaft have since been decommissioned and rehabilitated.

The second was an EMPr Addendum, approved during 2003 which included the underground mining of the Block 8 Reserve (both the No. 2 Coal Seam and the No. 4 Coal Seam) as well as an additional man and material shaft complex known as the Simunye Shaft (previously referred to as the Ithemba Lethu Shaft).

During 2011, another EMPr Addendum was applied for to combine all the previous work done at Middelbult Colliery into one single integrated document which represented the overall comprehensive EMPr for Middelbult (Shondoni Block 8) Colliery.

This EMPr included all the historic shaft complexes as well as an additional man and material shaft referred to as the Shondoni Shaft, conveyors and underground mining operations, but in compliance with the requirements of both the subsequent Mineral and Petroleum Resources Development Act (Act No. 28 of 2002; MPRDA) as well as National Environmental Management Act (Act No. 107 of 1998; NEMA).

The Middelbult coal reserve has largely been depleted and this mine will soon enter its decommissioning phase. It is foreseen that this mine will be out of operation within the next 4 years. To ensure sustainable reserve utilisation, Sasol Mining's Shondoni Colliery wishes to expand its operations to a new Block 8 North Reserve Area (see Figure 1(a)). This will require that four prospecting rights be included in the larger mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area.

Consequently, in order to facilitate the management of a decommissioning mine and an operational mine, Sasol Mining wants to separate the current approved 2011 integrated EMPr into two separate management programmes. One for the Middelbult Colliery (decommissioning mine) and one for the Shondoni Colliery (operational mine).

Figure 1(a) illustrates the above-mentioned reserve areas, the historical mining layout as well as the proposed Environmental Management Plan (EMP) boundary areas for Middelbult and Shondoni Colliery. The man and material shaft complexes associated with these proposed EMP boundaries are also indicated on Figure 1(a). The Shondoni and Simunye Shaft Complexes and associated infrastructure will form part of the Shondoni Colliery EMP boundary area. In addition, the Main and West Shaft Complexes and associated infrastructure to be decommissioned/ demolished will be included in the Middelbult Colliery EMP boundary area.

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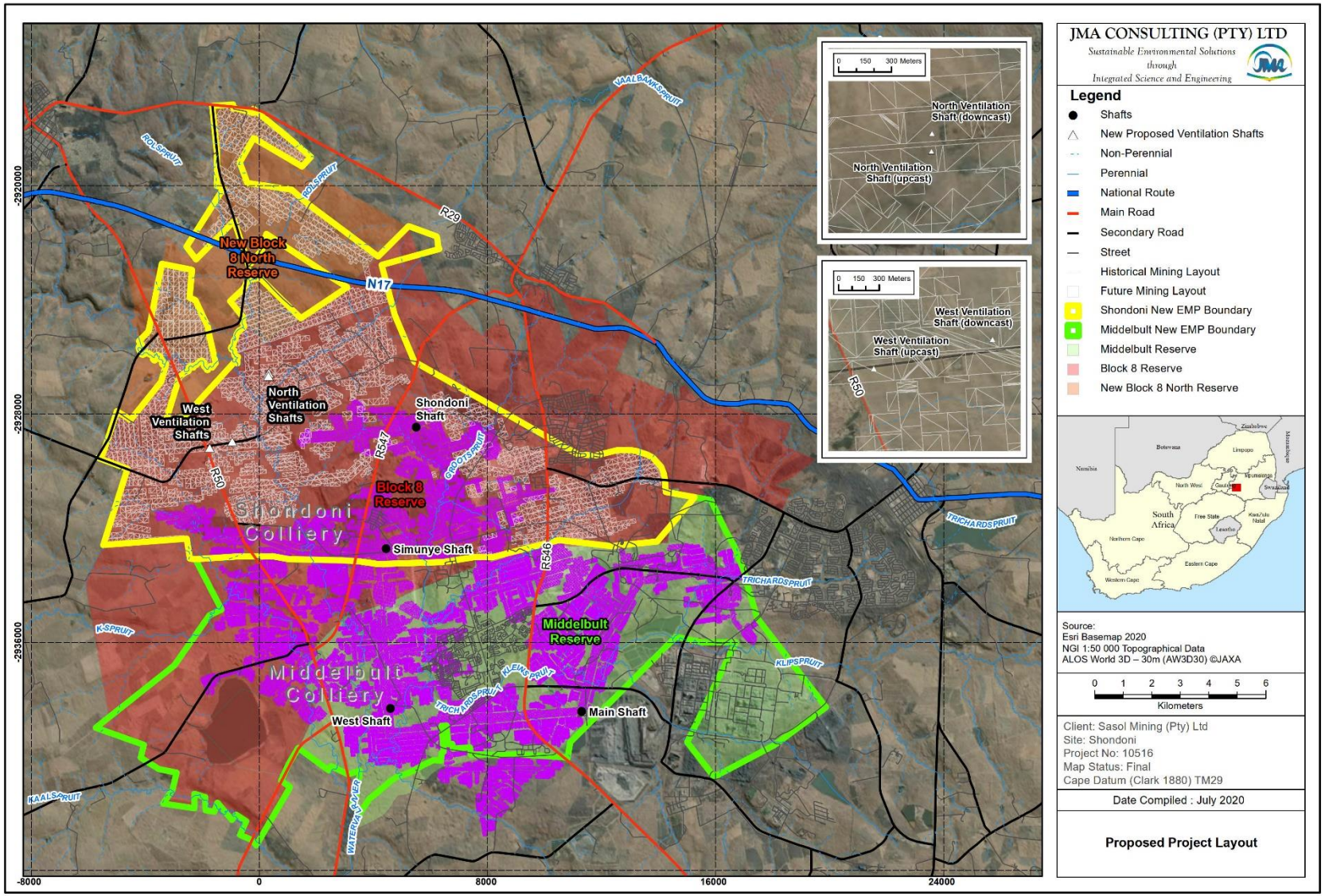

Figure 1(a): Proposed Project Layout

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This project will focus on the operations of the Shondoni Colliery and all the related current and proposed activities. Proposed activities include the underground mining (see Figure 1(a)) associated with the new Block 8 North Reserve Area as well as four new additional ventilation shafts. To ensure sufficient ventilation for the underground mine workings, these shafts are required in the north, north-western region of the Shondoni Colliery EMP boundary area (see Figure 1(a)).

The proposed project requires Environmental Authorisation (EA) in terms of the provisions of the MPRDA, NEMA and the National Water Act (Act No. 36 of 1998; NWA). Based on the nature of the proposed activities at Shondoni Colliery, the necessary applications have to be supported by *inter alia* a Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process as provided for in the 2014 Environmental Impact Assessment (EIA) Regulations (GNR 982 of 04 December 2014), as amended.

In view of the fact that Shondoni Colliery operates as a mine, the administrative process is that of the "Single Environmental System" with the Department of Mineral Resources and Energy (DMRE) being the Competent Authority (CA) for the EA Application.

The DMRE has developed Reporting Templates in support of the "Single Environmental System", (Scoping Report, Basic Assessment Report, Environmental Impact Assessment Report as well as Environmental Management Programme Report), with strict instructions and content requirements.

The DMRE Templates essentially represent a summary by the Environmental Assessment Practitioner (EAP) of more comprehensive information and requires that supporting details be provided as Appendices to the DMRE Template Report.

This Scoping Report emulates the DMRE Template for a Scoping Report and supporting information is attached as detailed Appendices. The content of this Scoping Report and Plan of Study gives full compliance with the requirements for a Scoping Report as detailed in Appendix 2 of the EIA Regulations of 2014, as amended. This report will serve as the main reference for any supporting documentation and specialist studies compiled and conducted in support of the Scoping Process.

The Scoping Process will be conducted as part of the larger S&EIR Process as shown in the diagram presented in Figure 1(b) herein below. Of particular significance is the Process Timeline indicated on the diagram.

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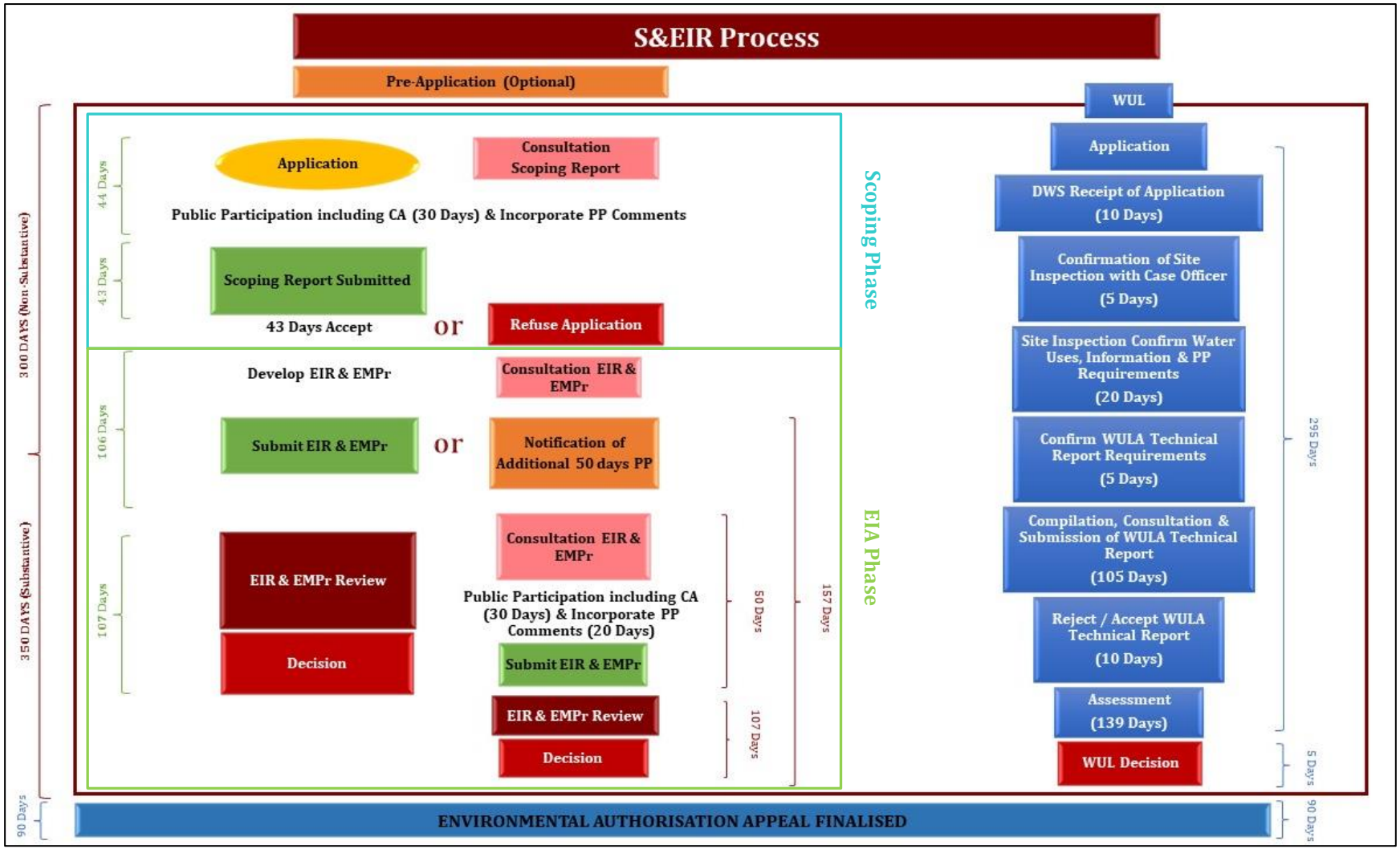

Figure 1(b): The Scoping and Environmental Impact Reporting (S&EIR) Process with the relevant Timeline

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2. DETAILS OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

2.1. DETAILS OF THE EAP WHO PREPARED THE REPORT

Table 2.1(a): Details of the Environmental Assessment Practitioner (EAP)

Project Consultancy	JMA Consulting (Pty) Ltd
Company Registration	2005/039663/07
Professional Affiliation	Environmental Assessment Practitioners Association of South Africa (EAPASA - EAP 2019/943); South African Council for Natural Scientific Professions (SACNASP – Pr.Sci.Nat. 400291/12)
Contact Person	Ms René Wolmarans (Pr. Sci. Nat.)
Physical Address	15 Vickers Street DELMAS 2210
Postal Address	P O Box 883 DELMAS 2210
Telephone Number	+27 13 665 1788
Fax Number	+27 13 665 2364
E-mail	rene@jmaconsult.co.za

2.2. EXPERTISE OF THE EAP

The Environmental Assessment Practitioner (EAP) for this project was Ms René Wolmarans (Pr. Sci. Nat.).

2.2.1. Qualifications of the EAP

René Wolmarans holds the following degrees:

- B.Sc. from the University of Pretoria (2006) with major subjects in Ecology.
- B.Sc. (Hons) from the University of Pretoria (2007) with field of specialisation Ecology (Invasion Biology).
- M.Sc. (cum laude) from the University of Pretoria (2010) with field of specialisation Ecology (Invasion Biology).

René Wolmarans is registered as an Environmental Assessment Practitioner (EAP 2019/943) with the Environmental Assessment Practitioners Association of South Africa (EAPASA) in accordance with the prescribed criteria of Regulation 15(1) of the Section 24H Registration Authority Regulations (Regulation No. 849, Gazette No. 40154 of 22 July 2016, of the NEMA, Act No. 107 of 1998, as amended).

In addition, she holds a Professional Registration with South African Council for Natural Scientific Professions (SACNASP) since 2012 – 400291/12. She is registered as a professional scientist in the following category:

- Ecological Science

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2.2.2. Past Experience of the EAP

René Wolmarans started her working career as an Intern at the South African National Biodiversity Institute (SANBI) Threatened Biodiversity Research Programme followed by being employed as an Environmental Practitioner at Clean Stream Scientific Services.

She was appointed as a Scientist at JMA Consulting (Pty) Ltd in 2012 and has been responsible for the compilation of Basic Assessment Reports (BAR), Scoping and Plan of Study Reports, Environmental Impact Assessment Reports (EIAR) and Environmental Management Programme (EMPr) Reports.

Subsequently, she is also assisting with the development of Integrated Water and Waste Management Plans (IWWMP) and External Audit Reports on Water Use Licences (WUL) and Waste Management Licences (WML). In addition, she facilitates the Stakeholder Engagement Programmes as required by Environmental Management Legislation.

2.3. CV OF THE EAP

A Synoptic CV of the EAP is attached as **APPENDIX 2(A)** to this report.

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3. LOCATION OF THE ACTIVITY

3.1. ACTIVITY BACKGROUND

Sasol Mining operates several underground coal mines in the Secunda area in the Mpumalanga Province. Middelbult Colliery which represents one of the underground mines became operational in 1981 and during its existence, Middelbult Colliery has gone through several expansions. These expansions consisted of several reserve blocks being added to the mining right area as well as the construction of several man and material shaft complexes and the associated mining and other infrastructure to ensure access to these exploitable coal reserves.

Since its inception, Middelbult Colliery obtained two EMPr's approved in terms of the provisions of the former Minerals Act (Act No. 50 of 1991). The first which was approved during 2002, authorised the underground mining of the Middelbult Reserve, and four man and material shaft complexes namely, Main Shaft, North Shaft, West Shaft and North-West Shaft. Both the North Shaft as well as North West Shaft have since been decommissioned and rehabilitated.

The second was an EMPr Addendum, approved during 2003 which included the underground mining of the Block 8 Reserve as well as an additional man and material shaft complex known as the Simunye Shaft (previously referred to as the Ithemba Lethu Shaft).

During 2011, another EMPr Addendum was applied for to combine all the previous work done at Middelbult Colliery into one single integrated document which represented the overall comprehensive EMPr for Middelbult (Shondoni Block 8) Colliery. This EMPr included all the historic shaft complexes as well as an additional man and material shaft referred to as the Shondoni Shaft, conveyors and underground mining operations, but in compliance with the requirements of both the subsequent MPRDA as well as NEMA.

The Middelbult Reserve has largely been depleted and this mine will soon enter its decommissioning phase. It is foreseen that this mine will be out of operation within the next 4 years. To ensure sustainable reserve utilisation, Sasol Mining wishes to expand its operations to a new Block 8 North Reserve Area. This will require that four prospecting rights be included in the larger mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area.

Consequently, in order to facilitate the management of a decommissioning mine and an operational mine, Sasol Mining wants to separate the current approved 2011 integrated EMPr into two separate management programmes. One for the Middelbult Colliery (decommissioning mine) and one for the Shondoni Colliery (operational mine).

Shondoni Colliery will now comprise of the Simunye and Shondoni Shaft Complexes. The Simunye Shaft was approved during 2003 and became operational during 2006.

The Shondoni Shaft was approved during 2011 and construction of the shaft and ancillary infrastructure commenced in September 2013. The first coal was mined from the Shondoni Shaft during June 2016.

Shondoni Mine was issued a Water Use Licence (WUL 08/C12D/ACFGIJ/2027) during 2013 which will be amended to incorporate all the water uses (current and new) associated with this new proposed Shondoni Colliery EMP boundary area.

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3.2. CONTACT DETAILS

A summary of the relevant company details and the contact persons is indicated in Table 3.2(a) and Table 3.2(b) and (c) respectively. The business registration certificate is attached as **APPENDIX 3(A)** to this report.

Table 3.2(a): Company Details

Name of Company	Sasol Mining (Pty) Ltd
Trading Name	Sasol Mining (Pty) Ltd Shondoni Colliery
Registration Number	1950/038590/07
Date Established	26/09/1950
Country Established	Republic of South Africa
VAT Registration Number	4170113312
Physical Address	R547 Kinross/ Balfour Road, Secunda, 2302

Table 3.2(b): General Manager

Contact Person	Godfrey Tshivhase
Telephone Number	+27 17 614 1500
Cell phone Number	+27 79 897 5309
Email Address	Godfrey.tshivhase@sasol.com
Postal Address	Sasol Mining Shondoni Colliery, Secunda, Mpumalanga, 2302

Table 3.2(c): Mine Manager - Production Services

Contact Person	Marcus Geyser
Telephone Number	+27 17 614 1264
Cell phone Number	+27 79 894 7850
Email Address	Marcus.geyser@sasol.com
Postal Address	Private Bag X1015, Secunda, 2302

3.3. REGIONAL SETTING AND LOCATION OF ACTIVITY

Shondoni Colliery falls within the Govan Mbeki Local Municipality which is located within the Gert Sibande District Municipality of the Mpumalanga Province of South Africa (refer to Table 3.3(a) and Figure 3.3(a)). The central coordinates of the site are 26°28'04.54"S; 29°01'31.72"E (WGS 84).

Table 3.3(a): Summary of the Regional Setting and Location of the Activity

Central Coordinate of the Site	26°28'04.54"S; 29°01'31.72"E
Nearest Town / City	Evander is 6 km east of the Shondoni Shaft Complex
Local Municipality	Govan Mbeki Local Municipality
District Municipality	Gert Sibande District Municipality
Province	Mpumalanga
Country	Republic of South Africa

The town of Evander is approximately 6 km east of the activity, specifically the Shondoni Shaft Complex. Table 3.3(b) provides a summary of the activity information in relation to other neighbouring towns/cities.

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Table 3.3(b): Activity in relation to Neighbouring Towns/Cities

Town	Distance from Shondoni Shaft (km)	Direction from Shondoni Shaft Complex
Evander	6 km	East
Kinross	7 km	North-East
Embalenhle	10 km	South-East
Secunda	14 km	South-East
Trichardt	17 km	East
Leandra	18 km	North-West

Shondoni Colliery is located within a region characterised by agricultural activities, coal mining (other Sasol Mines), gold mining activities (Evander Gold Mining) and in close proximity to the Embalenhle Township (see Figure 3.3(b)).

Direct access is gained to the Shondoni Shaft Complex from the R547 whilst the Simunye Shaft Complex is accessed by a tar road that links the R547 and R546. The R547 and R546 roads run in a south-westerly to north-easterly direction to the west and east of the Shondoni Shaft Complex respectively and links up with the R50, R29 and N17 (see Figure 3.3(b)).

The Shondoni Colliery project area is relatively flat, slightly undulating and ranges in elevation between 1500 mamsl and 1700 mamsl (see Figure 3.3(c)). The natural surface topography has been moderately altered as a result of the various anthropogenic and mining activities in the area. Several mine dumps, ash dumps and stockpiles are evident in the greater Shondoni Colliery area.

Shondoni Colliery is located in the northern and middle region of the C12D Quaternary Catchment, with a very small western part at the top extension block, of the activity boundary area, falling within the B11D Quaternary Catchment. The C12D Quaternary Catchment falls within the Vaal River (C) Primary Catchment within the Upper Vaal Water Management Area. The B11D Quaternary Catchment falls within the Olifants River (B) Primary Catchment within the Olifants Water Management Area (Figure 3.3(d) and Figure 3.3(e)).

The Shondoni Colliery project area is drained by the Rolspruit, Grootspruit, Winkelhaakspruit and the Trichardtspruit which joins the Waterval River upstream of the confluence with the upper Kaalspruit (Figure 3.3(c)). The Waterval River eventually drains to the Vaal River upstream of the Vaal Dam, from where the stream flows in a westerly direction to the Vaal Barrage, Bloemhof Dam, eventually joining the Orange River.

A map/plan depicting the boundary of the proposed activity and the associated major infrastructure is shown in Figure 3.3(b). A large-scale version of this map is attached as **APPENDIX 3(B)** to this report.

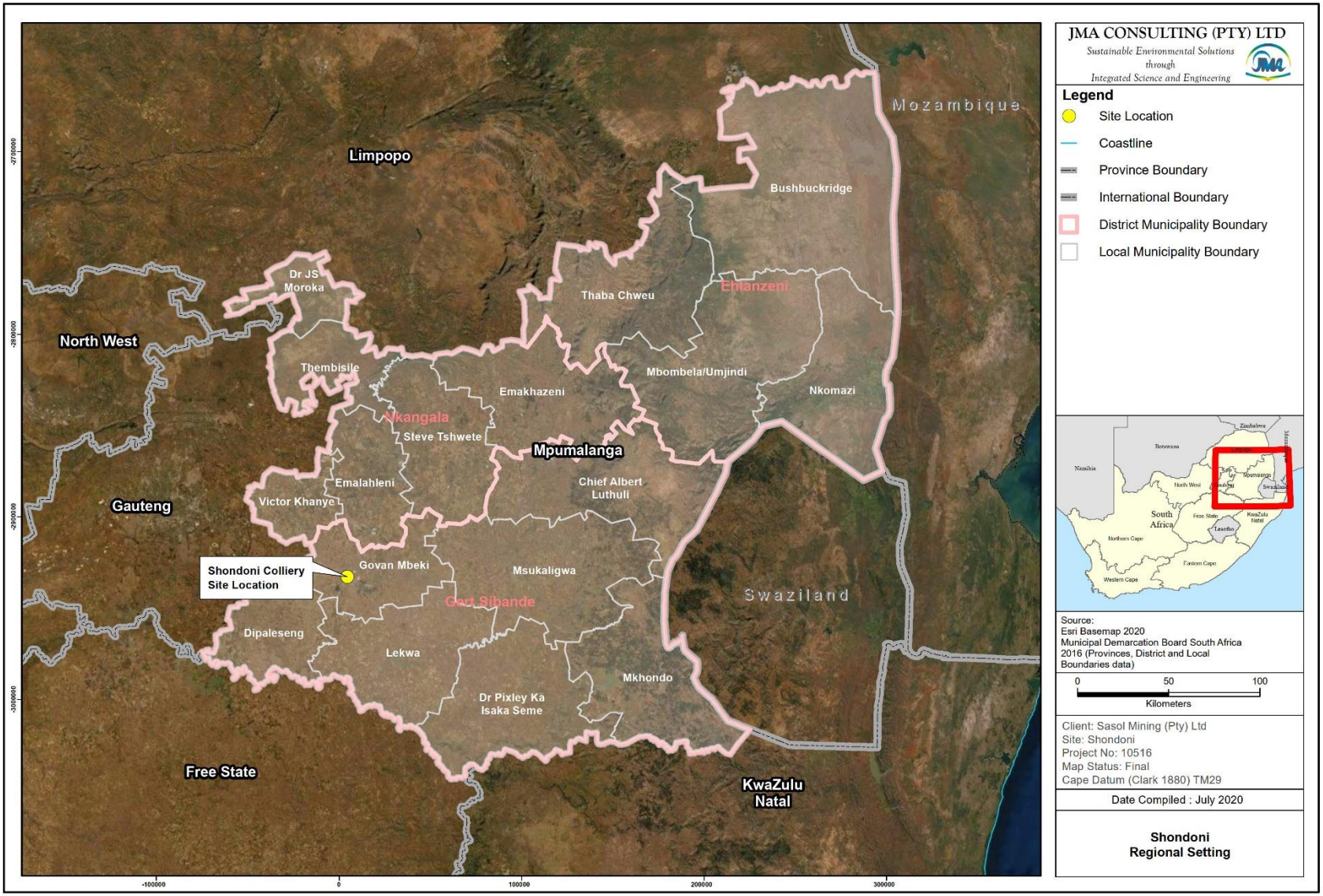

Figure 3.3(a): Regional Setting of Shondoni Colliery

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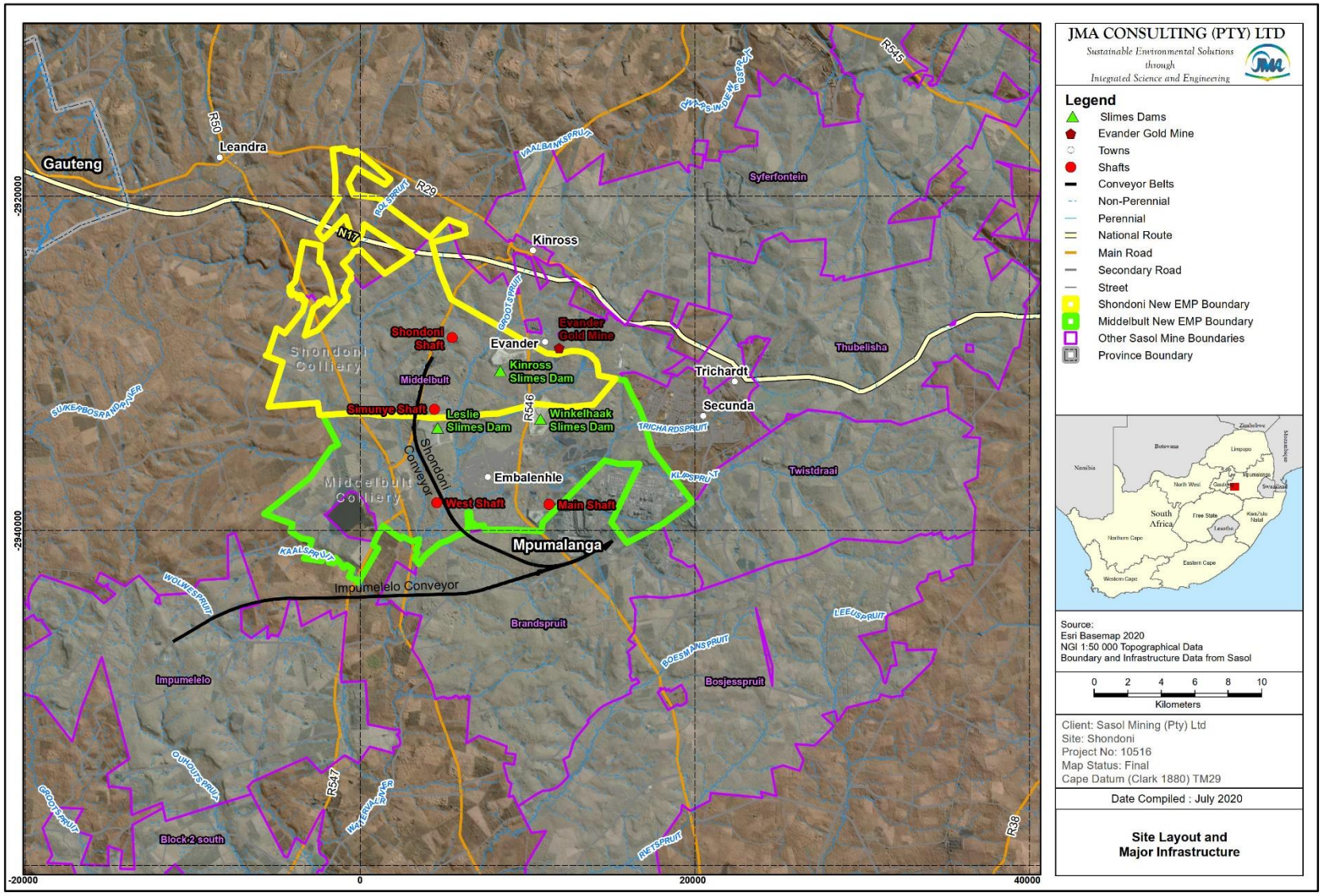

Figure 3.3(b): Site Layout and Major Infrastructure Map in relation to Shondoni Colliery

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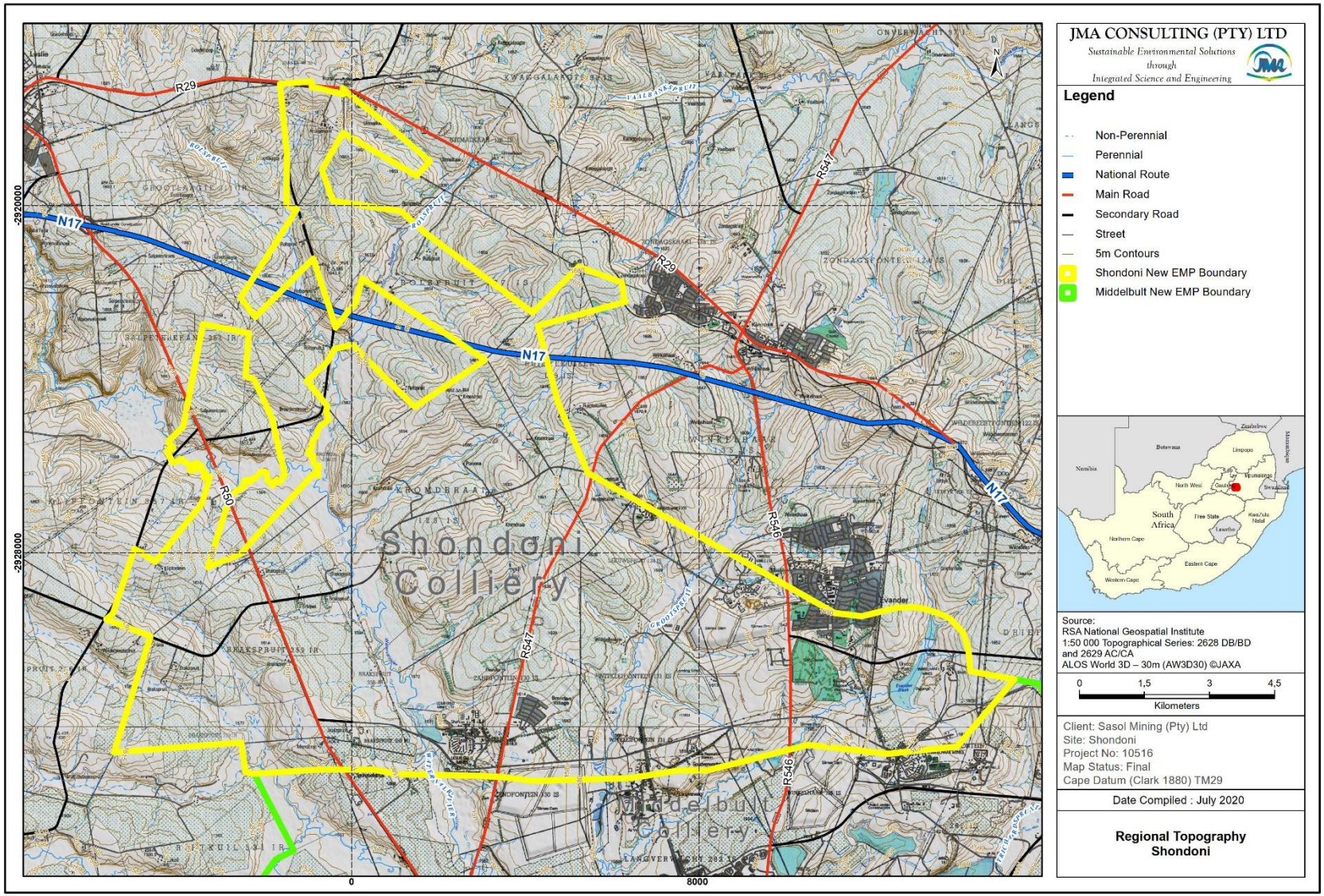

Figure 3.3(c): Regional Topography (Topographical Map 2628 BD/ DB and 2629 AC/CA)

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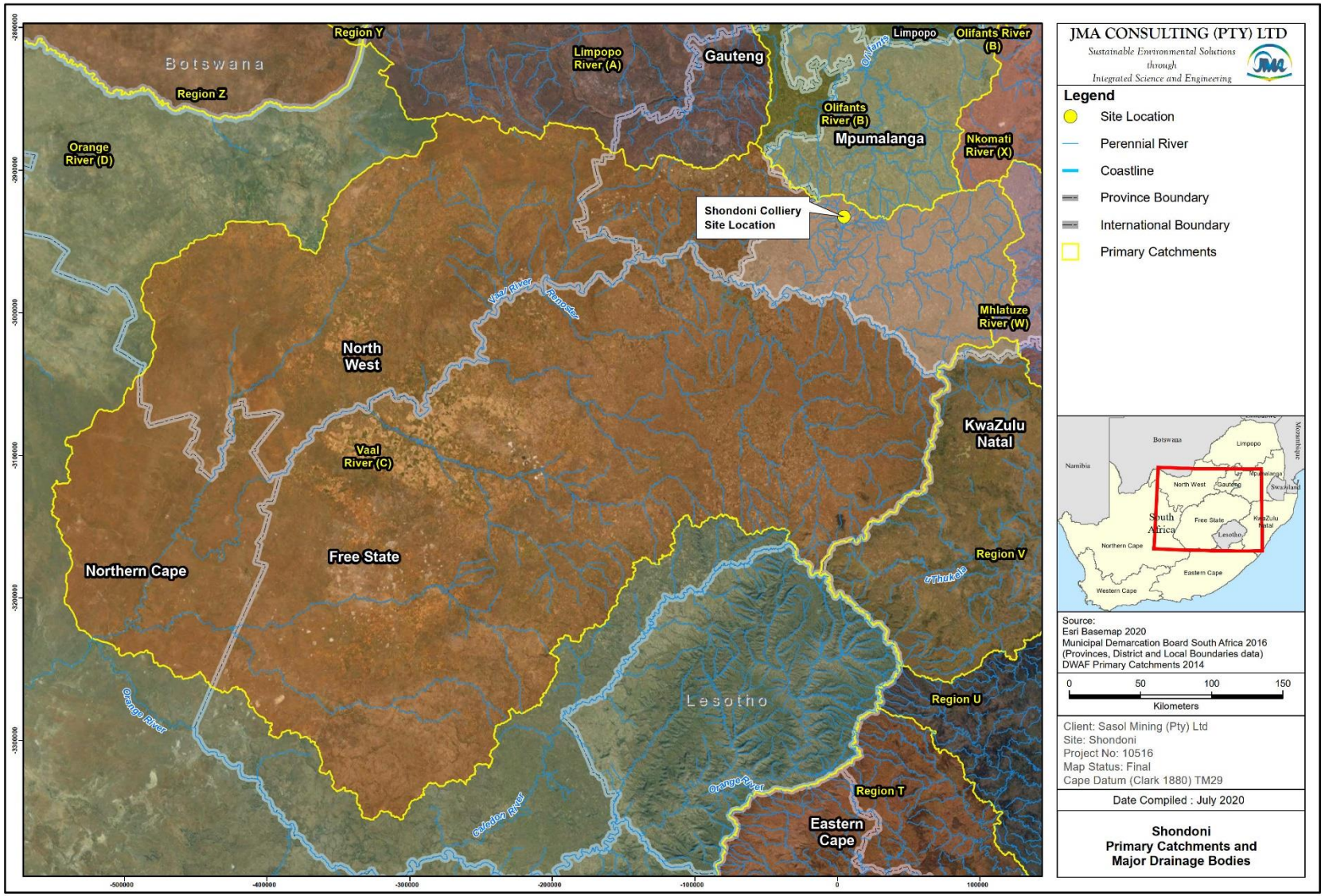

Figure 3.3(d): Primary Catchments and Major Surface Water Drainage Bodies

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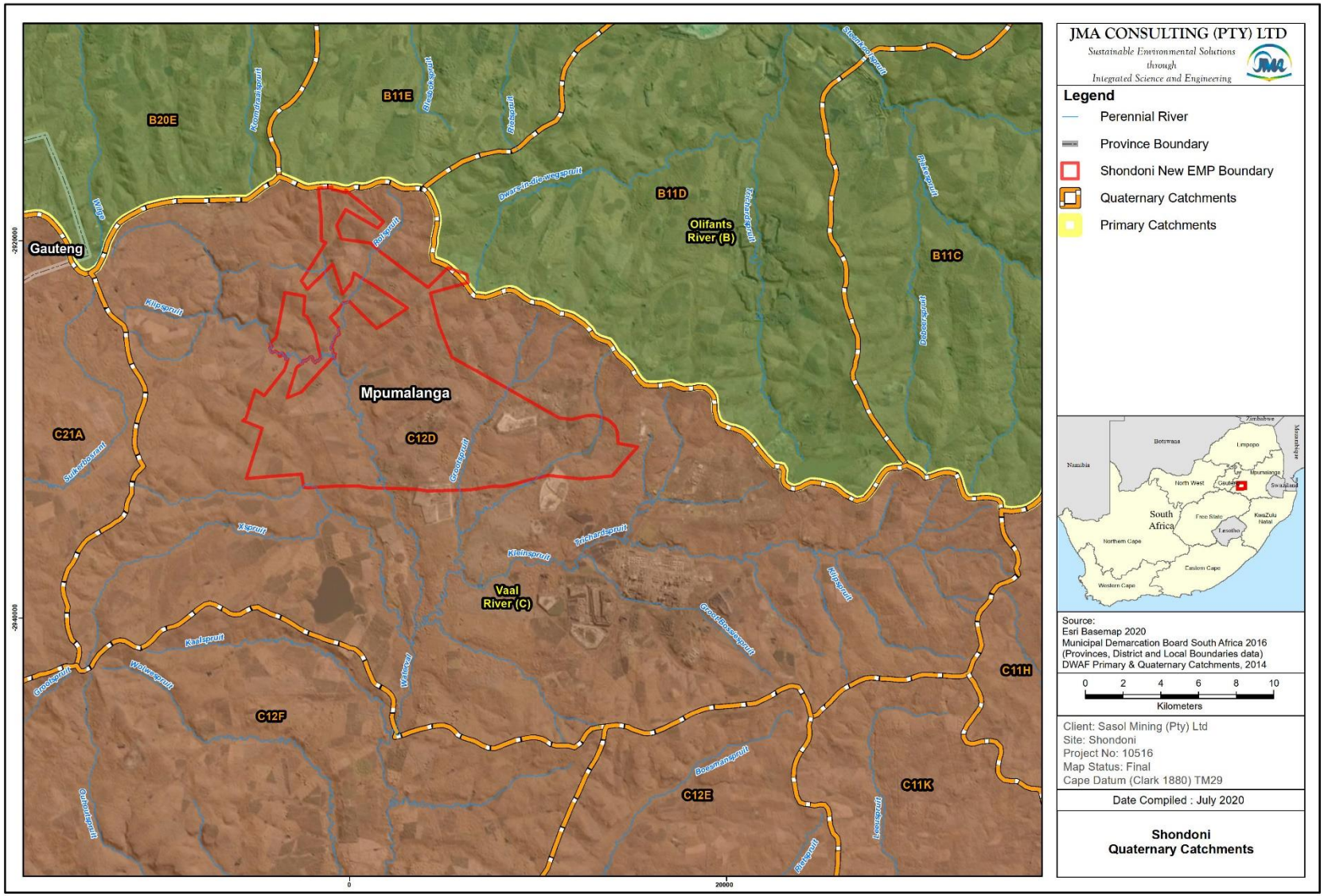

Figure 3.3(e): Delineated Quaternary Catchments

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3.4. DESCRIPTION OF THE PROPERTY

Details pertaining to the farm portions on which the Shondoni Colliery activities, underground mining and associated infrastructure are located are listed in Table 3.4(a). These farm portions are delineated on Figure 3.4(a).

Table 3.4(a): Summary of the Farm Portions associated with Shondoni Colliery

Farm Names	Grootlaagte 311 IR, Uitmalkaar126 IS, Rolspruit 127 IS, Winkelhaak 135 IS, Driefontein 137 IS, Langverwacht 282 IS, Witkleifontein 131 IS, Leeuwspruit 134 IS, Ruigtekuilen 129 IS, Kaufela 815 IS, Goedverwachting 287 IS, Osizweni 575 IS, Zandfontein 130 IS, Kromdraai 128 IS, Salpeterkranz 351, Adullam 577 IS, Klipfontein 357 IR, Grouwwater 353 IR, Brakspruit 359 IR, Rietkuil 531 IR, Springbokdraai 277 IS	
Application Area	14 366.31 ha	
Magisterial District	Highveld Ridge	
Distance and Direction from nearest town	Evander is 6 km east of Shondoni Shaft	
21-digit Surveyor General Code for each Farm Portion	Grootlaagte 311 IR, Portion 9	T0IR00000000031100009
	Grootlaagte 311 IR, Portion 3	T0IR00000000031100003
	Uitmalkaar S126 IS, Portion 6	T0IS00000000012600006
	Rolspruit 127 IS, Portion 3	T0IS00000000012700003
	Rolspruit 127 IS, Portion 4	T0IS00000000012700004
	Rolspruit 127 IS, Portion 5	T0IS00000000012700005
	Rolspruit 127 IS, Portion 18	T0IS00000000012700018
	Rolspruit 127 IS, Portion 13	T0IS00000000012700013
	Rolspruit 127 IS, Portion 14	T0IS00000000012700014
	Rolspruit 127 IS, RE	T0IS00000000012700000
	Rolspruit 127 IS, Portion 22	T0IS00000000012700022
	Rolspruit 127 IS, Portion 1	T0IS00000000012700001
	Rolspruit 127 IS, Portion 8	T0IS00000000012700008
	Winkelhaak 135 IS, Portion 93	T0IS00000000013500093
	Winkelhaak 135 IS, Portion 94	T0IS00000000013500094
	Winkelhaak 135 IS, Portion 84	T0IS00000000013500084
	Winkelhaak 135 IS, Portion 37	T0IS00000000013500037
	Winkelhaak 135 IS, Portion 86	T0IS00000000013500086
	Winkelhaak 135 IS, Portion 56	T0IS00000000013500056
	Winkelhaak 135 IS, Portion R5	T0IS00000000013500005
	Winkelhaak 135 IS, Portion 13	T0IS00000000013500013
	Winkelhaak 135 IS, Portion 133	T0IS00000000013500133
	Winkelhaak 135 IS, Portion 81	T0IS00000000013500081
	Winkelhaak 135 IS, Portion 54	T0IS00000000013500054
	Winkelhaak 135 IS, Portion 163	T0IS00000000013500163
	Winkelhaak 135 IS, Portion 104	T0IS00000000013500104
	Winkelhaak 135 IS, Portion 101	T0IS00000000013500101
	Winkelhaak 135 IS, Portion 107	T0IS00000000013500107
	Winkelhaak 135 IS, Portion 55	T0IS00000000013500055
	Winkelhaak 135 IS, Portion 147	T0IS00000000013500147
	Winkelhaak 135 IS, Portion 134	T0IS00000000013500134
	Winkelhaak 135 IS, Portion 3	T0IS00000000013500003

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21-digit Surveyor General Code for each Farm Portion	Driefontein 137 IS, Portion 6	T0IS00000000013700006
	Driefontein 137 IS, Portion 2	T0IS00000000013700002
	Driefontein 137 IS, Portion 12	T0IS00000000013700012
	Driefontein 137 IS, Portion 23	T0IS00000000013700023
	Driefontein 137 IS, Portion 22	T0IS00000000013700022
	Driefontein 137 IS, Portion 14	T0IS00000000013700014
	Driefontein 137 IS, Portion 97	T0IS00000000013700097
	Driefontein 137 IS, Portion 15	T0IS00000000013700015
	Driefontein 137 IS, Portion 16	T0IS00000000013700016
	Langverwacht 282 IS, Portion 6	T0IS00000000028200006
	Langverwacht 282 IS, Portion 7	T0IS00000000028200007
	Witkleifontein 131 IS, Portion 1	T0IS00000000013100001
	Witkleifontein 131 IS, RE	T0IS00000000013100000
	Witkleifontein 131 IS, Portion 4	T0IS00000000013100004
	Witkleifontein 131 IS, Portion 3	T0IS00000000013100003
	Leeuwspruit 134 IS	T0IS00000000013400000
	Ruigtekuilen 129 IS, RE	T0IS00000000012900000
	Ruigtekuilen 129 IS, Portion 1	T0IS00000000012900001
	Kaufela 815 IS	T0IS00000000081500000
	Goedverwachting 287 IS	T0IS00000000028700000
	Osizweni 575 IS	T0IS00000000057500000
	Zandfontein 130 IS, Portion 8	T0IS00000000013000008
	Zandfontein 130 IS, Portion 2	T0IS00000000013000002
	Zandfontein 130 IS, Portion 3	T0IS00000000013000003
	Zandfontein 130 IS, Portion 19	T0IS00000000013000019
	Zandfontein 130 IS, Portion 25	T0IS00000000013000025
	Zandfontein 130 IS, Portion 11	T0IS00000000013000011
	Zandfontein 130 IS, Portion 12	T0IS00000000013000012
	Zandfontein 130 IS, Portion 5	T0IS00000000013000005
	Zandfontein 130 IS, Portion 21	T0IS00000000013000021
	Zandfontein 130 IS, Portion 6	T0IS00000000013000006
	Zandfontein 130 IS, Portion 4	T0IS00000000013000004
	Kromdraai 128 IS, Portion 8	T0IS00000000012800008
	Kromdraai 128 IS, Portion 21	T0IS00000000012800021
	Kromdraai 128 IS, Portion 19	T0IS00000000012800019
	Kromdraai 128 IS, RE	T0IS00000000012800000
	Kromdraai 128 IS, Portion 12	T0IS00000000012800012
	Kromdraai 128 IS, Portion 4	T0IS00000000012800004
	Kromdraai 128 IS, Portion 3	T0IS00000000012800003
	Kromdraai 128 IS, Portion 1	T0IS00000000012800001
	Kromdraai 128 IS, Portion 10	T0IS00000000012800010
	Kromdraai 128 IS, Portion 2	T0IS00000000012800002
	Kromdraai 128 IS, Portion 9	T0IS00000000012800009
	Kromdraai 128 IS, Portion 13	T0IS00000000012800013
	Kromdraai 128 IS, Portion 17	T0IS00000000012800017
	Kromdraai 128 IS, Portion 18	T0IS00000000012800018

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21-digit Surveyor General Code for each Farm Portion	Salpeterkranz 351 IR, Portion 2	T0IR00000000035100002
	Salpeterkranz 351 IR, Portion 14	T0IR00000000035100014
	Adullam 577 IS	T0IS00000000057700000
	Klipfontein 357 IR, Portion 5	T0IR00000000035700005
	Klipfontein 357 IR, Portion 4	T0IR00000000035700004
	Klipfontein 357 IR, Portion 7	T0IR00000000035700007
	Grouwwater 353 IR, Portion 2	T0IR00000000035300002
	Brakspruit 359 IR, Portion 5	T0IR00000000035900005
	Brakspruit 359 IR, Portion 8	T0IR00000000035900008
	Brakspruit 359 IR, Portion 1	T0IR00000000035900001
	Brakspruit 359 IR, Portion 7	T0IR00000000035900007
	Brakspruit 359 IR, Portion 11	T0IR00000000035900011
	Brakspruit 359 IR, R	T0IR00000000035900000
	Brakspruit 359 IR, Portion 18	T0IR00000000035900018
	Brakspruit 359 IR, Portion 19	T0IR00000000035900019
	Brakspruit 359 IR, Portion 4	T0IR00000000035900004
	Brakspruit 359 IR, Portion 16	T0IR00000000035900016
	Brakspruit 359 IR, Portion 3	T0IR00000000035900003
	Brakspruit 359 IR, Portion 15	T0IR00000000035900015
	Brakspruit 359 IR, Portion 13	T0IR00000000035900013
	Brakspruit 359 IR, Portion 2	T0IR00000000035900002
	Brakspruit 359 IR, Portion 12	T0IR00000000035900012
	Rietkuil 531 IR, Portion 7	T0IR00000000053100007
	Springbokdraai 277 IS, Portion 6	T0IS00000000027700006
	Springbokdraai 277 IS, Portion 1	T0IS00000000027700001

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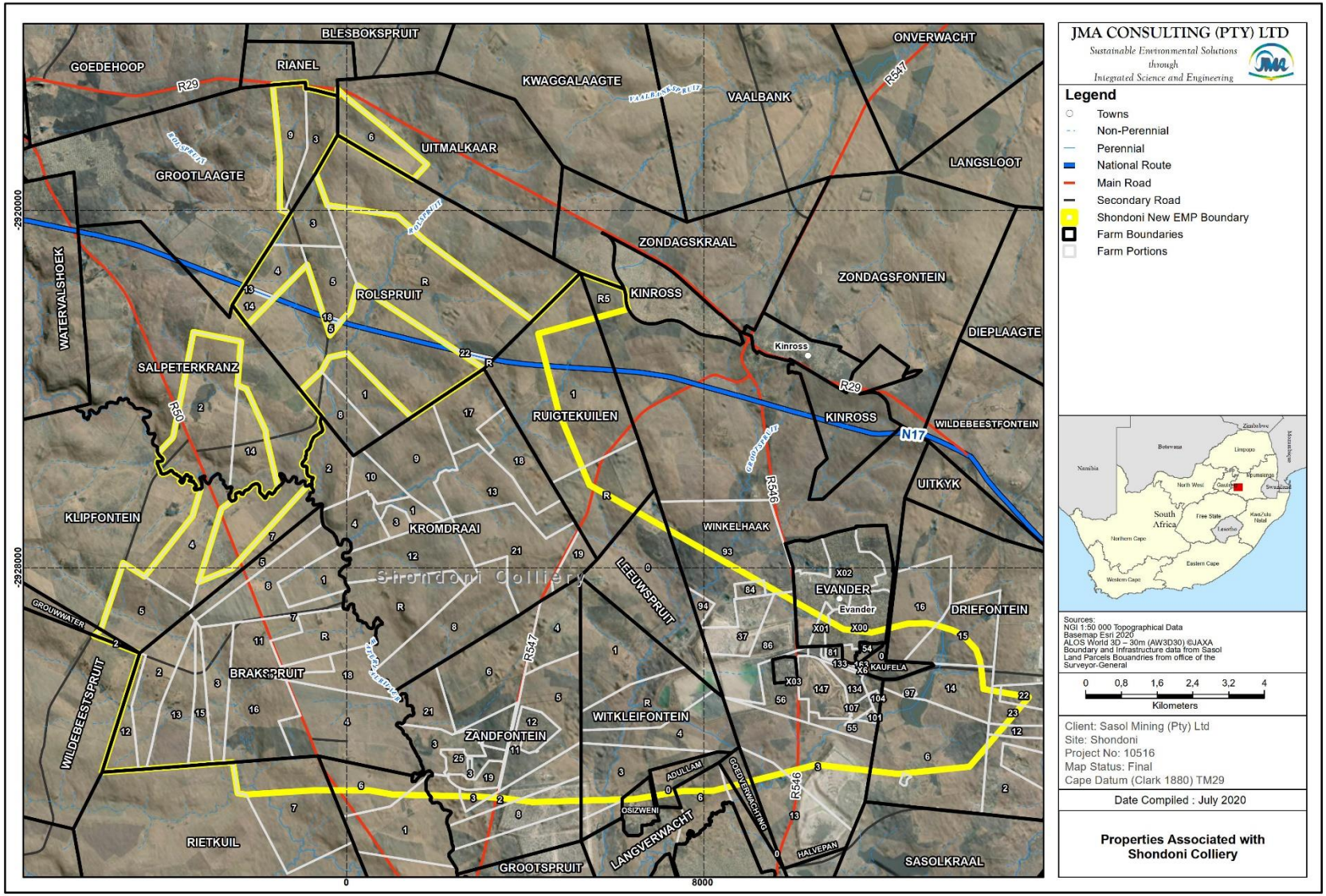

Figure 3.4(a): Properties Associated with Shondoni Colliery

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3.5. DETAILS OF RELEVANT MUNICIPALITY

Details of the Local Municipality and the relevant Contact Person is given in Table 3.5(a) and similarly for the District Municipality in Table 3.5(b).

Table 3.5(a): Summary of the Local Municipality Details and Contact Person

Local Authority	Govan Mbeki Local Municipality
Designation	Speaker
Contact Person	Nhlakanipho Zuma
Email Address	nhlakanipho.z@govanmbeki.gov.za

Table 3.5(b): Summary of the District Municipality and Contact Person

District Authority	Gert Sibande District Municipality
Designation	Head of Communications
Contact Person	Bongi ka Dube
Email Address	bongi@gsibande.gov.za

3.6. DETAILS OF RELEVANT GOVERNMENT AUTHORITIES

3.6.1. National Authorities/Agencies/Institutions

Department of Mineral Resources and Energy (DMRE)

National Department	Department of Mineral Resources and Energy - Head Office - Pretoria
Directorate	Director General
Contact Person	Adv T Mokoena
Postal Address	Private Bag X59, ARCADIA, 0007
Telephone Number	+27 12 444 3880
Email Address	thabo.mokoena@dmre.gov.za

Department of Environment, Forestry and Fisheries (DEFF)

National Department	Department of Environment, Forestry and Fisheries (DEFF) - Head Office - Pretoria
Directorate	Deputy Director-General Chemicals and Waste Management
Contact Person	Mark Gordon
Postal Address	Private Bag X 447, PRETORIA, 0001
Telephone Number	+27 12 399 9759
Email Address	mgordon@environment.gov.za

Department of Water and Sanitation (DWS)

National Department	Department of Water and Sanitation - Head Office - Pretoria
Directorate	Head of Office to Deputy Minister
Contact Person	Thami Bembe
Postal Address	Private Bag X313, PRETORIA, 0001
Telephone Number	+27 12 336 6885
Email Address	BembeT@dws.gov.za

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3.6.2. Provincial/Regional Authorities/Agencies/Institutions

Regional Department of Mineral Resources and Energy (DMRE)

Provincial Department	Mpumalanga - eMalahleni
Directorate	Acting Regional Manager
Contact Person	Ms Mashudu Maduka
Physical Address	Saveways Crescent Centre, Mandela Drive, EMALAHLENI, 1035
Telephone Number	+27 13 653 0500
Facsimile Number	+27 13 690 3288
Email Address	mashudu.maduka@dmre.gov.za

Regional Department of Water and Sanitation (DWS)

Regional Department	Gauteng Region - Pretoria
Water Management Area	Upper Vaal & Olifants
Contact Person	Joyce Lekoane / Khathutshelo Mudau
Postal Address	Private Bag X995, PRETORIA, 0001
Telephone Number	+27 12 392 1381
Cellular Phone	+27 82 600 5669
Email Address	lekoanej@dws.gov.za / MudauK@dws.gov.za

3.6.3. Other Authorities/Agencies/Institutions

South African Heritage Resources Agency (SAHRA)

National Department:	South African Heritage Resources Agency – Head Office - Pretoria
Contact Person	Phillip Hine
Physical Address	Office 101, 1st Floor, Suncardia Mall, 541 Madiba Street, PRETORIA
Telephone Number	+27 12 320 8490
Facsimile Number	+27 12 320 8486
Email Address	PHINE@sahra.org.za

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4. SCOPE OF OVERALL SHONDONI COLLIERY ACTIVITIES

Information used to compile these sections of the report was primarily sourced from existing documentation/ reports such as the Mining Work Programme (MWP), the Social and Labour Plan (SLP) for the Sasol Secunda Mining Complex as well as the Amended EMPr dated January 2011. The information was further supplemented with information provided by the Applicant and the site inventory and site layout which was verified during site inspections conducted on several occasions during 2020.

4.1. SUMMARY OF OVERALL ACTIVITIES

The current overall activities at Shondoni Colliery can be summarised as follows:

- Man and Material Shafts and Ventilation Shafts
- Underground mining of the Block 8 Reserve by means of the bord and pillar method
- Conveyance of coal from the underground sections and storage of coal on surface in the surface bunker
- Conveyance of unprocessed coal by the overland conveyor to the Sasol Coal Supply (SCS) West Stockpile Area
- Water management activities and infrastructure (potable water, service water and storm water management including the relevant pipelines)
- Waste management activities and infrastructure (including the sewage treatment plants)
- Roads, Servitudes, Power lines
- Prospecting Activities
- Rescue Boreholes

The project description provided in sections 4.4 and 4.5 of this report will describe the current activities associated with Shondoni Colliery at the Shondoni and Simunye Shaft Complexes respectively, which have previously been authorised/ approved.

In order to support the increased coal reserve utilisation in the new Block 8 North Reserve Area, four additional ventilation shafts are proposed for the north, north-western region of the Shondoni Colliery EMP boundary area. A brief description of the proposed activities, i.e. underground mining associated with the new Block 8 North Reserve Area as well as the new ventilation shafts is provided in section 4.6 of this report.

4.2. PROJECT RESOURCE ATTRIBUTES

4.2.1. Mineral Deposit

The geology of the area consists of mainly sedimentary and igneous strata of the Witwatersrand, Ventersdorp, and Transvaal Supergroups, as well as igneous rock from the Bushveld Complex, which sub outcrops along the sandstone/siltstone base of the Karoo Supergroup. The base of the Karoo consists of tillite overlain by sandstone and siltstone of the Pietermaritzburg Formation, which is in turn overlain by sediments from the Vryheid Formation. Between the upper sandstone\siltstone layers, several coal seams have developed namely the C2, C3, C4L, C4U and C5 Coal Seams. The coal is of a low-grade bituminous quality occurring in horizontal seams.

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4.2.2. Mineable Seam/ Ore Bodies

Of the coal seams mentioned, only the No. C2 and the No. C4L Coal Seams are mineable within the project area reserves. The average depth to the No. C4L Coal Seam is some 117 m below ground surface. The No. C2 Coal Seam occurs some 20 m – 30 m deeper.

Continuous Miner (CM)'s are used to cut the coal at the mining face of the two coal seams. Approximately 45% of the coal seam is extracted. The coal is loaded automatically onto shuttle cars from which it is loaded onto a conveyor system which runs along the incline shaft to the surface.

No blasting activities take place, except in cases where dolerite structures need to be penetrated to gain access to the coal seams.

4.2.3. Planned Life of Mine/Facility

Underground mining is anticipated to continue up to 2050. Mining activities will continue as long as it remains economically viable to mine these exploitable reserves.

4.2.4. Product Specifications

The coal is of a low-grade bituminous quality.

4.2.5. Product Market

On surface, the Run of Mine (ROM) coal goes directly to the surface bunker from where it is conveyed by the overland conveyor which links up with the southern Impumelelo (Sasol) conveyor. From here it is transported to SCS West stockpiles prior to use as feedstock by the Sasol Synfuels Operations (SSO), Secunda (see Figure 4.2.5(a)).

4.3. PROJECT MOTIVATION

4.3.1. Need for Product

The coal mined at Shondoni Colliery will contribute as feedstock to the SSO. Through the years, significant portions of the areas where coal mining could be conducted economically have been depleted. To sustain a steady supply of suitable quality coal to Sasol's petrochemical facilities, Sasol Mining has embarked on a reserve acquisition project by applying for and acquiring prospecting and mining rights over areas within or adjacent to the Secunda Complex mining right.

4.3.2. Strategic Importance of the Resource/Product

SSO in Secunda arguably represents one of the single most strategic industries in South Africa.

SSO operates the world's only commercial coal-based synthetic fuels manufacturing facility, producing synthesis gas (syngas) through coal gasification and natural gas reforming. Proprietary technology is used to convert syngas into synthetic fuel components, pipeline gas and chemical feedstock for the downstream production of solvents, polymers, comonomers and other chemicals.

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4.3.3. Socio-Economic Benefits

Sasol's annual contribution to the South African gross domestic product amounts to several billions of rand. Annually, Sasol produces approximately 34% of the country's liquid fuel requirements and at least 20% of the country's saleable coal.

Sasol is the largest corporate tax contributor in South Africa through taxes and levies, excluding fuel and employee taxes.

Furthermore, Sasol is committed to social investment, as illustrated in the approved SLP, and invests money in upliftment projects, sports, university bursaries and community skills training.

Therefore, Sasol Mining, a subsidiary of Sasol, contributes significantly to the South African economy and intends on maintaining its contribution as a cornerstone of Sasol South Africa's business sector. It remains paramount for Sasol Mining to ensure sustainable growth in communities, South Africa and the Sasol Company organisation.

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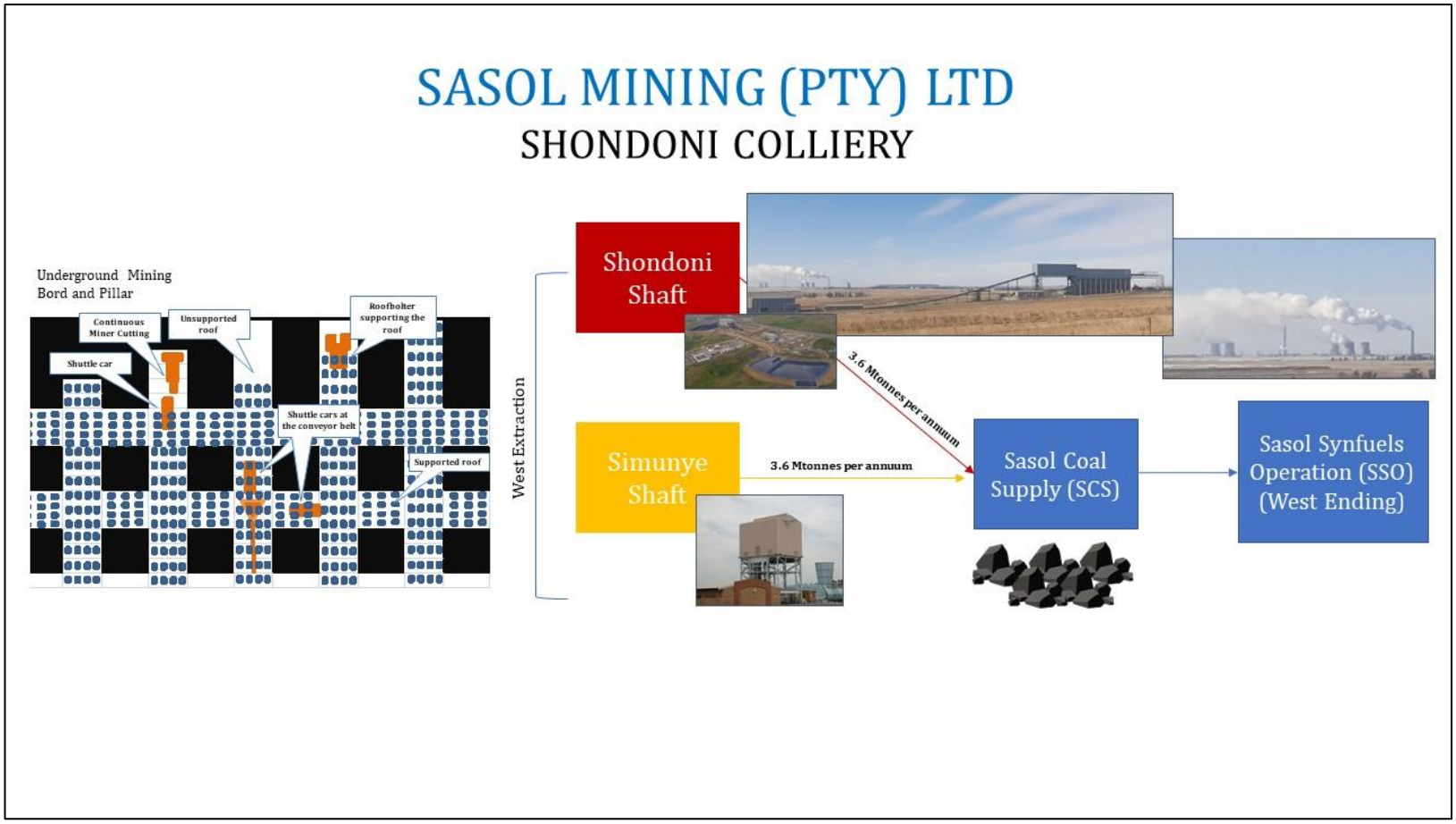

Figure 4.2.5(a): General Process Flow Diagram depicting the Overall Production Operations at Shondoni Colliery

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4.4. SHONDONI SHAFT INFRASTRUCTURE AND PROCESS

A layout map of the infrastructure at the Shondoni Shaft Complex is provided in Figure 4.4(a).

4.4.1. General Site Layout

4.4.1.1. Access Roads

The Shondoni Shaft Complex is accessed along a tar road from the R547 provincial secondary road which connects Kinross and Balfour/ Standerton (refer to Figure 3.3(b)). It can also be accessed from a private tarred road that connects the R580 and the R547.

4.4.1.2. Security Fence and Access

The Shondoni Shaft Complex is located within a fenced secondary security area. Access to the shaft complex is obtained through reporting to the security gate and building.

4.4.1.3. Offices, Workshops and Changehouses

The Shondoni Shaft Complex is a modern building complex, comprising of offices, workshops with wash bays, stores and changehouses (refer to Figure 4.4(a)). The building also makes provision for facilities such as:

- Laundry Room
- Auditorium/ Conference Centre
- Boiler Room
- Lamp Room
- Offices for Union Representatives
- Production and Communication Centre
- Control Room
- Canteen
- First Aid Room
- Facilities for the Proto Teams

4.4.1.4. Internal Roads and Parking Areas

The internal roads and parking areas are fully paved and other open areas within the shaft complex is grassed.

4.4.1.5. Electricity Supply and Substations

The Shondoni Shaft Complex is supplied with Eskom power which is distributed from electrical substations (refer to Figure 4.4(a)). The Shondoni Shaft 11 kV main substation supplies medium voltage to the surface infrastructure, underground mining infrastructure (via the surface infrastructure reticulation system), production sections and stonework sections.

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The surface 11 kV distribution includes the following:

- Bunker Reclaim Conveyor
- Bunker
- Tripper Conveyors
- Incline Conveyors
- Overland Conveyor
- Shondoni Shaft Site Complex

An existing 10 MVA overhead line from the Middelbult Central Mine provides power to the conveyor drives.

4.4.1.6. Fuel and Oil Storage

Fuel and oil storage on surface comprise of one 23 m^3 tank hydraulic fuel, one 46 m^3 tank diesel and two 9 m^3 tanks of multigrade engine oil and industrial gear oil respectively. These tanks are located on a concrete floor and within a bunded area (see Figure 4.4(a)).

4.4.1.7. Gas Storage

Gas is stored on surface at the Gas Store (see Figure 4.4(a)) from where it is taken underground. Types of gas stored include Comethical, Argoshield, Nitrogen, Acetylene and Oxygen.

4.4.1.8. Explosives Off-Load Area

Explosives are delivered to site at the explosives off-load area (see Figure 4.4(a)) from where it is transported underground for when blasting events are necessary. No explosives are stored on surface.

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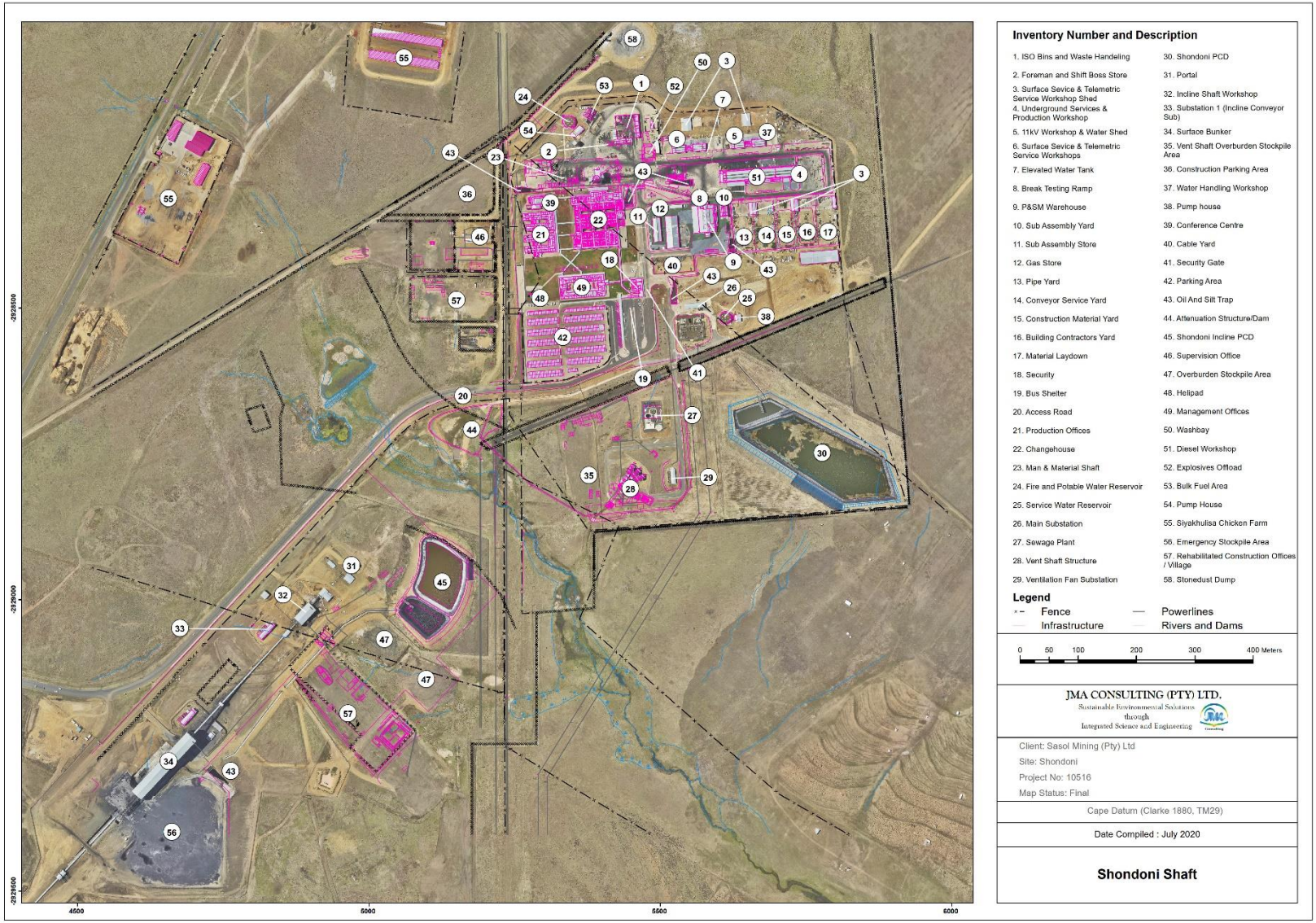

Figure 4.4(a): Shondoni Colliery Site Layout Plan – Shondoni Shaft Complex

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4.4.2. Mining Operation and Infrastructure

4.4.2.1. Underground Mining Method

Underground mining can be done by three major methods:

- Bord and pillar mining, whereby a limited percentage of the coal seam is removed from "bords", whilst "pillars" of coal are left behind in order to support the overlying geological formations. This type of mining ensures a stable overburden and no surface subsidence occurs in mined out areas.
- Increased or high extraction mining, whereby sections of the pillars left behind are removed during retreat from certain mining areas. Depending on subsurface conditions, "quartering" or "halving" of pillars are performed. Although the intention is to maintain overburden and surface stability, instability and eventual surface subsidence can occur if pillar failure occurs with time.
- Total extraction mining, whereby the entire coal seam is removed. This type of mining is done through "long walling" or "short walling" where the entire coal seam thickness is cut from the work face, with controlled collapse of the overlying strata, or else through "stooping" when entire coal pillars are removed during retreat from bord and pillar sections. This type of mining results in instability, mostly also in surface subsidence, both of which cause increased influx of groundwater and surface water into the mine, as well as aquifer dewatering of overlying aquifers.

Currently, the mining method at Shondoni Colliery is bord and pillar mining. The diagram shown in Figure 4.4.2.1(a) represents a cross section through the underground workings indicating vertical (downcast) and incline man and material shafts, vertical ventilation shafts (upcast), as well as the two coal seams to be mined. The surrounding rock material is referred to as overburden and interburden (between the two coal seams).

The ventilation air flow through the workings is illustrated by the blue and red arrows.

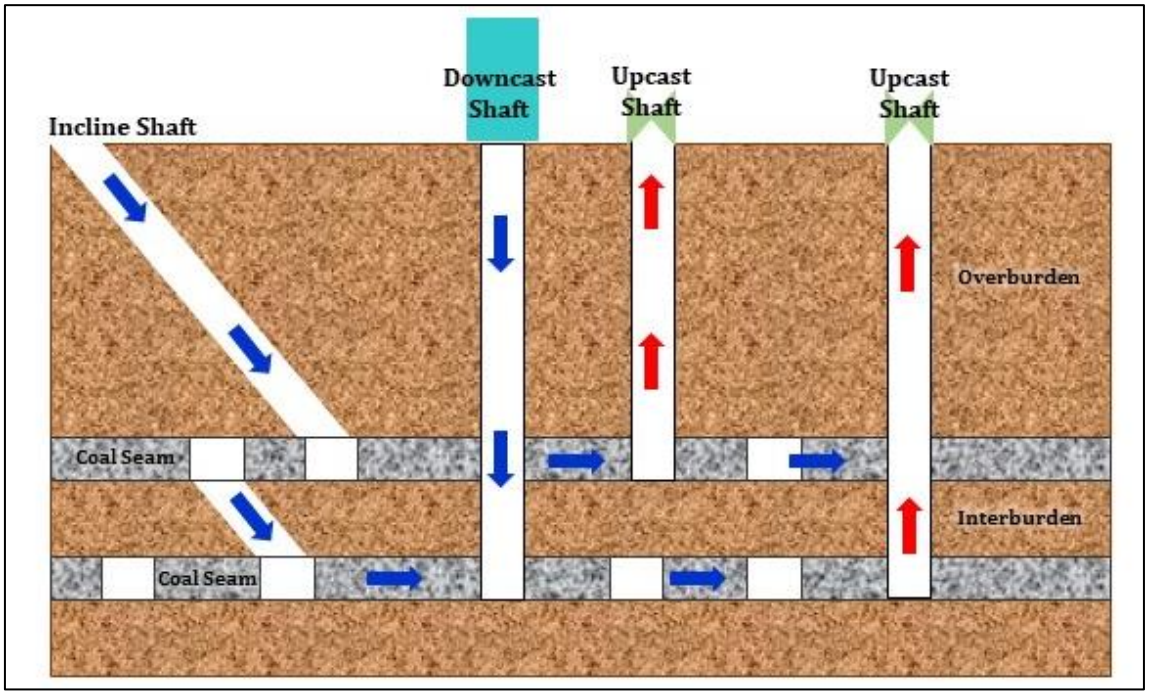

Figure 4.4.2.1(a): Cross Section through Underground Workings

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The diagram shown in Figure 4.4.2.1(b) represents a planned view of the underground workings, portraying the roads, pillars and working faces. The utilisation of stonework to manipulate air flow is also shown.

Important to note is the large mass of coal not extracted during bord and pillar mining, which could motivate the requirement for high extraction mining to optimise extraction of the coal seams in the future.

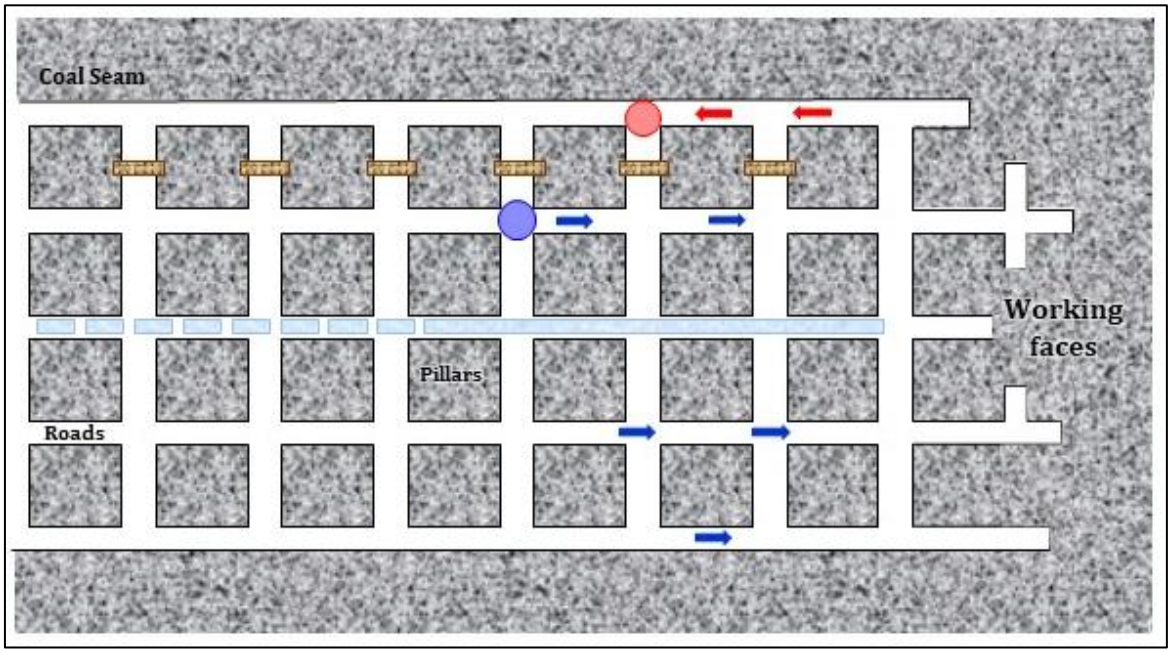

Figure 4.4.2.1(b): Plan View of Underground Workings

4.4.2.2. Underground Mining Equipment

Mining equipment utilised underground comprise of the following items:

- Continuous Miner (CM)
- Shuttle car
- Roofbolter
- Laud Haul Dumper (LHD)
- Tractor and Stoneduster
- Non-flameproof LDV

Stonework sections are used to blast in the areas where there are dykes.

The Shondoni Shaft Complex has conveyors underground that conveys coal from underground sections to the surface bunker. Refer to section 4.4.3.2 of this report for a complete description of the coal conveyance and storage associated with the Shondoni Shaft Complex.

4.4.2.3. Underground Mining Plan

The proposed mine plan and mining schedule for the entire Shondoni Colliery is provided in Figure 4.4.2.3(a).

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4.4.2.4. Man and Material Shaft

The Shondoni man and material shaft (see Figure 4.4(a)) is equipped with a headgear mounted winder and single deck cage suitable for transporting 200 people as well as a fully assembled 20 tonne shuttle cars. This payload further allows for a CM to be transported underground.

A decline shaft, at an inclination of 12º houses two conveyors, running parallel to each other which serve as the primary materials handling connection from the underground bunker to the surface, and also as a second airway intake.

Apart for a 50 mm water column (for firefighting and dust suppression) and a lighting cable, no other services are provided in the decline. The decline also serves as a secondary personnel escape way.

Water seepage in the shaft is directed to the sump at the bottom of the shaft.

Other than people, equipment and material no other services utilises the Shondoni man and materials shaft.

4.4.2.5. Ventilation Shaft

Ventilation shafts are required to ventilate the underground mine workings.

At the Shondoni Shaft Complex, a 9.0 m diameter upcast ventilation shaft (see Figure 4.4(a)) is provided which is fitted with three main fans installed on surface. The three main fans are installed in a tri-furcation arrangement.

A photograph of a typical ventilation shaft surface infrastructure is shown in Figure 4.4.2.5(a).

Figure 4.4.2.5(a): Typical Ventilation Shaft Surface Infrastructure

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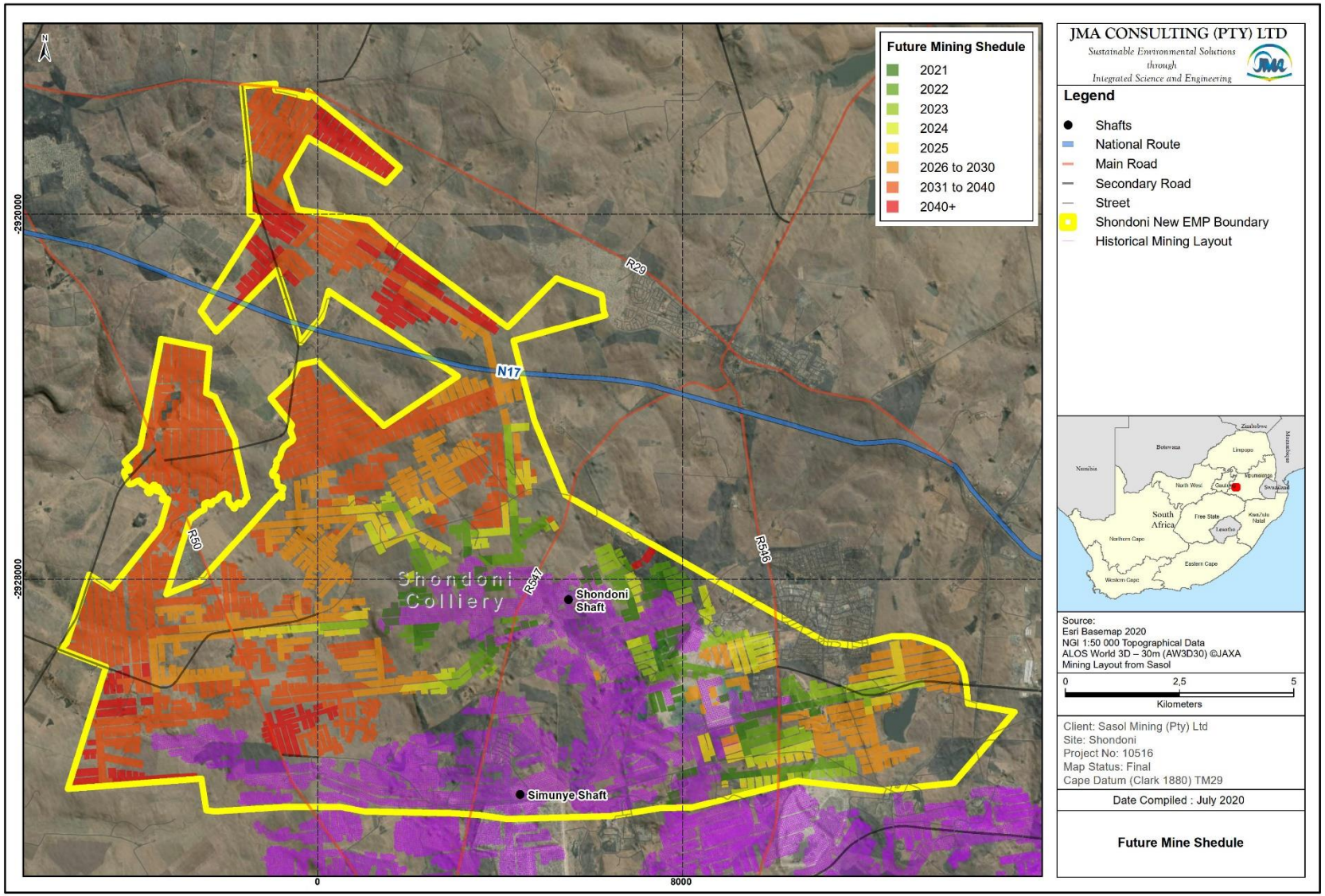

Figure 4.4.2.3(a): Proposed Mine Plan and Mining Schedule at Shondoni Colliery

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4.4.3. Mine Materials Stockpiles

4.4.3.1. Topsoil/ Overburden (Waste Rock) Stockpiles

Soils removed during the topsoil stripping prior to construction was stockpiled, whilst rock overburden material removed during shaft sinking was used to construct perimeter berms in the shaft area and storm water flow management berms. Once the berms were constructed, the stockpiled soils were used to cover all berms and level areas prior to re-vegetation.

Excess overburden and soils have been stockpiled separately for later use during the decommissioning, closure and rehabilitation of the shaft. The overburden stockpile has been shaped to be free draining, covered with topsoil and re-vegetated to minimise infiltration, thus effectively minimising the potential for the formation of contaminated leachates.

Borrow pits used during the construction phase were recently rehabilitated by sloping the sides to 1:3, making the borrow pits free draining and hydroseeding the area.

4.4.3.2. Coal Storage and Conveyance

Coal removed from underground is stored in silos located at the surface bunker which feeds the overland conveyor system (see Figure 4.4(a)). Coal is not processed on site but is conveyed by overland conveyor to the SCS West stockpiles. The surface bunker is covered with an appropriate barrier system to prevent potential contamination of groundwater.

The overland conveyor receives material from the reclaim conveyor and travels approximately 15 km before discharging coal onto an existing overland conveyor that runs to the SCS.

To prevent carry back spillage along the conveyor route, belt turnovers are used, with one at the head-end and one at the tail-end. Belt turnovers ensure the dirty side of the belt is facing up for both top and bottom strands of the conveyor, such that residual material does not fall off the belt as it passes over idlers.

Dust suppression sprays are used at the transfer chute, and all scrapings from the discharge pulley are directed into the surge bin. A surge bin is located at the discharge point of the overland conveyor, prior to feeding on to the SCS conveyor system. The bin has a nominal capacity of 2 000 tonnes to allow for clearing of the overland conveyor system. The bin is made of steel, lined at the discharge cone and other high-wear areas. The presence of a surge bin with sufficient volume is to permit emptying of the overland conveyors and so adds flexibility to undertake maintenance that requires movement of the conveyors during prolonged outages at SCS.

The overland conveyor is located within a fenced servitude. The servitude is also used as far as possible for water reticulation (i.e. pipelines) as well as for electricity distribution (i.e. overhead power lines). The servitude has a service road within the security fence and access to the servitude is restricted via dedicated access gates. No access onto neighbouring properties along the conveyor servitude is allowed. Stream crossings of the infrastructure have been authorised in the WUL (WUL 08/C12D/ACFGIJ/2027).

The conveyor system is covered, and critical sections are fitted with special low noise rollers to minimise noise. Access across and underneath the servitude is provided to landowners. The access crossings are specifically designed according to the individual requirements of the relevant property owner.

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4.4.3.3. Emergency Throw-Out Area and Stockpile

An emergency throw-out area is located at the downstream end of the surface bunker. Coal is stored here during periods when the overland conveyor is not running. The coal is then stockpiled at the emergency coal stockpile area located at the tail-end of the reclaim conveyor. Front end loaders are used to reclaim the ROM coal and feed it back into the reclaim conveyor for conveyance to SCS. The capacity of the emergency coal stockpile is 15 000 tonnes. The emergency throw-out area has a 300 mm thick protection layer of compacted G6-material (compacted to 93%) on top of the lining and subgrade and fill layers , draining diagonally into the silt trap adjacent to the throw-out area (see Figure 4.4(a)).

4.4.3.4. Stonedust Dump

Stonedust is delivered to the shaft complex and stockpiled (see Figure 4.4(a)) before it is transported underground. Stonedust is applied on the mined-out areas underground to prevent methane accumulation.

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4.4.4. Water Management

A schematic presentation of the water reticulation at the Shondoni Shaft Complex is provided in Figure 4.4.4(a). Water management generally comprise of the following:

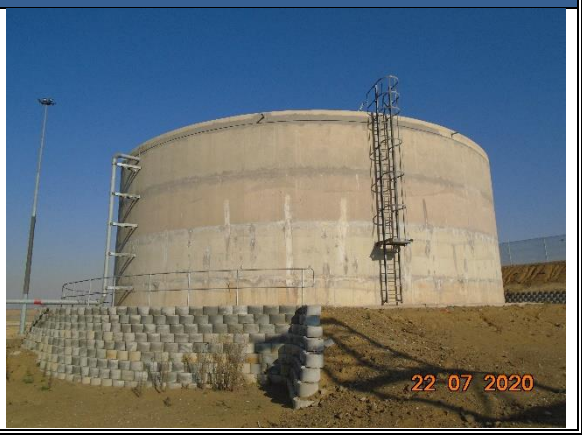
- Potable Water Supply and Storage
- Service Water Management and Storage
- Storm Water Management
- Underground/ Mine Water Management and Storage
- Water and Salt Balance

4.4.4.1. Potable Water Supply and Storage

Potable water is provided by Rand Water (municipal supply) to the Shondoni Shaft Complex. The water is received via pipeline and stored in a potable water reservoir. Potable water is supplied to the office block, workshops and wash bay area via the header tank.

Potable water is also used in the fire hydrants and watering of the garden around the office buildings.

Table 4.4.4.1(a): Details of the Potable Water Reservoir

Potable Water Reservoir		
Central Coordinates	26°27'57.95"S 29°03'11.85"E	
Storage Capacity	+/- 1900 m^3	

4.4.4.2. Service Water Supply and Storage

Service water requirements are sourced from the underground water make (i.e. water accumulating underground) as well as from contaminated storm water captured and contained in the Pollution Control Dams (PCD) on surface at the Shondoni Shaft Complex.

The Shondoni Shaft service water is recycled from the two PCD's (the Shondoni PCD and the Shondoni Incline PCD) via the surface service water reservoir, to the underground mining operations.

The Shondoni PCD is designed to collect dirty storm water from the shaft area and mine water from the underground operations. The PCD is divided into two separate sections which include an area where the water is allowed to settle and an evaporation section which provides the necessary capacity for flood events. This dam is lined and has been designed to contain a 1:100 year flood event.

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Currently, water in the Shondoni PCD is not being reused into the mining operations as the pipelines to transport the water underground has not yet been constructed. The water from underground operations is pumped from the underground settling dam to the surface service water reservoir from where it will then be pumped to the various areas around the mine which requires service water.

If the water level in the underground dam becomes too low water will then be pumped from the Incline PCD to the underground dam for use by the CM's and other machinery in the underground workings. This process ensures an effective water reticulation system and prevents unnecessary water loss.

The Incline PCD has been constructed near the incline shaft and conveyer belt. The primary purpose of this dam is to collect all dirty water from the incline shaft, conveyer belt and emergency throw-out coal storage area. This dam is lined and has been designed to contain a 1:100 year flood event. The Incline PCD is divided into two separate sections which include an area where the water is allowed to settle and an evaporation section.

Water in the evaporation section must be operated to ensure a free board of 0.8 m is always applicable. This will ensure that there is enough pressure to pump water underground for mining purposes as well as enough capacity available, should heavy rainfall occur, to prevent overflow into the environment.

The water contained in this dam is utilised for dust suppression within the designated areas and more specifically to wet the coal when it is brought up from the underground workings and to clean the conveyer belt. Should the Incline PCD become too full or additional water is required underground, water can be pumped from the Incline PCD to the Shondoni PCD or to the underground workings.

A leak detection system is located downstream of the Shondoni and Incline PCD's which is utilised to ensure no leakages occur from these dams. Should a leak be detected the necessary measures will be taken to ensure the liner of the dams is repaired.

The surface PCD's are specifically constructed facilities as they contain affected (contaminated) storm water and are authorised in terms of an NWA section 21(g) water use.

The Shondoni Shaft PCD has a capacity of 80 000 m^3 while the Incline Shaft PCD has a capacity of 35 000 m^3.

The total amount of service water (mine water) used underground for the cooling of machines and dust suppression in 2019 was 60 000 m^3 per annuum.

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Table 4.4.4.2(a): Details of the Service Water Reservoir

Surface Water Reservoir		
Central Coordinates	26°28'08.89"S 29°03'21.47"E	
Storage Capacity	+/- 1700 m^3	

Table 4.4.4.2(b): Details of the Shondoni PCD

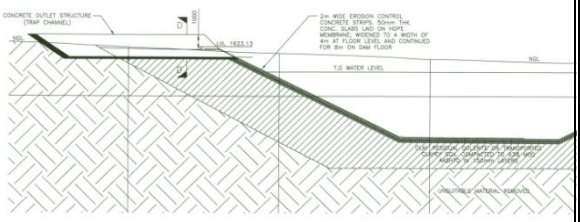
Shondoni PCD		
Central Coordinates	26°28'16.39"S 29°03'26.89"E	
Footprint Area	+/- 2.55 ha	
Crest Length	+/- 732 m	
Max Wall Height	5 m	
Freeboard	0.8 m	
Dam Storage Capacity	80 000 m^3	
Wall Type	Clayed dolerite compacted to 93 %	
Liner Type	Composite Liner/ HDPE Membrane liner	

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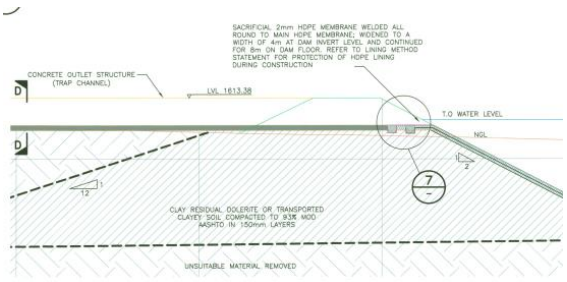
Table 4.4.4.2(c): Details of the Shondoni Incline PCD

Shondoni Incline PCD		
Central Coordinates	26°28'23.21"S 29°03'03.93"E	
Footprint Area	+/- 1.60 ha	
Crest Length	+/- 475 m	
Max Wall Height	5 m	
Freeboard	0.8 m	
Dam Storage Capacity	35 000 m³	
Wall Type	Clayed dolerite compacted to 93 %	
Liner Type	Composite Liner/ HDPE Membrane liner	

4.4.4.3. Storm Water Management System

Storm water management at the Shondoni Shaft Complex was designed and implemented in accordance with the requirements of the Regulations on the Use of Water for Mining and Related Activities aimed at the Protection of Water Resources, 1999 (GN 704 of 04 June 1999) promulgated under the NWA. Storm water management infrastructure includes berms and canals to separate and convey clean and dirty water, as well as two storm water PCD's, one located on either side of the tributary of the Grootspruit that runs in a north-west by south-east direction between the main shaft complex and the exit of the incline shaft and surface bunker.

Clean water is diverted around and off the site whilst dirty water from the shaft area is captured in a number of silt traps which dispose of the water to the Shondoni PCD. The natural topography was used to separate the clean and dirty storm water at the shaft. Buildings, general offices, management offices and parking areas are all located on the south eastern slope. Runoff from this area is considered to be clean. The clean runoff is allowed to drain to the existing stream located south of this slope via an attenuation structure (referred to as the attenuation dam) that was requested by the Department of Water and Sanitation (DWS).

DWS requested that an attenuation structure be constructed in order to control the volume and velocity of the water from the catchment to prevent erosion of the watercourse downstream of the shaft complex.

All the potentially dirty areas, such as the diesel workshop, oil stores and other buildings with the possibility to contaminate the storm water is situated on the north eastern slope. This entire area is curbed and bunded to channel all the storm water into the Shondoni PCD.

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The incline shaft, coal bunker and emergency stockpile are located on the southern banks of the watercourse which runs between the main shaft infrastructure and the exit of the incline shaft. Clean runoff from upslope areas is diverted around the dirty areas by means of berms and canals. Dirty runoff from the area is collected in the dirty storm water canals and pass through the silt trap before it reaches the Incline Shaft PCD.

In terms of the requirements of GN 704 of the NWA, polluted storm water runoff must be contained in specially constructed PCD's and may not be discharged into any water resource without the necessary water authorisation. The water in the PCD's (the Shondoni PCD and Incline PCD) is reused on the mine for dust suppression or for mining activities or pumped back underground for storage.

Table 4.4.4.3(a): Details of the Attenuation Structure/ Dam

Attenuation Structure/ Dam		
Central Coordinates	26°28'15.09"S 29°03'04.81"E	
Footprint Area	+/- 0.62 ha	
Crest Length	+/- 256 m	
Dam Storage Capacity	Attenuation structure/ dam not used for storing of water, but for reducing the velocity of storm water	
Wall Type	Earth Fill and Bidim & Gabion Mattress	
Liner Type	No liner	

4.4.4.4. Underground/ Mine Water Management

The general mining sequence is planned to unlock underground storage capacity for water found underground in the sense that the deeper sections of the coal seams are mined first. This results in storage being created for underground water behind the CM's on the coal seam elevation. The result of this mining philosophy is that water found underground flows under gravity into storage sections, referred to as underground water compartments.

Refer to Figure 4.4.4.4(a) illustrating the current underground mine water compartments already being used for water storage as well as future mine compartments that could be used for the same purpose.

For the biggest part of the operational mining phase, water found underground is therefore only pumped to surface if underground service water demand outstrips the supply sourced from the storm water PCD's located on surface. Underground water is being pumped to surface to create a favourable pressure head and for the safe continuation of the underground mining.

4.4.4.5. Water and Salt Balance

Golder Associates Africa (Pty) Ltd was appointed to compile a water and salt balance model for Shondoni Colliery (which currently only comprise of the Shondoni Shaft Complex). The main aim of the model is to produce a site-wide water and salt balance in accordance with the DWS requirements.

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Additional features added to the model allow the user to simulate various scenarios and assist with water management planning on site. The model was developed in GoldSim. Input data is updated on an Excel Spreadsheet.

The site-wide water and salt balance required by DWS is exported from GoldSim to an Excel Output sheet.

The model can also be used to track the following information:

- Water used;
- Water stored;
- Water abstracted;
- Water supplied; and
- Water released.

Simulating current or long-term scenarios and assessing:

- Water storage availability reflecting changes in rainfall and abstraction rates; and
- Water availability for mine water uses.

The current water balance is presented in Figure 4.4.4.5(a) and salt balance in Figure 4.4.4.5(b).

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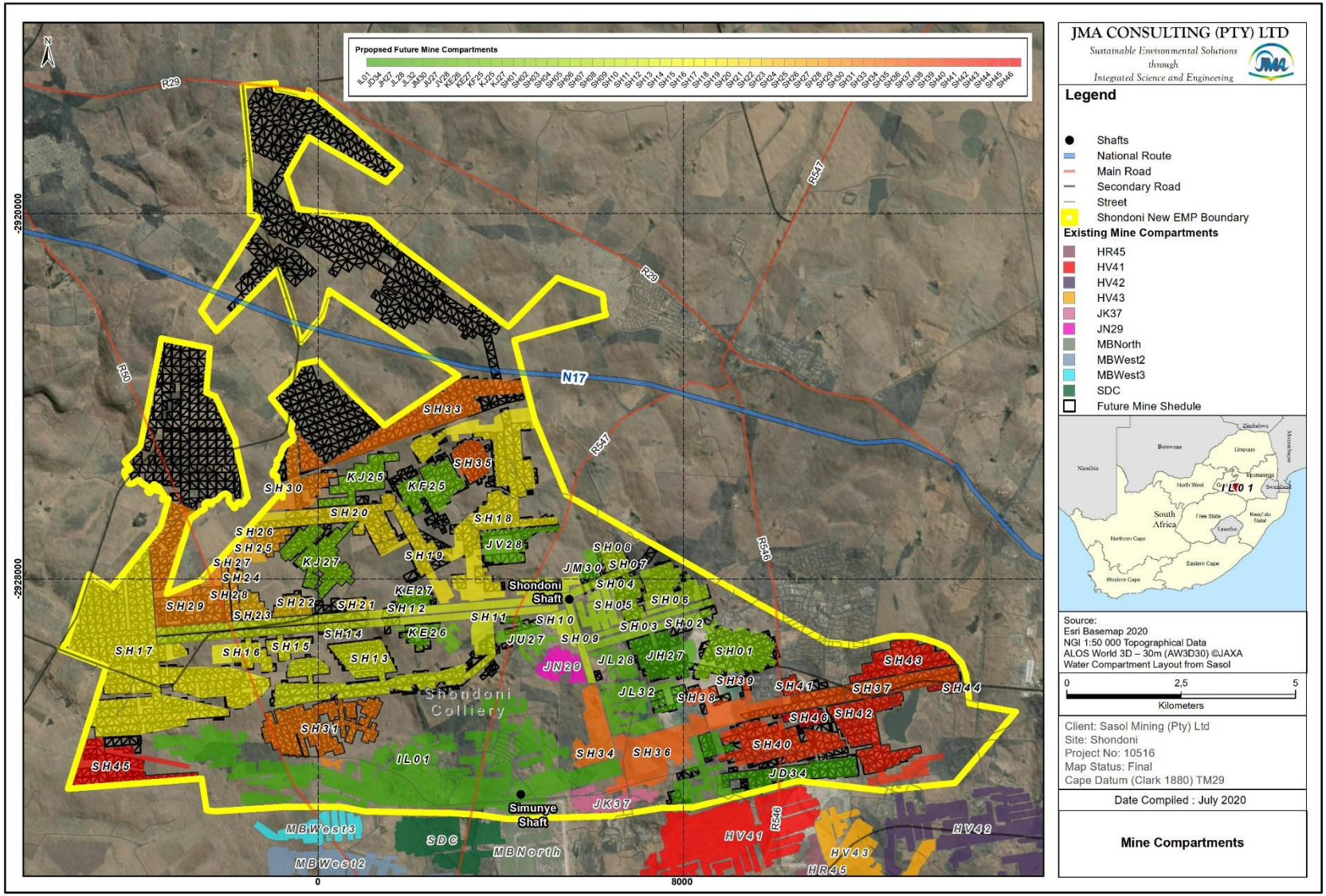

Figure 4.4.4.4(a): Mine Compartments (current and future) associated with Shondoni Colliery

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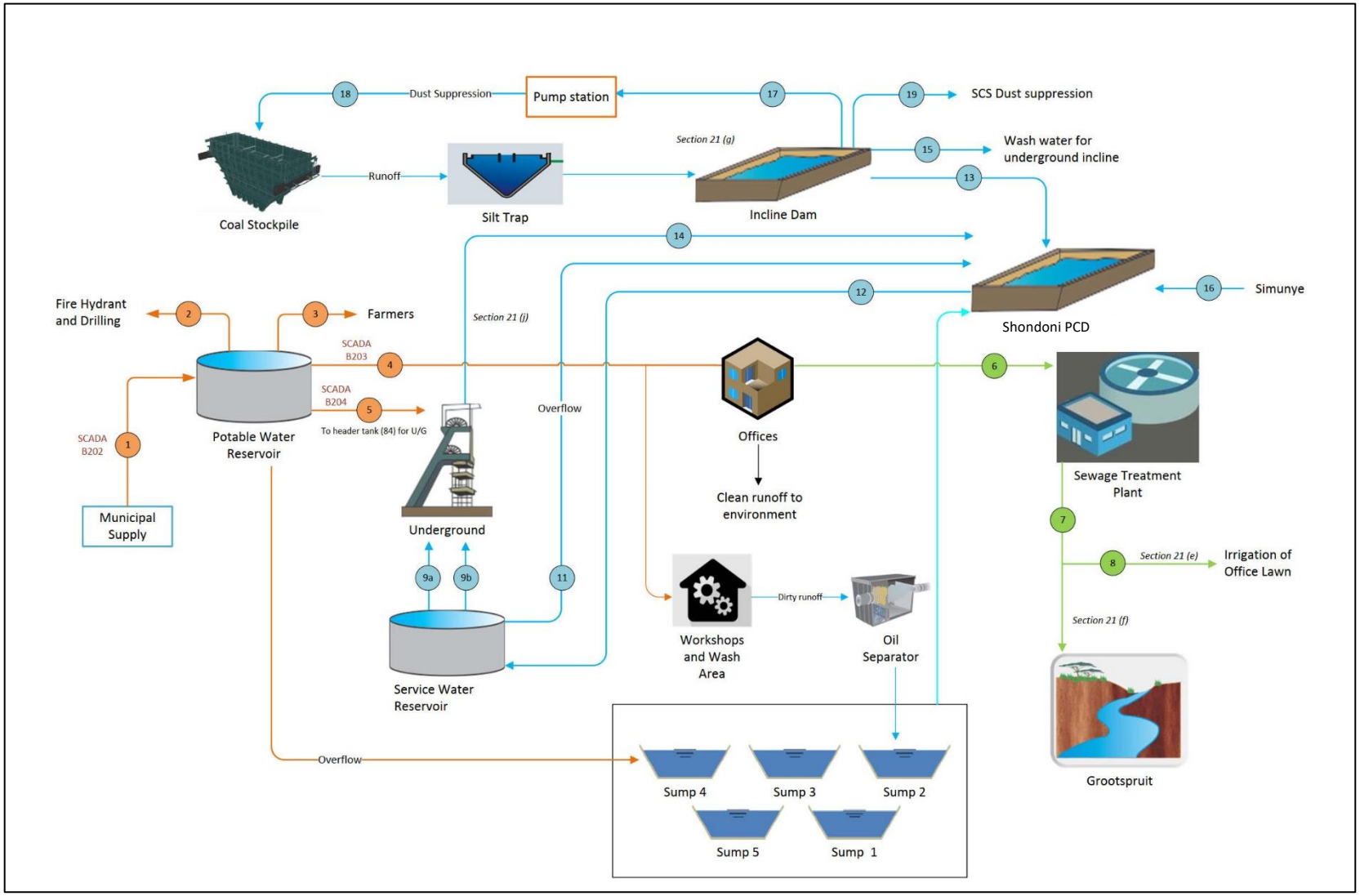

Figure 4.4.4(a): Water Reticulation at the Shondoni Shaft Complex

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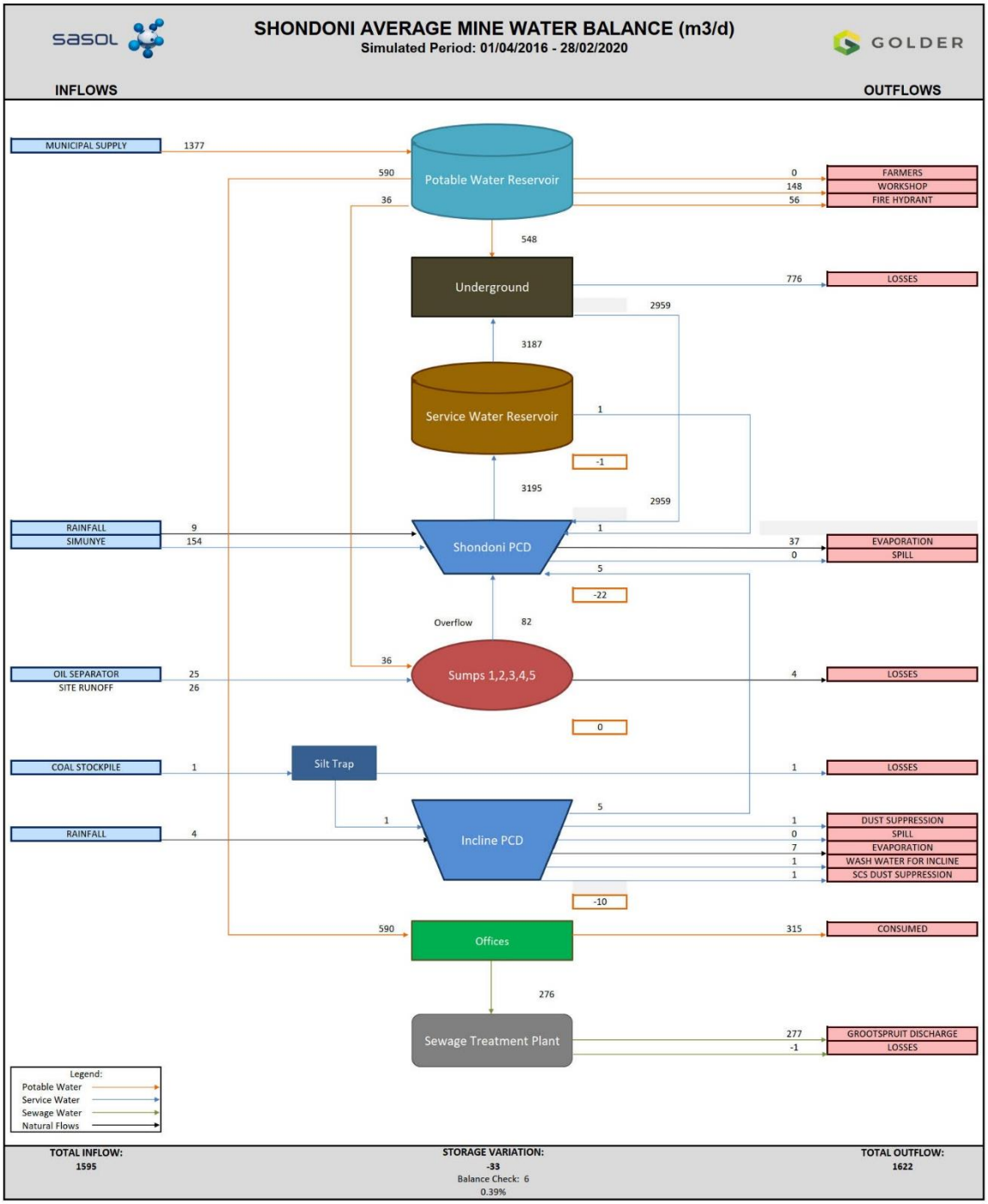

Figure 4.4.4.5(a): Average Water Balance for Shondoni Shaft Complex (simulated period April 2014 – February 2020)

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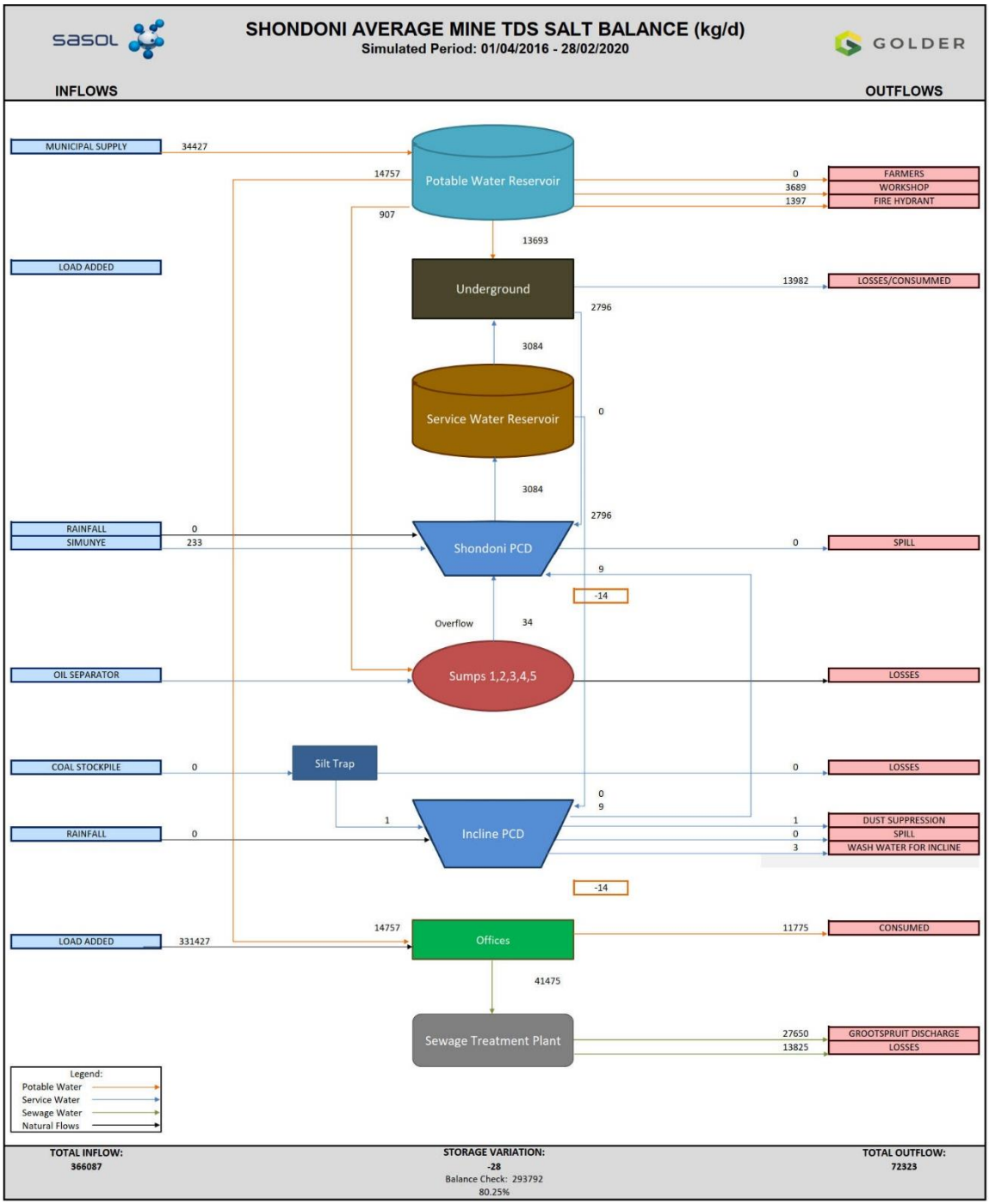

Figure 4.4.4.5(a): Average Salt Balance for Shondoni Shaft Complex (simulated period April 2014 – February 2020)

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4.4.5. Waste Management

The following waste management activities will be discussed under this heading:

- Mining Residue Disposal
- Sewage Treatment Plant
- General Waste Disposal
- Hazardous Waste Disposal

4.4.5.1. Mining Residue Disposal

During the construction phase of the Shondoni Shaft Complex, overburden material that was excavated from the shaft was used for berm walls and embankments at the shaft complex. These berms and embankments were covered with topsoil and vegetated.

Coal is not processed at the Shondoni Shaft Complex therefore no mining waste such as discard, or coal fines slurry are generated.

4.4.5.2. Sewage Treatment Plant

A modular batch type plant at the Shondoni Shaft Complex treats all the sewage generated at the shaft complex area.

The Sewage Treatment Plant (STP) comprise of the following:

- An inlet works;
- Batch reactor where the sewage is treated using biological organisms in an aerated tank;
- Treated effluent will be discharged to a chlorine contact;
- Treated effluent is discharged to a Tributary of the Grootspruit; and
- Sludge drying beds. Sludge is dried prior to disposal to a skip which is removed by a registered Waste Contractor and disposed to an approved licenced landfill site.

The STP is designed to treat 200 m^3 sewage per day as per the DWS General Standard. The treated effluent which accrues from domestic use is licenced to be discharged as a point source discharge into the stream running between the Shondoni Vertical and Incline Shafts, i.e. a Tributary of the Grootspruit. It is now proposed that this treated effluent be used for the irrigation of the gardens around the shaft complex (40 000 m^2) and Shondoni Colliery will apply accordingly to have this authorised in the WUL to be amended for Shondoni Colliery.

4.4.5.3. General Waste Disposal

General, domestic and small volumes of industrial waste are separated and stored temporarily at the ISO Yard (see Figure 4.4(a)) in bins within dedicated concrete lined and bunded structures, for removal off-site by licenced waste management contractors.

The following are examples of domestic waste associated with the shaft complex:

- Garden waste
- Office paper waste
- Cardboard boxes
- Plastics
- Glass waste
- Polyvinyl chloride (PVC) plastic waste

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- Wood waste
- PVC plastic waste
- Clean rags
- Redundant furniture

The following are examples of industrial waste associated with the shaft complex:

- Picks
- Conveyor belts (more than 2 m)
- Conveyor belts (less than 2 m)
- Clean Personal Protective Equipment (PPE) (uncontaminated)
- Scrap steel waste
- Rubber waste, safety shoes, gumboots, gloves
- Rubber waste (contaminated)
- Electrical waste (cables/ motors)
- Building rubble (tiles, bricks, carpet, ceiling, etc.)

Unused equipment for example crushers is stored at the Redundant Materials Yard from where it is sold during auctions.

4.4.5.4. Hazardous Waste Disposal

Hazardous waste generated at the shaft complex are disposed of into appropriate bins located at the ISO Yard (see Figure 4.4(a)). Hazardous waste is stored within a concrete lined bunded structure. The waste contractor is responsible for removing and disposing of the waste to an appropriate licenced landfill site.

The following are examples of hazardous waste associated with the shaft complex:

- Battery and clamp lamp waste
- Chemical containers (including old oil and Grease containers, 210 ℓ oil drums and contaminated rags)
- Contaminated PPE
- Contaminated sludge from sumps
- Contaminated soil
- Contaminated spillsorb and stone dust
- Dried sewage sludge
- Electrical waste, e.g. light fittings
- Electronic waste (appliances, telecoms, pc's etc.)
- Explosive waste (undetonated)
- Filters from LVD's and LHD
- Fire extinguishers
- Fluorescent tube waste
- Hydraulic pipes
- Incinerated ash
- Ink cartridges
- Medical waste (bandages and sharps)
- Old/ used oil
- Paint and thinner waste
- Polychlorinated Biphenyls (PCB) contaminated waste
- Resin waste
- Self-breathing apparatus

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- Small batteries (e.g. Duracell)
- Telephone batteries
- Vehicle batteries
- Weed control waste (fertilizers and chemical containers)

Possible oil spillages onto surface may occur at the workshop and wash bay areas. A special oil trap and oil separator system is provided whereby all oil in the wash bay and workshop area is captured and all storm water runoff is captured, skimmed and recycled.

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4.5. SIMUNYE SHAFT INFRASTRUCTURE AND PROCESS

A layout map of the infrastructure at the Simunye Shaft Complex is provided in Figure 4.5(a).

4.5.1. General Site Layout

4.5.1.1. Access Roads

The Simunye Shaft Complex is accessed along a tar road from the R547 provincial secondary road which connects Kinross and Balfour/ Standerton. It can also be accessed from a private tarred road that connects the R580 and R547.

4.5.1.2. Security Fence and Access

The Simunye Shaft Complex is located within a fenced secondary security area. Access to the shaft complex is obtained through reporting to the security gate and building.

4.5.1.3. Offices, Workshops and Changehouses

The Simunye Shaft complex is a modern building complex that include the following:

- Offices
- Changehouse
- Lamp Room
- Workshops
- Carports/ Parking Areas
- Stores

4.5.1.4. Internal Roads and Parking Areas

Similarly, to the Shondoni Shaft Complex, the internal roads and parking areas are fully paved and other open areas within the shaft complex is grassed.

4.5.1.5. Electricity Supply and Substations

The Simunye Shaft Complex is supplied with Eskom power which is distributed from electrical substations. The Simunye Shaft 11 kV supplies medium voltage to the surface infrastructure which includes the surface ventilation fan substation, surface mining infrastructure (via the surface infrastructure reticulation system), production sections, stonework sections and underground conveyors.

4.5.1.6. Fuel Storage

No fuel is stored at the Simunye Shaft Complex. Fuel requirements is sourced from the Shondoni Shaft Complex if necessary.

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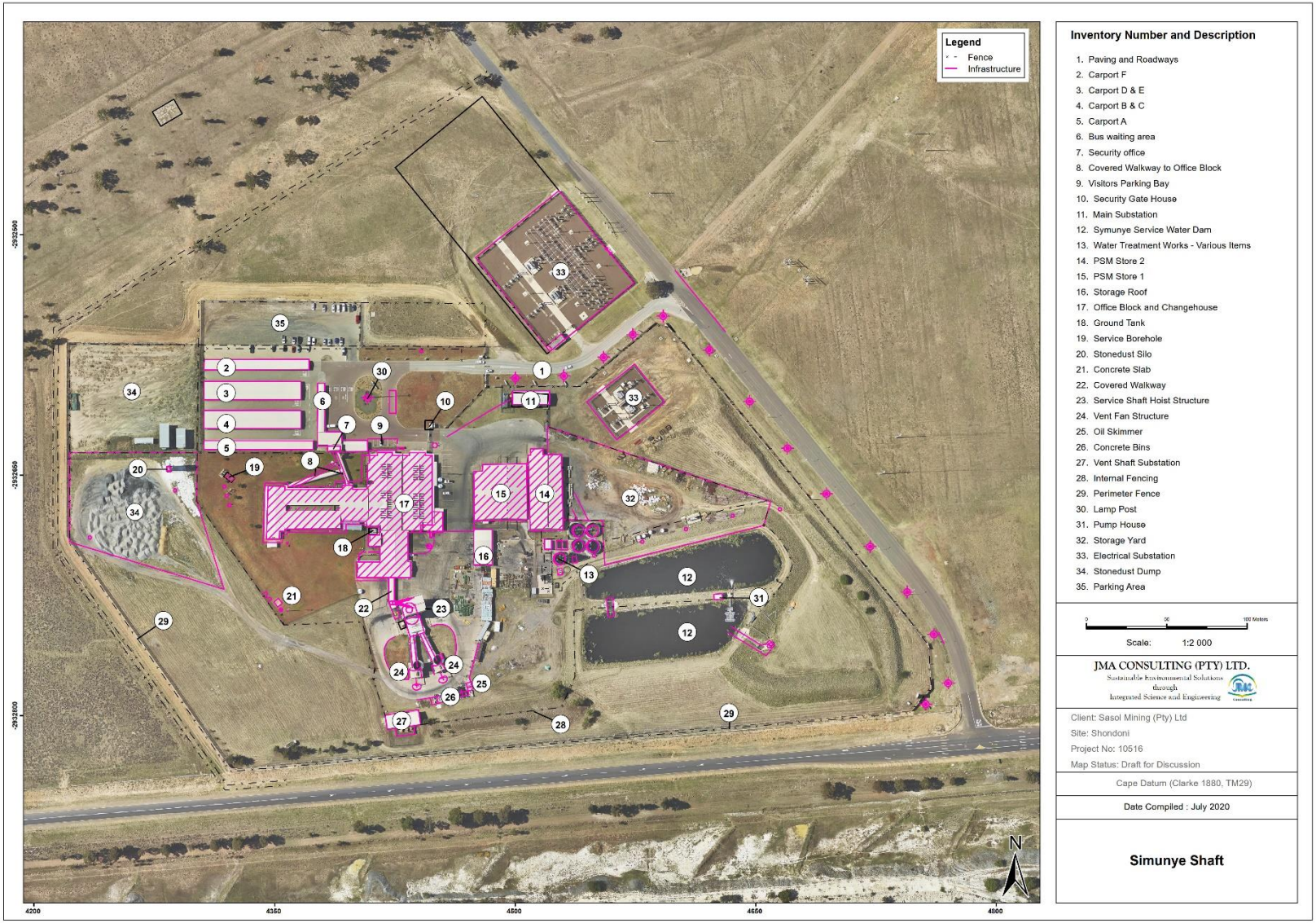

Figure 4.5(a): Shondoni Colliery Site Layout Plan – Simunye Shaft Complex

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4.5.2. Mining Operation and Infrastructure

4.5.2.1. Underground Mining Method

The underground mining method applied from the Simunye Shaft Complex is similar to that at the Shondoni Shaft Complex which is discussed in section 4.4.2.1.

4.5.2.2. Underground Mining Equipment

The underground mining equipment utilised at the Simunye Shaft Complex is similar to at the Shondoni Shaft Complex which is discussed in section 4.4.2.2.

4.5.2.3. Underground Mining Plan

The proposed mine plan and mining schedule for the entire Shondoni Colliery is provided in Figure 4.4.2.3(a).

4.5.2.4. Man and Material Shaft

The Simunye man and material shaft (see Figure 4.5(a)) is 14.3 m long and 8.6 m wide and when it reaches a full depth, it will be 140 m deep.

It is used to transport people and material to and from the underground workings and also for ventilation purposes. The shaft can accommodate a 7 m by 3 m cage suitable for transporting 12 tonne capacity.

4.5.2.5. Ventilation Shaft

At the Simunye Shaft Complex, an upcast ventilation shaft is provided which is fitted with two main fans installed on surface. The two main fans are installed in a bi-furcation arrangement.

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4.5.3. Mine Materials Stockpiles

4.5.3.1. Topsoil/ Overburden (Waste Rock) Stockpiles

Soils removed during the topsoil stripping prior to construction of the surface infrastructure was stockpiled, whilst rock overburden material removed during shaft sinking was used to construct perimeter berms in the shaft area as well as storm water flow management berms. Once the berms were constructed, the stockpiled soil was used to cover all berms and levelled areas, after which they were re-vegetated.

4.5.3.2. Coal Storage and Conveyance

Coal from the Simunye Shaft Complex is transported by underground conveyor belt to the Shondoni Shaft Complex surface bunker. From here it is transported by overland conveyor to the SCS West plant, where it is processed and supplied to SSO.

4.5.3.3. Stonedust Dump

Stonedust is delivered to the shaft complex and stockpiled (see Figure 4.5(a)) before it is transported underground. Stonedust is applied on the mined-out areas underground to prevent methane accumulation.

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4.5.4. Water Management

A schematic presentation of the water reticulation at the Simunye Shaft Complex is provided in Figure 4.5.4(a). Water management generally comprise of the following:

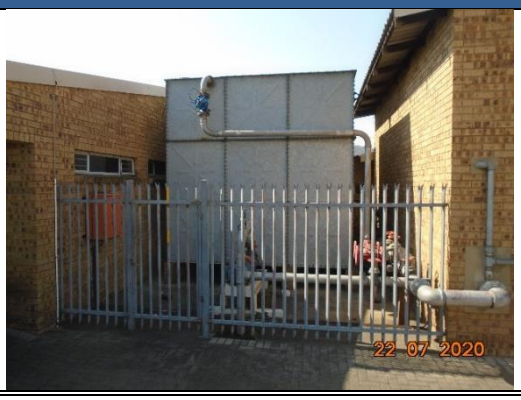
- Potable Water Supply and Storage
- Service Water Management and Storage
- Storm Water Management
- Underground/ Mine Water Management and Storage
- Water and Salt Balance

4.5.4.1. Raw/Potable Water Supply and Storage

Simunye Shaft Complex uses Rand Water (municipal supply) for potable and domestic purposes.

The water is received via pipeline and it is distributed directly into the mine. A header tank is located at the shaft complex which is used as an emergency tank when there is no water coming from the Rand Water pipeline.

Table 4.5.4.1(a): Details of the Header Tank

Header Tank		
Central Coordinates	26°30'24.33"S 29°02'38.30"E	
Storage Capacity	+/- 50 m³	

4.5.4.2. Service Water Supply and Storage

Service water requirements are sourced from the two service water dams at the Simunye Shaft Complex.

These dams are authorised in terms of an NWA Section 21(g) water use. These dams receive water accumulating underground and contaminated storm water runoff from the shaft complex.

Furthermore, grey water and sewage originating from the shaft complex is separated. Grey water is pumped directly to the service water dams and sewage is treated at the sewage treatment plant. Treated sewage effluent then also reports to the service water dams.

The Simunye Shaft Complex process water is recycled from the two service water dams to the underground mining operations.

The top Service Water Dam has a capacity of 6 500 m³ while the bottom Service Water Dam has a capacity of 6 900 m³ (refer Figure 4.5(a)).

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Table 4.5.4.2(a): Details of the Service Water Dam (Top)

Service Water Dam (Top)		
Central Coordinates	26°30'25.25"S 29°02'45.17"E	
Footprint Area	+/- 0.41 ha	
Crest Length	+/- 297 m	
Max Wall Height	3 m	
Freeboard	0.8 m	
Dam Storage Capacity	6 500 m^3	
Liner Type	Clay lined	

Table 4.5.4.2(b): Details of the Service Water Dam (Bottom)

Service Water Dam (Bottom)		
Central Coordinates	26°30'26.54"S 29°02'44.80"E	
Footprint Area	+/- 0.36 ha	
Crest Length	+/- 275 m	
Max Wall Height	3 m	
Freeboard	0.8 m	
Dam Storage Capacity	6 900 m^3	
Liner Type	Clay lined	

4.5.4.3. Storm Water Management System

Storm water management at the Simunye Shaft Complex is achieved through the implementation of the following:

- The clean and dirty areas are separated by vegetated berms in some areas;
- The dirty water conveyance infrastructure has concrete lined sections;
- The dirty water is pumped to the service water dams on surface and excess water is sent to the underground workings;
- Service water is sourced from surface service water dams (which also function as pollution control dams); and
- Treated sewage effluent is disposed in the service water dams.

Storm water pollution at this shaft is restricted to possible contamination from paved areas and workshops. Oil traps are installed, surface water is recycled and transferred to the dam after oil skimming has taken place.

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4.5.4.4. Underground/ Mine Water Management

The general mining sequence is planned to unlock underground storage capacity for water found underground in the sense that the deeper sections of the coal seams are mined first. This results in storage being created for underground water behind the CM's on the coal seam elevation. The result of this mining philosophy is that water found underground flows under gravity into storage sections, referred to as underground water compartments.

Refer to Figure 4.4.4.4(a) illustrating the current underground mine water compartments already being used for water storage as well as future mine compartments that could be used for the same purpose.

For the biggest part of the operational mining phase, water found underground is therefore only pumped to surface if underground service water demand outstrips the supply sourced from the storm water PCD's located on surface. Underground water is being pumped to surface to create a favourable pressure head and for the safe continuation of the underground mining.

4.5.4.5. Water and Salt Balance

Golder Associates Africa (Pty) Ltd was appointed to compile a water and salt balance model for the previous Middelbult Colliery of which the Simunye Shaft Complex formed part of.

The main aim of the model is producing a site-wide water and salt balance in accordance with the DWS requirements. Additional features added to the model allow the user to simulate various scenarios and assist with water management planning on site. The model was developed in GoldSim. Input data is updated on an Excel Spreadsheet. The site-wide water and salt balance required by DWS is exported from GoldSim to an Excel Output sheet.

The model can also be used to track the following information:

- Water used;
- Water stored;
- Water abstracted;
- Water supplied; and
- Water released.

Simulating current or long-term scenarios and assessing:

- Water storage availability reflecting changes in rainfall and abstraction rates; and
- Water availability for mine water uses.

The current water balance for the Simunye Shaft as part of the previous Middelbult Colliery is presented in Figure 4.5.4.5(a) and the salt balance as Figure 4.5.4.5(b).

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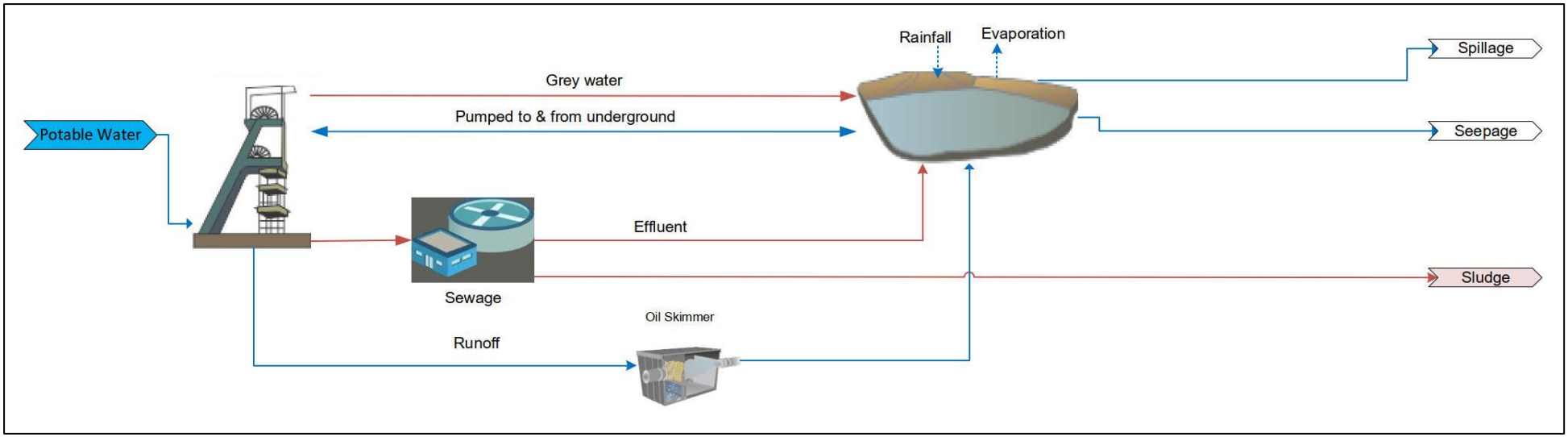

Figure 4.5.4(a): Water Reticulation at the Simunye Shaft

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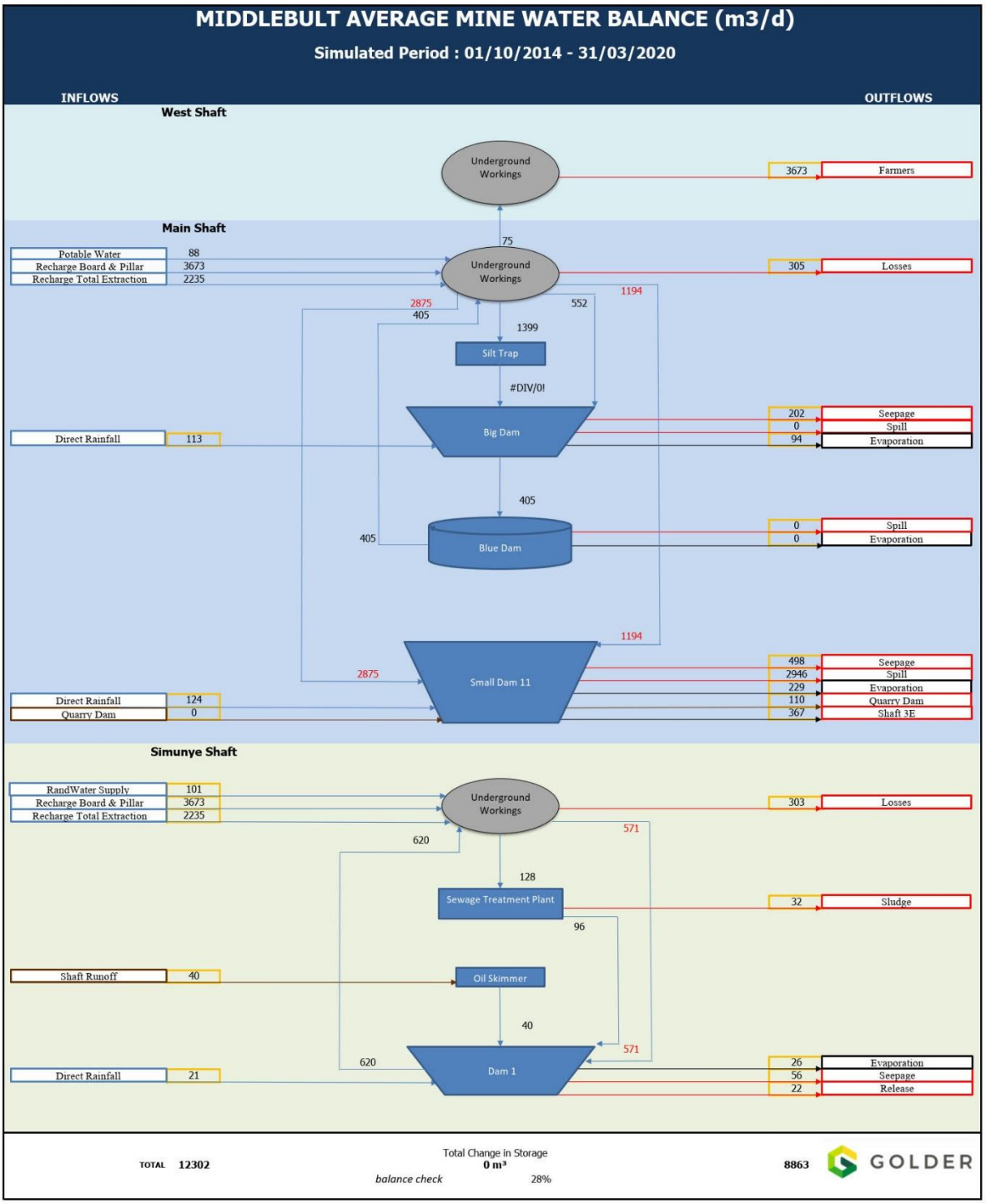

Figure 4.5.4.5(a): Average Water Balance for the Simunye Shaft Complex provided in the bottom block (simulated period October 2014 – March 2020)

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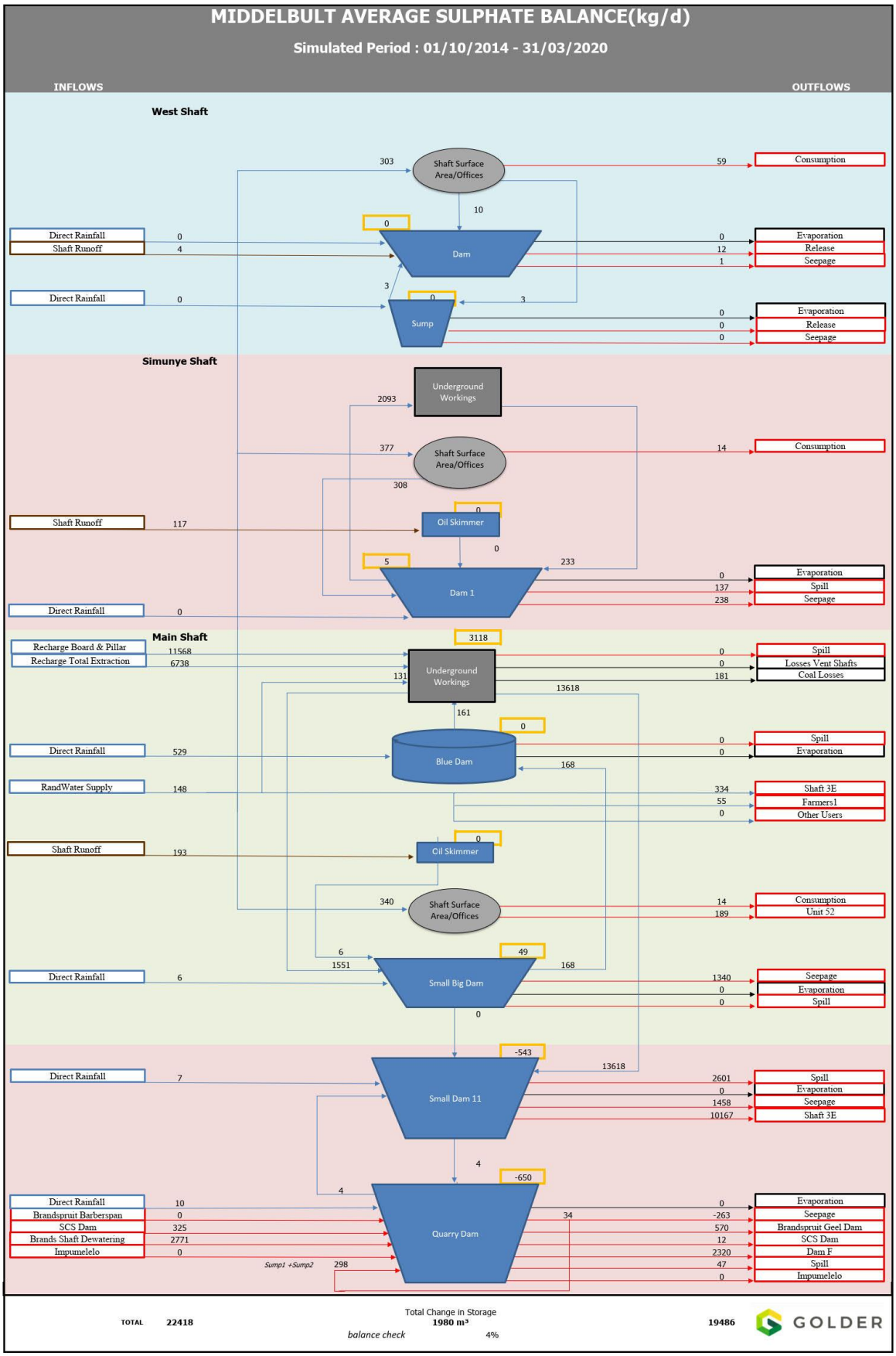

Figure 4.5.4.5(b): Average Salt Balance for the Simunye Shaft Complex provided in the second block (simulated period October 2014 – March 2020)

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4.5.5. Waste Management

The following waste management activities will be discussed under this heading:

- Mining Residue Disposal
- Sewage Treatment Plant
- General Waste Disposal
- Hazardous Waste Disposal

4.5.5.1. Mine Residue Disposal

No mining waste such as discard or coal fines slurry is generated at the Simunye Shaft. The coal cut from the coal seams underground is conveyed as ROM coal from the underground to the Shondoni Shaft surface bunker along the conveyor belt to the SCS West stockpiles.

Overburden material derived from this shaft complex is discussed in section 4.5.3.1 of this report.

4.5.5.2. Sewage Treatment Plant

The Simunye Shaft has its own Sewage Treatment Plant (STP). This plant operates as a sequencing batch process and reactor system which treats all the sewage generated at the shaft complex area.

The Sewage Treatment Plant (STP) comprise of the following:

- Barscreens
- Raw sewage sumps
- Aeration tanks
- Surge tank
- Baffle tank
- Chlorine tank
- Sludge beds

Sludge is dried prior to disposal to a skip which is removed by a registered Waste Contractor and disposed to an approved licenced landfill site. Treated effluent is pumped to the Service Water Dams. The STP is designed to treat 200 m^3 per day as per the DWS General Standard.

4.5.5.3. General Waste Disposal

General, domestic and small volumes of industrial waste are separated and stored temporarily at the Storage Yard (see Figure 4.5(a)) in bins within dedicated concrete lined and bunded structures for removal off-site by licenced waste management contractors. Examples of general waste generated at the shaft complexes are discussed in section 4.4.5.3 of this report.

4.5.5.4. Hazardous Waste Disposal

Hazardous waste generated at the shaft complex are disposed of into appropriate bins located at the Storage Yard (see Figure 4.5(a)). Hazardous waste is stored within a concrete lined bunded structure. The waste contractor is responsible for removing and disposing of the waste to an appropriate licenced landfill site. Examples of hazardous waste generated at the shaft complexes are discussed in section 4.4.5.4 of this report.

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4.6. PROPOSED ACTIVITIES, INFRASTRUCTURE AND PROCESSES

Proposed activities related to this project within the Shondoni Colliery EMPr boundary area include the underground mining activities associated with the new Block 8 North Reserve Area as well as four new ventilation shafts.

4.6.1. Underground Mining in the new Block 8 North Reserve Area

Illustrated in Figure 4.6.1(a) are the four granted prospecting rights areas/properties within the new Block 8 North Reserve Area that will be included into the mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area.

This project relates *inter alia* to the inclusion of these areas/ properties into the Shondoni Colliery EMP boundary.

The properties that relate to these prospecting rights are the following (prospecting rights reference number relayed in brackets):

- Farm Grootlaagte 311 IR, Portion 3 (MP4084PR)
- Farm Uitmalkaar 126 IS, Portion 6 (MP4084PR)
- Farm Rolspruit 127 IS, Portion 1 (MP3080PR_14073PR), Portion 5 (MP3080PR_14073PR), Portion 8 (MP11204PR) and Remaining Extent (MP3080PR_14073PR)
- Farm Salpeterkranz 351 IR, Portions 2 and 14 (MP11274PR)

Underground mining within this new Block 8 North Reserve Area will utilise the same underground mining method and mining equipment as discussed in Sections 4.4.2.1 and 4.4.2.2 of this report. The underground mining plan and schedule proposed for the entire Shondoni Colliery is provided in Section 4.4.2.3 of this report.

4.6.2. Ventilation Shafts

To ensure sufficient ventilation in the proposed extended underground workings, four new ventilation shafts are required in the north, north-western region of the Shondoni Colliery EMP boundary area (see Figure 4.6.2(a)). A photograph of a typical ventilation shaft surface infrastructure is shown in Figure 4.4.2.5(a). Sometimes ventilation shafts and the man and material shaft are located within the same excavation. However, ventilation shafts can also exist separate from the man and material shaft. Ventilation shafts located in remote areas away from the man and material shaft complexes are referred to as satellite shafts. These shafts are usually constructed through raise boring from underground and the surface infrastructure comprises shaft exits together with extraction infrastructure.

The northern ventilation shafts (an up- and downcast separately) will require a combined footprint of more or less 1.5 ha. The access route to these facilities will be negotiated and confirmed with the applicable property owner, but the road will be approximately 3 m in width. Infrastructure associated with these facilities include three fan structures and a power supply substation. A stonedust silo, ash silo, oil and fuelling bowser could also possibly be constructed if and when required.

The western ventilation shafts (an up- and downcast separately) will require a 1 ha and 0.4 ha footprint respectively. Access to these facilities will be obtained by an existing secondary road. Infrastructure associated with these facilities include two fan structures and a power supply substation.

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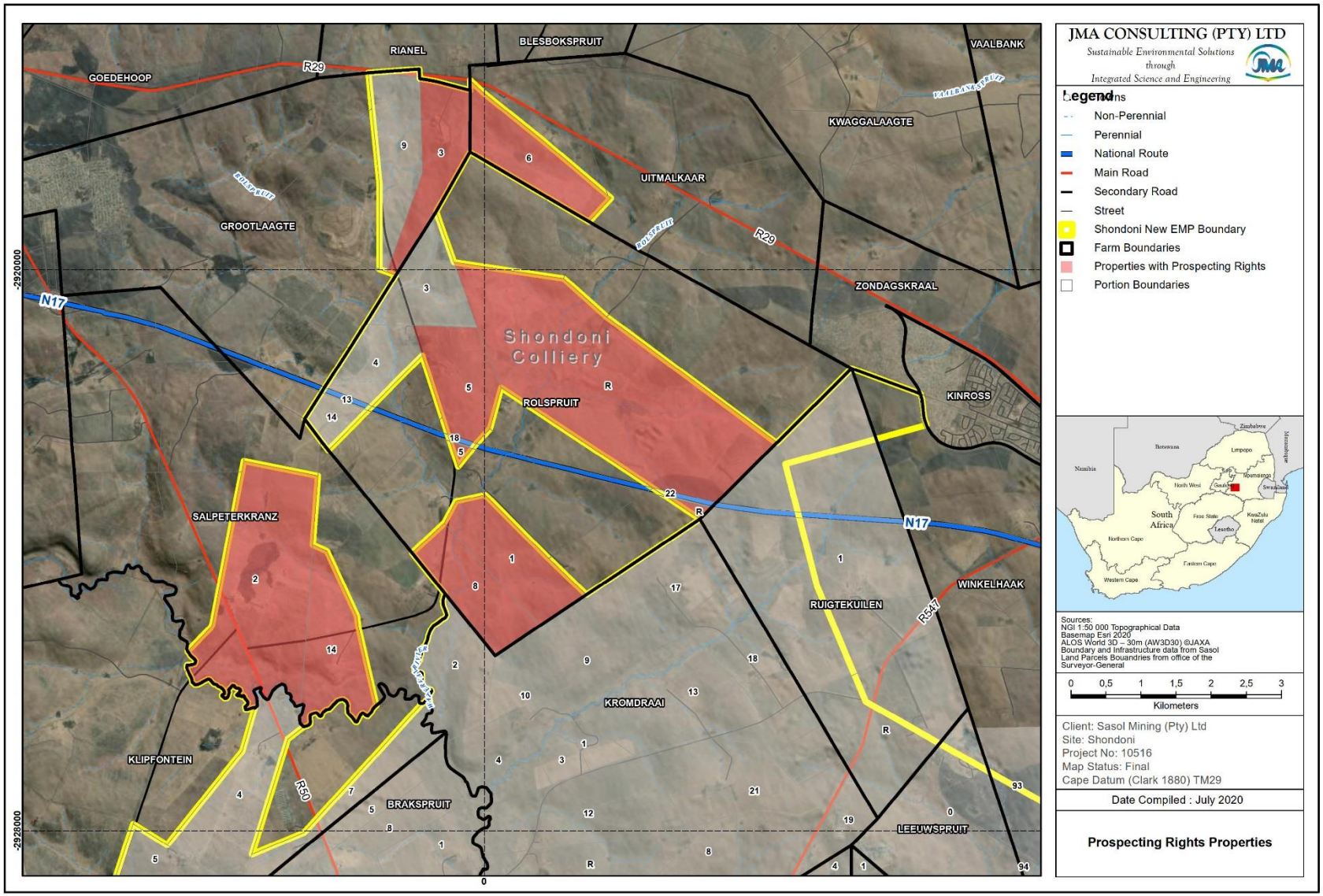

Figure 4.6.1(a): Prospecting Right Properties to be included within the Shondoni Colliery EMP boundary

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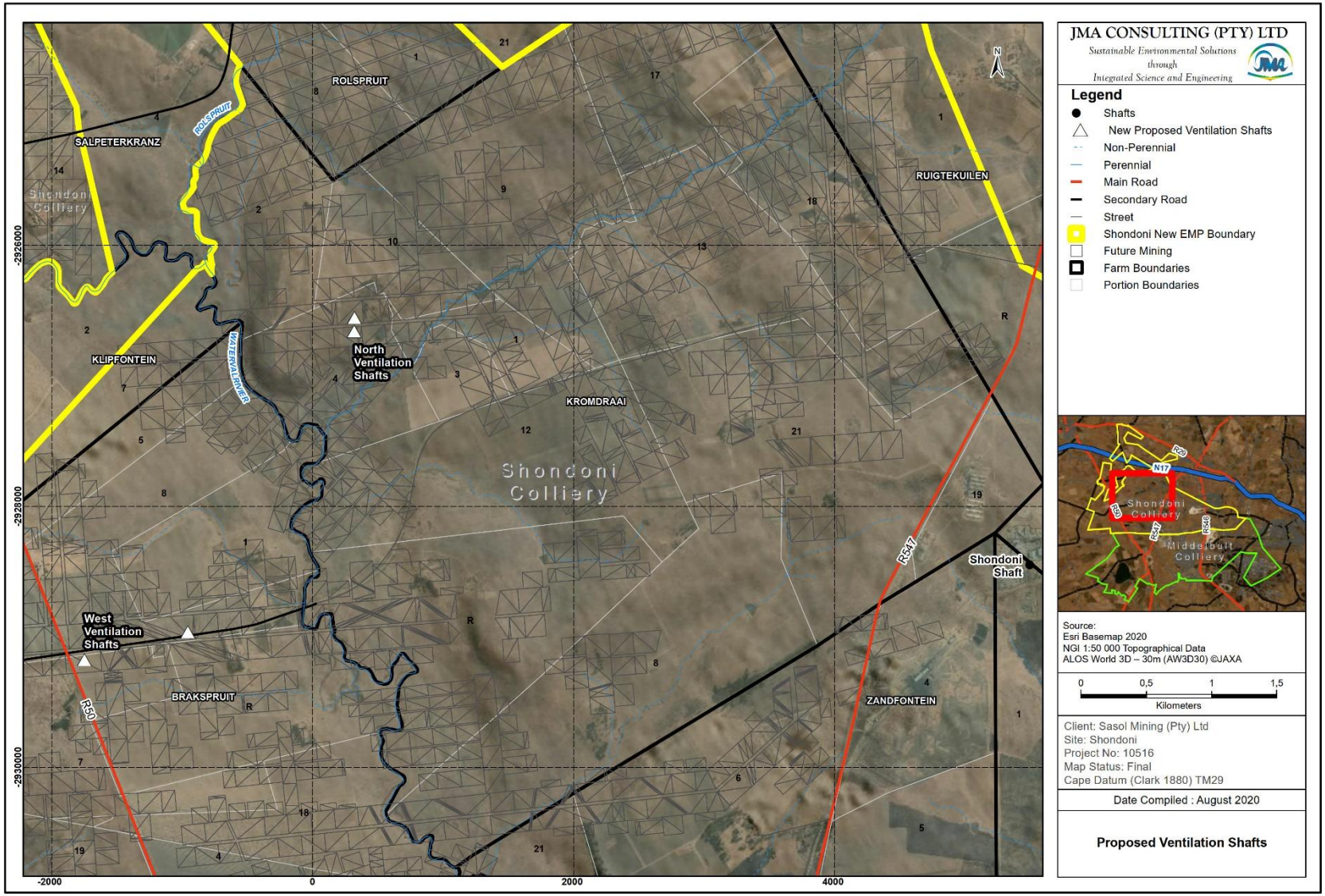

Figure 4.6.2(a): Position of the four proposed Ventilation Shafts

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4.7. LISTED AND SPECIFIED ACTIVITIES TRIGGERED

The proposed activities related to this project within the Shondoni Colliery EMPr boundary area, require authorisation in terms of the MPRDA, NEMA and the NWA and the S&EIR Process as is provided for in the EIA Regulations needs to be followed for this project.

The relevant listed activities which may be triggered by the proposed project specified in Listing Notice 1 (LN1; GNR 983), Listing Notice 2 (LN2; GNR 984) or Listing Notice 3 (LN3; GNR 985) of EIA Regulations 2014 (as amended), are relayed in Table 4.7(a).

Table 4.7(a): Listed and Specified Activities at Shondoni Colliery

Name of Activity	Aerial Extent of Activity (ha/m²)	Listed Activity	Applicable Listing Notice/ Not Listed
Underground Mining in the new Block 8 North Reserve Area	2442.82 ha	Activity and operation of that activity that requires a Mining Right including the associated infrastructure	LN2 Activity 17
Proposed Ventilation Shafts	West Upcast Ventilation Shaft 1 ha	Development of facilities/ infrastructure for the transmission and distribution of electricity outside urban areas with a capacity of more than 33 but less than 275 kilovolts	LN1 Activity 11
		Clearance of 1 ha or more indigenous vegetation	LN1 Activity 27
		Activity and operation of that activity that requires a Mining Right including the associated infrastructure	LN2 Activity 17
		Clearance of 300 m² or more indigenous vegetation	LN3 Activity 12
	West Downcast Ventilation Shaft 0.4 ha	Activity and operation of that activity that requires a Mining Right including the associated infrastructure	LN2 Activity 17
		Clearance of 300 m² or more indigenous vegetation	LN3 Activity 12
	North Upcast and Downcast Ventilation Shaft Combined Area 1.5 ha	Development of facilities/ infrastructure for the transmission and distribution of electricity outside urban areas with a capacity of more than 33 but less than 275 kilovolts	LN1 Activity 11
		Clearance of 1 ha or more indigenous vegetation	LN1 Activity 27
		Any process of activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act	LN1 Activity 30
		Activity and operation of that activity that requires a Mining Right including the associated infrastructure	LN2 Activity 17
		Clearance of 300 m² or more indigenous vegetation	LN3 Activity 12
Application for new Water Uses and Amendment of the current WUL (08/C12D/ACFGIJ/2027) to comprise all water uses associated with the new Shondoni Colliery EMP boundary area	-	Development of facilities/ infrastructure that requires a permit/ licence or amended permit/ licence in terms of the NWA.	LN2 Activity 6

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4.8. PROJECT PHASES, ACTIVITIES AND TIMELINES

In broad terms, construction is the phase in which any infrastructure at Shondoni Colliery is established, the production phase of the mine and plants will constitute the operational phase, decommissioning and closure phase will be when production/operation has ceased, infrastructure are being demolished and removed and the site is being rehabilitated in line with a closure plan and finally the post closure phase refers to the period of time when maintenance and aftercare of rehabilitated areas and facilities is required to ensure closure objectives are met.

4.8.1. Construction Phase

With regards to the underground mining, the Shaft Complexes (Shondoni and Simunye), accessing the coal seams are already developed. Therefore, currently there will be no new shaft complex construction activities.

The construction phase for the four new ventilation shafts will comprise either all, or some, of the actions listed below:

- Fencing of the construction site (including laydown and parking areas)
- Vegetation clear and grub
- Topsoil stripping and stockpiling
- Blasting (if necessary) during shaft construction
- Excavated materials used to construct berms and embankments around and within shaft complex
- Levelling
- Delivery of plant and materials
- Civil and/or mechanical construction of shaft
- Site clean-up
- Commissioning

The time frame for construction of a ventilation shaft will not exceed 18 months.

4.8.2. Operational Phase

During the operational phase most activities will occur underground. The two coal seams will be mined with CM's and therefore no routine mining related blasting will occur. However, when dolerite structures need to be penetrated to access the coal seams, limited underground blasting will occur from time to time.

The coal is cut at the mining faces, loaded automatically onto the shuttle cars from which it is loaded onto the conveyor system which takes the coal along the incline shaft to surface.

On surface the coal goes directly into the surface bunker from where it is transferred onto the overland conveyor which transports the ROM coal to SCS West Plant. The surface coal bunker also has an emergency surface throw-out area in the event that the conveyor system cannot handle the volume of coal as a result of maintenance. Surface activities at the shaft complexes relate to general administration and management.

Underground personnel access the mine through the vertical people and material shaft after preparing for shifts in the changehouses, where they also wash and refresh at the end of shifts.

The shaft complexes also handle all materials that need to go underground and has stores and workshops to cater for repairs that cannot be done underground.

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Operation of the ventilation shafts comprise of the operation of extraction fans to drive the upcast ventilation system.

Apart from the operational activities, general water management and waste management is also done on surface at the shaft complexes. Potable water, service water and storm water management infrastructure are located at the shafts and operated on an ongoing basis. Waste generated on surface is disposed in bins located in dedicated areas and removed by waste management contractors.

Water make in the underground mining sections is largely managed underground and within a series of surface located PCD's. The portion which is required for service water purposes is pumped to surface and stored in specially constructed service water dams, and then gravitated back underground for use for mining and dust suppression.

Underground mining is anticipated to continue up to 2050 and will continue as long as it remains economically viable to mine these exploitable reserves. Therefore, all the above activities are foreseen to continue for the duration of this time period.

4.8.3. Decommissioning and Closure Phase

During the decommissioning and closure phase, all infrastructure must preferably be decommissioned and demolished.

Infrastructure identified to be decommissioned must be completely removed and the land rehabilitated to an agreed end land use. Waste generated during the decommissioning of infrastructure must be classified and disposed of in an appropriate manner as required by the National Environmental Management: Waste Act (Act No. 59 of 2008; NEMWA).

Prior to decommissioning of any facility authorised in the applicable WUL, conditions pertaining to the decommissioning and closure of those facilities must be adhered to.

Decommissioning of water containment facilities will generally entail an assessment of the water quality and sludge found in the water containment facilities to determine the appropriate measure of disposal. Once the water and sludge have been disposed of, an assessment and classification of the facility liner should be performed to determine appropriate disposal. If no liner is present, a soil contamination assessment must be undertaken to determine appropriate remediation and rehabilitation measures.

Decommissioning of the sewage treatment plants will generally entail classification of the waste that remains after the sewage treatment operations have ceased to determine appropriate disposal. If waste is required to be removed from site by a waste removal contractor and disposed of at a licenced facility, records of the disposal must be retained by Sasol Mining.

All shafts (man and material as well as ventilation shafts) must be backfilled with either overburden material, ash and/ or building rubble. Caution must be taken to prevent steel from being used as backfill material as it can result in water pollution should it be exposed to water and/ or air. Shafts must be capped with an engineered designed concrete slab. Record of these designs should be retained by Sasol Mining.

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To prevent any spontaneous combustion of coal or contamination of nearby water courses, all coal must be removed as far as practicable possible, during the decommissioning and rehabilitation of surface coal service bunkers which include emergency coal stockpile areas as well as coal storage bunkers. Removed coal must be transported to other Sasol Mines for reuse or disposal. All associated infrastructure should be decommissioned/demolished as discussed above.

Recommended mine water (water accumulating underground) management during the decommissioning phase entails flooding of the underground workings with adequate, water quality monitoring procedures in place.

During decommissioning the relevant subsidence risk assessment should be updated/ re-assessed to determine which cracks that resulted from surface subsidence in the project area classifies as significant. Rehabilitation of these areas should then follow Sasol Mining rehabilitation protocol in this regard.

All excavations (shafts, water containment facilities, foundations etc.) within the project area must be backfilled with overburden material, rocks, ash and rubble and made free draining as indicated in a decommissioning and closure plan. This should be followed by placing of topsoil, fertilisation and re-vegetation with indigenous vegetation. Alien invasive species monitoring must be implemented.

Once the area has been rehabilitated, the land survey plan must be updated and submitted to the DMRE.

4.8.4. Post Closure Phase

The project area will have been rehabilitated to an agreed end land use. Post Closure water quality monitoring and adequate management procedures will be implemented.

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5. POLICY AND LEGISLATIVE CONTEXT

All relevant Acts, Regulations, Formal Departmental Guidelines and Templates, as well as Formal Provincial and Municipal Regulatory Frameworks are considered routinely during the compilation of Scoping and EIA/EMP Reports.

After due consideration of the above mentioned, a Table was compiled to summarise the Policy and Legislative Context of the project which was considered in terms of this project.

The first column of this table references the Applicable Legislation and Guidelines used to determine the legislative background and context of the project. The second column gives a brief description of how, when and where it has been considered/applied during the Scoping and EIA Phases of the project and the third column describes how the project and associated activities will comply with and respond to the Policy and Legislative Context.

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Table 5(a): Policy and Legislative Context of the Shondoni Project

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) Section 24 of the Constitution states that everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that - • *prevent pollution and ecological degradation;* • *promote conservation; and* • *secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	A comprehensive S&EIR Process will be undertaken, including the necessary public participation, to identify the potential impacts associated with the project. The prescribed reports, i.e. Scoping Report, Environmental Impact Assessment Report (EIAR) and an Environmental Management Programme (EMPr) will be compiled in support of this process. The EMPr will include mitigation measures as well as monitoring plans that will ensure that the relevant environment is managed in a sustainable manner to support the rights as enshrined in the Constitution.
Mineral and Petroleum Resource Development Act, 2002 (Act No. 28 of 2002) The MPRDA is the central Act governing mining in South Africa and the preamble to the MPRDA affirms the State's obligation to protect the environment for the benefit of present and future generations, to ensure ecologically sustainable development of mineral and petroleum resources and to promote economic and social development. **MPRDA Regulations** ▪ *Mineral and Petroleum Resources Development Regulations – GNR 527 of 23 April 2004 as amended.* **DMRE Templates and Guidelines** ➢ *DMRE Templates for a Scoping Report, Environmental Impact Assessment and Environmental Management Programme Report and DMRE Guidelines for the compilation of these reports.* ➢ *DMRE Guidelines for Consultation with Communities and Interested and Affected Parties.*	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process. The (S&EIR) Process will be undertaken to meet the requirements of the MPRDA read with the EIA Regulations, 2014 (as amended).	A comprehensive S&EIR Process will be undertaken, including the recommended public participation, and the prescribed reports, i.e. Scoping Report, Environmental Impact Assessment Report (EIAR), an Environmental Management Programme (EMPr) and Specialist Reports will be compiled and submitted as per the latest guidelines and templates developed and provided by the Competent Authority (CA). This process will be administered under the "Single Environmental System" with the Department of Mineral Resources and Energy (DMRE) being the CA for the EA Application. The Applicant is the holder of a converted new order mining right which was consolidated from what used to be several prospecting and mining rights, known as the Secunda Complex Mining Right (MP 30/5/1/2/3/21/138 MR). The Applicant has applied (September 2020) to have this mining right amended to include four prospecting rights on the following properties which are applicable to the Shondoni Colliery EMPr area: • Portions 1, 5, 8 & RE of the Farm Rolspruit 127 IS; • Portions 2 & 14 of the Farm Salpeterkranz 351 IR; • Portion 6 of the Farm Uitmalkaar 126 IS; and • Portion 3 of the Farm Grootlaagte 311 IR The EMPr in terms of the MPRDA that have been approved for the project site is listed below: • Approved EMPr Addendum [January 2011 compiled by JMA Consulting (Pty) Ltd] for the Middelbult - Block 8 – Shondoni.

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
National Environmental Management Act, 1998 (Act No. 107 of 1998) – NEMA Section 24 of the NEMA, headed "Environmental Authorisations" sets out the provisions which are to give effect to the general objectives of Integrated Environmental Management, and laid down in Chapter 5 of the NEMA. In terms of section 24(1), the potential impact on the environment of listed activities must be considered, investigated, assessed and reported on to the competent authority charged by the NEMA with granting of the relevant environmental authorisation. In terms of section 24F(1) of the NEMA no person may commence an activity listed or specified in terms of section 24(2)(a) or (b) unless the competent authority has granted an environmental authorisation for the activity. **NEMA Regulations** ▪ *Public Participation Guideline – GNR 807 of 10 October 2012* ▪ *Fees for consideration and processing of applications for environmental authorisations and amendments thereto – GN 141 of 28 February 2014* ▪ *Guideline on Need and Desirability of the Environmental Impact Assessment (EIA) Regulations – GN 891 of 20 October 2014* ▪ *EIA Regulations – GNR 982 of 08 December 2014 as amended* ▪ *EIA Regulations: Listing Notice 1 – GNR 983 of 08 December 2014 as amended* ▪ *EIA Regulations: Listing Notice 2 – GNR 984 of 08 December 2014 as amended* ▪ *EIA Regulations: Listing Notice 3 – GNR 985 of 08 December 2014 as amended* ▪ *National Exemption Regulations in terms of the National Environmental Management Act 1998 (Act No 107 of 1998) – GNR 994 of 08 December 2014* ▪ *National Appeal Regulations in terms of the National Environmental Management Act 1998 (Act No 107 of 1998) – GNR 993 of 08 December 2014* ▪ *Financial Provisioning Regulations – GNR 1147 of 20 November 2015 as amended* ▪ *Notice of the Requirement to submit a report generated by the National Web based Environmental Screening Tool in terms of Section24(5)(h) of the National Environmental Management Act, 1998 and Regulation 16(1)(b)(v) of the Environmental Impact Assessment (EIA) Regulations (GNR 982 of December 2014 as amended) – GNR 960 of July 2019*	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	The S&EIR Process will be undertaken in accordance with the principles of Section 24 of NEMA as well as with the EIA Regulations 2014 (as amended), promulgated in terms of NEMA. The Stakeholder Engagement Programme / Public Participation Programme was designed as recommended in the Public Participation Regulations and guidelines. Application fees relevant to the project were determined by the applicable regulations. The prescribed reports for the S&EIR Process, i.e. Scoping Report, Environmental Impact Assessment Report (EIAR) and an Environmental Management Programme (EMPr) will be compiled according to the requirements in the amended EIA Regulations. The Listing Notices have been reviewed against the project activities to determine the listed activities triggered and for which an application for EA has been submitted. Costs/Financial Provisioning associated with the environmental management of all the life cycle phases of the project was considered following the Financial Provisioning regulations. The Need and Desirability of the Project were considered and discussed following the regulations and guidelines provided by DEFF.

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Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
▪ *Procedures to be followed for the assessment and minimum criteria for reporting of identified environmental themes in terms of section 24(5)(a) and (h) of the National Environmental Management Act, 1998, when applying for environmental authorisation – GNR 320 of 20 March 2020* **DEFF Guidelines** ➢ *Need and Desirability Guideline in terms of the Environmental Impact Assessment Regulations 2017* ➢ *Public Participation Guideline in terms of National Environmental Management Act, 1998 Environmental Impact Assessment Regulations, 2017*		
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) – NEMWA The objects of this Act are to protect health, well-being and the environment by providing reasonable measures for minimising the consumption of natural resources; avoiding and minimising the generation of waste; reducing, re-using, recycling and recovering waste; treating and safely disposing of waste as a last resort; preventing pollution and ecological degradation; securing ecologically sustainable development while promoting justifiable economic and social development; promoting and ensuring the effective delivery of waste services; remediating land where contamination is present, or may be present, a significant risk of harm to health or the environment; and achieving integrated waste management reporting and planning; to ensure that people are aware of the impact of waste on their health, well-being and the environment; to provide for compliance with the measures set out above and generally, to give effect to section 24 of the Constitution in order to secure an environment that is not harmful to health and well-being. **NEMWA Regulations** ▪ *Waste Classification and Management Regulations – GNR 634of 23 August 2013* ▪ *National Norms and Standards for the Assessment of Waste for Landfill Disposal – GNR 635 of 23 August 2013* ▪ *National Norms and Standards for Disposal of Waste to Landfill – GNR 636 of 23 August 2013* ▪ *List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment – GNR 921 of 29 November 2013* ▪ *Norms and Standards for Storage of Waste –GNR 926 of 29 November 2013*	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	The Act, Regulations and Guidelines were considered to determine if any activities (current and proposed) classifies as a listed waste activity for which a WML Application would be required.

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
▪ *National Norms and Standards for the Remediation of Contaminated Land and Soil Quality – GN 331 in Government Gazette No. 37603 dated 2 May 2014* ▪ *Amendment to the List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment – GN 1094 of 13 February 2015* ▪ *Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits from a Prospecting, Mining, Exploration or Production Operation – GNR 632 of 24 July 2015* ▪ *Amendments to the List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment – GNR 633 of 24 July 2015* ▪ *National Norms and Standards for the Sorting, Shredding, Grinding, Crushing, Screening and Bailing of General Waste – GN 1093 of 11 October 2017* ▪ *Amendment to the List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment – GN 1094 of 11 October 2017* **DEFF Guidelines** ➢ *The Waste Licensing Application Process in terms of the National Environmental Management: Waste Act 2008 (No. 59 of 2008).* ➢ *Framework for the Management of Contaminated Land of May 2010* **SANS Guideline** ➢ *South African National Standard, SANS 10234:2008, Edition 1.1, Globally Harmonized System of Classification and Labelling of Chemicals (GHS), SABS Standards Division*		
National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) – NEMAQA Section 21 read with section 22 of the NEMAQA states that the Minister responsible for Environmental Affairs may publish a list of activities which result in atmospheric emissions and which the Minister reasonably believes has or may have a significant detrimental effect on the environment. Section 22 of the NEMAQA states that no person may without a provisional atmospheric emission licence or an atmospheric emission licence conduct an activity listed on a national or provincial list published in terms of the Act.	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	The Act and Regulations were considered during the Air Quality Specialist study undertaken.

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Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
The National Ambient Air Quality Standards were published on 24 December 2009 and provide *inter alia* for national ambient air quality standards for PM10. In addition to the above, the National Ambient Air Quality Standards for PM2.5 came into effect on 29 June 2012. While the NEMAQA does not require industry or mining companies to comply with the standards as published, Provincial and Local Authorities have the authority to ensure compliance with the standards. Section 19 and 20 of the NEMAQA provides for the management of priority areas. The national air quality officer, after consulting with the provincial and local air quality officer, must prepare an air quality management plan ("AQMP") in respect of a priority area. The AQMP must be submitted to the Minister for approval within 6 months after the declaration of the area as a priority area. Prior to approval of an AQMP the Minister must follow a consultative process as prescribed in section 56 and 57 of the NEMAQA. The Minister may prescribe regulations necessary for implementing and enforcing approved AQMPs, including: • *funding arrangements;* • *measures to facilitate compliance with such plans;* • *penalties for any contravention of or any failure to comply with such plans; and* • *regular review of such plans* **NEMAQA Regulations** ▪ *National Ambient Air Quality Standards – GNR 1210 of 24 December 2009* ▪ *Highveld Priority Area Air Quality Management Plan - GNR 144 of 02 March 2012* ▪ *National Ambient Air Quality Standard for particulate matter with aerodynamic diameter less than 2.5 micron metres (PM 2.5) – GNR 486 of 29 June 2012* ▪ *National Dust Control Regulations – GNR 827 of 01 November 2013* ▪ *List of Activities which result in atmospheric emissions which have or may have a significant detrimental effect on the Environment, including Health, Social Conditions, Economic Conditions, Ecological Conditions or Cultural Heritage – GN 893 of 22 November 2013 as amended* ▪ *National Regulations Regarding Air Dispersion Modelling – GNR 533 of 11 July 2014* ▪ *National Atmospheric Emission Reporting Regulations – GNR 283 of 02 April 2015*		

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
▪ *Regulations Prescribing the Format of the Atmospheric Impact Report – GNR 284 of 02 April 2015* ▪ *National Greenhouse Gas Emission Reporting Regulations – GNR 275 of 03 April 2017* ▪ *National Pollution Prevention Plans Regulations -GNR 712 of 21 July 2017*		
National Water Act, 1998 (Act No. 36 of 1998) – NWA The purpose of the NWA, as set out in Section 2 thereof, is to ensure that the country's water resources are protected, used, developed, conserved, managed and controlled, in a way which, *inter alia*, takes into account the reduction and prevention of pollution and degradation of water resources. The NWA states, in section 3 thereof, that the National Government is the public trustee of the Nation's water resources. The National Government must ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons and in accordance with its constitutional mandate. **NWA Regulations** ▪ *Regulations requiring that a water use be registered – GNR 1352 of 12 November 1999* ▪ *Regulations on use of water for mining and related activities aimed at the protection of water resources – GNR 704 of 4 June 1999* ▪ *Replacement of General Authorisation in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) – GN 1199 of 18 December 2009* ▪ *Regulations regarding the safety of dams in terms of Section 123(1) of the National Water Act, 1998 – GNR 139 of 24 February 2012* ▪ *General Authorisation in terms of section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in section 21(c) or section 21(i) – GN 509 in Government Gazette No. 40229 dated 26 August 2016* ▪ *Revision of General Authorisation for the Taking and Storing of Water – GN 538 in Government Gazette No. 40243 of 2 September 2016* ▪ *New Nine (9) Water Management Areas of South Africa – GN 1056 in Government Gazette No. 40279 dated 16 September 2016* ▪ *Regulations Requiring that the Taking of Water for Irrigation Purposes be Measured, Recorded and Reported – GN 131 in Government Gazette No. 40621 of 17 February 2017* ▪ *Water Use Licence Application and Appeals Regulations, 2017 – GNR 267 in Government Gazette No. 40713 of 24 March 2017*	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	Water Uses at the project site have been authorised in terms of the following authorisation issued by the Department of Water and Sanitation (DWS): • A Water Use Licence (WUL) issued to Sasol Mining (Pty) Ltd – Shondoni Mine on the 12th of February 2013. File Number: 16/2/7/C121/C151 Licence Number: 08/C12D/ACFGIJ/2027. Application for new Water Uses and Amendment of the current WUL (08/C12D/ACFGIJ/2027) to include all water uses associated with the new Shondoni Colliery EMP boundary area will be done in due course. Specialist assessments related to surface water, which includes aquatic ecosystems and wetlands, and groundwater referred to regulations and guidelines provided in terms of evaluating the impact associated with the project activities as well as when proposing management measures and monitoring programmes.

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
DWS Guidelines ➢ *DWAF, Second Edition, 1998. Waste Management Series. Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste.* ➢ *DWAF, Second Edition, 1998. Waste Management Series. Minimum Requirements for Waste Disposal by Landfill.* ➢ *DWAF, Second Edition, 1998. Waste Management Series. Minimum Requirements for Water Monitoring at Waste Management Facilities.* ➢ *Guidelines for the Utilization and Disposal of Wastewater Sludge – Volume 1: Selection of Management Options; 2006.* ➢ *Guidelines for the Utilization and Disposal of Wastewater Sludge – Volume 2: Requirements for the Agricultural Use of Sludge; 2006.* ➢ *Guidelines for the Utilization and Disposal of Wastewater Sludge – Volume 3: Requirements for the On-site and Off-site Disposal of Sludge; 2006.* ➢ *Guidelines for the Utilization and Disposal of Wastewater Sludge – Volume 4: Requirements for the Beneficial Use of Sludge; 2006.* ➢ *Guidelines for the Utilization and Disposal of Wastewater Sludge – Volume 5: Requirements for Thermal Sludge Management Practices and for Commercial Products Containing Sludge; 2006.* ➢ *Best Practice Guideline A1 – Small-Scale Mining (Standard format); 2006* ➢ *Best Practice Guideline A1.1 – Small-Scale Mining (User Format); 2006* ➢ *Best Practice Guideline G1 – Storm Water Management; 2006* ➢ *Best Practice Guideline G2 – Water and Salt Balances; 2006* ➢ *Best Practice Guideline H3 – Water Reuse and Reclamation; 2006* ➢ *External Guideline: Generic Water Use Authorisation Application Process, 2007* ➢ *Internal Guideline: Generic Water Use Authorisation Application Process, 2007* ➢ *Best Practice Guideline A3 – Water Management in Hydrometallurgical Plants; 2007* ➢ *Best Practice Guideline A4 – Pollution Control Dams; 2007* ➢ *Best Practice Guideline G3 – Water Monitoring Systems; 2007* ➢ *Best Practice Guideline H4 – Water Treatment; 2007* ➢ *Best Practice Guideline A2 – Water Management for Mine Residue Deposits; 2008* ➢ *Best Practice Guideline A5 – Water Management for Surface Mines; 2008* ➢ *Best Practice Guideline A6 – Water Management for Underground Mines; 2008* ➢ *Best Practice Guideline G4 – Impact Prediction; 2008*		

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Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
➢ *Best Practice Guideline G5 – Water Management Aspects for Mine Closure; 2008* ➢ *Best Practice Guideline H1 – Integrated Mine Water Management; 2008* ➢ *Best Practice Guideline H2 – Pollution Prevention and Minimization of Impacts; 2008* ➢ *Operational Guideline: Integrated Water and Waste Management Plan, 2010* ➢ *Water Conservation and Water Demand Management Guideline for the Mining Sector in South Africa; DWA, 2011.* ➢ *Internal Guideline: Section 21(a) and (b) Water Use Authorisation Application Process (taking and/or storing water)* ➢ *Internal Guideline: Section 21(c) and (i) Water Use Authorisation Application Process (impeding or diverting the flow of water in a watercourse and /or altering the bed, banks, course or characteristics of a watercourse)* ➢ *Internal Guideline: Section 21(e), (f), (g), (h) and (j) Water Use Authorisation Application Process (waste discharge related)* ➢ *The Resource Quality Objectives for the Vaal River were published in the Government Gazette in April 2016; DWS 2016.* **SANS Guideline** ➢ *SANS 241:2015 Drinking Water Standard*		
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) – NEMBA The purpose of the NEMBA is to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA so as to protect species and ecosystems that warrant national protection. The NEMBA gives effect to ratified international agreements affecting biodiversity to which South Africa is a party, and which bind the Republic. The NEMBA must be read together with the NEMA and in particular, must be guided by the principles set out in Section 2 of the NEMA, as set out above. It is important to note that the NEMBA will find applicability throughout the lifetime of a project, from the commencement of operations to the decommissioning. The NEMBA provides for the publishing of various lists of species and ecosystems by the Minister of Environmental Affairs as well as by the Member of an Executive Council ("MEC") responsible for the conservation of biodiversity of a province in relation to which certain activities may not be undertaken without a permit.	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	The Act and the Regulations were consulted as part of the Ecological specialist studies conducted as part of the project. Ecological specialist studies included a Floral Assessment, Faunal Assessment, Wetlands Assessment and an Aquatic Ecosystem Assessment. These Assessments were undertaken to determine the current status of the environment and to determine any potential ecological sensitivity (threatened ecosystems) to be avoided and mitigated. In addition, this legislation was consulted in order to determine if any permits, authorisations, licences and/or consents needed to be obtained in order to commence/continue with the project and relevant activities.

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
In terms of Section 57 of the NEMBA, no person may carry out any restricted activity involving any species which has been identified by the Minister as "critically endangered species", "endangered species", "vulnerable species" or "protected species" without a permit. The NEMBA defines "restricted activity" in relation to such identified species so as to include, but not limited to, hunting, catching, capturing, killing, gathering, collecting, plucking, picking parts of, cutting, chopping off, uprooting, damaging, destroying, having in possession, exercising physical control over, moving or translocating. **NEMBA Regulations and Lists** ▪ *Publication of lists of critically endangered, endangered, vulnerable and protected species - GNR 151 of 23 February 2007* ▪ *Threatened and Protected Species Regulations – GNR 152 of 23 February 2007* ▪ *National List of Ecosystems that are Threatened and in need of Protection – GNR 1002 of 09 December 2011* ▪ *Publication of National List of Invasive Species – GNR 507 of 19 July 2013* ▪ *Publication of Prohibited Alien Species – GNR 508 of 19 July 2013* ▪ *Alien and Invasive Species Regulations – GNR 598 of 01 August 2014* ▪ *Threatened or Protected Species (TOPS) Regulations- GN 255 of 31 March 2015* ▪ *Alien and Invasive Species Lists – GNR 864 of July 2016*		
Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) - CARA The purpose of the Conservation of Agricultural Resources Act ("**CARA**") is to provide for the control over the utilisation of the natural agricultural resources of the Republic so as to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants. Biological control reserve is defined in GNR 1048 as "*an area designated by the executive officer in terms of regulation 15D of the regulations for the breeding of biological control agents*". **CARA Regulations** ▪ *Regulations – GNR 1048 of 25 May 1984* ▪ *Weed Control Scheme – GNR 1044 of 25 May 1984*	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	Provisions of CARA will be taken into account in the soil and land capability specialist study in terms of the mitigation measures proposed to prevent the degradation of the agricultural potential of soil, to protect land against soil erosion and to prevent water logging and salinisation of soils by means of proposing suitable soil management objectives and measures.

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
Mpumalanga Nature Conservation Act , 1998 (Act No. 10 of 1998) - MNCA The MNCA consolidates and amends the laws relevant to biodiversity conservation in Mpumalanga and provides for the proclamation of protected species of flora and fauna, as well as the regulation of the hunting and fishing industries within the province. The following schedules are relevant to this report: Schedule 2 (Protected Game) Schedule 11 (Protected Plants)	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	The Act was consulted as part of the Ecological specialist studies conducted as part of the project. Ecological specialist studies included a Floral Assessment, Faunal Assessment, Wetlands Assessment and an Aquatic Ecosystem Assessment.
National Heritage Resources Act, 1999 (Act No. 25 of 1999) – NHRA The NHRA aims to, *inter alia*, promote good management of the national estate, and to enable and encourage communities to nurture and conserve their legacy so it may be bequeathed to future generations. The preamble to the NHRA states that our heritage is unique and precious, and it cannot be renewed. The national estate means the "national estate" defined in section 3 of the NHRA. This section states that those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered as part of the national estate and fall within the sphere of operations of heritage resources authorities. Section 3 (3) read with section 2 provides that cultural significance, for purposes of the NHRA, means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. Section 34 of the NHRA provides for a mechanism for protecting immovable property by providing for an outright prohibition on altering or demolishing any structure or part of any structure, which is older than 60 years, without a permit issued by the relevant provincial heritage resources authority. If a permit is refused, consideration must be given to designating the place concerned as a heritage site, or protected area or heritage area within three months of such refusal. An important provision in the NHRA is section 38 of the Act which states that any person who intends to undertake developments categorised in the section must at the very earliest stages of initiating such development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	A Phase I Heritage Impact Assessment (HIA) study was done according to Section 38 of the National Heritage Resources Act (No. 25 of 1999). The aims with the Phase I HIA study were to establish whether any of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No. 25 of 1999) do occur in the project area and, if so, to determine the nature and the extent of these remains. In addition, to establish whether any of the types and ranges of heritage resources which have been identified in the project area will be affected by the project operations and, if so, to establish appropriate mitigation and management measures for these heritage resources.

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
Environment Conservation Act, 1989 (Act No. 73 of 1989) - ECA In terms of section 21 of the ECA, the Minister may identify activities that may have a substantial detrimental effect on the environment, whether in general or in respect of certain areas. Such activities were identified during 1997. Section 22 of the ECA *inter alia* states that no person shall undertake an activity identified in terms of section 21(1) of the Act or cause such an activity to be undertaken except by virtue of a written authorisation issued by the relevant government authority. The erstwhile Minister of Environmental Affairs and Tourism identified the activities which may have a substantial detrimental effect on the environment in terms of section 21 of the ECA and which accordingly required authorisation by government prior to the undertaking of the identified activities. These activities and the prescribed authorisation process were identified in regulations promulgated in terms of the Act and were referred to as the "listed activities" and the "EIA Regulations" respectively. The provisions in the regulations containing the listed activities and the EIA Regulations have all, with the exception of section 22 in the ECA read with section 29(4), been repealed, with the commencement of the listed activities in terms of the NEMA in 2006. **ECA Regulations** ▪ *Noise control regulations in terms of section 25 of the Environment Conservation Act, 1989 – GNR 154 of January 1992 (as amended)* **ECA Guidelines** ➢ *SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'.* ➢ *SANS 10328:2008. 'Methods for environmental noise impact assessments'*	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	The ECA was consulted as this Act still has a Regulation relevant to the project to be undertaken, i.e. Noise Regulations. These Regulations will be consulted as part of the Noise specialist study and will be applied during the impact assessment as well as when appropriate management objectives and measures will be proposed during the compilation of the EMP.
Mine Health and Safety Act, 1996 (Act No. 29 of 1996) - MHSA To provide for protection of the health and safety of employees and other persons at mines and, for the purpose to promote a culture of health and safety; to provide for the enforcement of health and safety measures; to provide for appropriate systems of employee, employer and State participation in health and safety matters; to establish representative tripartite institutions to review legislation, promote health and enhance properly targeted research; to provide for effective monitoring systems and inspections, investigations and inquiries to improve health and safety; to promote training and human resources development; to regulate employers' and employees' duties to identify hazards and eliminate, control and	All Application Forms, Documents and Reports (Draft and Final) compiled and submitted in support of the Scoping and Environmental Impact Assessment and Reporting (S&EIR) Process.	The MHSA will be consulted when appropriate management objectives and measures will be proposed during the compilation of the EMPr.

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied	How does this development Comply with and Respond to the Policy and Legislative Context
minimise the risk to health and safety; to entrench the right to refuse to work in dangerous conditions; and to give effect to the public international law obligations of the Republic relating to mining health and safety; and to provide for matters connected therewith.		

6. NEED AND DESIRABILITY OF THE PROJECT

The need and desirability for the proposed project was provisionally considered during this Scoping Phase at the hand of the Integrated Environmental Management Guideline referenced as:

DEA (2017), Guideline on Need and Desirability, Department of Environmental Affairs (DEA), Pretoria, South Africa.

The overall motivation for the proposed project is to ensure and optimise sustainable reserve utilisation whilst ensuring effective and directed management of an operational mine, i.e. Shondoni Colliery.

The Need and Desirability Assessment is presented in Tabular format, focussing on the two major aspects of importance namely:

- Securing ecological sustainable development and use of natural resources – Table 6(a).
- Promoting justifiable economic and social development - Table 6(b).

The objective of this assessment for the Scoping Phase is to ensure that all the relevant considerations have been taken into account. During the scoping process, the questions contained in the tables will be used to identify key issues to be addressed, as well as to identify alternatives that will firstly, avoid the negative impacts or to mitigate the negative impacts, and secondly that will enhance the positive impacts.

The scoping process may find that many of the questions have clear answers and that no further information has to be gathered related to the specific question. In this regard it would be required for the Scoping Report to clearly answer all the questions including a clear indication which questions do not require further information to be generated during the EIA Phase. However, the outcome remains provisional until it has been confirmed during the EIA Phase.

Column 3 of Table 6(a) and (b) will indicate if additional assessment is required during the EIA Phase of the project. In the event that additional assessment is indicated (**YES**) it will receive attention during the Environmental Impact Assessment and will be described in the EIAR as well as during the design of Mitigation Measures by the team of specialists and as documented in the EMPR.

Items highlighted to be assessed further will be described and detailed in the Plan of Study section of this report (Section 9).

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Table 6(a): Securing Ecological Sustainable Development and Use of Natural Resources

Need and Desirability Guideline Batch 1 Questions	Answer	Further Assessment Required in EIA (Yes/No)
1. How will this development (and its separate elements/ aspects) impact on the ecological integrity of the area?	Ecological baseline assessments (terrestrial and freshwater winter surveys) were conducted by suitable and qualified ecologists during the Scoping Phase of the project. Important to note that these assessments could not be completed (i.e. no summer surveys could be undertaken) due to time constraints imposed by the Covid-19 virus which was classified as a pandemic by the World Health Organisation ("WHO"), and following related developments within South Africa, the Government declared a nationwide lockdown with severe restrictions on travel and movement. Aspects to be considered/ additional assessments required in order to finalise and conclude the specialist environmental studies by each specialist, is provided and discussed in detail in section 9.3 of this report.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.1. How were the following ecological integrity considerations taken into account?	Baseline Ecological Assessments was informed by relevant available databases which included (but was not limited to) the South African National Biodiversity Institute (SANBI) Threatened Species Programme (TSP), Mucina and Rutherford (2006), Version 2017.1 of the Red List of South African Plants, Important Bird Areas in conjunction with the South African Bird Atlas Project (SABAP 2), National Web-based Environmental Screening Tool, the National Freshwater Ecosystem Priority Areas (NFEPA) database, updated WET-Health Version 2.0, Mpumalanga Biodiversity Sector Plan (MBSP) and the National Land Cover 2014 Dataset.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.1.1. Threatened Ecosystems,	According to the National Threatened Ecosystem Database (2011) the project area is located in the Soweto Highveld Grassland, which is listed as a Threatened Ecosystem (Vulnerable). Any remnants of untransformed grassland present in the project area should be considered to be high value natural habitat that is representative of Soweto Highveld Grassland until this can be confirmed during the summer surveys to be conducted during the EIA Phase of the project.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.1.2. Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure,	Extensive Freshwater Ecosystem Priority Area (FEPA) wetlands occur across the study area. Almost 53 % of wetland habitat was considered to be of High Importance and Sensitivity, with this including the majority of the Floodplain wetlands on site. A key determinant resulting in the High Importance and Sensitivity rating of many of the Floodplain wetlands was the ecological importance and sensitivity, specifically the landscape level aspect. The threatened status of the vegetation type of the area, the diversity of habitats supported by the floodplain wetlands and the large size of these wetlands contributed towards this rating. This result also largely mirrors the Mpumalanga Biodiversity Sector Plan (2014), which identified much of the floodplain wetlands as Critical Biodiversity Areas (CBAs) Irreplaceable or Optimal.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.

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Need and Desirability Guideline Batch 1 Questions	Answer	Further Assessment Required in EIA (Yes/No)
	As part of the EIA phase of the study, extensive further work is proposed to improve the accuracy and level of detail of the wetland assessment. To ensure the desired, and required, improved accuracy and level of detail on the wetland delineation and assessment can be achieved, it is critical that further wetland work be undertaken during the summer months, and ideally towards the peak of the summer growing season (i.e. between November and March).	
1.1.3. Critical Biodiversity Areas ("CBAs") and Ecological Support Areas ("ESAs"),	The Mpumalanga Biodiversity Sector Plan (2013) indicates numerous Critical Biodiversity Areas (CBAs), across the study area. It is clear from the linear nature of many of these CBAs that they are associated with the larger wetlands and rivers of the study area, while large areas of CBAs also occur associated with remaining natural grassland areas. The presence and location of CBA's and ESA's will be verified and confirmed during the summer surveys of the environmental specialist studies to be finalised and concluded during the EIA Phase of this project.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.1.4. Conservation targets,	The Mpumalanga Biodiversity Sector Plan (2013) is an important planning tool for identifying areas that are required for the conservation of a representative and sustainable sample of the province's biodiversity. The MBSP provides guidance on where land uses that are incompatible with biodiversity should be avoided and thus the primary decision support tool for the biodiversity component of EIA's. According to the MBSP, the key areas that need to be conserved in the project area are, major drainage lines and fragments of natural grassland. These areas will be assessed further during the EIA Phase of the project to verify and confirm the presence and locality within the project area. Mitigation/ Management targets will then subsequently also be proposed during this phase of the project.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.1.5. Ecological drivers of the ecosystem,	The Freshwater Specialist will verify and confirm the ecological drivers present and relevant in the project area during the summer survey to be finalised and concluded during the EIA Phase of this project.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.1.6. Environmental Management Framework (EMF),	No current/ up to date Environmental Management Framework for the Govan Mbeki local municipality could be located and assessed.	Yes - to be verified during the EIA Phase of the project.-
1.1.7. Spatial Development Framework, and	The proposed project and activities are in line with the objectives/ vision/ mission of the Govan Mbeki Municipality Spatial Development Framework.	No

Need and Desirability Guideline Batch 1 Questions	Answer	Further Assessment Required in EIA (Yes/No)
1.1.8. Global and international responsibilities relating to the environment (e.g. RAMSAR sites, Climate Change, etc.)	Impacts associated with the proposed new activities are expected to be localised, do not contain climate change elements (gaseous pollutants) and do not threaten any RAMSAR sites.	No
1.2. How will this development disturb or enhance ecosystems and/ or result in the loss or protection of biological diversity?	The combined development footprint of the North Ventilation Shaft might encroach on natural grassland. The position of all proposed ventilation shafts was however determined by the simulation model to ensure an optimal ventilation benefit.	Yes - to be verified during the EIA Phase of the project.-
1.2.1. What measures were explored to firstly avoid these negative impacts?	A comprehensive alternatives assessment in terms of the following were considered (full details of this process are relayed in Section 8.1 of this report): • property on which or location where the activity is proposed to be undertaken • type of activity to be undertaken • design or layout of the activity • technology to be used in the activity • operational aspects of the activity • the option of not implementing the activity Proposed Ventilation Shafts will be designed by specialist civil engineers according to all legal and guideline requirements.	No
1.2.2. Where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts?	The detail design of the proposed activity should take cognisance of the potential impact and implement adequate measures to avoid the impact, e.g. minimise the footprint, avoid unnecessary disturbance in area of concern.	Yes – delineation of natural grassland should be confirmed during summer survey.
1.2.3. What measures were explored to enhance positive impacts?	No positive impacts are expected in terms of the natural resources.	No
1.3. How will this development pollute and/or degrade the biophysical environment?	The potential impacts associated with the proposed activities that require new footprints were assessed and the outcome of this assessment is relayed in section 8.8 of this report.	Yes - Comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.3.1. What measures were explored to firstly avoid these impacts?	A comprehensive alternatives assessment in terms of the following were considered (full details of this process are relayed in Section 8.1 of this report): • property on which or location where the activity is proposed to be undertaken • type of activity to be undertaken • design or layout of the activity • technology to be used in the activity	Yes - Comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.

Need and Desirability Guideline Batch 1 Questions	Answer	Further Assessment Required in EIA (Yes/No)
	• operational aspects of the activity • the option of not implementing the activity Proposed Ventilation Shafts will be designed by specialist civil engineers according to all legal and guideline requirements.	
1.3.2. Where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts?	The detail design of the proposed activity should take cognisance of the potential impact and implement adequate measures to avoid the impact, e.g. minimise the footprint, avoid unnecessary disturbance in area of concern.	Yes – delineation of natural grassland should be confirmed during summer survey.
1.3.3. What measures were explored to enhance positive impacts?	No positive impacts are expected in terms of the natural resources within the project area.	No
1.4. What waste will be generated by this development?	None of the proposed activities will generate waste.	No
1.4.1. What measures were explored to firstly avoid waste?	Not Applicable	Not Applicable
1.4.2. Where waste could not be avoided altogether, what measures were explored to minimise, reuse and/or recycle the waste?	Not Applicable	Not Applicable
1.4.3. What measures have been explored to safely treat and/or dispose of unavoidable waste?	Not Applicable	Not Applicable
1.5. How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage?	A site-specific Phase 1 Heritage Impact Assessment (HIA) was conducted by a heritage specialist which confirms that none of the proposed activities which requires new footprints will disturb any cultural/heritage resources of any significance.	No
1.5.1. What measures were explored to firstly avoid these impacts?	Not Applicable	Not Applicable
1.5.2. Where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts?	Chance find procedures have been developed by the heritage specialist and will be incorporated into the EMPr to be implemented if any heritage resources are discovered during any construction/ operational or decommissioning activities.	No
1.5.3. What measures were explored to enhance positive impacts?	No positive impacts are expected in terms of the heritage resources within the project area.	No

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Need and Desirability Guideline Batch 1 Questions	Answer	Further Assessment Required in EIA (Yes/No)
1.6. How will this development use and/or impact on non-renewable natural resources?	To ensure sustainable reserve utilisation, Sasol Mining's Shondoni Colliery wishes to expand its operations to a new Block 8 North Reserve Area.	No
1.6.1. What measures were explored to ensure responsible and equitable use of the resources?	The Mining Right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area will be amended and the associated amended mining work programme will be submitted for approval by the competent authority.	No
1.6.2. How have the consequences of the depletion of the non-renewable natural resources been considered?	Sasol Mining uses selected technologies to safely and sustainably source, produce and market chemical and energy products competitively to create superior value for their customers, shareholders and other stakeholders.	No
1.6.3. What measures were explored to firstly avoid these impacts?	All impacts associated with current activities at Shondoni Colliery have been considered during the application and approval of all the environmental authorisations relevant to the site.	No
1.6.4. Where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts?	The approved EMPr will be amended to include and address all impacts associated with the proposed project (with regards to all the current and future activities).	Yes – Amendment of the Approved EMPr
1.6.5. What measures were explored to enhance positive impacts?	An approved Social and Labour Plan will be amended and submitted for approval by the competent authority.	No
1.7. How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part?	Specialist assessments in terms of surface water, groundwater and wetlands have commenced and will be finalised and concluded during the next phase of the project. A comprehensive ecological impact assessment will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMPr.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.7.1. Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds?	Specialist assessments in terms of surface water, groundwater and wetlands have commenced and will be finalised and concluded during the next phase of the project. A comprehensive ecological impact assessment will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMPr.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.

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Need and Desirability Guideline Batch 1 Questions	Answer	Further Assessment Required in EIA (Yes/No)
1.7.2. What measures were explored to firstly avoid the use of resources?	Service water requirements for Shondoni Colliery are and will be sourced from the underground water make.	No
1.7.3. If avoidance is not possible, to minimise the use of resources?	Not Applicable	Not Applicable
1.7.4. What measures were taken to ensure responsible and equitable use of the resources?	A Water Balance will be updated/ calculated as part of the Water Use Licence Application Process.	Yes – A Water Use Licence Application will be submitted to DWS.
1.7.5. What measures were explored to enhance positive impacts?	Not Applicable	Not Applicable
1.7.6. Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)? *note: (sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reduce the amount of waste they generate, without compromising their quest to improve their quality of life)*	Service water requirements for Shondoni Colliery are and will be sourced from the underground water make.	No
1.7.7 Does the proposed use of natural resources constitute the best use thereof? In other words, is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources for the proposed development alternative?)	Not Applicable	Not Applicable

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Need and Desirability Guideline Batch 1 Questions	Answer	Further Assessment Required in EIA (Yes/No)
1.7.8 Do the proposed location, type and scale of development promote a reduced dependency on resources?	Not Applicable	Not Applicable
1.8. How were a risk-averse and cautious approach applied in terms of ecological impacts?	A comprehensive set of baseline assessments were conducted and will be finalised by a team of specialists in support of the proposed project. For all the environmental components considered, the relevant specialists will, during the EIA Phase, conduct impact assessments, compile management plans and provide inputs on monitoring requirements. The civil engineering design team will then design the proposed facilities in compliance with the specialists' recommendations and subject to current best practice and legal requirements.	Yes - Comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.8.1. What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Ecological baseline assessments (terrestrial and freshwater winter surveys) were conducted by suitable and qualified ecologists during the Scoping Phase of the project. These assessments could not be completed (i.e. no summer surveys could be undertaken) due to time constraints imposed by the Covid-19 virus which was classified as a pandemic by the World Health Organisation ("WHO"), and following related developments within South Africa, the Government declared a nationwide lockdown with severe restrictions on travel and movement. Aspects to be considered/ additional assessments required in order to finalise and conclude the specialist environmental studies by each specialist, is provided and discussed in detail in section 9.3 of this report.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.8.2. What is the level of risk associated with the limits of current knowledge?	To ensure the desired, and required, accuracy and level of detail can be achieved for all the specialist environmental assessments, it is **critical** that further field surveys be undertaken during the summer months, and ideally towards the peak of the summer growing season (i.e. between November and March).	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP
1.8.3. Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	The risk averse and cautious approach followed is evident in the request for Extension on the prescribed timeframe for the EIA Phase, i.e. submitting the Final EIA/ EMP report to the DMRE in order to finalise and conclude the supporting specialist environmental studies in support of this project (see section 9.6 of this report). A comprehensive description of all the specialist environmental assessments that still need to be performed in order to provide comprehensive ecological and scientific information of high integrity in support of this project is relayed in section 9.3 of this report.	Yes - Baseline assessments (summer surveys) need to be completed and finalised during the EIA Phase of the project. Ensuing comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP

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Need and Desirability Guideline Batch 1 Questions	Answer	Further Assessment Required in EIA (Yes/No)
1.9. How will the ecological impacts resulting from this development impact on people's environmental right in terms following:	-	-
1.9.1. Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	A comprehensive set of baseline assessments were conducted and will be finalised by a team of specialists in support of the proposed project. For all the environmental components considered, the relevant specialists will, during the EIA Phase, conduct impact assessments, compile management plans and provide inputs on monitoring requirements. The civil engineering design team will then design the proposed facilities in compliance with the specialists' recommendations and subject to current best practice and legal requirements.	Yes - Comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.9.2. Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	No positive impacts are expected in terms of the natural resources within the project area.	No
1.10. Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	In view of the fact that it is deemed that all potential negative biophysical impacts that could result from the proposed project can be effectively managed, mitigated and rehabilitated, it is not expected that the proposed project will have any significant adverse socio-economic impacts. The overall motivation for the proposed project is to ensure and optimise sustainable reserve utilisation whilst ensuring effective and directed management of an operational mine, i.e. Shondoni Colliery, hence it can be argued that the proposed project will support the socio-economic wellbeing of the people.	Yes - Comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.
1.11. Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives/ targets/ considerations of the area?	At this point in time it is our assessment that the significant negative impacts associated with proposed developments can effectively be managed to acceptable levels.	Yes - Comprehensive ecological impact assessments will be conducted during the EIA Phase. The outcome will be documented in the EIAR and the proposed mitigation/ management of potential impacts will be provided in the EMP.

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Need and Desirability Guideline Batch 1 Questions	Answer	Further Assessment Required in EIA (Yes/No)
1.12. Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the project), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	In as much as the ideal situation would be to fully avoid sensitive environmental features by utilising a Site Selection Matrix, the nature of the proposed activities at Shondoni Colliery are dictated by the mineable seams within the naturally occurring mineral deposit. To ensure a sustainable supply of suitable quality coal to Sasol's petrochemical facilities, Sasol Mining has embarked on a reserve acquisition project by acquiring prospecting and mining rights over areas within or adjacent to the Secunda Complex mining right. Extension of the current underground mining activities into the new Block 8 North Reserve Area will therefore be associated with granted prospecting rights that will be included into the greater mining right (MP 30/5/1/2/3/2/ 1/138 MR) applicable to the coal reserve area. To ensure sufficient ventilation in the proposed extended underground workings, four new ventilation shafts are required in the north, north-western region of the Shondoni Colliery EMP boundary area. These shafts are required to ensure sufficient airflow in the underground mine workings which is a legal requirement in terms of the Mine Health and Safety Act and Regulations. The locality of these shafts was determined by ventilation simulation models which are informed by inter alia the mine layout and mine schedule. The most important limitation of these simulations is the ability to provide 80 m3/s (1 m/s in the last through road)of airflow as a minimum legal requirement for each underground section. Based on the above, it follows that a traditional Site Selection Matrix was not employed to select the preferred sites associated with the proposed activities. Sites were selected to ensure an optimal ventilation benefit and then subjected to an environmental impact assessment to confirm their suitability/acceptability from an environmental perspective. Alternative sites were investigated for both the West and North Up- and Downcast Ventilation Shafts as discussed in Table 8.1.1(a). In the case of the West Ventilation Shafts, the alternative sites could not be considered as the simulation models indicated that this would result in inadequate ventilation to the underground workings. In terms of the North Ventilation Shafts, the simulated positions were environmentally unsuitable (close to a watercourse). The alternative sites proposed further away from the watercourse could however be selected as the preferred alternative as the simulation models indicated that sufficient ventilation could be provided from these locations.	No
1.13. Describe the positive and negative cumulative ecological/biophysical impacts in relation to its location & existing and other planned developments in the area?	If the proposed project is managed as per the EMPr to be submitted and approved the cumulative impact on the bigger area can effectively be managed to acceptable levels.	Yes - A comprehensive cumulative impact assessment will be performed as part of the EIA Phase of this project.

Table 6(b): Promoting Justifiable Economic and Social Development

Need and Desirability Guideline Batch 2 Questions	Answer	Further Assessment Required in EIA (Yes/No)
2.1. What is the socio-economic context of the area, based on, amongst other considerations, the following considerations?		
2.1.1. The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area,	The development priorities as formulated by local economic stakeholders include the upgrading and maintenance of public and social infrastructure (e.g. clinics, police stations, schools etc.), employment creation, skills and youth development, diversified economic development and rural development.	No
2.1.2. Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.),	The SDF focuses on a few development corridors in the municipal area for specific purposes. In terms of this study the most important are a new economic special zone/industrial zone as envisaged between Secunda and Embalenhle with a focus on diversified activities including agro-processing and logistics. A rural strip south from Leandra is earmarked for future urban expansions. An urban agriculture zone is also envisaged just west from Kinross.	No
2.1.3. Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.),	The current land use within the EMPr boundary is mainly natural grasslands and cultivated (rain-fed) crops (maize and soya beans). There is just one pivot (irrigated) system in the central west area of the EMPr boundary. The area also has existing mines as well as mines to its southern border.	No
2.1.4. Municipal Economic Development Strategy ("LED Strategy").	Focus areas of the LED strategy are: Enterprise development, development of a green economy, tourism enhancement, skills development, urban renewal through projects of the Expanded Public Works programme focusing on social and municipal infrastructure as well as rural agricultural development.	No
2.2. Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	In terms of the SDF: The urban agricultural zone (west of Kinross) as future urban expansion zones of the SDF (south of Leandra) possibly falls within the EMPr area. Underground mining activities could possibly result in some surface subsidence which could impact negatively on these spatial objectives.	No
2.2.1. Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	The project will assist in job creation, skills development (through the SLP) and youth development. The SLP of the larger Secunda Mining Complex focuses on skills development programmes for their labour force and provide advice to their suppliers. Social funds should also be available to assist the low levels of social and municipal investment in the local area.	No
2.3. How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	It is an existing mine that should not affect the community's sense of place. The visual field of the communities should also not be impacted as this project relates mainly to the extension of underground mining activities. It could instead provide stability/continuity when replacing jobs from other mines that have reached end of life (e.g. Middelbult Colliery or as part of larger Secunda Mining Complex).	Yes

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Need and Desirability Guideline Batch 2 Questions	Answer	Further Assessment Required in EIA (Yes/No)
2.4. Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term?	In the case of surface subsidence due to underground mining/insufficient rehabilitation, future generations could experience negative impacts from underground mining activities in EMPr boundary area. Conversely, tax revenues from the mine could benefit future generations if spent on public programmes with long term positive impacts (e.g. education).	Yes
2.4.1. Will the impact be socially and economically sustainable in the short- and long-term?	Positive impacts will be medium term/ until the coal reserves are depleted. Long term negative impacts should be neutralised through a rehabilitation program.	Yes
2.5. In terms of location, describe how the placement of the proposed development will:		
2.5.1. Result in the creation of residential and employment opportunities in close proximity to or integrated with each other,	Yes, the EMPr boundary area is located on the western fringes of Secunda. The largest township with the highest densities in the municipal area (Embalenhle) is located in close proximity of the Shondoni Colliery EMPr boundary area.	No
2.5.2. Reduce the need for transport of people and goods,	People from nearby settlements can be employed if necessary.	No
2.5.3. Result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms public transport),	Employment numbers from the local communities might be too low to achieve scale and cost advantages for public transport.	No
2.5.4. Compliment other uses in the area,	Mining is one of the major land uses in and around the EMPr boundary area.	No
2.5.5. Be in line with the planning for the area,	Yes, see 2.5.4 above	No
2.5.6. For urban related development, make use of underutilised land available with the urban edge,	Not Applicable	Not Applicable
2.5.7. Optimise the use of existing resources and infrastructure,	Yes, substantial investment has been made in the Shondoni and Middelbult Collieries in 2016. Since the infrastructure is still rather new, the investor would need to capitalise on these investments for positive economic returns on the investment.	No
2.5.8. Opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	No, bulk infrastructure is already present and in use.	No
2.5.9. Discourage "urban sprawl" and contribute to compaction/densification,	No, the Shondoni Colliery is located on the outer western fringes Secunda, Kinross, Evander and Leandra. It could however provide some job opportunities for outlying settlements as discussed in 2.5.1 above.	No
2.5.10. Contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of	Not Applicable	Not Applicable

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Need and Desirability Guideline Batch 2 Questions	Answer	Further Assessment Required in EIA (Yes/No)
current needs,		
2.5.11. Encourage environmentally sustainable land development practices and processes,	Not Applicable	Not Applicable
2.5.12. Take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	Yes, it is located within close proximity of other mines and is determined by the coal reserve. It is also close to the Secunda Synfuels Operations.	No
2.5.13. The investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential),	Yes, the EMP boundary areas is located next to the Secunda Synfuels Operations.	No
2.5.14. Impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and	The project relates to the expansion of current activities, and hence the sense of place should already have become accustomed to mining activities.	No
2.5.15. In terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	Not likely.	No
2.6. How were a risk-averse and cautious approach applied in terms of socio-economic impacts?	Impacts will be quantified as far as possible using the largest margins for the impacted communities. The risk rating methodology as well as interviews with local stakeholders should also add control mechanism during the EIA Phase.	Yes
2.6.1. What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Local socio-economic data is sometimes limited but will not materially affect the conclusion of the assessment.	No
2.6.2. What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	Medium-Low.	Yes
2.6.3. Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	To be conducted during the EIA Phase.	Yes
2.7. How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following:		
2.7.1. Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	The Operation must adhere to the Occupational, Health and Safety Act (Act No.85 of 1993). Preventative measures will be assessed during the EIA Phase.	Yes

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Need and Desirability Guideline Batch 2 Questions	Answer	Further Assessment Required in EIA (Yes/No)
2.7.2. Positive impacts. What measures were taken to enhance positive impacts?	Will be established in during the EIA Phase.	Yes
2.8. Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socio-economic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	Underground mining activities could cause subsidence of agricultural land that would limit the agricultural potential of the land. Underground mining would most possibly limit full agricultural use a couple of years after closure. Wetland areas could be affected during construction or operations that could reduce the eco-systems services from these areas.	Yes
2.9. What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	To be assessed during the EIA Phase.	Yes
2.10. What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)?	'The polluter shall pay' principle should protect the local community against external/environmental costs related to the development. Preventative measures will be assessed during the EIA Phase.	Yes
2.10.1. Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	Need to establish during the EIA Phase.	Yes
2.11. What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	Need to establish during the EIA Phase.	Yes
2.12. What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	Need to establish during the EIA Phase.	Yes
2.13. What measures were taken to:		
2.13.1. Ensure the participation of all interested and affected parties,	A comprehensive stakeholder engagement programme is compiled at the start of the project following the relevant available legislation and guidelines. • National Environmental Management Act, 1998 (Act No. 107 of 1998) – NEMA	No

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Need and Desirability Guideline Batch 2 Questions	Answer	Further Assessment Required in EIA (Yes/No)
	• Public Participation Guideline – GNR 807 of 10 October 2012 • Publication of the companion guideline on the implementation of the Environmental Impact Assessment Regulations, 2010 – GNR 805 of 10 October 2012 • Public Participation Guideline in terms of National Environmental Management Act, 1998 Environmental Impact Assessment Regulations, 2017 A formal I&AP database is compiled at the start of the project and is updated/expanded as the process continues.	
2.13.2. Provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	A comprehensive stakeholder engagement programme is followed as stipulated in the relevant and available legislation and guidelines above. People are provided with the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation. All information pertaining to the stakeholder engagement process will be provided in three official languages.	No
2.13.3. Ensure participation by vulnerable and disadvantaged persons,	A comprehensive stakeholder engagement programme is followed as stipulated in the relevant and available legislation and guidelines above. A formal I&AP database is compiled at the start of the project and is updated/expanded as the process continues. Participation of all I&AP's are encouraged.	No
2.13.4. Promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means,	A comprehensive stakeholder engagement programme is followed as stipulated in the relevant and available legislation and guidelines above. Information provided to the I&AP's with regards to the project and the impact on the environment and the management of these impacts are clear and concise and opportunity is provided for any questions. Opportunity is also provided for I&AP's to provide comments to which the EAP will provide feedback as part of the formal process to which the I&AP's have access to.	No
2.13.5. Ensure openness and transparency, and access to information in terms of the process	A comprehensive stakeholder engagement programme is followed as stipulated in the relevant and available legislation and guidelines above. Information provided to the I&AP's with regards to the project and the impact on the environment and the management of these impacts are clear and concise and opportunity is provided for any questions. Opportunity is also provided for I&AP's to provide comments to which the EAP will provide feedback as part of the formal process to which the I&AP's have access to.	No
2.13.6. Ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge, and	A comprehensive stakeholder engagement programme is followed as stipulated in the relevant and available legislation and guidelines above. Information provided to the I&AP's with regards to the project and the impact on the environment and the management of these impacts are clear and concise and opportunity is provided for any questions.	No

Need and Desirability Guideline Batch 2 Questions	Answer	Further Assessment Required in EIA (Yes/No)
	Opportunity is also provided for I&AP's to provide comments to which the EAP will provide feedback as part of the formal process to which the I&AP's have access to.	
2.13.7. Ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein were be promoted?	A comprehensive stakeholder engagement programme is followed as stipulated in the relevant and available legislation and guidelines above. A formal I&AP database is compiled at the start of the project and is updated/expanded as the process continues. Participation of all I&AP's are encouraged.	No
2.14. Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)	The development provides job opportunities for low, medium and skilled labour. It also provides procurement opportunities for local businesses.	No
2.15. What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work?	Project needs to conform to Mine Health and Safety Act (Act No. 29 of 1996).	No
2.15.1. What measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	Workers should be projected under the Mine Health and Safety Act (Act No. 29 of 1996).	No
2.16. Describe how the development will impact on job creation in terms of, amongst other aspects:		No
2.16.1. The number of temporary versus permanent jobs that will be created,	The project will enable the mine to continue at current (permanent) employment levels with a possibility to replace lost jobs due to mine closures elsewhere in the larger Secunda Mining Complex (including Middelbult Colliery). Some temporary jobs might also be created during the construction phase.	Yes
2.16.2. Whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area),	Only in as far as local labour replaces current workers that stay outside the area. There might also be limited short term opportunities related to additional mining infrastructure being constructed.	Yes
2.16.3. The distance from where labourers will have to travel,	There is a large pool of unskilled labour within or close to the EMPr boundary area. Need to assess to what extent local labour is used in the collieries within the EMPr area.	Yes
2.16.4. The location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and	There is a large pool of unskilled labour within or close to the EMPr boundary area. Need to assess to what extent local labour is used in the collieries within the EMPr area.	Yes

Need and Desirability Guideline Batch 2 Questions	Answer	Further Assessment Required in EIA (Yes/No)
2.16.5. The opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	It is a possibility that agricultural land and jobs might be lost due to subsidence of land related to underground mining activities.	Yes
2.17. What measures were taken to ensure:		
2.17.1. That there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and	A comprehensive stakeholder engagement programme is followed as stipulated in the relevant and available legislation and guidelines above. All the relevant competent authorities form part of the formal I&AP database. Participation of all I&AP's are encouraged.	
2.17.2 That actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	To date no conflict of interest between organs of state were noted. Should any conflict arise, it will be dealt with in the formal stakeholder engagement programme as prescribed by the relevant and available legislation and guidelines above.	
2.18. What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	To be assessed during the EIA Phase.	Yes
2.19. Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	To be assessed during the EIA Phase.	Yes
2.20. What measures were taken to ensure that he costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	To be assessed during the EIA Phase.	Yes
2.21. Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	Alternatives to the project is at this stage rather academic since it is the expansion of an existing project	No

Need and Desirability Guideline Batch 2 Questions	Answer	Further Assessment Required in EIA (Yes/No)
2.22. Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	The numerous mines in the local area, increase the energy intensity of the local economy and jointly result in an undiversified economy vulnerable to fluctuations in international commodity prices. It also jointly becomes an attractive hub for homeless and unskilled jobseekers from elsewhere to settle in the area that place pressure on public service delivery and infrastructure, it could impact negatively on safety and security related issues in the local area	Yes

7. PERIOD OF ENVIRONMENTAL AUTHORISATION REQUIRED

The coal mined at Shondoni Colliery will contribute as feedstock to the SSO. Through the years, significant portions of the areas where coal mining could be conducted economically have been depleted. To sustain a steady supply of suitable quality coal to Sasol's petrochemical facilities, Sasol Mining has embarked on a reserve acquisition project by applying for and acquiring prospecting and mining rights over areas within or adjacent to the Secunda Complex mining right.

Most of the designs for operational facilities are done for time periods varying between 20 years and 30 years. It would therefore seem realistic to request that whichever authorisations are granted, they be granted for a time period of **at least 30 years**.

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8. SELECTION OF PREFERRED ACTIVITY, SITE AND LOCATION

The objective of this section is to determine the specific site layout having taken into consideration:

- the comparison of the originally proposed site plan,
- the comparison of this plan with the plan of environmental features and current land uses,
- the issues raised by interested and affected parties, and
- the consideration of alternatives to the initially proposed site layout as a result.

8.1. DETAILS OF ALTERNATIVES CONSIDERED

In terms of the different alternatives to be considered, reference is made to the definition for *alternatives* as contained in the EIA Regulations – GNR 982 of 04 December 2014.

"*alternatives*" in relation to a proposed activity, means different ways of meeting the general purpose and requirements of the activity, which may include alternatives to the -

(a) property on which or location where the activity is proposed to be undertaken
(b) type of activity to be undertaken
(c) design or layout of the activity
(d) technology to be used in the activity
(e) operational aspects of the activity
(f) the option of not implementing the activity

8.1.1. Alternatives Associated with Proposed New Activities

The following proposed activities at Shondoni Colliery were identified for EA and alternatives associated with the activities have been considered:

- Underground mining of the new Block 8 North Reserve Area
- Construction and Operation of West Upcast Ventilation Shaft
- Construction and Operation of West Downcast Ventilation Shaft
- Construction and Operation of North Upcast Ventilation Shaft
- Construction and Operation of North Downcast Ventilation Shaft

An Alternative Identification and Motivation Table (Table 8.1.1(a)) has been compiled which provides a summary of the outcome of the alternative's assessment. Refer to Figure 8.1.1(a) for the alternative positions considered in terms of the proposed ventilation shafts. The assessment was further informed by the mining and site layout and environmental features map.

Refer to sections 8.5, 8.6 and 8.7 of this report for a description of the current land uses and the environmental features map compiled in support of this project.

A large-scale version of the proposed site layout plan, overlaid on the environmental features map, is attached as **APPENDIX 8(A)** to this report.

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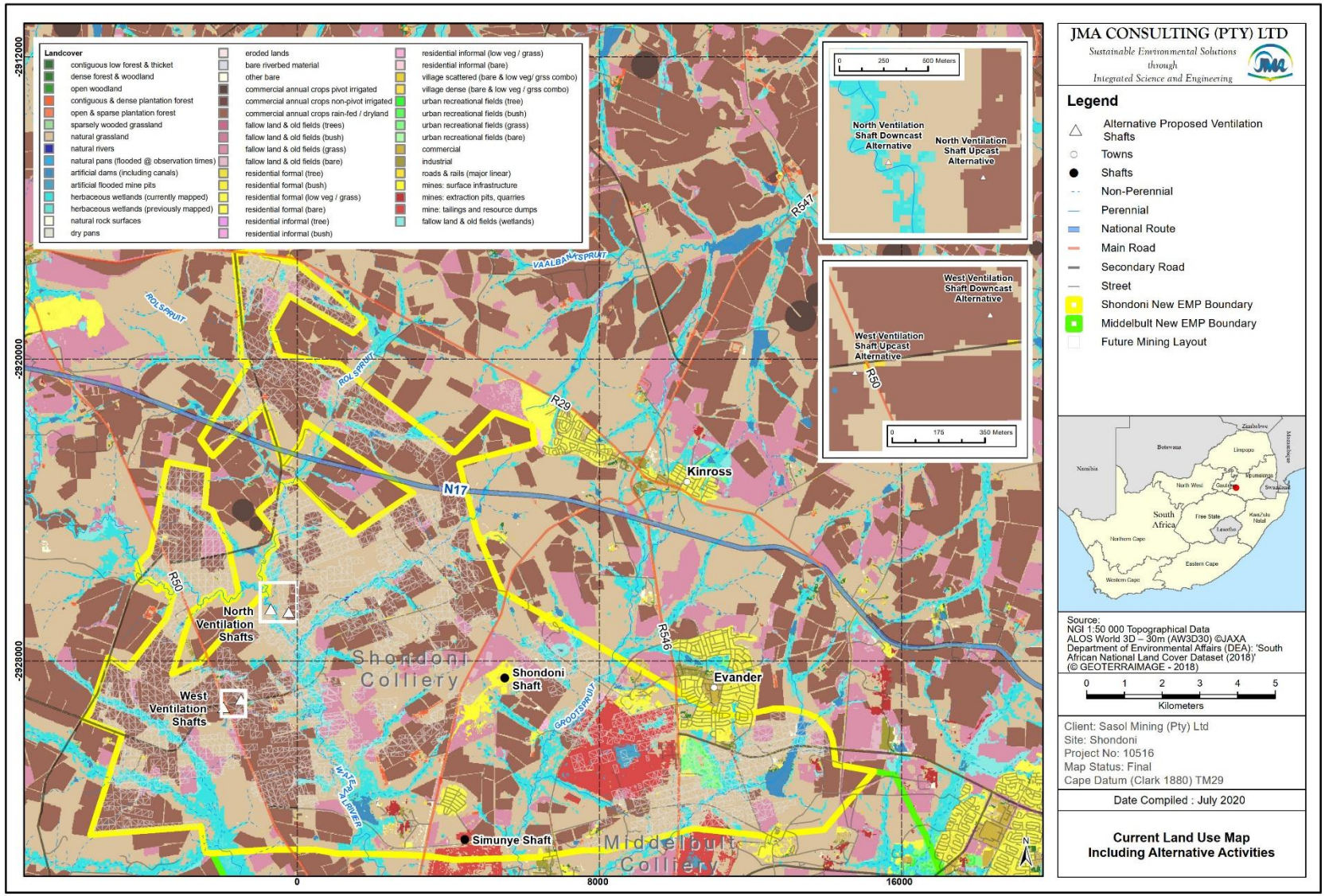

Figure 8.1.1(a): Alternative Positions Considered in terms of the proposed Ventilation Shafts

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Table 8.1.1(a): Alternatives Identification and Motivation

Activity	Alternative Property	Alternative Site	Alternative Type of Activity	Alternative Design/ Layout	Alternative Technology	Alternative Operational Aspects	No-Go Alternative
Underground mining of new Block 8 North Reserve	Extension of current underground mining activities on properties associated with granted prospecting rights within the new Block 8 North Reserve Area that will be included into the mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area.	Extension of a current activity approved in the 2011 EMPr.	Coal Mining can be done as either open cast or underground mining. As a result of the depth of coal within the Shondoni Colliery EMP boundary area, open cast mining is not possible and therefore only underground mining methods are viable.	The mine plan/ schedule provided in section 4.4.2.3 of this report was optimised during a series of planning meetings during which aspects related to *inter alia* coal seam extraction, water make, subsidence and groundwater recharge was considered and optimised.	Underground mining can be done by three major methods namely Bord and Pillar Mining, Increased or High Extraction Mining, Total Extraction Mining. These methods are discussed in section 4.4.2.1 of this report. Bord and Pillar Mining is currently being conducted but the other methods will be considered if deemed necessary/viable.	Standard Bord and Pillar Mining is currently being conducted.	The coal mined at Shondoni Colliery will contribute as feedstock to the SSO. Significant portions of the areas where coal mining could be conducted economically have been depleted. To ensure a sustainable supply of suitable quality coal to Sasol's petrochemical facilities, Sasol Mining has embarked on a reserve acquisition project by acquiring prospecting and mining rights over areas within or adjacent to the Secunda Complex mining right.
Preferred Alternative	**No Property Alternative**	**No Site Alternative**	**Underground Mining**	**No Design/ Layout Alternative**	**Currently Bord and Pillar Mining. Other methods could be considered if deemed necessary/ viable.**	**Currently Bord and Pillar Mining. Other methods could be considered if deemed necessary/ viable.**	**The no-go option will prevent sustainable development**
West Upcast Ventilation Shaft	Operations will be on Properties associated the mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area.	**Alternative Site 1**: Position identified by simulation model to ensure adequate ventilation. Site located in close proximity to farmer residences. **Alternative Site 2:** Positions selected further from farmer residences in attempt to alleviate potential negative impacts but simulation model indicated these positions would result in a ventilation limitation.	Ventilation Shafts are required in order to ensure sufficient airflow in the underground mine workings which is a legal requirement in terms of the Mine Health and Safety Act and Regulations.	The design and layout of a ventilation shaft is determined by ventilation simulation models. The most important limitation of these simulations is the ability to provide 80 m^3/s (1 m/s in the last through road)of airflow as a minimum legal requirement for each underground section.	The development of the ventilation shaft will be done in compliance with current legislation and best practise guidelines and through standard civil construction technologies as determined by the approved civil designs as well as site conditions.	The Ventilation Shaft will operate in accordance with approved design specifications as informed by the simulation model to ensure an optimal ventilation benefit.	Ventilation Shafts are required in order to ensure sufficient airflow in the underground mine workings.
Preferred Alternative	**No Property Alternative**	**Alternative Site 1**	**No Activity Type Alternative**	**No Design/ Layout Alternative**	**No Technology Alternative**	**No Operational Aspects Alternative**	**The no-go option will result in inadequate underground ventilation**
West Downcast Ventilation Shaft	Operations will be on Properties associated the mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area.	**Alternative Site 1:** Position identified by simulation model to ensure adequate ventilation. Site located in close proximity to farmer residences. **Alternative Site 2:** Positions selected further from farmer residences in attempt to alleviate potential negative impacts but simulation model indicated these positions would result in a ventilation limitation.	Ventilation Shafts are required in order to ensure sufficient airflow in the underground mine workings which is a legal requirement in terms of the Mine Health and Safety Act and Regulations.	The design and layout of a ventilation shaft is determined by ventilation simulation models. The most important limitation of these simulations is the ability to provide 80 m^3/s (1 m/s in the last through road)of airflow as a minimum legal requirement for each underground section.	The development of the ventilation shaft will be done in compliance with current legislation and best practise guidelines and through standard civil construction technologies as determined by the approved civil designs as well as site conditions.	The Ventilation Shaft will operate in accordance with approved design specifications as informed by the simulation model to ensure an optimal ventilation benefit.	Ventilation Shafts are required in order to ensure sufficient airflow in the underground mine workings.

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Activity	Alternative Property	Alternative Site	Alternative Type of Activity	Alternative Design/ Layout	Alternative Technology	Alternative Operational Aspects	No-Go Alternative
Preferred Alternative	**No Property Alternative**	**Alternative Site 1**	**No Activity Type Alternative**	**No Design/ Layout Alternative**	**No Technology Alternative**	**No Operational Aspects Alternative**	**The no-go option will result in inadequate underground ventilation**
North Upcast Ventilation Shaft	Operations will be on Properties associated the mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area.	**Alternative Site 1:** Position identified by simulation model to ensure adequate ventilation. Downcast Shaft located too close to a watercourse. **Alternative Site 2**: Approximately 530 m to the east of Alternative Site 1. Adequate ventilation still possible and located further away from watercourse.	Ventilation Shafts are required in order to ensure sufficient airflow in the underground mine workings which is a legal requirement in terms of the Mine Health and Safety Act and Regulations.	The design and layout of a ventilation shaft is determined by ventilation simulation models. The most important limitation of these simulations is the ability to provide 80 m^3/s (1 m/s in the last through road)of airflow as a minimum legal requirement for each underground section.	The development of the ventilation shaft will be done in compliance with current legislation and best practise guidelines and through standard civil construction technologies as determined by the approved civil designs as well as site conditions.	The Ventilation Shaft will operate in accordance with approved design specifications as informed by the simulation model to ensure an optimal ventilation benefit.	Ventilation Shafts are required in order to ensure sufficient airflow in the underground mine workings.
Preferred Alternative	**No Property Alternative**	**Alternative Site 2**	**No Activity Type Alternative**	**No Design/ Layout Alternative**	**No Technology Alternative**	**No Operational Aspects Alternative**	**The no-go option will result in inadequate underground ventilation**
North Downcast Ventilation Shaft	Operations will be on Properties associated the mining right (MP 30/5/1/2/3/2/1/138 MR) applicable to the coal reserve area.	**Alternative Site 1:** Position identified by simulation model to ensure adequate ventilation. Site located too close to a watercourse. **Alternative Site 2:** Approximately 530 m to the east of Alternative Site 1. Adequate ventilation still possible and further away from watercourse.	Ventilation Shafts are required in order to ensure sufficient airflow in the underground mine workings which is a legal requirement in terms of the Mine Health and Safety Act and Regulations.	The design and layout of a ventilation shaft is determined by ventilation simulation models. The most important limitation of these simulations is the ability to provide 80 m^3/s (1 m/s in the last through road)of airflow as a minimum legal requirement for each underground section.	The development of the ventilation shaft will be done in compliance with current legislation and best practise guidelines and through standard civil construction technologies as determined by the approved civil designs as well as site conditions.	The Ventilation Shaft will operate in accordance with approved design specifications as informed by the simulation model to ensure an optimal ventilation benefit.	Ventilation Shafts are required in order to ensure sufficient airflow in the underground mine workings.
Preferred Alternative	**No Property Alternative**	**Alternative Site 2**	**No Activity Type Alternative**	**No Design/ Layout Alternative**	**No Technology Alternative**	**No Operational Aspects Alternative**	**The no-go option will result in inadequate underground ventilation**

8.2. DETAILS OF STAKEHOLDER ENGAGEMENT FOLLOWED

A summary of the Stakeholder Engagement/ Public Participation Programme undertaken in support of this project is provided in the sections below. A Comprehensive Stakeholder Engagement Programme (SEP) Report will be attached as Appendix to the Draft/Final EIA Report. This report will provide the details and copies of all documents and information provided to Interested and Affected Parties (I&AP's) as well as proof of all the actions taken during the SEP undertaken in support of this project.

8.2.1. The I&AP Database

At the start of any stakeholder engagement process a formal I&AP database must be compiled which needs to be updated/expanded as the process continues. The relevant regulations define I&AP's as:

- Any person, group of persons or organisation interested in, or affected by an activity
- Any organ of state that may have jurisdiction over any aspect of the activity

As per guidelines considered, I&AP's were deemed as the following:

- Landowners
- Lawful Land Occupier
- Landowners or Lawful Land Occupier on adjacent properties
- Municipal Councillor (Ward Councillor)
- The Local Municipality
- The District Municipality
- Traditional Authority/Leaders
- Host Communities
- The Department of Rural Development and Land Reform
- The Department of Water and Sanitation (DWS)
- The Department of Environment, Fisheries and Forestry (DEFF)
- Other relevant Government Agencies and Institutions responsible for the various aspects of the environment and for infrastructure

Having full regard for the above, a formal I&AP database was compiled for this project. This database will continually be updated throughout the process.

8.2.2. Proof of Notifications to Landowners, Land Occupiers and I&AP's

During the Notice of Application and Scoping Phase Public Meeting Stage, a Notification Letter was compiled to formally inform provisionally identified I&AP's of the project as well as the SEP to be followed.

8.2.3. Information provided to I&AP's

In support of this notification, a Background Information Document (BID) relaying the information pertaining to the project (including maps and diagrams) as well as the SEP to be followed was also compiled for distribution to I&AP's.

At the onset of the SEP, the Notification Letter and BID were e-mailed to I&AP's in cases where relevant details were available.

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A Registration Form and Questionnaire were also e-mailed on this occasion where I&AP's were invited to provide general comments to the EAP but also specifically to provide details of any other I&AP not included in the provisional I&AP database which they deemed relevant to the project. To ensure that all I&AP's were notified, notifications were also sent via sms'e.

Newspaper advertisements as well as site notices were compiled by JMA Consulting relaying information pertaining to the project, the SEP to be followed as well as information regarding the Scoping Phase Public Meeting held on 04 September 2020.

Newspaper advertisements (English and Afrikaans) appeared on 21 August 2020 in the Ridge Times. These advertisements notified I&AP's of the Scoping Phase Public Meeting to be held on 04 September 2020 at the Shondoni Shaft Complex Auditorium.

Site Notices were put up in advance of the Scoping Phase Public Meeting at the following sites:

- Shondoni Shaft Complex Entrance
- Simunye Shaft Complex Entrance
- Secunda Public Library
- Embalenhle Community Library
- Evander Public Library
- Kinross Public Library

The Draft Scoping Report compiled in strict compliance with the EIA Regulations were made available to I&AP's for review. Electronic copies of this report were made available on the JMA website http://www.jmaconsult.co.za/public participation/Sasol Shondoni and CD's were also available and distributed to I&AP's on request. Notifications were e-mailed and sms'ed to all Registered I&AP's after distribution of reports in cases where relevant details were available. Time frames for commenting were clearly indicated to I&AP's and were set for a minimum 30-day period as required by the NEMA EIA Regulations.

The Draft Scoping Report was made available for comment on 04 September 2020 to I&AP's for a 30-day period until 07 October 2020.

The Draft Scoping Report was available for I&AP review at the following public venues:

- Secunda Public Library
- Embalenhle Community Library
- Evander Public Library
- Kinross Public Library

8.2.4. Public and other Meetings

The Scoping Phase Public Meeting was held on 04 September 2020 at the Shondoni Shaft Complex Auditorium.

The EAP addressed the full agenda of the meeting in the format of a slide show and explained what the proposed project entailed. The contents of the Draft Scoping Report were discussed with the I&AP's and opportunity was provided to I&AP's to ask questions and to raise concerns regarding the proposed project.

I&AP's were informed that the Draft Scoping Report would be available for public review. Time frames in this regard were communicated to the I&AP's as well as the details on where the reports were available and how they could obtain a copy thereof.

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8.2.5. The Stakeholder Engagement Programme (SEP) Report

A SEP Report will be compiled in support of the S&EIR Process followed for this project.

The NEMA regulations were reviewed specifically for requirements relating to the Stakeholder Engagement Process. These regulations were strictly adhered to during the SEP conducted for this project.

Several guideline documents are currently available to assist persons when conducting a stakeholder engagement process and all of these documents were extensively studied and incorporated into the planning for this report. However, the primary source of guidance was the EIA Regulation GNR 807 of 10 October 2012 – Publication of Public Participation Guideline.

The Guidelines describe the Stakeholder Engagement Process as follows:

- Provide an opportunity for I&AP's, EAP's and the CA to obtain clear, accurate and understandable information about the environmental impacts of the proposed activity or implications of a decision;
- Provide I&AP's with an opportunity to voice their support, concerns and questions regarding the project, application or decision;
- Provide I&AP's with the opportunity of suggesting ways of reducing or mitigating any negative impacts of the project and for enhancing its positive impacts;
- Enable an applicant to incorporate the needs, preferences and values of affected parties into its application;
- Provide opportunities for clearing up misunderstandings about technical issues, resolving disputes and reconciling conflicting interests;
- It is an important aspect of securing transparency and accountability in decision-making; and
- It contributes towards maintaining a healthy, vibrant democracy.

This SEP Report will continually be updated during the project and will reflect and addresses all comments that were received during the I&AP Review periods. The draft/ final SEP Report will be submitted to the relevant authorities as an Appendix to the Draft/Final EIA Report.

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8.3. SUMMARY OF ISSUES RAISED BY I&AP'S

A summary of the Issues raised by I&AP's is relayed in Table 8.3(a) and is provided below. A concise description of the views on the preferred alternatives, views on the existing environment, views on potential impacts and mitigation is relayed in the sections below.

8.3.1. Views on Preferred Alternatives

No comments were received in terms of the Preferred Alternatives.

8.3.2. Views on Existing Environment

No comments were received in terms of the Exisiting Environment.

8.3.3. Views on Impacts and Mitigation

No comments were received in terms of the Impacts and Mitigation Aspects.

8.3.4. Issues and Concerns Register

A formal Issues and Concerns Register was compiled for this Project which will be attached as an APPENDIX to the SEP Report at the conclusion of the EIA Phase. However, for the purposes of this Scoping Report, the current version of the Issues and Concerns Register relating to this Scoping Phase is shown in Table 8.3(a).

8.3.5. Objections

An objection was received in terms of the proposed underground mining associated with the property registered to the Andrew James Trust; Farm Winkelhaak 135 IS, Portion 134. See Table 8.3(a) below.

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Table 8.3(a): Summary of the Issues Raised by I&AP's during the Scoping Phase

Name of I&AP's	Community / Company	Consulted	Date of Comments Received	Issue / Concern Raised	Response from EAP	Consultation Status e.g. Consensus, Dispute, Not Finalised etc.)
SCOPING PHASE						
Andrew James	Andrew James Trust	YES – Public Meeting 04 September 2020	05 October 2020	Andrew James Trust bought Portion 134 of the Farm Winkelhaak 135 IS, from Capital Mining in 1999 with the aim for future development. Sasol Mining approached me approximately 2 years after that and told me that they obtained the underground rights. I have signed a document that I take note of it but told the officer of concern that my sole purpose was to develop the land later. I signed the document without impairing my rights. We ask that the underground mining be reconsidered or if underground mining will take place that the mining method will allow for future development.	JMA Consulting received a letter from Sasol Mining summarising various discussions and communication with Mr James. See attached **APPENDIX 8 (B).** Sasol Mining is still of the opinion that any surface improvements will limit coal extraction and casue significant revenue losses and cannot give permission to develop infrastructure apart from what was previously agreed with Mr James.	Finalised

8.4. ENVIRONMENTAL BASELINE – TYPE OF ENVIRONMENT AFFECTED

In support of the requirement to submit a report generated by the National Web Based Environmental Screening Tool in terms of Section 24(5)(h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and Regulation 16(1)(b)(v) of the Environmental Impact Assessment (EIA) Regulations (GNR 982 of December 2014 as amended), when submitting an application for environmental authorisation, the required report generated is attached as **APPENDIX 8(C).**

The abovementioned Screening Report identified several environmental features/ attributes to be assessed and to be included in the assessment report (this Scoping Report). Refer to the table below (Table 8.4(a)) for the list of these environmental features/ attributes as well as comments/ motivation provided by the EAP in this regard.

Environmental baseline information relayed in the following sections was obtained from various sources including the 2011 EIA Process which were updated and supplemented with relevant baseline data generated since 2011, as well as specialist environmental studies conducted specifically in support of this project by a team of specialists. The full list of environmental components considered, is listed below:

- Socio-Cultural and Socio-Economic Aspects
- Archaeology, Heritage and Palaeontology
- Climate and Meteorology
- Topography
- Soils
- Land Capability
- Land Use
- Geology and Geochemistry
- Groundwater
- Surface Water
- Terrestrial Ecology (Plant Life & Animal Life)
- Aquatic Ecosystems
- Wetlands
- Air Quality
- Noise
- Visual Aspects

Summaries/ extracts of the current environmental conditions (baseline descriptions) relevant to the proposed project area have been obtained from these Specialist Baseline Reports compiled in support of this project and will be provided in the following sections.

Important to note that several of the specialists could not complete their baseline assessments due to time constraints imposed by the Covid-19 virus which was classified as a pandemic by the World Health Organisation ("WHO"), and following related developments within South Africa, the Government declared a National State of Disaster relating to Covid-19 in terms of section 27(1) of the Disaster Management Act, 2002. On 23 March 2020, President Cyril Ramaphosa announced measures to combat the spread of the Covid-19 coronavirus in South Africa – a nationwide lockdown with severe restrictions on travel and movement. The initial national lockdown was for a period of 21 days which as increased to five weeks.

Aspects to be considered in order to finalise and conclude the specialist environmental studies by each specialist, is provided and discussed in detail in section 9.3 of this report.

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For this reason, an extension is requested on the prescribed timeframe for the EIA Phase, i.e. submitting the Final EIA/ EMP report to the DMRE in order to finalise and conclude the supporting specialist environmental studies in support of this project. The proposed extension (timeframes) and motivation in this regard is provided in section 9.6 of this report.

The Specialist Reports will only be finalised during the EIA Phase of this project and are therefore not attached to this report but are fully referenced in each section and will be available in hard copy and electronic format during the EIA Phase of this project.

Table 8.4(a): Environmental Attributes identified in the Screening Report and comments from the EAP

Environmental Attribute/ Specialist Assessment	Comment/ Motivation by the EAP
Agricultural	The Agricultural Sensitivity of the project area will be assessed and confirmed as part of the Soils, Land Capability and Land Use Specialist Assessment in support of the S&EIR Process. Refer to **APPENDIX 8(D)** for the professional opinion of the Soil Specialist in this regard.
Landscape/ Visual	A Visual Impact Assessment (VIA) will be performed and a relevant specialist report will be compiled in support of this S&EIR Process.
Archaeological and Cultural Heritage	An Archaeological and Cultural Heritage Impact Assessment will be performed, and a relevant specialist report will be compiled in support of this S&EIR Process.
Palaeontological	A Palaeontological Impact Assessment will be performed, and a relevant specialist report will be compiled in support of this S&EIR Process.
Terrestrial Biodiversity (Plant and Animal Life)	A Terrestrial Biodiversity (Plant Life and Animal Life) Impact Assessment will be performed and a relevant specialist report will be compiled in support of this S&EIR Process.
Aquatic Biodiversity	An Aquatic Biodiversity (Aquatic Ecosystems and Wetlands) Impact Assessment will be performed and a relevant specialist report will be compiled in support of this S&EIR Process.
Hydrology (Surface Water)	A Hydrology (Surface Water) Impact Assessment will be performed and a relevant specialist report will be compiled in support of this S&EIR Process.
Noise	A Noise Impact Assessment will be performed, and a relevant specialist report will be compiled in support of this S&EIR Process.
Radioactivity	The method and processes involved in underground coal mining by bord and pillar method, will not result in any radioactive materials accumulating. This assessment was therefore not deemed necessary in support of this project.
Traffic	The underground mining activities associated with this project will not have an effect on the surrounding traffic as the ROM coal extracted will be conveyed on established infrastructure, i.e. underground or overland conveyor. Therefore, a traffic impact assessment was not deemed to be required in support to this S&EIR Process.
Geotechnical	A Geotechnical Assessment will be performed if deemed necessary by the design team before the construction of the proposed ventilation shafts commences.
Climate	The underground mining activities associated with this project will not have an effect on the local/regional climate. Therefore, a climate impact assessment was not deemed to be required in support to this S&EIR Process.
Health	Health impacts will be assessed simultaneously with all the other environmental aspects impact assessments and will not be assessed as a separate aspect.
Socio-Economic	A Socio-Economic Impact Assessment will be performed, and a relevant specialist report will be compiled in support of this S&EIR Process.
Ambient Air Quality	An Ambient Air Quality Impact Assessment will be performed, and a relevant specialist report will be compiled in support of this S&EIR Process.
Seismicity	Mining induced seismic events are usually associated with deep gold mining activities. It is deemed unlikely that the method and processes involved in underground coal mining by bord and pillar method at Shondoni Colliery will result in any seismic events and a seismicity assessment was therefore not deemed necessary is support of the proposed project.

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8.4.1. Socio-Cultural and Socio-Economic Aspects

Specialist consultants from Southern Economic Development (SED) were requested to conduct a detailed Socio-Cultural/Economic specialist study in support of the proposed project.

The relevant Specialist Report is:

Socio-Economic Baseline Report for the Sasol Shondoni/Middelbult Environmental Authorisation Project, Mpumalanga Province July 2020; compiled by An Kritzinger (Economic Specialist) and Ingrid Snyman (Social Specialist).

The information provided below represents a concise summary of the baseline description compiled for the greater Shondoni/ Middelbult Colliery project area.

In terms of the demographic conditions, the project area (which consists of both the Middelbult and Shondoni Colliery) is located within the Govan Mbeki Municipality (GMM). The GMM population and households grew at a faster rate than the national population since 2011. These high growth rates coupled with lower female ratios, smaller household sizes and the relatively large economically active population suggest high-in migration to the municipal area of people looking for work on the mines, farms or in the greater Sasol Complex as a whole. The area south of the Shondoni Colliery EMP boundary area specifically shows high levels of people migrating to Embalenhle and the greater Secunda Complex area.

Some of the main social characteristics and challenges associated with the project area include the actuality that the population density within the project area is higher than the municipality in general, with almost half of the municipal population residing within the project area. Most of them (81%) resides in the Middelbult Colliery EMP boundary area (mainly Embalenhle), 11% in the New Block 8 North area and 8% in the lower density central areas of the Shondoni Colliery EMP boundary area.

Vulnerable households (female and child headed households) are more prevalent in the Middelbult and Shondoni Colliery EMP boundary areas than noticeably in the New Block 8 North (the rural area south of Lebohang). Due to the high in-migration into the project area, informal settlements have grown in the municipal area. Households living in shacks were much higher in the municipal area than nationally. A high concentration of informal houses is observed in the project area (Embalenhle and the rural areas to the west of the project area).

Despite the high incidence of informal houses in the project area, other municipal services are relatively well delivered apart from some regular refuse removal and sanitation backlogs in the rural area west of Embalenhle. However, residents in Embalenhle, eMzinoni and Leandra are showing increased dissatisfaction with the quality of service delivery (e.g. roads, littering, sewage spillages, electricity outages) with violent protests erupting in mid-2020 in the Emzinoni and Embalenhle areas over frequent electricity outages.

In general, GMM experiences a higher HIV/AIDS rate compared to the national figures and it shows an increasing trend. Clinics in this municipality are understaffed and it is most likely due to the rapid population growth.

The skill levels of the GMM labour force are higher than the national average - mainly due to the higher skills associated with the petro-chemicals industry in Secunda. Semi-skilled and skilled labour are however still scarce compared to the skills demand of the local economy.

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While the municipality has an extensive regional road network, the majority of regional and municipal roads have reached their lifespan and are in urgent need of upgrading and maintenance. The movement of numerous heavy vehicles transporting coal is also contributing to the road degradation.

The per capita crime rate of GMM is higher than the provincial average but lower than the national average and it shows a declining trend since 2011. GMM precincts that experience high crime rates in proportion to the population in the greater municipal area include Secunda/Trichardt, Evander and Kinross.

The municipality has technical and financial capacity constraints due to the high vacancy rates of key personnel. The GMM economy grew at a lower rate than the national economy since 2011. Despite the lower economic growth, population growth and in-migration to the area remained high. A large portion of profits and high skilled income earned from production activities in GMM are expatriated from the local area to be spent elsewhere in South Africa or outside the country.

Main sectors in the local economy include mining operations (coal and gold) and petro-chemicals produced at the SSO. Both sectors experienced positive but low economic growth since 2011. While the tertiary sector played a relatively smaller role in the GMM economy in terms of output, the main sectors made a major contribution towards employment. The trade, finance and services sector also showed strong growth since 2011.

Although formal employment grew at a higher rate than output since 2011, the growth in the labour force exceeded new job opportunities resulting in an increase in unemployment rates in the municipal area. Unemployment in GMM is however still below the national and provincial averages. Unemployment rates were higher in the project area than in the municipality in general. This is mainly due to the high unemployment rates in Embalenhle and the semi- rural area south of Lebohang.

While the GMM poverty rate is below the national average, still almost a third of households in the area lives below the poverty line. Social grants play a relatively large role in the GMM economy, as they contribute 24% towards total income, which is slightly higher than the 20% national average. As is the case with unemployment, poverty in the project area is also higher than in the municipality due to high poverty rates in the semi-rural area south of Lebohang; Embalenhle as well as the rural areas west from Embalenhle.

The share of unskilled labour income is slightly higher in the local economy than in the Province, mainly due to the petro-chemical sector that pays a relatively high share of income generated to low skilled labour.

The local economy is fairly focused on the mining sector whereas the manufacturing sector is focused on the production of petro-chemicals. Despite the fact that the markets for the products are relatively diversified between foreign and regional exports both these sectors are dependent on commodity prices. This means that the GMM economy face high exposure to volatile international commodity markets.

The GMM economy is less energy efficient than the national economy due to the large share of energy inefficient sectors like the mining and petro-chemicals sectors. On the other hand, the local economy is also more water efficient than the national economy due to the greater water efficiency of these sectors.

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The development priorities as formulated by local economic stakeholders include the upgrading and maintenance of public and social infrastructure (e.g. clinics, police stations, schools), employment creation, skills and youth development as well as diversified economic development.

Activities within the project area could have numerous possible socio-economic impacts on the local environment during various stages of the project, i.e. the construction, operational, de-commissioning and closure phases. These impacts will be investigated and quantified where possible during the ensuing socio-economic impact assessment (SEIA) study.

The main categories of potential impacts include:

- Social risks and impacts on diversity and gender (e.g. including impacts on safety, health, gender, social structures). The potential impact on farming activities and urban development due to possible subsidence and/or impact on water sources from underground mining activities would also be relevant here;
- Institutional impacts including the project's alignment with development opportunities and the additional demand on municipal services;
- Economic impacts including impacts on output, employment, poverty, income distribution, economic diversity and skills development; and
- Cumulative impacts related to other activities outside the project reinforcing negative impacts associated with the project.

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8.4.2. Archaeological and Heritage Aspects

Specialist consultant Dr Julius Pistorius was requested to conduct a detailed Archaeological and Heritage specialist study in support of the proposed project.

The relevant Specialist Report is:

A Phase I Heritage Impact Assessment Study for the Shondoni and Middelbult Mining Areas near Secunda in the Mpumalanga Province July 2020.

The information provided below represents an extract of the baseline description compiled with specific reference to the Shondoni Colliery EMP boundary area.

The Phase I Heritage Impact Assessment (HIA) for the Shondoni Colliery project area revealed the following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999), namely:

- Farmstead complexes comprising houses with outbuildings such as wagon sheds as well as individual residences;
- Graveyards and individual graves; and
- Commemorative beacons.

Refer to Figure 8.4.2(a) for a visual illustration of the location of these heritage resources.

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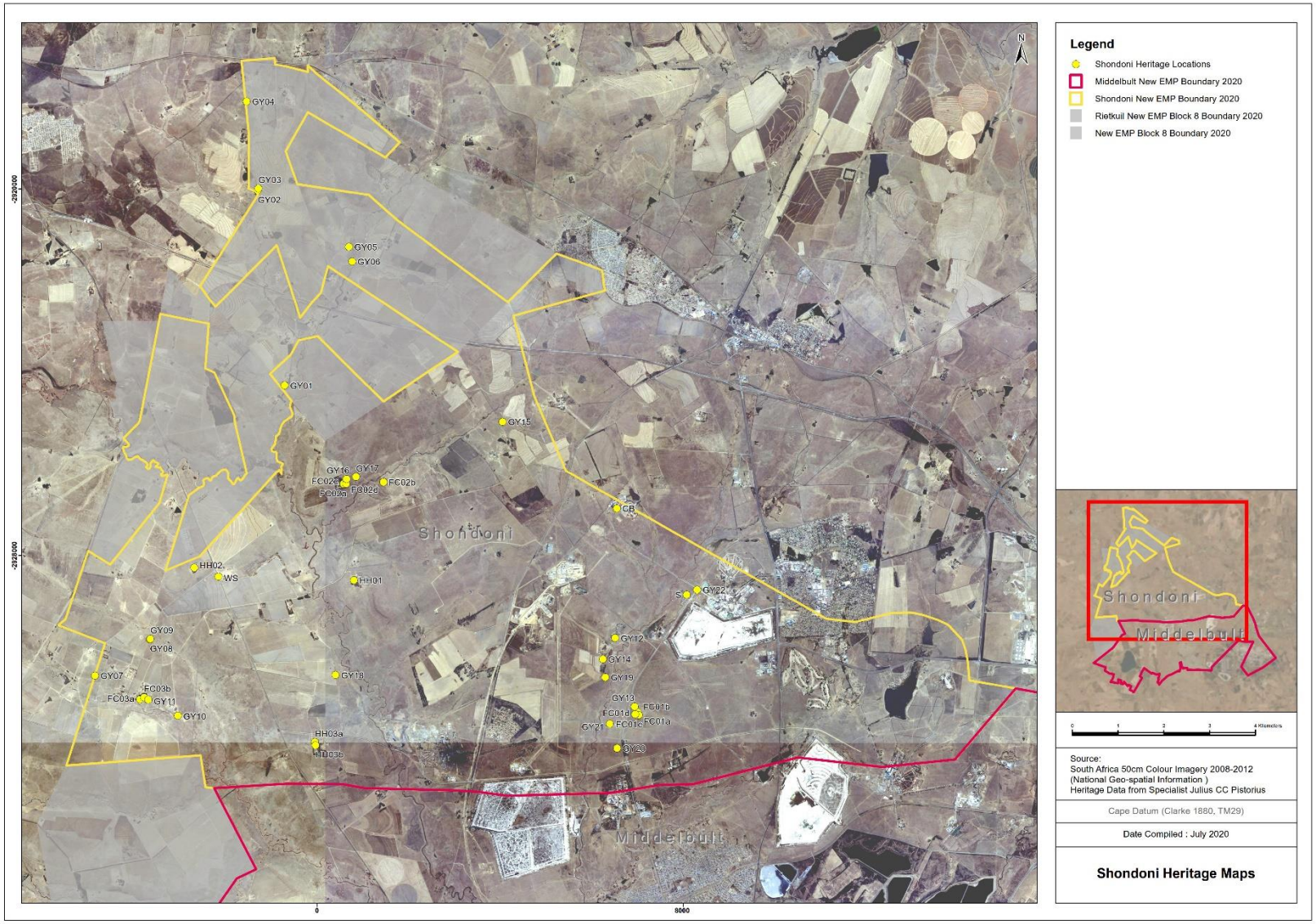

Figure 8.4.2(a): Map of the Heritage Resources within the Shondoni Colliery project area

8.4.2.1. Historical Remains (Farmstead Complexes, Historical Houses and Structures)

Presented in Table 8.4.2.1(a) is a list of the Historical Remains found within the Shondoni Colliery project area. Also relayed in this table are the coordinates of the remains.

Table 8.4.2.1(a): Historical Remains in the Shondoni Colliery Project Area

Historical Remains	Coordinates
Farmstead Complexes	
Farmstead Complex (FC01) Farmstead Complex on Witkleifontein 181IS consist of the following: FC01a: Main residence FC01b: Wagon Shed FC01c: 'Bywonershuis' (Cool room) FC01d: Elongated cattle enclosure	 26° 29' 43,735" S;29° 04' 13,562" E 26° 29' 41,454" S; 29° 04' 13,262" E 26° 29' 43,435" S; 29°04' 13,982" E 26° 29' 42,895" S; 29°04' 10,983" E
Farmstead Complex (FC02) Farmstead Complex on Kromdraai 128IS consists of the following: FC02a: Main residence FC02b: Wagon Shed FC02c: Rondavel FC02d: Cattle Kraal	 26° 26' 59,625" S; 29° 00' 20,709" E 26° 26' 58,125" S; 29° 00' 52,328" E 26° 26' 59,325" S; 29° 00' 20,889" E 26° 26' 59,385" S; 29° 00' 22,869" E
Historical Houses and Structures	
HH01: House on Kromdraai 128IS on turn of road with outbuilding	26° 28' 07,849" S; 29° 00' 29,129" E
HH02: House on Kromdraai 128IS with several outbuildings amongst others renovated wagon shed	26° 27' 58,999" S; 28° 58' 23,033" E
HH03a: House on Brendan Village dirt road HH03b: Wagon Shed	26° 30' 02,746" S; 28° 59' 58,350" E 26° 30' 04,946" S; 28° 59' 58,840" E
WS: Wagon Shed	26° 28' 05,209" S; 28° 58' 42,252" E
S: Shop on Kinross Mine road	26° 28' 17,979" S; 29° 04' 51,531" E
CB: Commemorative beacon and Karee tree	26° 27' 16,785" S; 29° 03' 56,463" E

Farmstead Complex 01

This farmstead complex on the Farm Witkleifontein 181 IS is associated with the Pieterse family. This complex holds the following individual structures (see Figure 8.4.2.1(a) and (b)):

- A wagon shed constructed with sandstone bricks and dolerite stone;
- A small square structure constructed with dolerite stone, probably served as a 'bywonershuis' or cool room ('koelkamer');
- A main residence constructed with sandstone bricks and dolerite stones; and
- An elongated cattle enclosure which was built with rocks.

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Figure 8.4.2.1(a): A possible 'bywonershuis' or a cool room ('koelkamer') on the farm Witkleifontein 181 IS which was constructed with dolerite stone	**Figure 8.4.2.1(b): A cattle enclosure on the farm Witkleifontein 181 IS constructed with stones**

Farmstead Complex 02

The farmstead complex on the Farm Kromdraai 128 IS is associated with some of the oldest graves that were observed in the area. The complex comprises of the following individual buildings (see Figure 8.4.2.1(c) and (d)):

- A wagon shed which was constructed with sandstone bricks and dolerite stone;
- A rondavel which was constructed with dolerite;
- An extended residence which was built with sandstone bricks as well as dolerite stone; and
- A cattle enclosure with exceptionally high walls which was probably used as an enclosure for cattle but which may also have served as a wagon shed.

These structures have fallen into disrepair since their first recording.

Figure 8.4.2.1(c): A historical wagon shed constructed with sandstone and possibly later strengthened with cement on the farm Kromdraai 128 IS	**Figure 8.4.2.1(d): The main residence in the farmstead complex on the farm Kromdraai 128 IS was built with sandstone and dolerite stone**

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A number of individual structures, mostly houses older than sixty years and with possible historical significance, occur in the project area. Some may have been part of farmstead complexes but now merely represent the last structures that are left of these historical complexes. Other structures which may hold historical significance were also recorded.

Historical House 01

This farm residence on the Farm Brakspruit 359 IR (Figure 8.4.2.1(e)) is fitted with a pitched corrugated iron roof. It was constructed with clay bricks and its walls are plastered.

This residence probably dates from the 1920's. It is associated with an outbuilding which probably served as a garage for a vehicle.

Historical House 02

This house on the Farm Kromdraai 128 IS (Figure 8.4.2.1(f)) next to the R50 was constructed during the 1930/40's and was built with clay bricks and cement. The walls of the house were plastered with cement and it is fitted with a pitched corrugated iron roof.

At least one sandstone outbuilding which was renovated is associated with the house. Three other outbuildings of which the outer walls were plastered are also associated with the house and wagon shed.

Figure 8.4.2.1(e): The historical house on the farm Brakspruit 359 IR which probably dates from the early twentieth century

Figure 8.4.2.1(f): A house dating from the 1930's or 1940's on the farm Kromdraai 128 IS next to the R50 is associated with several outbuildings most of which do not have historical significance

Historical House 03

This residence (Figure 8.4.2.1(g)) is located next to the dirt road that runs from the R50 to the Brendan Village. The residence is also associated with a wagon shed located to the back of the house.

Both structures were constructed with clay bricks and the wagon shed was plastered. Both structures are fitted with pitched corrugated iron roofs. The residence is constructed with face-bricks and is not plastered. It is fitted with steel window frames.

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Wagon Shed

This wagon shed (Figure 8.4.2.1(h)) on the Farm Rietkuil 531 IR was constructed with sandstone and fitted with a pitched corrugated iron roof.

A Shop

A general dealer shop (Figure 8.4.2.1(i)) occurs next to the Kinross Mine road. It was constructed with clay bricks and fitted with a pitched corrugated iron roof.

Figure 8.4.2.1(g): A house dating from the 1930's or 1940's with renovated wagon shed next to the R50

Figure 8.4.2.1(h): A wagon shed constructed with sandstone on Rietkuil 531 IR next to the Leandra-Balfour road

Figure 8.4.2.1(i): A general dealer shop next to the Kinross Mine road

Figure 8.4.2.1(j): A commemorative beacon in honour of mine workers who died during a mine disaster on 16 September 1986 in the No. 8 Shaft of Evander (Old Harmony) gold mine

Commemorative Beacons

A commemorative beacon (Figure 8.4.2.1(j)) for mine workers who died in a mine accident on 16 September 1986 is erected within the confines of Evander's (previously referred to as Harmony) No 8 Shaft complex. This granite tombstone bears the following inscription:

'In memory of the employees who died in the disaster 16 September 1986. Erected 16 September 1995'

A Karee tree (*Rhus lancea*) was planted next to the commemorative beacon to commemorate this event on 16 September 1994.

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8.4.2.2. Graveyards and Graves

Presented in Table 8.4.2.2(a) is a list of the Graveyards and Graves found within the Shondoni Colliery project area. Also relayed in this table are the coordinates of the remains.

Table 8.4.2.2(a): Coordinates for Graveyards and Graves in the Shondoni Colliery project area

Graveyards and Graves	Coordinates
GY01: The remains of approximately five farm workers on Rolspruit 127 IS	26° 25' 49,540" S; 28° 59' 34,450" E
GY02: One of two graveyards in close proximity to each other next to the Rolspruit dirt road. This graveyard belongs to the Makop family.	26° 23' 31,292" S; 28° 59' 13,151" E
GY03: The second of two graveyards in close proximity to each other next to the Rolspruit dirt road	26° 23' 29,792" S; 28° 59' 13,631" E
GY04: A single whitewashed cement headstone and a stone heap are visible in this graveyard next to the Rolspruit dirt road. Number of graves unknown.	26° 22' 27,988" S; 28° 59' 04,331" E
GY05: Unknown number of graves in a patch of grass in an agricultural field on Rolspruit 127 IS.	26° 24' 11,134" S; 29° 00' 25,028" E
GY06: Located against a slope running down to the Rolspruit	26° 24' 21,575" S; 29° 00' 27,608" E
GY07: Eleven graves on Brakspruit 359 IR next to a border fence. All covered with piles of stone	26° 29' 15,594" S; 28° 57' 04,755" E
GY08: Twenty-six graves on Brakspruit 359 IR next to border fence. All covered with piles of stones	26° 28' 49,852" S; 28° 57' 48,074" E
GY09: Five to six next to a border fence on Brakspruit 359 IR. All covered with piles of stones	26° 28' 49,432" S; 28° 57' 48,374" E
GY10: Large graveyard with approximately thirty-five graves on Brakspruit 359 IR.	26° 29' 44,095" S; 28° 58' 10,093" E
GY11: Graveyard of the Breytenbach and Pennel families on Brakspruit 359 IR	26° 29' 32,575" S; 28° 57' 46,814" E
GY12: Graveyard on Witkleifontein 181 IS in squatter camp.	26° 28' 48,771" S; 29° 03' 55,143" E
GY13: Pieterse graveyard on Witkleifontein 181 IS in open veldt near historical farmstead complex	26° 29' 37,434" S; 29° 04' 10,503" E
GY14: Near farmstead complex of J.C. Kruger on Witkleifontein 138 IS. Holds remains of six visible graves	26° 29' 03,772" S; 29° 03' 45,423" E
GY15: Located on Kromdraai 128 IS within a patch with cosmos flowers.	26° 26' 15,342" S; 29° 02' 26,285" E
GY16: Voortrekker graves overgrown with popular trees.	26° 26' 55,965" S; 29° 00' 23,289" E
GY17: Limited number of informal graves in thick grass next to fence and Voortrekker graves	26° 26' 54,464" S; 29° 00' 30,639" E
GY18: Voortrekker graves on Brakspruit 359 IR near Eskom's power lines	26° 29' 15,113" S; 29° 00' 14,530" E
GY19: Approximately twenty graves on Witkleifontein 131 IS	26° 29' 16,613" S; 29° 03' 47,343" E
GY20: Large cemetery which probably was part of a former village on Witkleifontein 131 IS	26° 30' 06,896" S; 29° 03' 56,823" E
GY21: Second large cemetery which probably was part of a former village on Witkleifontein 131 IS	26° 29' 49,795" S; 29° 03' 51,003" E
GY22: This graveyard is demarcated with a brick wall	26° 28' 14,449" S; 29° 04' 59,821" E

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Graveyard 01

Graveyard 01 (Figure 8.4.2.2(a)) is situated in a Blue Gum bush on the Farm Rolspruit 127 IS and holds the remains of approximately five individuals who may have been farm workers. Only one grave is fitted with a cross manufactured from cement but which has broken in pieces.

The following inscription is decipherable on the cross, namely:

'M Jahn Motaung ER 19. 30 TO 19.14'

Graveyard 02

Graveyard 02 (Figure 8.4.2.2(b)) is one of two which are located in close proximity to each other next to the Rolspruit dirt road. It is demarcated with a fence and holds the remains of approximately six or seven individuals.

Two of the graves are fitted with granite head stones. The inscriptions of one of the headstones read as follow:

'David Mako'

Figure 8.4.2.2(a): GY01 holds the remains of approximately five farm workers. One grave was fitted with a cement cross which has broken into pieces. It holds the remains of a certain Jahn

Figure 8.4.2.2(b): GY02 holds the remains of amongst others the Mako family

Graveyard 03

Graveyard 03 (Figure 8.4.2.2(c)) is one of two which are located in close proximity to each other next to the Rolspruit dirt road. It holds the remains of approximately eleven individuals most of which are covered with heaps of stones.

Two of the graves are decorated with granite headstones and trimmings. The inscriptions on the headstones read as follow:

' Martha Maseko 01-08-1990 08 01-1980'
'Martha Ndlovu 1918-01-28 1998-01-10'

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Graveyard 04

Graveyard 04 (figure 8.4.2.2(d)) is located on the eastern shoulder of the Rolspruit dirt road. It is located in tall grass and only a single grave and a heap of stones are visible. However, it is expected that more graves may exist.

Figure 8.4.2.2(c): GY03 is one of two graveyards located next to the shoulder of the Rolspruit dirt road

Figure 8.4.2.2(d): A single white-washed gravestone in GY04 may be one of several graves which may occur in this graveyard next to the Rolspruit dirt road

Graveyard 05

Graveyard 05 (Figure 8.4.2.2(e)) is located in a patch of tall grass in an agricultural field next to the Rolspruit dirt road.

It merely comprises heaps of stones which cannot be counted due to the tall grass cover. Considering the size of the patch with grass it is most likely that the graveyard holds a considerable number of graves.

Graveyard 06

Graveyard 06 (Figure 8.4.2.2(f)) is located against a slope running towards the Rolspruit. It holds approximately fifteen graves of which five are fitted with cement head stones and trimmings. No inscriptions are decipherable.

Figure 8.4.2.2(e): Graveyard 05 is located in a patch with tall grass. The number of graves in the graveyard is uncertain

Figure 8.4.2.2(f): Graveyard 06 is located against a slope running towards the Rolspruit on the farm with the same name. It holds approximately fifteen graves

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Graveyard 07

Graveyard 07 (Figure 8.4.2.2(g)) next to a border fence on the Farm Brakspruit 359 IR holds approximately eleven graves.

All of the graves are covered with piles of stones. At least one of the graves is demarcated with bricks.

Three of the graves are fitted with cement headstones and one with a slab of cement but no inscriptions on any of the headstones are decipherable.

Graveyard 08

Graveyard 08 (Figure 8.4.2.2(h)) on the Farm Brakspruit 359 IR is also located next to a border fence and joins a second smaller graveyard on the adjacent part of the same farm.

GY08 holds at least twenty-six graves all of which are covered with piles of stones.

None of the graves bare any identification of any nature.

Figure 8.4.2.2(g): At least eleven graves along a border fence on the farm Brakspruit 359 IR with no headstones with inscriptions

Figure 8.4.2.2(h): At least twenty-six graves occur along a border fence on the farm Brakspruit 359 IR with no identification of any nature

Graveyard 09

Graveyard 09 (Figure 8.4.2.2(i)) adjoins GY08 on the opposite side of a barbed wire fence on the Farm Brakspruit 359 IR.

It holds approximately six graves all of which are covered with piles of stones. At least one is demarcated with bricks.

Graveyard 10

This large graveyard (Figure 8.4.2.2(j)) on the Farm Brakspruit 359 IR holds at least thirty-five graves. It is located along a high plateau overlooking the Wildebeesspruit.

Several of the graves are fitted with cement head stones and cement crosses. Most of the others are covered with piles of dolerite stone. At least one of the graves is decorated with a granite headstone and demarcated with granite trimmings. The inscription on the headstone reads as follow:

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'Mazwabo Phunyuzwabo Masuku Wazalwa Ngo 1872 Walaca Ngo 1953'

Figure 8.4.2.2(i): At least six graves next to GY09 along a barbed wire fence on the farm Brakspruit 359 IR	**Figure 8.4.2.2(j): A large graveyard on Brakspruit 359 IR with at least thirty-five graves along a ridge overlooking the Wildebeesspruit**

Graveyard 11

This graveyard (Figure 8.4.2.2(k)) on the Farm Brakspruit 359 IR holds the remains of five individuals. Three of the graves are fitted with granite headstones with inscriptions.

Two of the inscriptions read as follow:

'In liefdevolle herinnering aan ons liewe ouers WSHP (190193) en AC Breytenbach (191195). Leer ons begunstig in u wil'

Aletta Catharina Penells Geb 5 Oct 1904 Gestorwe 18 April 1929 Rus in vrede moeder'

Graveyard 12

This graveyard (Figure 8.4.2.2(l)) on the Farm Witkleifontein 138 IS located in the midst of an informal settlement.

It holds the remains of approximately twenty individuals. Most of the graves are covered with piles of stones. A few cement headstones occur. No inscriptions were observed.

Figure 8.4.2.2(k): Five graves on the farm Brakspruit 359 IR belonging to the Breytenbach and Pennel families	**Figure 8.4.2.2(l): An informal graveyard on the farm Witkleifontein 138 IS which is barely visible in the midst of an informal settlement**

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Graveyard 13

This historical graveyard (Figure 8.4.2.2(m)) on the Farm Witkleifontein 138 IS is located in open veldt. It holds the remains of approximately twelve individuals, mostly from the Pieterse family. Most of the graves are covered with cement tombstones. A few granite headstones occur as well as a marble headstone.

The inscriptions on these headstones read as follow:

'Hier rus my dierbare eggenoot ons vader en grootvader Gielaum Jacobus Pieterse Gebore 28-10-1892 Oorlede 28-?-1954 Jes 40:7 Die gras verdor die blom verwelk'

'Hier rus ons moeder en grootmoeder Elizabetha Magrietha Pieterse Gebore van den Berg 7-12-1895 Oorlede 17-3-1958 Uit liefde vir al u sorg en trou'

Hier rus my geliefde eggenoot Barend Paul Pieterse Gebore 19 Julie 1835 Oorlede 23 November 1916 Gesang 62 Heilig Jesus Heilig my'

Graveyard 14

This historical graveyard (Figure 8.4.2.2(n)) is located near the abandoned farmstead complex of J.C. Kruger on the Farm Witkleifontein 138 IS and holds the remains of six visible graves, two of which are covered with piles of stones, three are fitted with cement head and tombstones and one is decorated with a granite tombstone and headstone. The inscription on the headstone reads as follow:

'Hier rus ons moeder Jaenetta Jacoba Nel Gebore Gouws 18-3-1895 Oorlede 21-12-1939'

Figure 8.4.2.2(m): This historical graveyard holds the remains of the Pieterse family. It is located in open veldt. Some of the graves have been vandalised

Figure 8.4.2.2(n): The historical graveyard on the farm Witkleifontein 138 IS dates from the 20th century and even possibly from the 19th century

Graveyard 15

This informal graveyard (Figure 8.4.2.2(o)) on the farm Kromdraai 128 IS located within a patch with cosmos flowers. The graveyard is overgrown but holds the remains of at least ten individuals.

Inscriptions on some of the granite headstones read as follow:

'Dlamini Finose *22-09-1942 †19-04-1992 Lala Ngokuthula Siyakuthanda'
'Mashiyane Jabulane Born 25-08-1943 Died 16-01-1990 lala ngo xolo'
'In memory of our mother Merriam Moldieni Mashiane *01-03-1937 28-02-1948'

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Graveyard 16

This historical graveyard (Figure 8.4.2.2(p)) on the Farm Kromdraai 128 IS currently overgrown with Popular trees. It may hold as many as ten or more graves, most of which comprises of heaps of dolerite stone.

One of the graves is fitted with a cement head stone which bears the following inscription:

'Hier rust Sameul Pieter Marthinus Mulder BG 16 Januarie 1882 Gesneuveld 12 Mei 1901 Gs 22 Rus my siel u God is koning wees tevrede met u lot'

A second gave contains a weathered sandstone headstone with the following inscription:

'Jan Simon Venter Voortrekker'

Figure 8.4.2.2(o): An informal graveyard with at least ten graves in a patch with cosmos flowers on the farm Kromdraai 128 IS

Figure 8.4.2.2(p): Voortrekker graves in a Popular bush on the farm Kromdraai 128 IS

Graveyard 17

A few informal graves (Figure 8.4.2.2(q)) occur next to a fence in close proximity to the Voortrekker graveyard in a Popular bush.

No inscriptions occur on any of the piles of stones in this graveyard.

Graveyard 18

Graveyard 18 is a historical graveyard (Figure 8.4.2.2(r)) on the Farm Brakspruit 359 IR and is located near Eskom's 400kV power line. This small demarcated graveyard is overgrown but may hold as many as six graves.

Inscriptions on some of the headstones read as follow:

'J.J. Oberholster 1880-1945 Hier rus Josea Jacobus Oberholster Gebore 19 Februarie 1892 Oorlede 22-?-1895 Ges 29 V3'

'Hier rus ons moeder Magdalena Dreyer Gebore Jun1895 Overlede 5 Julie 1933 Ges V1'

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Figure 8.4.2.2(q): A few piles with stone mark this graveyard in close proximity of the Voortrekker graveyard which is covered with a Popular bush

Figure 8.4.2.2(r): A historical graveyard on the farm Brakspruit 359 IR in open veldt near Eskom's power lines

Graveyard 19

This graveyard (Figure 8.4.2.2(s)) on the Farm Witkleifontein 131 IS may hold as many as twenty graves. Some of the graves were laid out with long elongated shapes.

No inscriptions or headstones with inscriptions occur.

Graveyard 20

This cemetery (Figure 8.4.2.2(t)) was probably part of a former village which was abandoned some time ago considering the rubble associated with the graves. The number of graves which could be identified amounted to seven.

Most of the graves are covered with piles of stones. A cement head stone as well as a granite slab with headstone were used as decorations on two graves.

No inscriptions could be deciphered at the time of the survey.

Figure 8.4.2.2(s): Graveyard on the farm Witkleifontein 131 IS with as many as twenty graves (Miller 2010:16)

Figure 8.4.2.2(t): A graveyard on the farm Witkleifontein 131 IS which is associated with an abandoned village (Miller 2010:16)

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Graveyard 21

This is a cemetery (Figure 8.4.2.2(u)) with as many as sixty graves. It is associated with rubble which may have been houses of a former village which was abandoned some time ago.

It holds an unknown number of graves.

Graveyard 22

This cemetery (Figure 8.4.2.2(v)) was demarcated with a brick wall which was vandalised while the iron frame which demarcated the graves was stolen.

The graveyard holds as many as eleven graves. Most of the graves are covered with piles of stones. No inscriptions occur.

It is located on the Farm Witkleifontein 131 IS at the entrance to the Kinross Mine.

Figure 8.4.2.2(u): A second graveyard on the farm Witkleifontein 131 IS which is associated with an abandoned village (Miller 2010:17)

Figure 8.4.2.2(v): A graveyard (foreground in tall grass) with eleven graves at the entrance to the Kinross Mine. The wall demarcating the graves were vandalised

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8.4.3. Palaeontological Aspects

Professor Bruce Rubidge was appointed by JMA Consulting (Pty) Ltd, on behalf of Sasol Mining (Pty) Ltd, to undertake a desktop Palaeontological Impact Assessment. The outcome of this assessment will be provided in the EIA Report.

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8.4.4. Climate and Meteorology

The Climate and Meteorology description was compiled from two Specialist Reports:

Sasol Mining (Pty) Ltd Surface Water Baseline Study Shondoni Colliery, August 2020

and

Air Quality Impact Assessment – Sasol Shondoni/ Middelbult Colliery, July 2020.

8.4.4.1. Regional Climate

The climate in the Mpumalanga Province is naturally defined by its topography. The Province is a summer-rainfall area divided by the Escarpment into the Highveld region with cold frosty winters and the Lowveld region with mild winters and a subtropical climate. The Escarpment area sometimes experiences snow on high ground. Thick mist is common during the hot humid summers.

The rainfall occurs mostly in summer, with about 87% of the annual rainfall being recorded during this period. There is a distinct seasonal variation in rainfall and the evaporation follows the same seasonal trend during the year for this region.

The windiest period is from August to February when an average hourly wind speed of up to 13 km/h can be expected.

8.4.4.2. Temperature

The average monthly temperature trends are presented in Figure 8.4.4.2(a) for the Secunda Club station. Monthly mean and hourly maximum and minimum temperatures are given in Table 8.4.4.2(a). Monthly average temperatures ranged between 10.1 °C in July and 19.9 °C.

The highest temperatures (36.4°C) were recorded in January and the lowest (-6.6°C) in July. During the day, temperatures increase to reach maximum at around 15:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 07:00 i.e. just before sunrise.

Table 8.4.4.2(a): Monthly temperature summary – Secunda Club (2015 - 2019)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum	7.0	9.2	4.9	3.9	-1.2	-4.3	-6.6	-4.6	-2.6	0.4	2.1	8.4
Average	19.8	19.8	18.8	16.2	13.0	10.2	10.1	13.8	16.6	18.2	18.9	19.9
Maximum	36.4	33.8	34.1	39.0	27.8	26.1	26.5	31.8	33.9	36.3	34.2	34.7

8.4.4.3. Mean Monthly and Annual Rainfall

Shondoni Colliery lies adjacent to the northern internal watershed of the quaternary catchment C12D located in the Upper Vaal Water Management Area shown in Figure 8.4.4.3(a) below. The Shondoni site falls within rainfall zone C1D. The Water Resources 2012 Report (WR2012) published in 2015 lists the Mean Annual Precipitation (MAP) for the quaternary catchment as 667 mm.

The Weather Bureau rainfall station nearest to the site is station #0478292 Langsloot, which is located approximately 17 km from Shondoni central area.

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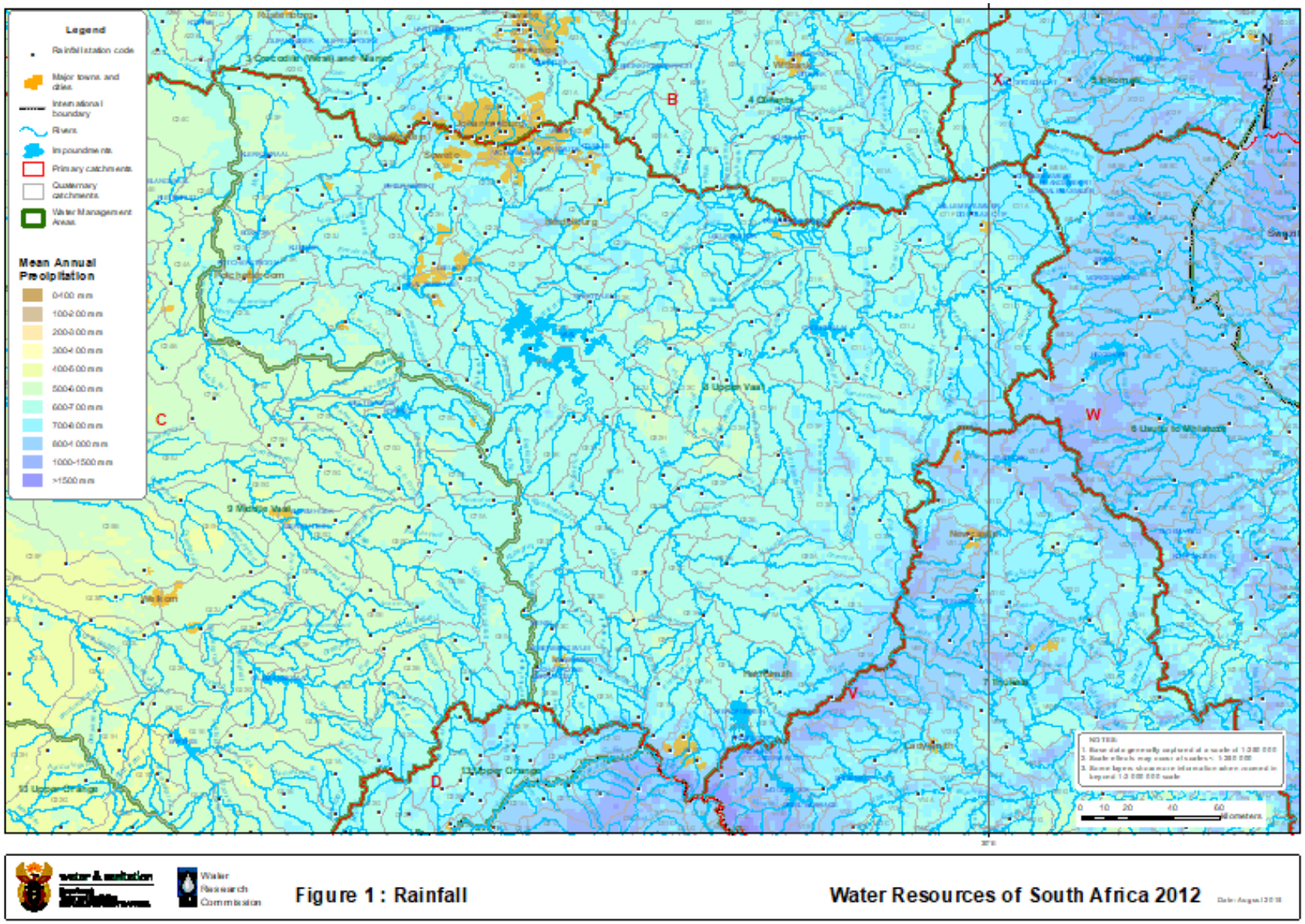

Figure 8.4.4.3(a): Average Rainfall Map – Upper Vaal Management Area: Zone C1D

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The TR102 listed the MAP for this station as 688 mm in 1981 and the South African Weather Bureau (SAWB) Design Rainfall Depths at selected stations in South Africa listed the MAP as 698 mm over an 80-year period.

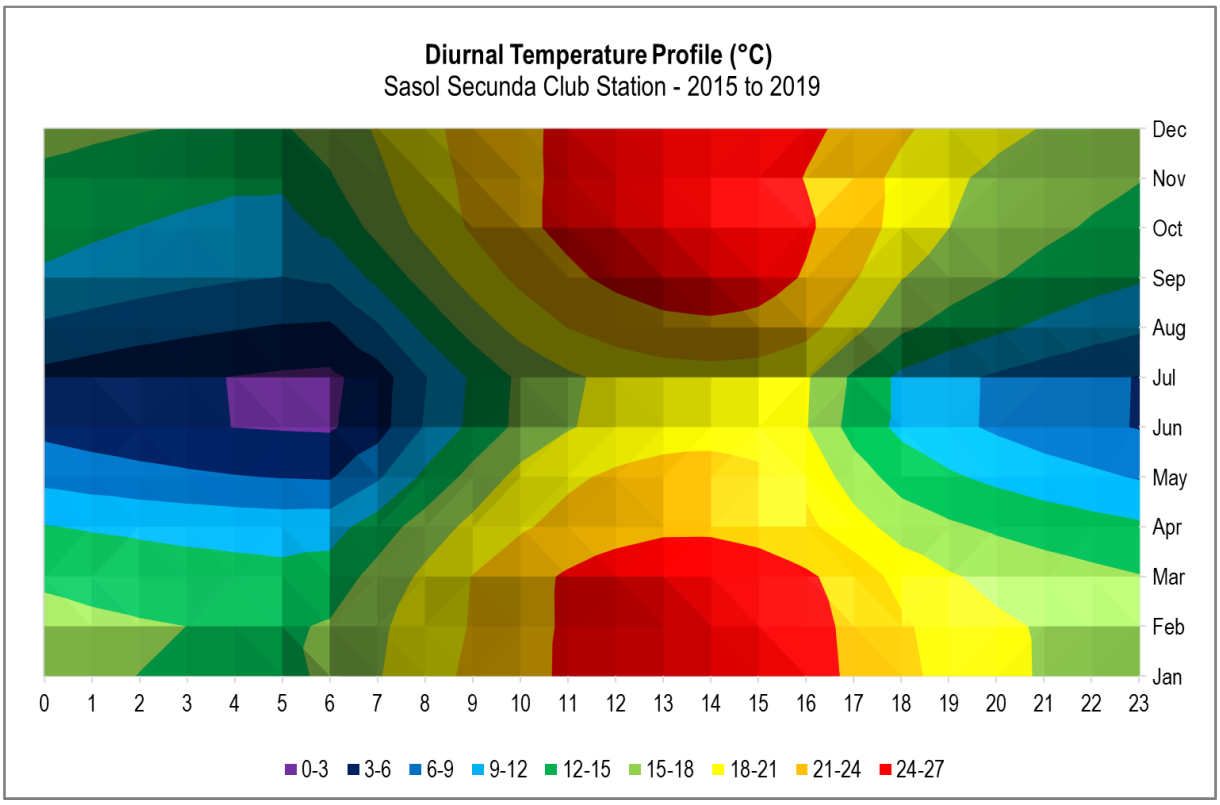

Figure 8.4.4.2(a): Monthly average temperature profile for Secunda Club (2015 – 2019)

Based on the data available at the time of a flood study conducted by Jones & Wagener in 2014 the MAP was taken as 688 mm, the same as the TR102 publication. However, the last 27 years of daily records kept by the mine from November 1993 until June 2020 was assessed and added to extend the records for Langsloot station. Based on the extended records over the past 27 years the MAP for Langsloot station was re-assessed and updated accordingly. The updated MAP was calculated as 699.8 mm which is considered to be acceptable in lieu of the climate changes that have occurred over the past 20 years. It is also similar to the MAP of 698 mm listed for Langsloot by the SAWB publication.

The variation in MAP as derived from TR102, SAWB as well as the updated MAP calculated for Langsloot rainfall station are shown in Table 8.4.4.3(a) below.

Table 8.4.4.3(a): Rainfall Station Langsloot – Extended Records

Weather Bureau Gauge No.	Station Name	Latitude		Longitude		Record Used	No. of Years	MAP (mm)
		D	M	D	M			
1) 478 292*	Langsloot	26	22	29	10	1919-1981	62	688
2) 478 292**	Langsloot	26	22	29	10	1919-1999	80	698
3) 478 292***	Langsloot	26	22	29	10	1993-2020	27	699.8
MAP using extended records for Shondoni Colliery = 699.8								

* TR102; ** SAWB Design Rainfall Depths at selected stations in SA; ***Updated records to Jun 2020

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The monthly rainfall distribution at Shondoni Colliery has been re-calculated and is indicated in the table below.

Table 8.4.4.3(b): Mean Monthly Rainfall for Shondoni Colliery (mm)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Total
%	10.6	13.9	18.2	21.4	12.9	10.2	6.0	2.2	0.9	0.4	0.9	2.5	100
Mean	**74.0**	**97.4**	**127.7**	**149.5**	**90.3**	**71.2**	**42.1**	**15.1**	**6.0**	**2.6**	**6.6**	**17.2**	**699.8**

As indicated in Table 8.4.4.3(b), about 87% of the total annual rainfall occurs during the wet months of October to March, while about 2.2% occurs during the driest 3 months (June to August).

8.4.4.4. Maximum Rainfall Intensities

Storm rainfall intensities are commonly used in estimating potential flood peaks and flood volumes. These intensities are dependent on the duration of the storm and the storm frequency or return period. The following rainfall depths for the Langsloot gauge #0478292 were extracted from Water Research Commission (WRC) Report 1060/1/03: Design Rainfall and Flood Estimation in South Africa.

Table 8.4.4.4(a): Rainfall for given duration and return period in mm

Duration (days)	Return Period (years)				
	5	10	20	50	100
1	75	88	102	121	137
2	94	110	126	148	165
3	105	123	140	163	181
7	134	154	174	200	219

As the local catchment areas in this project are relatively small, critical storm durations will be considerably less than the one day reflected in the table above. An alternate method of obtaining storm precipitation values for shorter durations is the formulation developed by Op ten Oord which is an analytical version of the well-known monograph C2 from the HRU 1/72 Report.

The results are provided in Table 8.4.4.4(b) below.

Table 8.4.4.4(b): Storm Rainfall as per Op ten Oord formulation (mm)

Duration (hrs)	Return Period (years)				
	5	10	20	50	100
0.5	33.2	40.8	50.2	66.1	81.4
1	41.9	51.6	63.5	83.6	102.9
2	49.5	60.9	75.0	98.7	121.6
6	59.6	73.4	90.4	119.0	146.5
12	65.5	80.6	99.3	130.7	160.9
24	71.3	87.8	108.1	142.3	175.2

The Op ten Oord formulation will be used in calculating the storm rainfall on the site where the critical storm duration for that particular point is less than 24 hours.

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8.4.4.5. Mean Monthly Evaporation

Shondoni Colliery falls within Evaporation Zone 12A which has a Mean Annual Evaporation (MAE) of 1580 mm as per WR2012 (See Figure 8.4.4.5(a) for Zone 12A). The nearest evaporation gauge C1E003 at Standerton has a MAE of 1434 mm which was recorded from 1960 until 1979. Gauge C1E003 is situated about 48 km from the Shondoni site and has a relatively short period of record. The MAE of 1580 mm is more recent and considered more relevant for the study area (see Table 8.4.45(a)).

Table 8.4.4.5(a): Monthly average S Pan evaporation (mm)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Total
Ave	171	172	185	179	149	138	105	85	69	74	108	145	1580
%	**10.85**	**10.88**	**11.71**	**11.36**	**9.37**	**8.76**	**6.62**	**5.37**	**4.36**	**4.71**	**6.83**	**9.18**	**100.0**

The Monthly Lake Evaporation is calculated and indicated in Table 8.4.4.5(b). This represents a monthly average for clear chemical unaffected water.

Table 8.4.4.5(b): Monthly average lake evaporation (mm)

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
S-pan mm	171	172	185	179	149	138	105	85	69	74	108	145	**1580**
Lake Convert	0.81	0.82	0.83	0.84	0.88	0.88	0.88	0.87	0.85	0.83	0.81	0.81	**0.84**
Lake Evap mm	138	141	153	150	131	121	92	74	59	61	87	117	**1324**

8.4.4.6. Surface Wind Field

Wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the red area, for example, representing winds > 7.5 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories, with each concentric circle representing 4% of the time. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicated.

The period wind field and diurnal variability for the Sasol operated Secunda Club meteorological station for the period 2015 to 2019 is provided in Figure 8.4.4.6(a). The monthly variability at this station is shown in Figure 8.4.4.6(b).

The data availability for this period was 94.23%. The predominant flow field at Secunda Club is from the east-north-easterly and west-north-westerly sectors. During day-time conditions winds from the west-north western sector increase while winds from the east-north-eastern sector are more frequent during night-time conditions Figure 8.4.4.6(a). The average wind speed over the 2015 to 2019 period was 2.46 m/s with an average wind speed of 2.9 m/s during the day and an average wind speed of 2.0 m/s during the night. Monthly variability in the wind field Figure 8.4.4.6(b) shows that the highest wind speeds occur during the spring months from August to November. Winds are generally calm during autumn and winter (April to July), with summer having fewer calm conditions, but generally lower wind speeds than spring.

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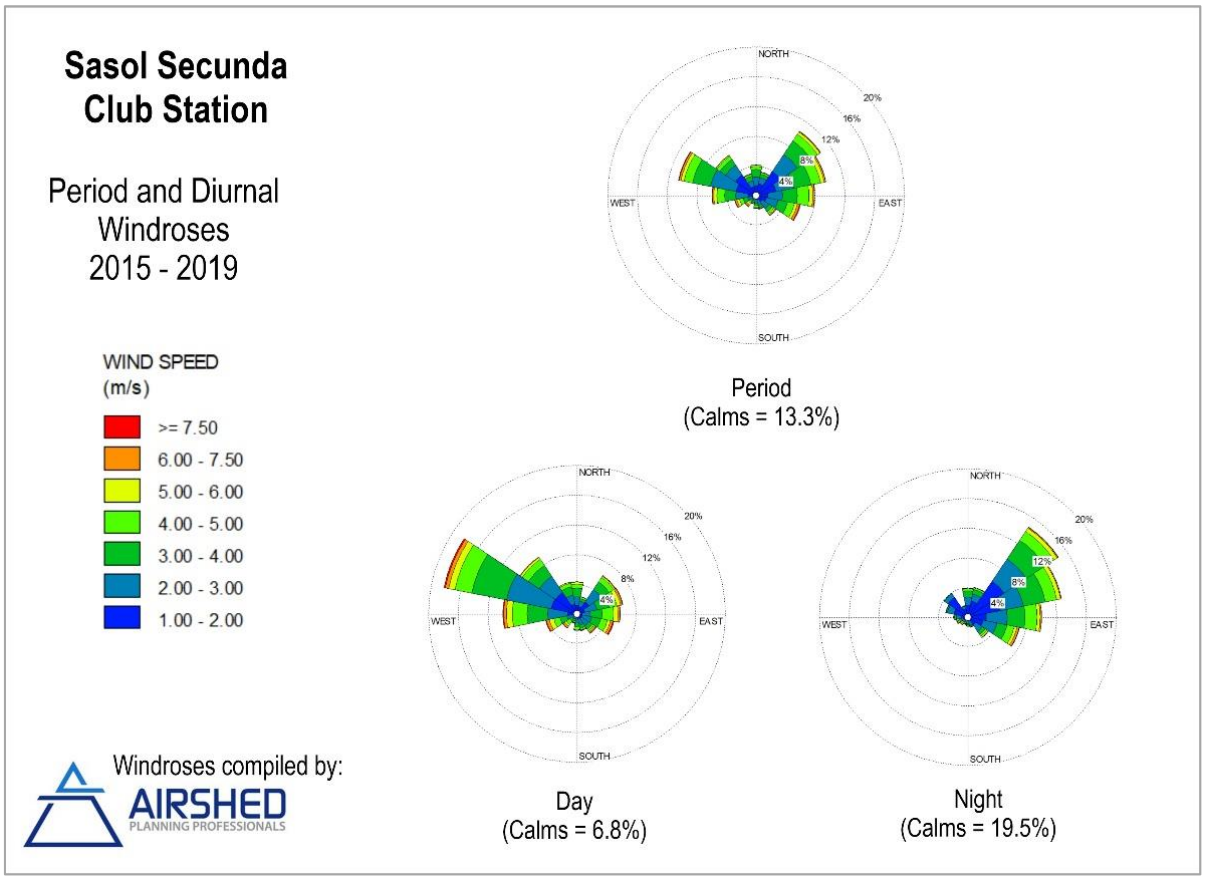

Figure 8.4.4.6(a): Period, day- and night-time wind rose for Secunda Club for the period 2015 – 2019

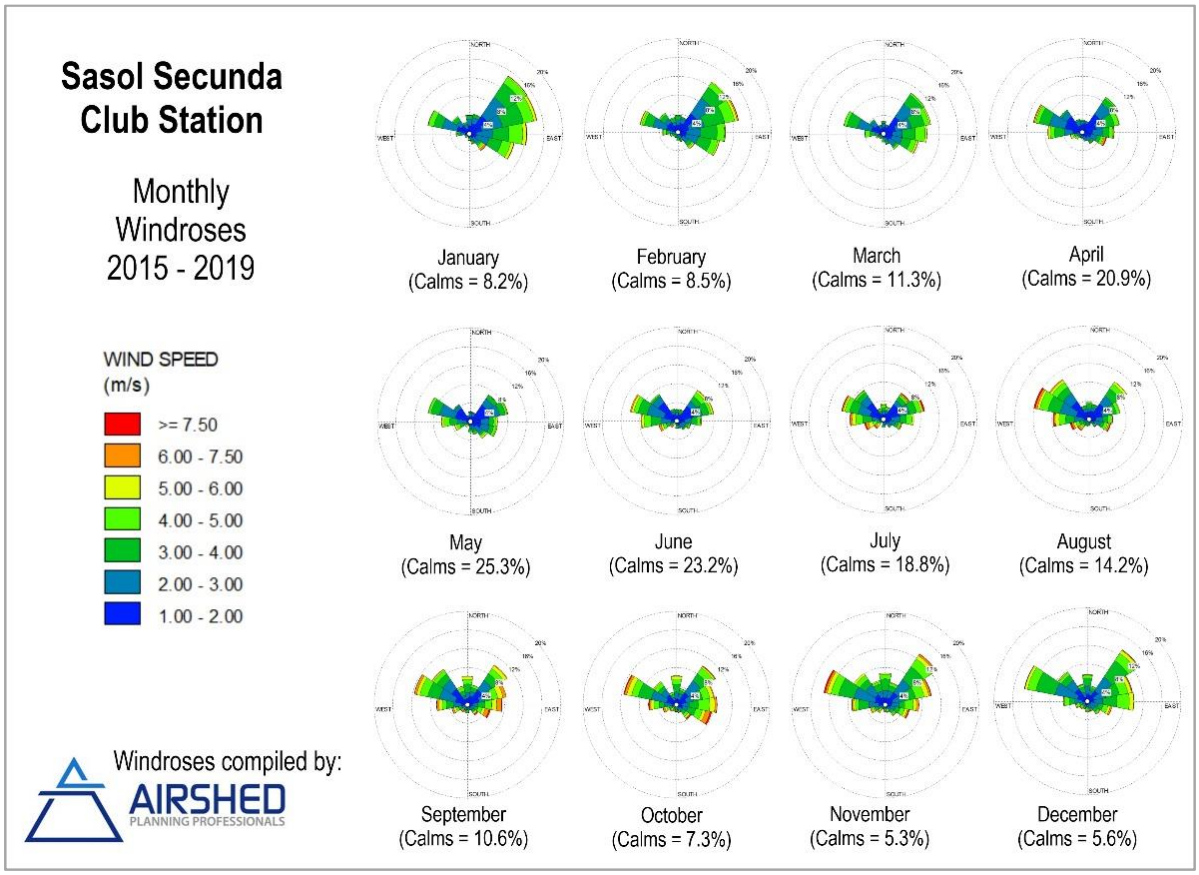

Figure8.4.4.6(b): Monthly wind roses for Secunda Club for the period 2015 – 2019

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A seasonal shift in the wind field is also observed, with predominant winds from the east-northeast during the summer and early autumn (December to March) and very little wind from the west-northwest during the summer compared to winter and spring. Over the 2015 to 2019 sampling period, wind speeds higher than 5.4 m/s (at which wind erosion from exposed areas such as stockpiles or open conveyors could occur) were recorded for 546 out of 16133 recorded hours, or about 2.5% of the time.

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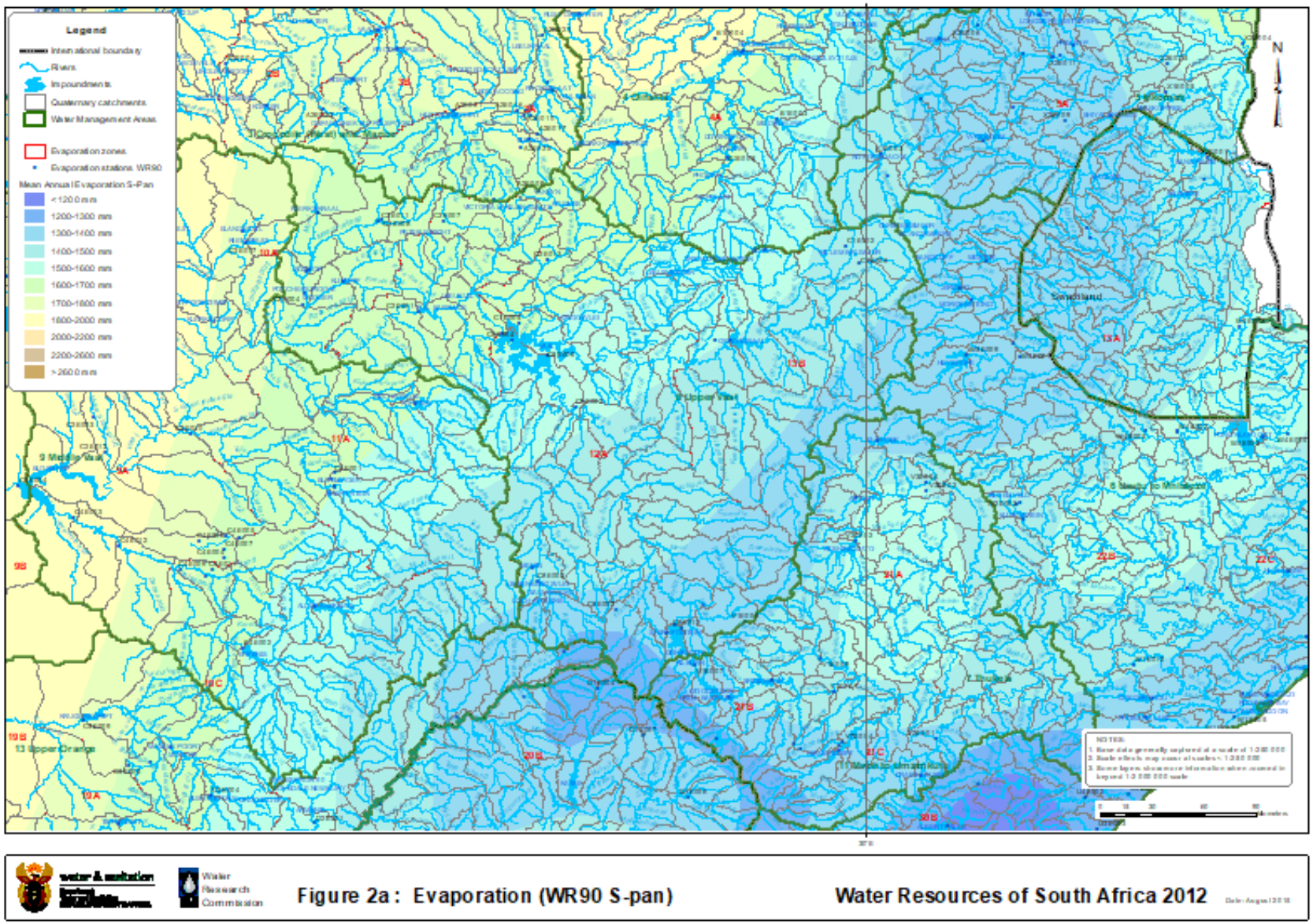

Figure 8.4.4.5(a): Average MAE Map – Upper Vaal Management Area: Zone 12A

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8.4.5. Topography

The regional topography of the Shondoni Colliery project area will be described at the hand of formally published topographical information as available from the 1:50 000 National Geospatial Information. Figure 8.4.5(a) shows the 30 m surface topographical contour for the project area, together with the surface drainage lines indicated on the 1: 50 000 topographical data. The Shondoni Colliery EMP boundary is indicated with a yellow line.

The project area stretches for some 22 km from west to east and some 18 km from north to south and generally slopes from north to south. The surface elevation in the north along the catchment divide is some 1700 mamsl and slopes down to 1500 mamsl in the south. The ground surface is gently undulating with steeper slopes next to the surface streams.

The surface water runoff from the entire project area, with the exception of a small area in the far north, drains along 4 major stream systems towards the Vaal River in the south. The westernmost stream system is a combination of the Kaalspruit and the Rolspruit. It drains in a generally south-easterly direction and joins the Waterval River in the far south of the project area.

The Waterval River, which essentially drains from north to south, runs to the east of the former system, and represents the main surface drainage feature which conveys all the surface runoff in the project area to the Vaal River. Due east from the Waterval River, and draining from the north-east, is the Grootspruit. It comprises two tributaries.

The easternmost stream, and which drains the area from the east, is the Trichardtspruit. This spruit system comprises the Trichardtspruit and the Bossiespruit, which between the two, drain all surface runoff from the SSO Complex.

Figure 8.4.5(b) represents a shaded relief map of the project area. This map is useful in obtaining an understanding of the general relief/morphology of the project area. The drainage valleys of the Waterval River, the Grootspruit and the Trichardtspruit is clearly visible on the map.

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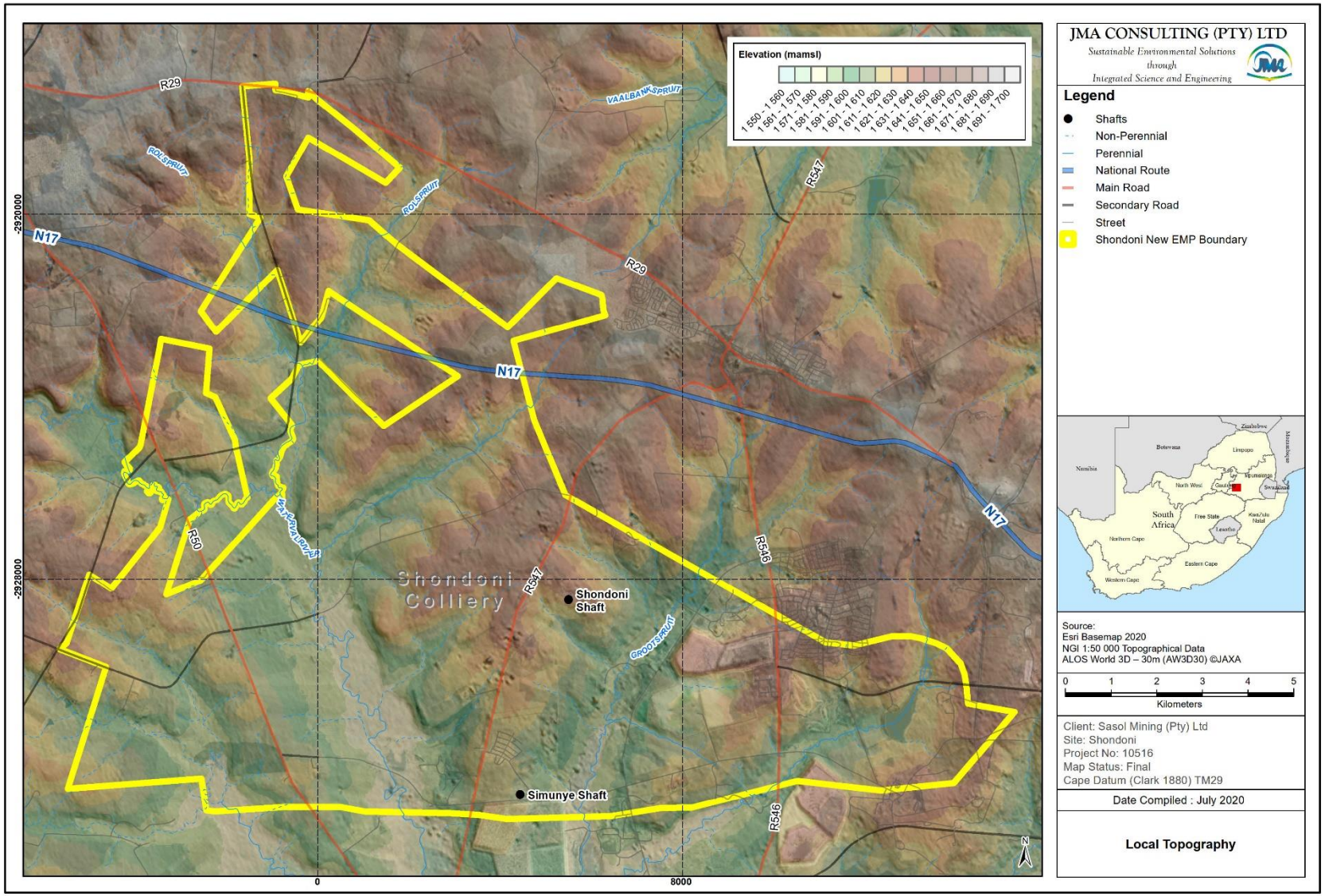

Figure 8.4.5(a): Topographical Contours (30 m) and Surface Streams in the Project Area

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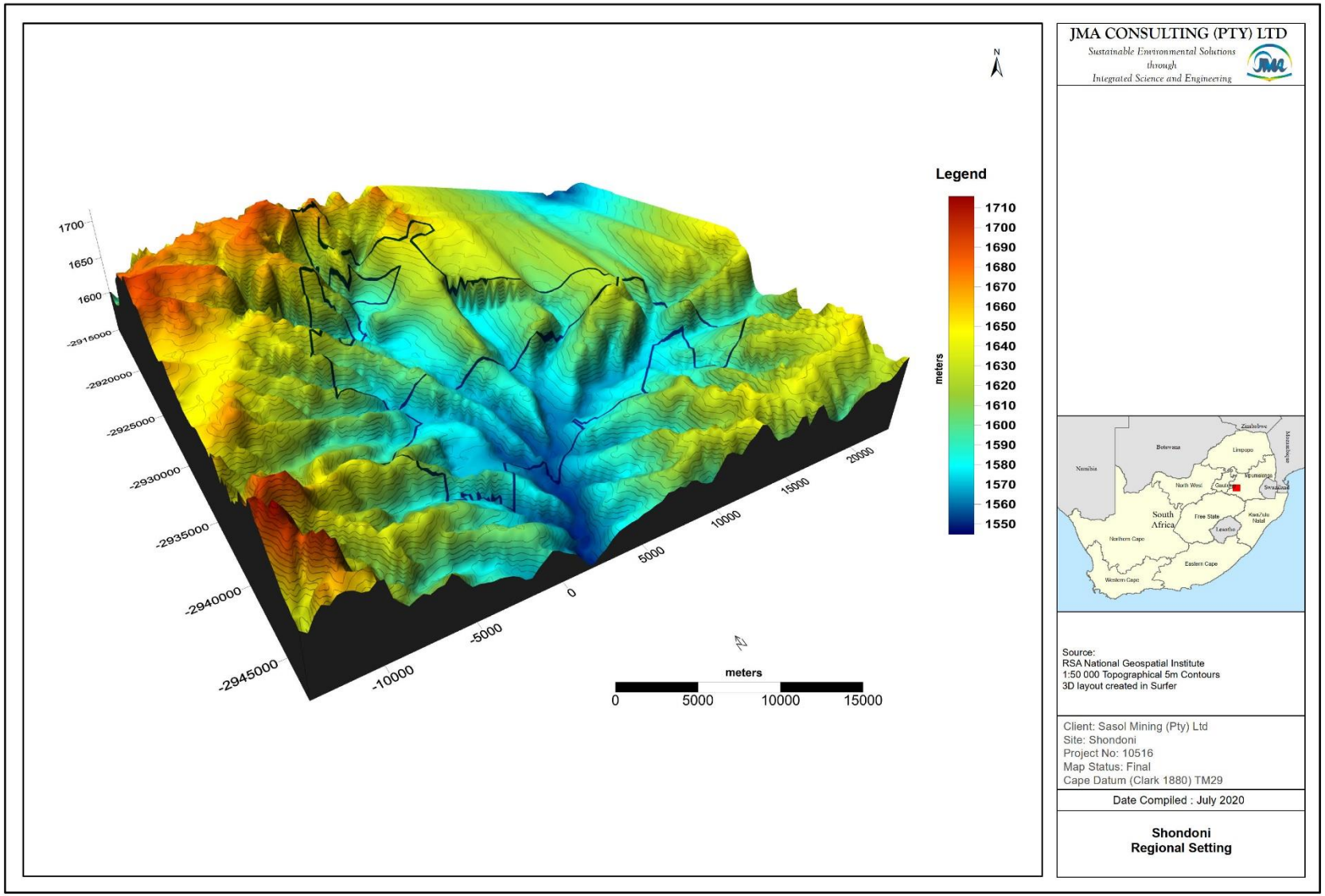

Figure 8.4.5(b): Two-dimensional Shaded Relief Map of the Project Area

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8.4.6. Soils, Land Capability and Land Use

Specialist consultants from Earth Science Solutions (ESS) were requested to conduct a detailed Soils, Land Use and Land Capability specialist study in support of the proposed project.

The relevant Specialist Report is:

Shondoni, Middelbult & New Block 8 North Project EMP/EIA Amendment Baseline Scoping Report Specialist Soils, Land Use & Land Capability Assessment, August 2020.

The information provided below represents a concise summary of the baseline description compiled for the greater Shondoni/ Middelbult Colliery project area.

The Sasol Mining Secunda Complex is situated to the south of Kinross and west of Trichardt/Secunda on the Mpumalanga Highveld of South Africa. The new Block 8 North project area is a natural extension of the coal resource in the area and forms a natural progression of the minable coal at a depth that includes the historic and current mining at the Middelbult Colliery and the Shondoni section in the south.

The areas that are currently being considered for underground mining development are regarded as greenfield sites in terms of the mining development. However, all of the areas of interest have been impacted and altered from their natural state by agricultural activities and/or existing industries and human settlement. These include both commercial cultivation of food crops as well as commercial grazing of the natural veldt grasses and/or the propagation and cultivation of grasslands for animal feeds. The impact on these sites renders them brownfields sites in terms of their environmental status when considering soils and land capability. The degree of alteration of these areas from their original or natural condition varies across the study area. The baseline studies have captured the pre mining/construction conditions, the point of departure for the impact assessment and ratings to follow during the EIA Phase.

The project falls within the Greater Olifants River water management area, an important surface water system that flows from north to the south and south east through the area of concern dividing the landscape into distinct secondary and tertiary catchments with their associated floodplain environs and distinctive river channel, terraces and impoundments, all of which are very significant in understanding the complex of soils and landforms within the project area.

The geomorphology of the area is important in better understanding the site sensitivities and vulnerabilities and the possible impacts that the proposed project might have on the overall biodiversity and the soils and land capability in particular, with the interactions of landform, climate, topography, soils, ground roughness and geology producing a complex inter-relationship that is basic to the soil forming processes and resultant soil characteristics.

The complex inter-relationships require that a scientifically defendable baseline of information is available before any impact assessment can be undertaken and any management or mitigation measures can be formulated.

Baseline assessments for the original 2011 Middelbult (Shondoni Block 8) Colliery EMP were performed to a great extent for the current project area and these information sets have been included as part of this baseline assessment.

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The soil characteristics and classification have been undertaken using the Taxonomic Soil Classification, a system developed for Southern Africa, and a system recognised nationally in terms of best practise guidelines.

The parameters noted include but are not limited to, soil depth, effective rooting depth, soil structure, soil texture, soil wetness indicators and soil colour.

In addition, and as part of the supporting information required in assessing the site sensitivity and the possible impact significance of a development on an area, the overall geomorphology has been looked at and considered in terms of the local climate, topographic slope and relative steepness of the terrain and ground roughness in association with the geology.

The site assessments have also looked at and considered the existing/pre-development soil utilisation potential or land capability, and place a significant weighting on the potential for utilisation of the soil in terms of rehabilitation, the workability of the materials and their inherent vulnerability, all factors that are considered important to the site sensitivity and overall sustainability of the project.

Observations made as part of the baseline assessment (Middelbult, Shondoni Block 8 and the new Block 8 North) confirmed that a strong correlation exists between the underlying lithologies (geology) and the soil forms mapped, while the topography and landform have also played a role in the pedogenisis and spatial distribution of the soils within the landscape. The variation in landform units has also been influenced, albeit to a lesser degree, by the local climate and hydrology of the site.

The attitude of the underlying lithologies (generally flat lying/horizontal) and the negative water balance (evaporation is higher than rainfall) has also had an influence on the weathering processes at work and the pedogenetic mechanisms (soil forming) that contribute to the soil forms mapped.

The *in-situ* derived soils are reflective of the underlying lithologies from which they are derived, the presence of an extensive dolerite sill that has intruded the sedimentary sequence having a strong influence on both the pedogenisis as well as the landform development.

The intrusive sills form a resistance layer within the geological sequence and produce more strongly structured and basic (iron, magnesium and calcium rich chemistry) materials, the streams and rivers having weathered through the resistant layer along fracture lines and faults, exposing the less resistant and more sandy loam type soils associated with the Karoo sediments that now form the ensized and often expansive alluvial floodplains that divide the area.

The result of these geomorphological interactions has resulted in a complex of soil forms and families, with a general trend from moderately shallow to shallow sandy loams and silty clay loams associated with the Karoo (Ecca) sediments and the highly structured and clay rich materials derived from the intrusive volcanics that make up a significant proportion of the soils in the areas mapped.

The accumulation of colluvial derived materials as part of the transition zone are reflected in the sandy clays and clay loams that vary in depth, water holding capabilities and drainage characteristics upslope of the alluvial floodplain deposits but downslope of the in-situ derived and more basic materials associated upper slopes. These soils are typified by and vary from strongly structured gleycutanic and terrestrial wet based soils, to fine sandy and silty loams with wetness features at depth across the lower portions of the soil catena.

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The erosion of, and accumulation of dolerite and diabase derived colluvial materials from upslope complicates the situation, the presence of iron, magnesium and calcium having an influence on both the chemical and physical characteristics of the colluvial and alluvial materials that are found as much younger soil materials within the river channels (floodplain deposits). These materials tend to be more highly structured, return much higher clay contents and are inherently more difficult to work with and on. Each of these soil groups (sandy loams, silty clay loams and gleyed materials) will need to be managed differently and if possible, separately, while the end land use should be matched to the soil qualities and their ability to be stored, managed and re-worked.

In contrast, the midslopes and upper-midslopes to crest slopes comprise in-situ derived soils with a more basic chemistry, pedocutanic to prismacutanic structure and a fine-grained texture. These soils associated with the volcanic intrusives (dolerite dykes and sills) that form the higher lying topographic areas due to their more resistant nature.

Using the taxonomic soil classification system, the dominant soil forms mapped comprise Avalon, Westleigh, Katspruit and Rensburg forms in the lower lying topographic positions associated with the streams and river floodplains and colluvial depositional zones, while the midslopes and upper midslopes are dominated by significantly large areas of deeper Avalon, Swartland, Sterkspruit and Arcadia form soils. The sub-dominant soil forms comprise for the most part Glenrosa, Mispah, areas of Mayo, Willowbrook, Valsrivier and Sepane form soils.

Variation in the hydromorphic soils included lower mid-slope to lower slope transitional form soils that comprise sandy clay to loamy and stratified sub soils and sandy topsoil on the alluvial outwash plains, to highly saturated gley and gleycutanic wetland form soil forms that are characterised by better than average organic carbon contents and well developed hydromorphic characteristics.

The soil physical characteristics returned topsoil clay percentages that range from as low as 10% on the sandy and silty loams, to more than 45% depending on the host/parent geology from which they are derived, and their position in the topography (crest slopes versus colluvial and/or alluvial bottom slope deposits), with variable structure (apedal to weak blocky) and soil water holding characteristics (40 mm/m to as high as 80 mm/m), subsoil clays that range from as low as 15% to greater than 65%, with associated moderate to very low in-situ permeability rates (0.60 m/day to 2.10 m/day) on the sandy clay loams and structured clay rich (gleycutanic) form soils respectively, highly variable water holding characteristics (60 mm/m to 160 mm/m) and poor to very poor intake (infiltration) rates (4 mm/m to 6 mm/m, depending on the type of clay present.

The physical characteristics are highly influenced by the parent materials from which the soils are derived, and to a lesser extent by their position in the topography (*in-situ* versus colluvial and/or alluvial derived materials).

The chemistry of the soils is typified by the parent materials from which the soils are derived, the sedimentary lithologies returning some distinctive differences from the intrusive/volcanic lithologies that occur within and cross cutting the bedded/layered sedimentary lithologies.

It is pertinent to note that the volcanic intrusives are relatively much more resistant to erosion and form the topographic highs, while the streams and rivers that have cut down through the dolerite sill formations have exposed the underlying sediments. The resultant mosaic and soil catena on the lower midslopes and lower topographic areas adjacent to the streams and river floodplains that comprise sandy loams and sandy clay loams of a predominantly sedimentary derived chemistry with a complex of colluvial derived materials representative of accumulations of the more basic materials from upslope.

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These soils comprise calcium, sodium and potassium salts and iron and magnesium metals mixed with the sedimentary derived chemistry, while the midslopes, upper midslopes and crest slopes are dominated by the more saline (potassium and sodium rich materials) chemistry of the basic volcanic materials.

The soils returned a range of pH values, with strongly alkali returns for the sedimentary derived soils, of between 4,25 and 7.5, and slightly acidic to neutral pH on the intrusive derived soils of between 6.5 and 7.5, a generally good supply of calcium and magnesium in a ratio of 3:1 for all but the alluvial derived soils associated with the riverine floodplain environments, areas that are generally under subscribed with potassium and phosphorous and in places zinc. The reserves of organic carbon are for the most part low to very low, with values that range from as low as 0.045C% to 0.45 C%.

Overall, and as a generalised statement, the soils require significant amounts of nutrient input if they are to be used for commercial farming ventures on a full rotation system.

The overall geomorphology (climate, topography, geology, soils, ground roughness etc.) has in turn been used to assess and rate the capability of the land in terms of its eco-system services and utilisation potential, the present (pre-development) land use a function of the local market demands. The Department of Environmental Affairs' Environmental Screening Tool has classified the planted areas as having a high sensitivity.

The land capability ranges from moderately small areas with good arable and agricultural potential, to moderate and very poor-quality arable materials that are generally associated with more shallow rooting depths and wetness characteristics as the confining feature at the soil base. These areas have in many cases been planted to commercial agriculture and have been classified as areas of high sensitivity in terms of the environmental screening tool guidelines. As an eco-system service these areas are considered important and form part of the food security to the population of South Africa, however, a significant proportion of the planted areas are considered marginal to poor in terms of the land capability rating guidelines.

In many cases the soils are too shallow (<750 mm), based on either the depth to an impermeable or wet layer, or restricted due to the strength of the soil structure, while the sites do not always meet a climate of crop yields that are at least equal to the current national average for the particular crops being grown. The high salt and metal concentrations (sodium, potassium, iron and magnesium rich chemistry) of many of the volcanic derived (dolerite sill) soils also renders them subject to high salinity conditions, while the high clay content and resultant strong structure renders them difficult to cultivate.

A significant proportion of the cultivated areas rate as moderate to low economic arable potential, and rate as wilderness/conservation or at best as natural grazing lands.

The present land use varies, from areas with little to no cultivation but with some commercial grazing, to areas with intensive commercial cropping, forestry and livestock grazing. There is little to no subsistence farming.

Based on these findings and with a broad understanding of the existing and proposed mining and related activities being planned (no detailed development plan other than the proposed mining areas was available at the time of study) the impacts will be rated in terms of the significance to the environment.

The following summary details the findings of the baseline assessment regarding the soils and their land capability:

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- A significant proportion of the areas within the project area and those that have been disturbed to date, returned soils that are of a moderate or low grazing land potential, with shallow to average soil depths, moderate to poor nutrient status and better than average water holding capabilities.
- The diversity of soil forms results in a variety of significant differences in how the differing materials need to be managed, stored and worked with. Many of the more clay rich soils will be difficult to work with, are prone to compaction when wet, and will erode if not well managed during storage or once exposed during the stripping operation (construction of infrastructure).
- The more sandy loams and silty loams are more easily worked on and stored, but are again prone to erosion if not well managed.
- The wet based soils mapped on the midslope (midslope seeps) have for the most part been impacted by cultivation, forestry and/or livestock grazing.
- The land capability is considered to be of a moderate or low potential "grazing" to low/poor potential "arable" status/rating, with significant areas of wet based soils and transition zone "wetland" status.
- Commercial livestock grazing, forestry and agriculture are the dominant commercial land use activities in the area.

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8.4.7. Geology and Geochemistry Aspects

JMA Consulting (Pty) Ltd conducted a detailed Geology (including Geochemistry) baseline specialist assessment in support of the proposed project.

The relevant Specialist Report is:

Geology Baseline Specialist Report for Shondoni Colliery including New Block 8 North Reserve Area; August 2020.

The information provided below represents a concise summary of the baseline description compiled for the greater Shondoni/ Middelbult Colliery project area.

The geology across the extent of the study area forms the basis for the topography, soils, vegetation, groundwater and surface water components of the biophysical environment, whilst at the same time provides the setting for the extensive underground mining operations. The geology and nature thereof, therefore, represents a crucially important component of the overall environment.

A fundamental understanding of the geology at Shondoni Colliery is thus a prerequisite on which to base impact assessments for soils, groundwater and surface water and from which to design and implement effective environmental management measures related to these environmental components.

The objectives for the geological study are as follows:

- Provide the regional geological setting in order to conceptualize the groundwater and mining environments;
- Provide site specific quantitative geological information in support of the soils and groundwater baseline studies and impact assessments, including aspects related to lithology, stratigraphy, mineralogy, geochemistry, weathering profile and structural features such as faults, dykes and sills; and
- Provide an understanding of the environment within which the underground mining operations take place.

The site-specific geology will be discussed with regards to the geological information recorded in the database which was provided by Sasol Mining and is therefore limited to the amount of geological data available at the time of the baseline assessment. The geological data was obtained from the geological logs recorded from the exploration boreholes across the Mine Lease Area (study area). The geological information was statistically assessed and evaluated with regards to the lithological thicknesses and structural compartmentalisation.

8.4.7.1. Regional Geology

The aim of this regional geological discussion is not intended to elaborate on the tectonics and formation of the geological attributes of the area, but rather to delineate the geological features of interest, describe the stability of the lithologies and set the scene for the geohydrological discussion as well. The occurrence and movement of groundwater, as well as the groundwater quality, are functions of the geological host rock in which the groundwater occurs, including the alteration thereof as a result of human activities, such as mining.

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The regional geology across the extent of the study area will be discussed with reference to the clipped region of the 1:250 000 Geological Map Series of South Africa – Sheet 2628 EAST RAND, (1986), displayed as Figure 8.4.7.1(a). The extent of the study area (Total Mine Lease Area) is delineated by and includes the Middelbult Reserve, Block 8 North Reserve, Springbokdraai Reserve as well as the Leeuwpan Reserve. The extents of the individual reserves are delineated by the green lines, whilst the position of the Shaft Complexes is located on Figure 8.4.7.1(a).

The regional geology map (Figure 8.4.7.1(a)) depicts that the surface geology within the study area is dominated by the sedimentary rocks of the Vryheid Formation (Pv) as well as Jurassic Age Dolerite Intrusives (Jd).

The Vryheid Formation forms part of the Ecca Group of the Karroo Supergroup, and outcrops extensively across the study area. The Vryheid Formation generically consists of interbedded sandstones and shale layers. Carbonaceous shale and coal layers are generally associated with the Vryheid Formation as well. The dolerite present within the study area (Jd) is younger than the Vryheid Formation and intruded into and through the sedimentary rocks of the Vryheid Formation. The dolerite intrusions typically occur as dykes and sills and are often responsible for the devolatisation of the coal adjacent to the dolerite intrusions. The riverbeds across the study area are typically associated with the deposition of tertiary and quaternary sands and sediments.

Figure 8.4.7.1(a) indicates that gold (Au), silver (Ag) and coal (C) has been or is currently being mined within the study area as well.

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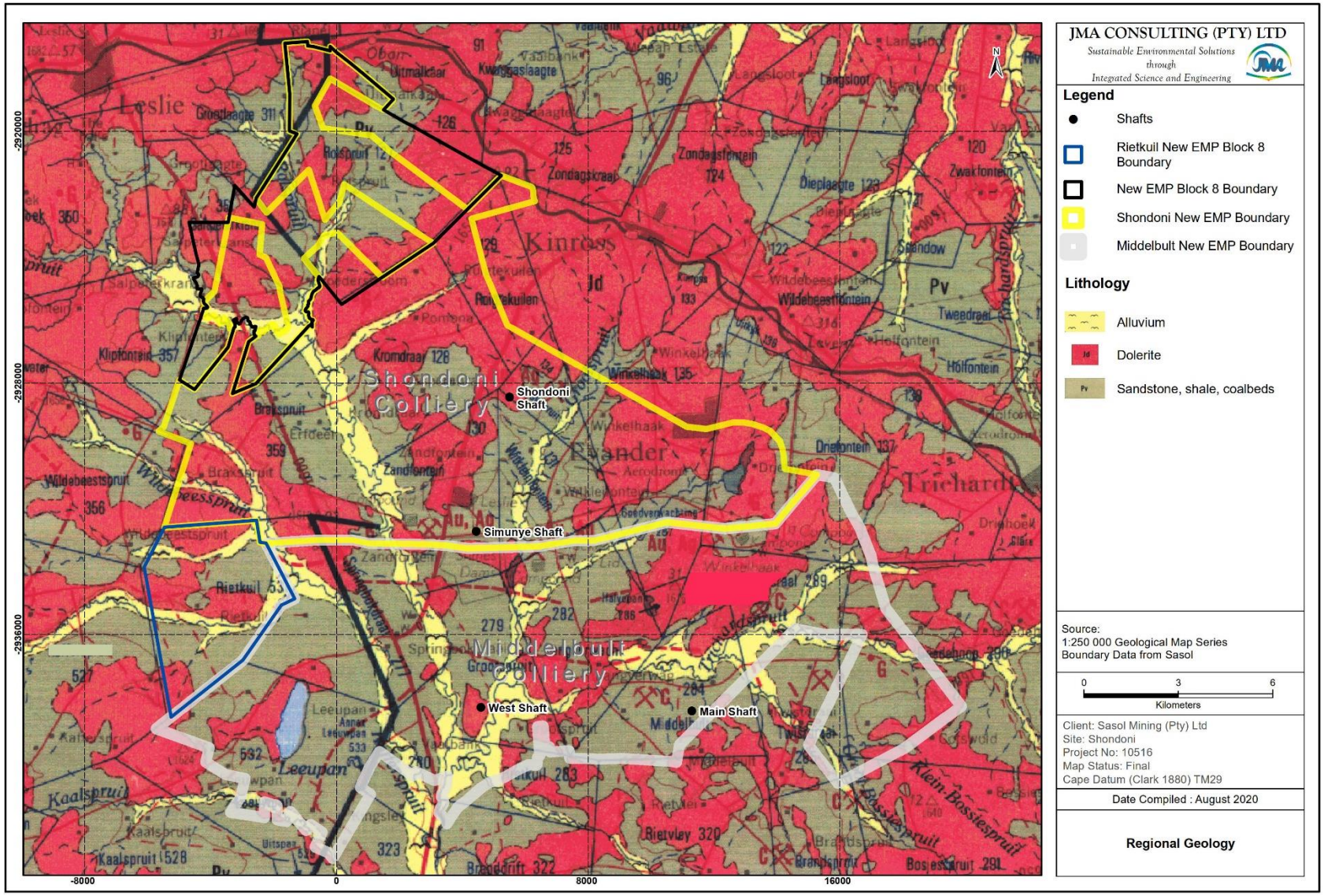

Figure 8.4.7.1(a): Regional Geological Map

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8.4.7.2. Site Geology

In addition to the exploration boreholes, geohydrological monitoring boreholes were drilled as part of the ongoing monitoring programme. These boreholes were logged according to the geology which they penetrated as well as the geohydrological properties of the subsurface. These boreholes were drilled in pairs (one shallow (SSW-) and one deep (SDF-) borehole) and were used to determine the geohydrological differences between shallow weathered zone aquifers and deeper Karoo aquifers.

The geology of the study area comprises mainly of sedimentary lithologies, belonging to the Karoo Supergroup, particularly, sandstone and sand/siltstone intervals of the Vryheid Formation, which rests unconformably on a (pre-Karoo) gabbro basement.

The general lithological profile of the study area, comprises of:

- Soft overburden consisting of soils and weathered sandstone and some occasional highly weathered dolerite;
- Hard overburden consisting of fresh to slightly weathered dolerite, sandstone and shale units;
- No.5 Coal Seam (only present in some areas);
- Inter burden units of sandstone;
- No.4H and/or 4L Coal Seam with a thin layer of sandstone in between if both are present;
- Karoo Sediments; and
- No. 2 Coal Seam.

Dolerite dykes and sills also appear unconformably across the study area.

Four cross sections were compiled by Sasol Mining in the past. The surface extents across which the cross sections are drawn are indicated in Figure 8.4.7.2(a). The site-specific geology will be discussed with reference to these cross sections as well as the information obtained from the geological logs generated for each of the exploration boreholes as well as the groundwater monitoring boreholes. The locations of the exploration boreholes, monitoring boreholes as well as the external user boreholes are indicated in Figure 8.4.7.2(b).

Figure 8.4.7.2 (c) shows the intersections of the main dolerite structures associated with the No. 4L Coal Seam as well as the major fault zones within the study area. The extent of coal devolatilisation associated with the different dolerite intrusions are indicated on Figure 8.4.7.2(c) as well.

The current proposed underground mining extent of the No 4 Coal Seam is far larger than for the No 2 Coal Seam. The coal will be mined out by standard bord and pillar underground mining methods from the No 4 seam, whilst the possibility of high extraction is considered by Sasol Mining.

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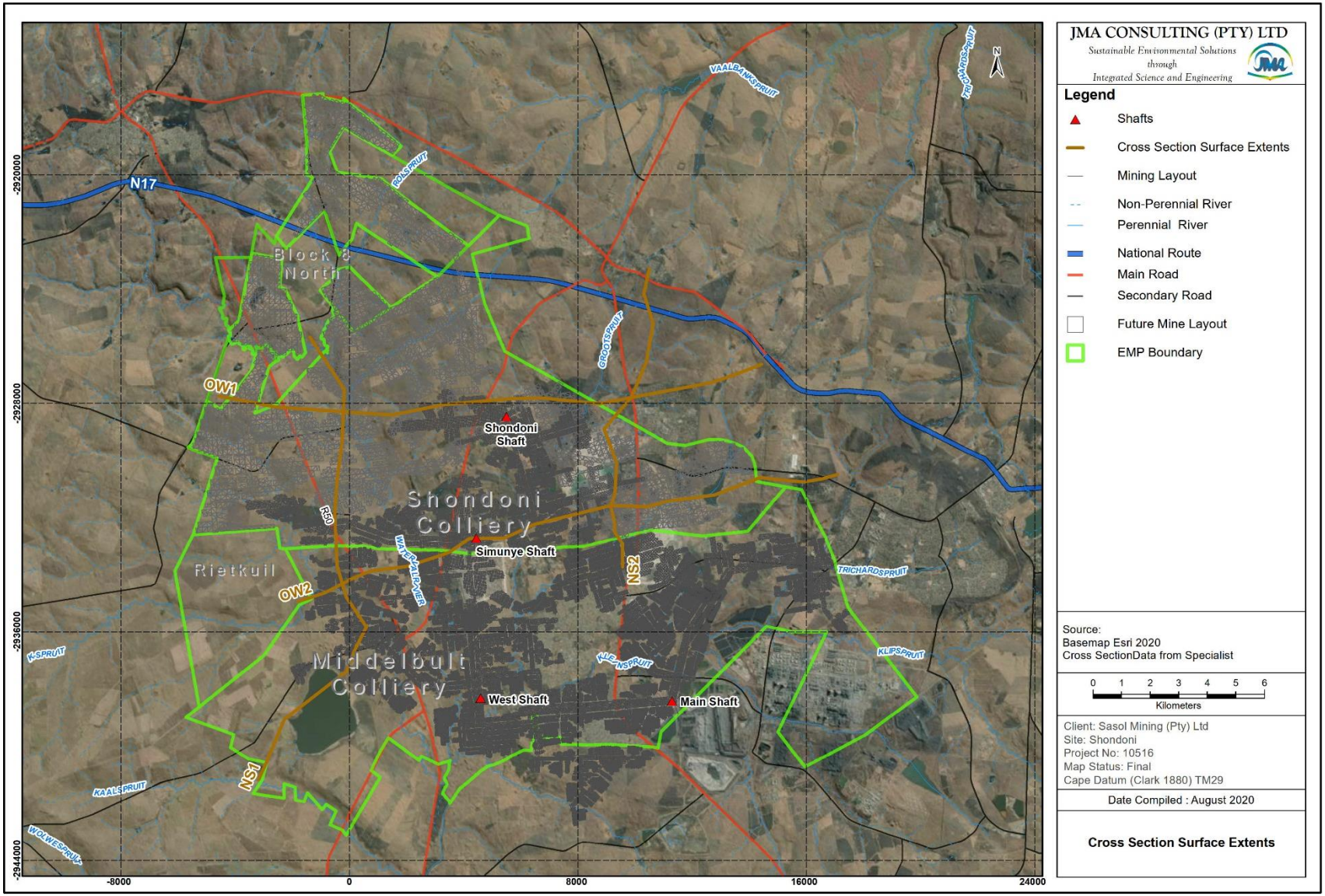

Figure 8.4.7.2(a): Regional Geological Map

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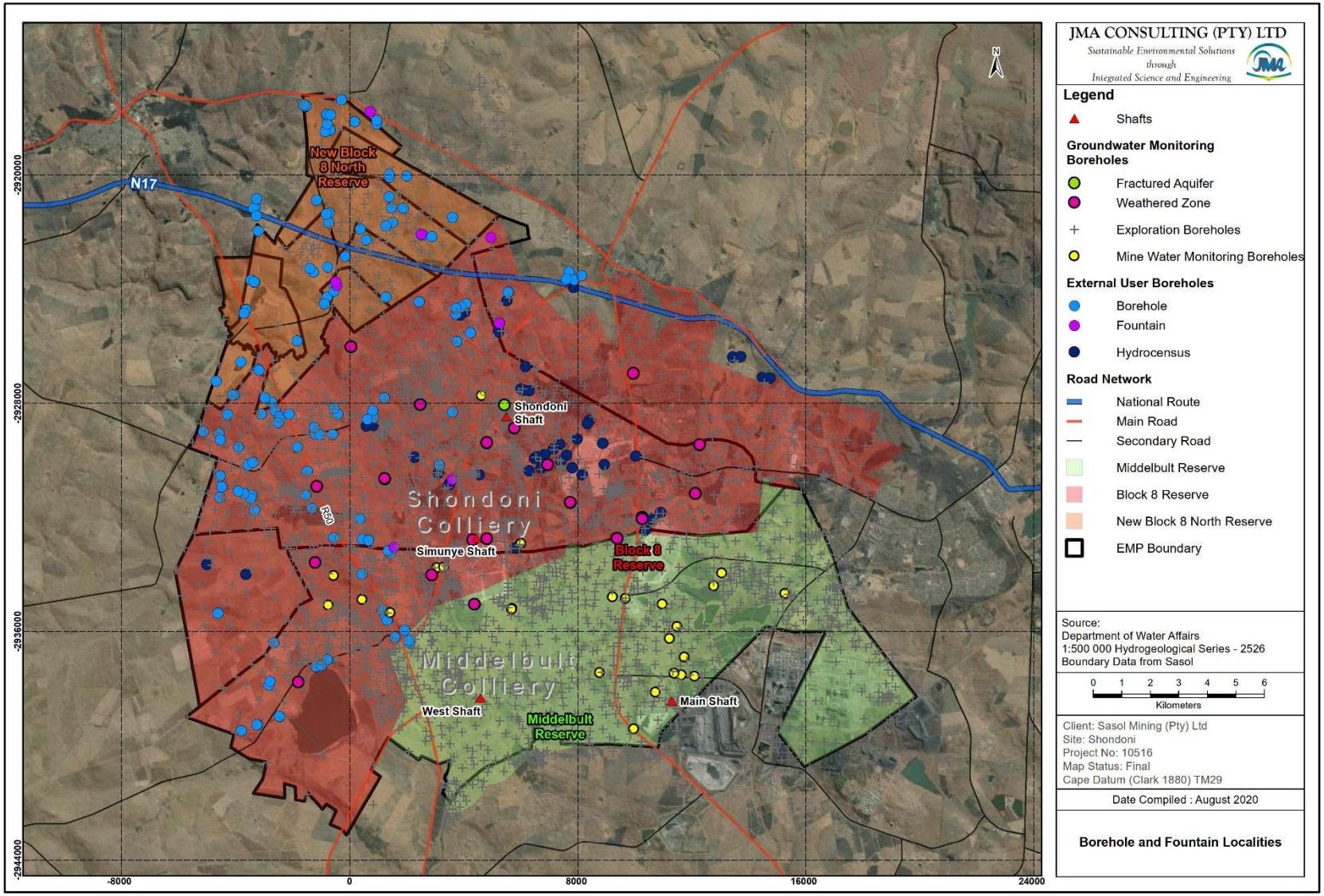

Figure 8.4.7.2(b): Regional Geological Map

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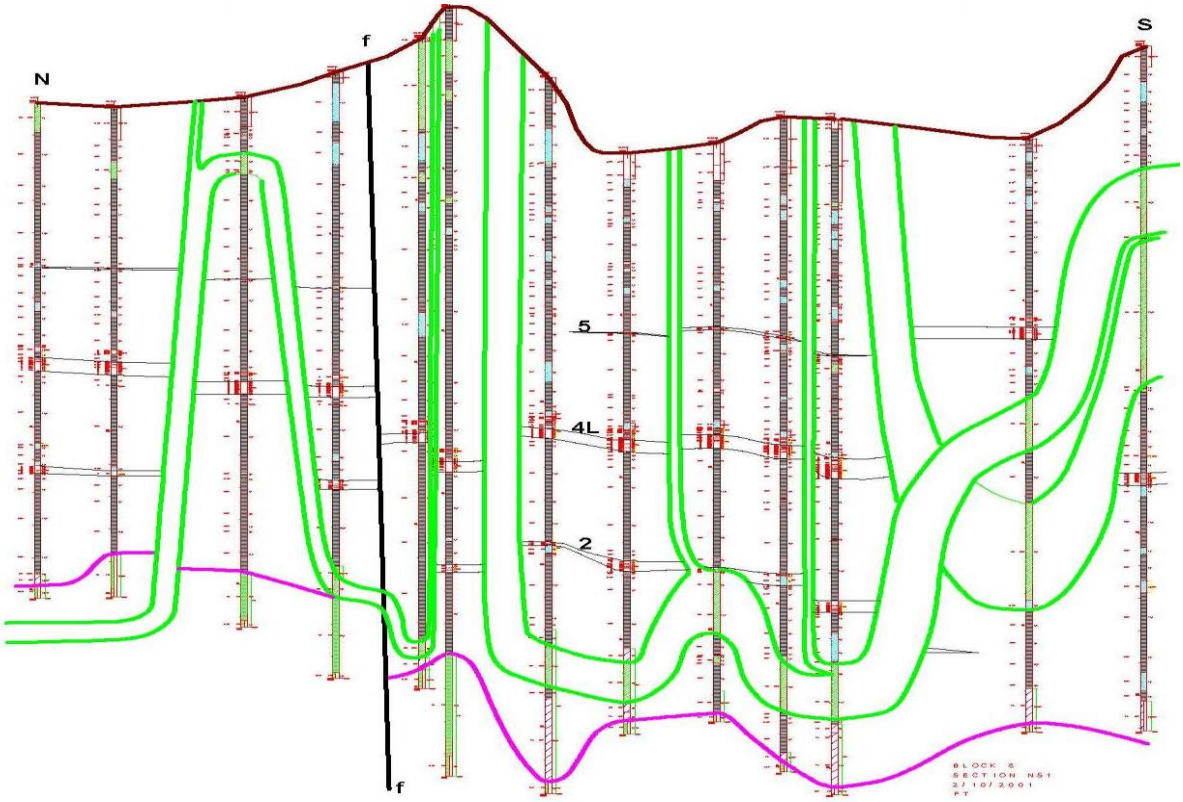
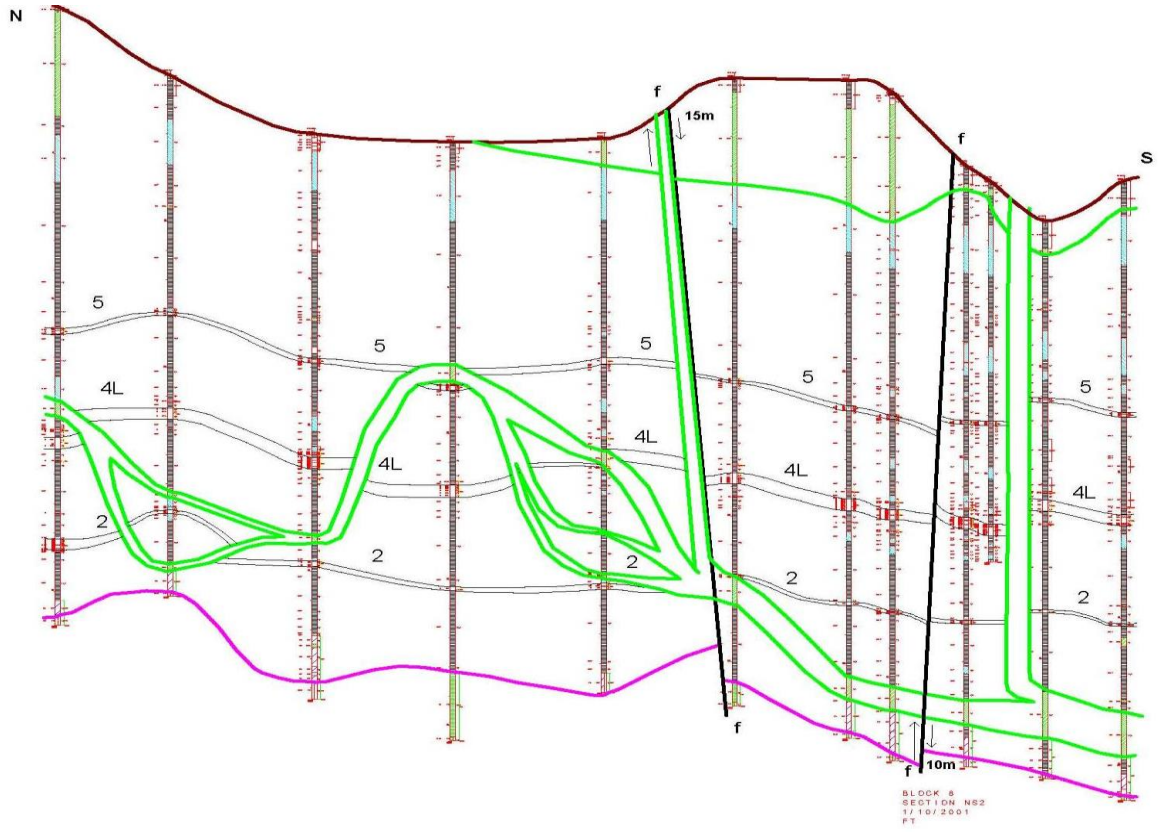


Cross Section NS1



Cross Section NS2

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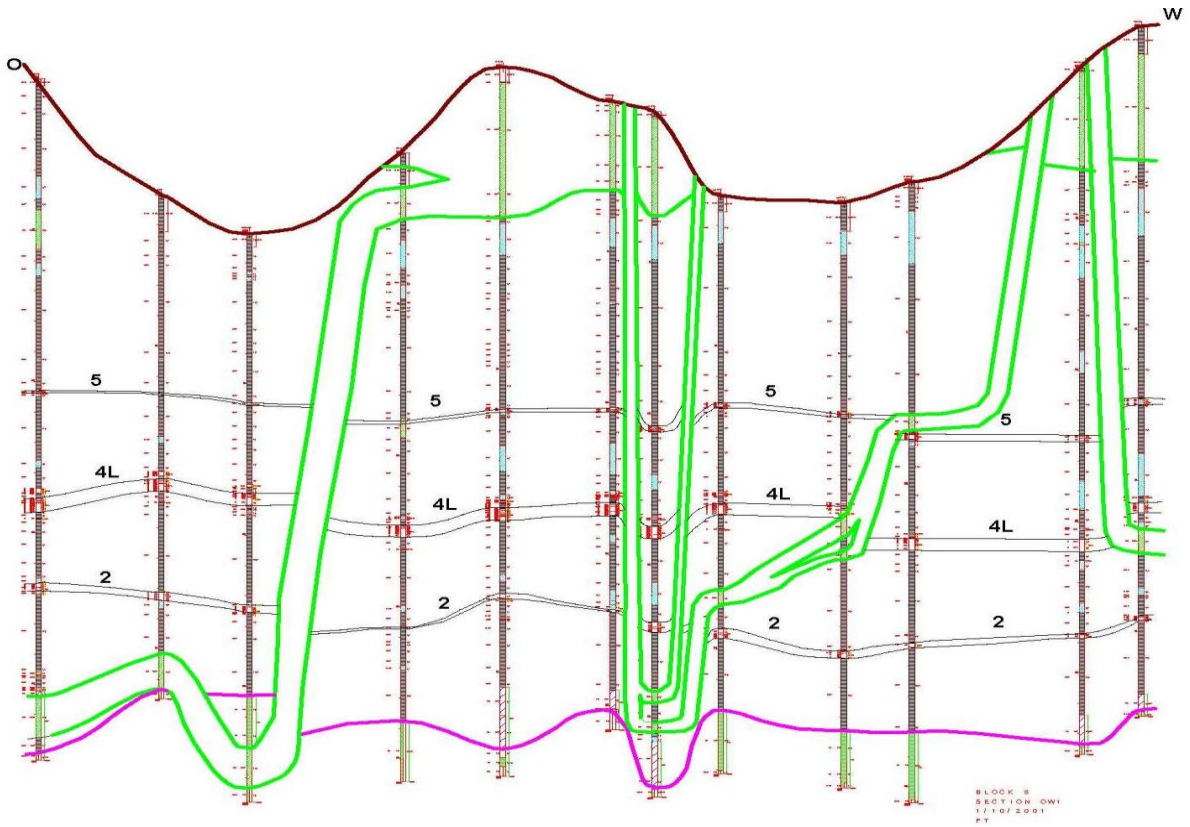
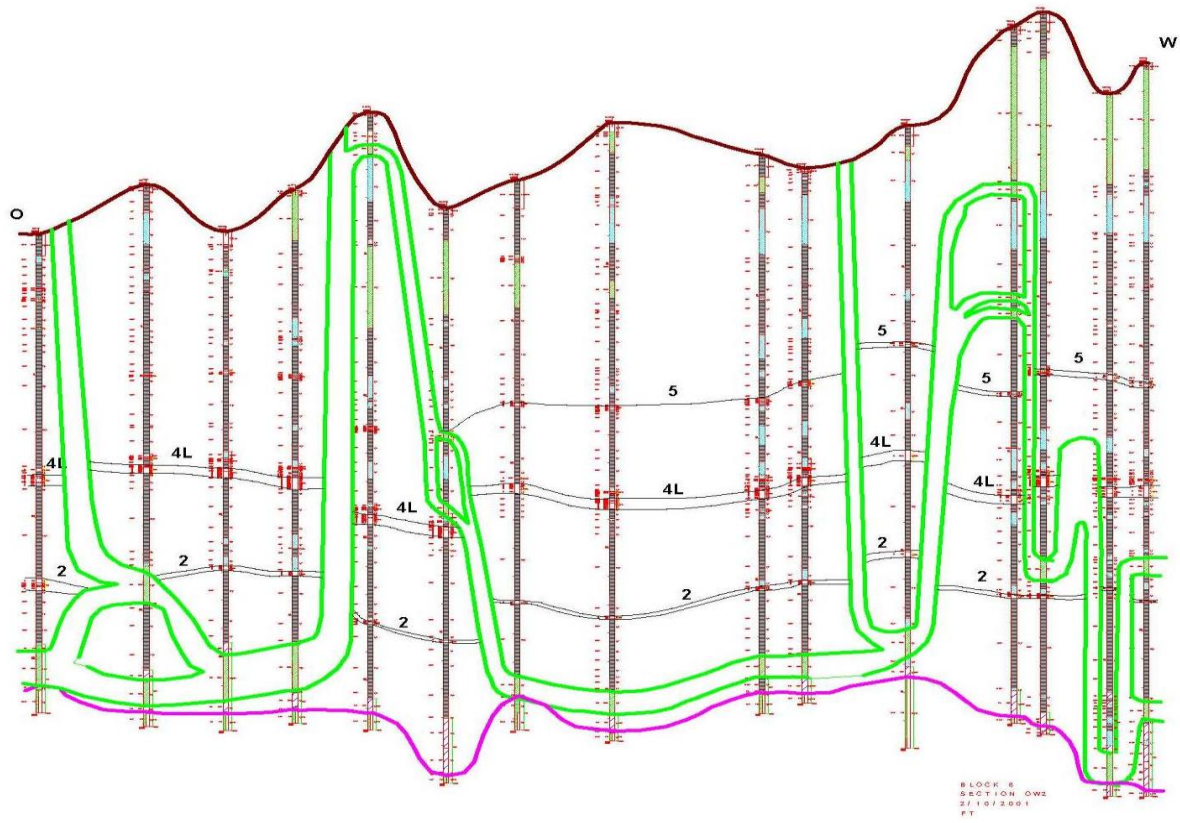


Cross Section OW1



Cross Section OW2

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The No. 4L seam ranges in elevation between 1436.20 mamsl and 1527.14 mamsl with an average elevation of 1483.43 mamsl. The No. 2 seam occurs some 20 to 30 m below the No. 4L seam and ranges in elevation between 1408.98 mamsl and 1493.50 mamsl with an average elevation of 1449.734 mamsl.

The No. 4L Coal Seam has the highest elevations within the new Northern Block Reserve and becomes progressively lower towards the South across the Block 8 and Springbokdraai Reserves. The No. 4L Coal Seam is the deepest across the southern as well as south-western extent of the Block 8 Reserve. The No. 4L Coal Seam has a high lying area across the south-western corner of the Middelbult Reserve, whilst the central parts of the Middelbult Reserve have the lowest No. 4L Coal Seam elevations.

The No. 2 Coal Seam floor elevation contours across the study area depicts a similar pattern as the No 4L Coal Seam floor elevations contours. The No. 2 Coal Seam has the highest elevations across the northern extent of the Block 8 Reserve as well as the New Northern Block reserve. The No. 2 Coal Seam floor elevations become progressively lower towards to the south, across the extent of the Block 8 Reserve. The lowest elevations occur across the south-western extent of the Block 8 Reserve, the Springbokdraai Reserve as well as the central areas of the Middelbult Reserve. The No. 2 Coal Seam elevation becomes progressively higher across the south-western corner of Middelbult Reserve up to an elevation of 1475 mamsl.

The coal seams have been displaced and devolatilised to varying degrees as a result of the tectonics and intrusives within the study area. The locations of the dolerite intrusions as well as the extents of devolatilisation of the No. 4 Coal Seam associated with the intrusives are delineated on Figure 8.4.7.4 (a). The displacement of the coal seams as a result of the dolerite intrusions, generally ranges from no displacement to not much more than the than the coal seam thickness itself. There is however a displacement of roughly 35 m, almost equal to the thickness of the transgressing and troughing B4 sill, compartmentalising the southern-most portion of the reserve on Leeuwpan 532 IR, and is indicated on cross-section NS1.

Apart from the portions of the Block 8 Reserve separated from Middelbult Colliery, compartmentalised and sub-compartmentalised by transgressing B8 dolerite sills, the north-western portion of the reserve with specific reference to the cadastral farms Salpeterkranz 128 IS, Rolspruit 127 IS, Klipfontein 357 IR, Brakspruit 359 IR and Kromdraai 128 IS, is further compartmentalised by a 20 m thick transgressing B4 dolerite sill.

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8.4.7.3. Weathering Profile

The limit of weathering as well as the total overburden depths of the study area was determined from the exploration boreholes as recorded by Sasol Mining and is summarised in Table 8.4.7.3(a).

Table 8.4.7.3 (a): Summary of the Limit of Weathering and Overburden Depths

Description	Value	
Soft soil overburden thickness (*m*)	Min.	1.42
	Max.	23.32
	Ave.	**6.44**
Weathering Thickness (*m*) *(Highly weathered zone, followed by a slightly weathered/fractured zone)*	Min.	9.14
	Max.	33.56
	Ave.	**15.27**
Total Overburden from surface to the No.5 coal seam – where present (*m*)	Min.	0.00
	Max.	135.55
	Ave.	**76.17**
Total Overburden from surface to the No.4L coal seam (*m*)	Min.	16.95
	Max.	182.40
	Ave.	**108.54**
Total Overburden from surface to the floor of the Karoo Sediments (*m*)	Min.	91.28
	Max.	256.73
	Ave.	**182.87**

Table 8.4.7.3(a) indicates that the study area has an average overburden (soil) thickness of 6.44 m, and ranges in thickness from 1.42 m to 23.32 m. The soil is predominantly underlain by a highly weathered zone, followed by a slightly weathered to fractured zone. The weathered zone consists of soft overburden, weathered sandstone and some occasional weathered dolerite. The overburden becomes progressively harder and consists of more fractured to slightly weathered dolerite, sandstone and shale units. The total weathering thickness across the study area ranges between 9.14 m and 33.56 m, with an average thickness of 15.27 m across the extent of the study area.

The depth to the No. 5 Coal Seam ranges between 0 m (where it outcrops at the surface) and a maximum depth of 135.55 m below the surface. The No. 5 Coal Seam lies at an average depth of 76.17 m below the surface level, across the extent of the study area. The No. 4 Coal Seam lies at a greater depth and is a lot more extensive than the No. 5 Coal Seam within the study area. The No. 4L Coal Seam ranges in depth from 16.95 m to 182.40 m below the surface, with an average depth of 108.54 m below the surface. The No. 4L Coal Seam is underlain and predominantly separated from the No. 2 by the Karroo Sediments.

The base of the Karoo consists of tillite overlain by sandstone and siltstone of the Pietermaritzburg Formation, which is in turn overlain by sediments from the Vryheid Formation.

8.4.7.4. Dykes and Faults

The Karoo sediments were displaced by two phases of post-Karoo dolerite intrusions. The oldest, namely the B4 dolerite intrusions, are fine to medium crystalline dolerite, typically occurs as a massive sill, is mostly restricted to the surface and has a maximum thickness of ± 49 m. This sill is eroded away in the lower lying areas.

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Locally the B4 dolerite is not only surface bound but transgresses the coal seams in a trough-like fashion to effectively compartmentalise these portions of the reserve on the mining horizon (Figure 8.4.7.4(a)).

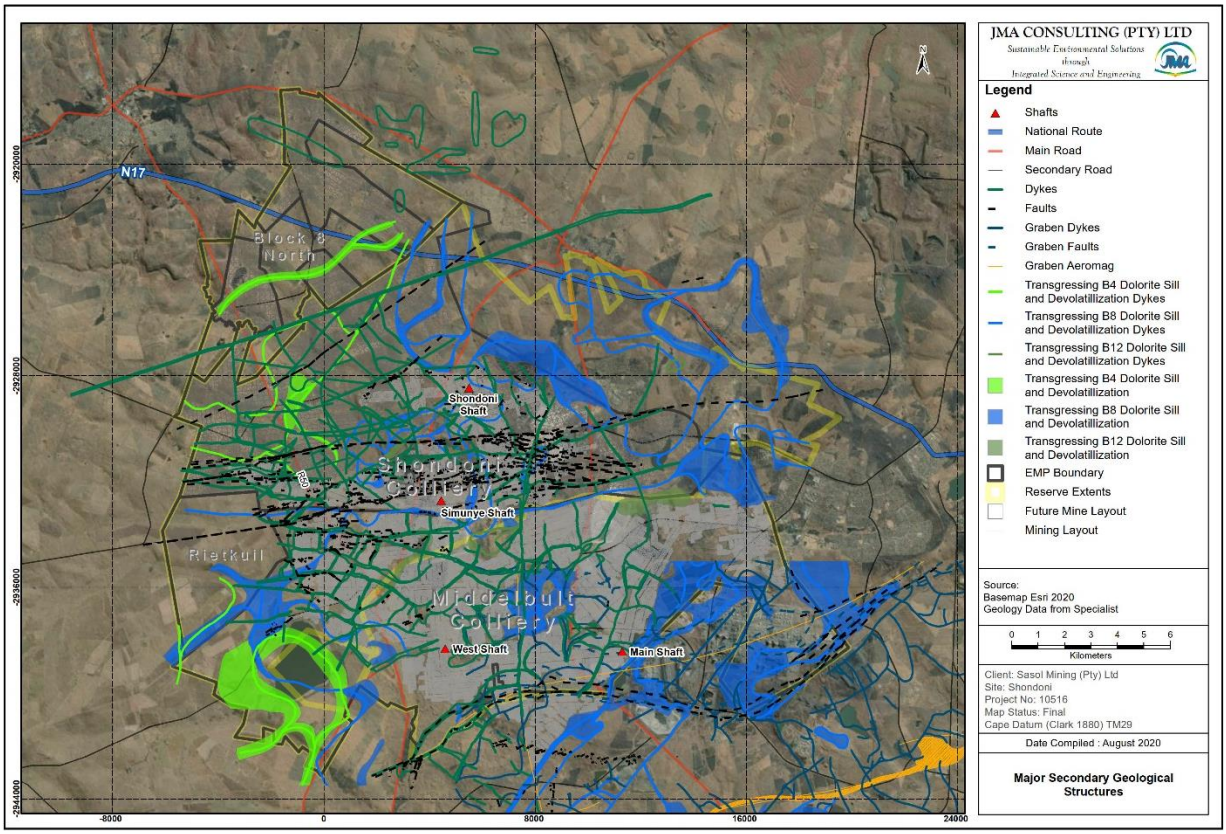

Figure 8.4.7.4(a): Major Secondary Geological Structures within the Study Area

The B6 dolerite is a porphyritic dolerite, usually 3 m thick and intersects the coal seams less frequently than the B8 dolerite. The B8 dolerite is a fine-grained porphyritic dolerite and intruded later than the B4 dolerites. The B8 dolerite intruded along semi-planar features, with the result that it is mainly exposed as dykes, i.e. almost vertical intrusives. The B8 ranges in thickness from very thin to a maximum of 18 m. The prominent, east-west striking dyke or sub-vertical sill, separating most of the Block 8 Reserve from Middelbult Colliery (Figure 8.4.7.4(a)), can be seen to range in thickness between 7 m and 15 m.

The B8 sill dolerite, ± 18 m in thickness, features near vertical off-shoots (dykes), where it transfers from one horizontal plane to another. These features occur predominantly along the planes of transference. This phenomenon results in extensive geological compartmentalisation observed across the study area.

The B12 dolerite is a light grey, fine-grained porphyritic dolerite with large needle-like phenocrysts, roughly ranging in thickness between 0,12 m and 0,75 m. The B12 dolerite does not intersect the No. 4L seam as abundantly as the B4 or B8 dolerite intrusions (Figure 8.4.7.4 (a)).

Twenty-three dolerite intersections were recorded in twenty of the drilled monitoring boreholes. Thirteen water strikes, associated with host rock contacts as well as the contact between weathered and fresh dolerite, were recorded along these intersections.

In the central portion of the study area two normal faults of significance occur. The larger of the two faults has a throw of 15 m to the south, the dip also being to the south.

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This fault has an east-west strike and stretches between Brandspruit 359 IR in the west and the town of Evander in the east, over a distance of 15.5 km, intersecting the Gold Mine Slimes Dams to the west of Evander (Figure 8.4.7.4 (a)).

This fault zone was intersected in boreholes SSW-7, SDF-7 and SDF-10. Major water strikes were encountered in boreholes SSW-7 and SDF-7, both located some 800 m west of the Gold Mine Slimes Dams. Borehole SSW-7 intersected large calcified fracture planes with pyrite mineralisation, yielding water make of ± 22 l/s, in the overlying B4 dolerite at a depth of 17-18 m. Borehole SDF-7, situated some 10 m south of borehole SSW-7, recorded a water strike of ± 19 l/s, also at a depth of 17-18 m in a highly fractured B4 dolerite (no calcification observed), and a further ± 10 l/s at a depth of 41-43 m, along a fracture in a fresh sandstone/shale succession. The strike of this fault zone beyond the study area boundary has not been confirmed.

The smaller fault situated some 2 km south of the larger fault to the south has a throw of 9 m to the north on the No.4L seam, the dip also being to the north. As with the larger fault, the strike is also east-west in orientation. It stretches between Witkleifontein 131 IS in the west and between Evander's Sewage Works and the Winkelhaak Mines Slimes Dams in the east, over a distance of 4 km. The strike of this fault zone beyond the property boundary has also not been confirmed.

8.4.7.5. Mineralogy and Geochemistry

The objective of the geochemical assessment is to determine the environmental risk of the selected geological material on the environment. This study is currently ongoing and will be completed once all laboratory tests have been concluded during the EIA Phase of the project.

The objectives of the geochemical assessment were to determine the following:

- Identify which geological units could have negative environmental impact;
- Develop sampling plan to obtain representative samples of the selected geological units;
- Select an appropriate analytical plan to determine the environmental risks of selected geological units;
- Investigate the mineralogical and elemental compositions of the geological units;
- Classify the geological units in terms of their ability to generate acid drainage in the long term;
- Conduct short and long-term leaching tests on underground roof, sidewall and floor rocks;
- Set-up a conceptual model to identify physio-chemical interactions of the underground mining void as flooding occurs;
- Determine the long-term underground water quality; and
- Provide conclusions and present future possible work.

Five overburden samples were taken from the exploration boreholes L134055 and L134060. The samples represent the main lithological units found in the overburden of the Shondoni and Middelbult Collieries mining area.

12 Samples were taken from four sampling localities from the Middelbult Colliery underground mining area. Samples were collected from the floor, roof and sidewall at each of the localities.
Six samples were collected from two sampling localities from the Shondoni Colliery underground mining area. Samples were collected from the floor, roof, and sidewall at each of the localities.

The 18 collected underground samples were composited into nine samples which were subjected to geochemical testing along with the five overburden core samples. The roof, sidewall and floor samples from each of the six localities were composited into a single floor, sidewall and roof sample used for kinetic testing.

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Geochemical testing conducted on the nine composite samples include X-Ray Diffraction (XRD), Whole Rock Analysis, Acid-Base Accounting (ABA), Net-Acid Generation (NAG) and Static 1:4 Reagent water leaching.

From the mineralogical and elemental investigations, the *overburden* is dominantly silicate minerals from the XRD investigation with the sandstone, siltstone and shale samples consisting of quartz, kaolinite, palygorkite and muscovite. Pyrite, dolomite and siderite are present in abundances that will influence the environmental influence of the rocks. Dolerite is also dominated by the silicate minerals plagioclase with the associated pyroxene mineral augite. Coal seams in the overburden is dominantly organic carbon, there are also minor amounts of calcite, dolomite and pyrite present in the coal. Elementally, the silicate samples consist predominantly out of the major oxide SiO_2, with only significant elevated above the Average Upper Crust (AUC) values include TiO_2 and CaO in the dolerite samples. Trace elements elevated significantly include Ce, Cu, Se, and V.

Middelbult underground samples
The roof and floor rocks are dominantly quartz with associated silicate minerals kaolinite, muscovite, plagioclase. Only the Mid 34 roof sample had significant pyrite content. The samples have dolomite and siderite present in trace amounts. The sidewall/coal samples are dominantly organic carbon and a considerable amount of kaolinite and quartz content. No major oxides were significantly elevated except for SiO_2 because of the high quartz content in some of the roof and floor. Trace metals elevated include Ag, As, Ce, Cd, Hf, Hg, Se, and Zr.

Shondoni underground samples
The roof and floor rocks are dominantly quartz with associated silicate minerals kaolinite, muscovite, plagioclase. The roof rocks have a considerable amount of pyrite content of 7.75 % with only a trace amount of dolomite also present. The sidewall / coal samples are dominantly organic carbon with quartz and kaolinite also present. The sidewall / coal samples have a significant pyrite content as well as some calcite and dolomite. No major oxides were significantly elevated, only SiO_2 was marginally elevated in the roof samples.

From the ABA and NAG it is evident that the overburden material has low to very low risk to generate acid drainage in the long-term. The *Shondoni* roof, sidewall/coal and floor rocks have a very high risk of generating severe acid drainage over the long-term. The *Middelbult* roof samples have a very high risk of generating severe acid drainage over the long-term, the sidewall/coal and floor samples have a medium to high risk to generate acidic drainage due to the presence of some carbonate minerals that will buffer any acid generation.

The leachate from the *Middelbult* and *Shondoni* roof samples indicate that samples are already acid generating and have a very acidic pH. The sulphate of the sample is also very elevated with concentrations of between 2 696 mg/l and 3 474 mg/l. Multiple metals are also leaching at elevated concentrations from the roof rocks which include Al, As, Cd, Cr, Fe, Mn, Ni, U and Zn. The sidewall / coal samples have a neutral pH and an alkalinity concentration of between 134 mg/l to 185 mg/l.
The only parameters that leached at elevated concentration from the sidewall / coal samples is ammonia. From the *Middelbult* and *Shondoni* floor samples the *Middelbult* samples have a near neutral pH but the *Shondoni* sample has an acidic pH. All three of the samples have elevated Total Dissolved Solids (TDS) and sulphate concentrations. Only the *Shondoni* floor sample has elevated metal concentration in the leachate which are Al, Fe, Mn, Na, and Ni.

This information will, along with the kinetic testing data, be used for the follow-up report which will include the geochemical modelling and final conclusions.

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8.4.8. Groundwater Aspects

JMA Consulting (Pty) Ltd conducted a detailed Groundwater baseline specialist assessment in support of the proposed project.

The relevant Specialist Report is:

Groundwater Baseline Specialist Report for Shondoni Colliery including New Block 8 North Reserve Area; August 2020.

The information provided below represents a concise summary of the baseline description compiled for the greater Shondoni/ Middelbult Colliery project area.

Sasol Mining operates several underground coal mines in the Secunda Area. Middelbult - Shondoni Colliery represents one of the underground mines and has been in operation since 1981. During its existence Middelbult Colliery has gone through several expansions. Whilst some of the original shafts have already been closed and rehabilitated, new shafts have been developed to access the coal reserves.

As part of this ongoing development to ensure access to exploitable reserves, Sasol Mining is now investigating options to increase its reserve utilisation of the Block 8 North Reserves for the existing Shondoni Colliery operations. At the same time the current mine lease area is also extended to now include the Block 8 Northern Coal Reserves.

The proposed infrastructure expansion of the Shondoni operations, comprise the underground workings for the additional reserve blocks Block 8 Northern Reserves and additional Ventilation Shafts. The proposed future mining activities will be conducted by means of underground mining operations, utilising the bord-and-pillar and possible high extraction methods to extract coal from the No.4 and No.2 Coal Seams. It is anticipated that approximately 7.2 million tonnes of coal per year will be mined.

The regional geohydrology of the study area will be discussed with reference to the available information relevant to the map extract displayed as Figure 8.4.8(a). This map extract was clipped from the published 1:500 000 Hydrological Map Series of the Republic of South Africa, Sheet 2526 Johannesburg, 1999.

The regional geohydrological attributes of the study area are clearly a function of the geological formation distribution. Two distinctly separate surface stratigraphic sequences (Pe and Jd) occur within the study area, each with their own geohydrological manifestations. Both sequences outcrop extensively and interchangeably across the extent of the study area.

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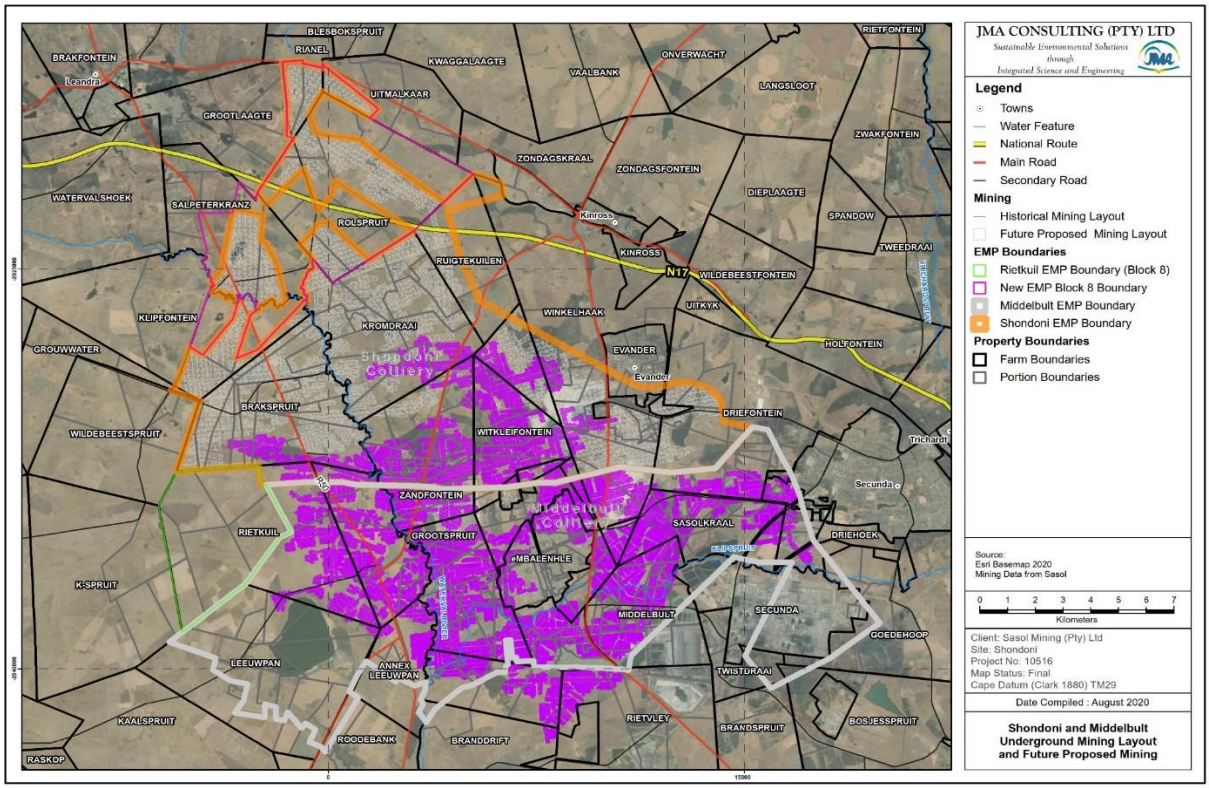

Figure 8.4.8(a): Shondoni and Middelbult Colliery current and future Underground Mining Layout

8.4.8.1. Regional Geohydrology

Geohydrological Zone 1: Permian Age Ecca Group Sediments

The surface geology within the southern extent of the study area is predominantly underlain by the argillaceous rocks (shale, mudstone and siltstone) and arenaceous (sandstone) of the Ecca Group – denoted by Pe on Figure 8.4.8.1(a).

The primary groundwater occurrences within this zone are in joints and fractures associated with the contact zones, related to the heating and cooling of the country rock, caused by the intrusions of the dolerite dykes and sills. Groundwater is also extensively present within the weathered zones of the Ecca Group lithologies.

The borehole yielding potential within this geohydrological zone is classified as d2, which indicates an average yield which varies between 0.1 l/s to 0.5 l/s, although much larger yields are often associated with more localized contact zones. The aquifer type is classified as intergranular and fractured, and no large-scale groundwater abstraction is indicated to occur from these aquifers within the bounds of the study area. The groundwater potential for the western area is given as between 40 and 60%, which indicates the probability of drilling a successful borehole (yield > 0.1 l/s) whilst the probability of obtaining a yield in excess of 2 l/s is given as between 0% and 20%.

Geohydrological Zone 2: Jurassic Age Dolerite

The surface geology across the northern extent of the Coal Reserve as well as the new Block 8 North Reserve consists almost entirely of ultramafic to mafic Jurassic Age Dolerite Intrusives – denoted by Jd on Figure 8.4.8.1(a).

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The primary groundwater occurrences within this zone are in joints and fractures associated with the contact zones, related to the heating and cooling of the intrusive bodies as well as in the contact zones with the host rock. The borehole yielding potential within this geohydrological zone is predominantly classified as d2, which indicates an average yield which varies between 0.1 l/s to 0.5 l/s, although much larger yields are often associated with more localised contact zones.

The aquifer type is classified as intergranular and fractured, and no large-scale groundwater abstraction is indicated to occur from these aquifers within the bounds of the study area. There is however a localised area within the dolerite to the south-east of the study area that is classified as d3, indicating that the average yield varies between 0.5 and 2.0 l/s. The aquifer type is still classified as intergranular and fractured.

The groundwater potential for the western area is given as between 40 and 60%, which indicates the probability of drilling a successful borehole (yield > 0.1 l/s) whilst the probability of obtaining a yield in excess of 2 l/s is given as between 0% and 20%.

The mean annual recharge to the groundwater system within the study area is estimated to be between 25 mm and 50 mm per annum, which relates to about 5% of the mean annual precipitation (MAP). The groundwater contribution to surface stream base flow is relatively low, estimated to be less than 25 mm per annum.

The aquifer storativity (S) for the fractured aquifers in this part of the study area is estimated to be between 0.001 and 0.01. The saturated interstice types (storage medium) are fractures which are restricted principally to the zone directly below the groundwater level. The pristine groundwater quality is good with a Total Dissolved Solids (TDS) range of between 300 mg/l to 500 mg/l. The groundwater is classified to be of the hydrochemical type B, with dominant cations Ca^{2+} and Mg^{2+} and dominant anion being HCO_3-.

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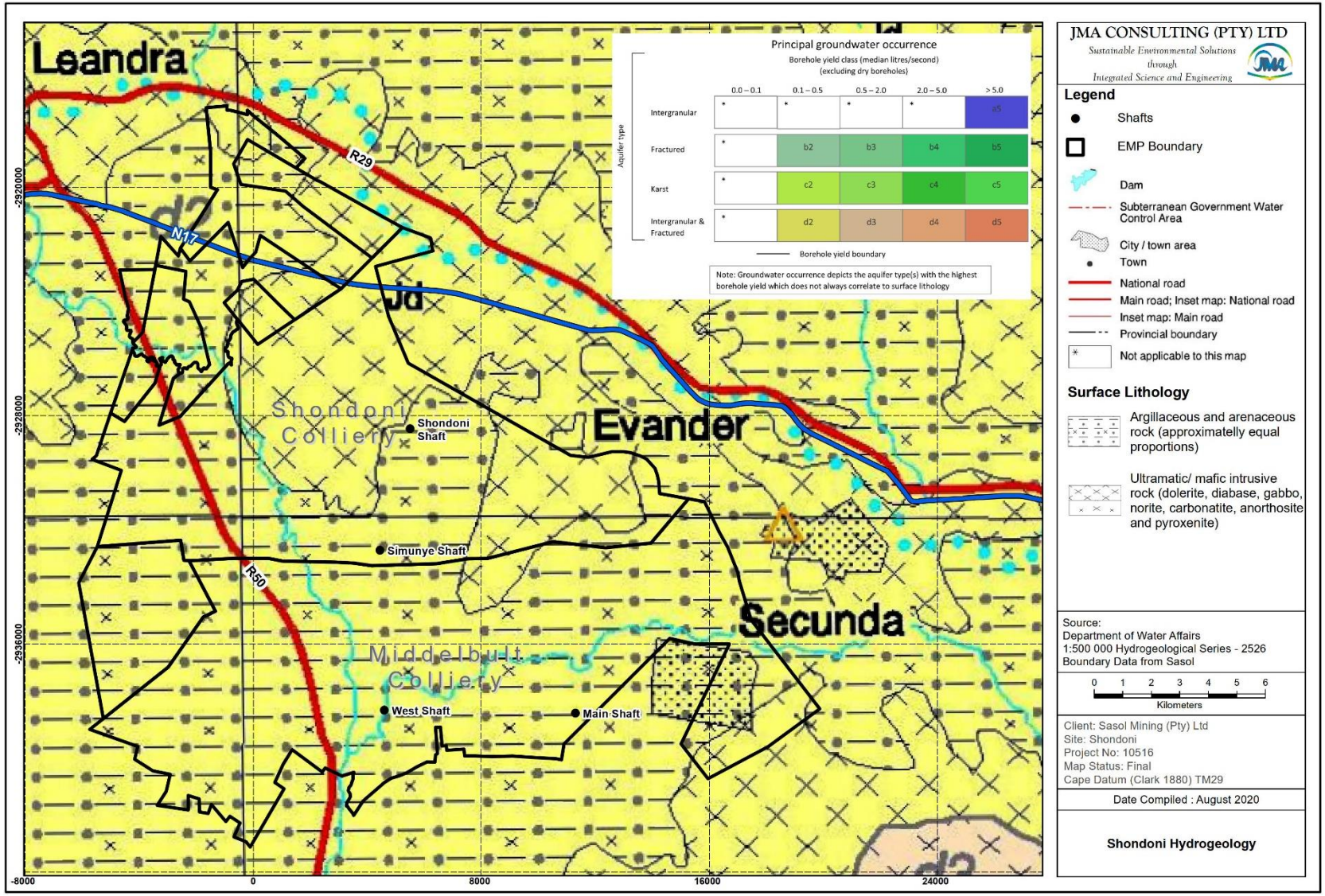

Figure 8.4.8.1(a): Regional Geohydrology of the Study Area

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8.4.8.2. Physical Aquifer Description

During previous geohydrological investigations, a total of 30 monitoring boreholes were drilled specifically for geohydrological purposes. The boreholes were drilled in pairs, one shallow borehole (SSW-) of 30 m deep to investigate the shallow weathered zone aquifer(s), and one deep borehole (SDF-) ranging in depth between 80 - 150 m, to investigate the deep fractured aquifer. The shallow weathered zone aquifer(s) were sealed off in the deep boreholes (SDF-) with 30 m solid steel casing and sealed with cement and bentonite at the surface. The solid casing installed in the shallow boreholes (SSW-) ranged in depth between 2 m and 12 m, averaging at 6 m. The borehole logs and site reports, as well as multi-parameter profiles for these boreholes were recorded.

The boreholes were sited using geophysical (magnetic) methods with the aim of intersecting the following geological structures:

- Four boreholes pairs (SSW- & SDF- 4, -7, -10 & -13) were sited to intersect the large east-west orientated normal fault that stretches over roughly 16 km between Brandspruit 359 IR in the west and the town of Evander in the east. This large feature also intersects the Gold Mine Slimes Dams to the west of Evander.
- One pair of boreholes (SSW- & SDF-2) were sited to intersect the smaller normal fault that stretches over roughly 4 km between Witkleifontein 131 IS in the west and Evander's Sewage Works and the Winkelhaak Mines Slimes Dams in the east.
- Two pairs of boreholes (SSW- & SDF-6 & -9) were sited to penetrate the two dykes intersecting both the Gold Mine Slimes Dams.
- One pair of boreholes (SSW- & SDF-3) was sited to intersect the 7 m thick sub-vertical rising B8 dolerite sill that compartmentalizes or separate most of the Block 8 Reserve from the Middelbult Colliery underground workings.

8.4.8.3. Aquifer Matrix (Soil and Geological Matrix)

The surface of the study area consists predominantly of overburden and a dark brown to black, sandy clay layer, with an average thickness of between 1 and 2 meters thick. The clay layer is quite extensive across the extent of the study area and formed due to the weathering of the underlying lithologies. The nature of the clay layer is therefore dependant on the underlying host rock lithologies.

The host rock within the study area consists of sedimentary lithologies of the Vryheid Formation as well as Jurassic Age dolerite intrusions. The Vryheid Formation forms part of the Ecca Group of the Karroo Supergroup, and consists of interbedded sandstone, mudstone and shale layers. Carbonaceous shale and coal layers are generally associated with the Vryheid Formation as well. The dolerite present within the study area is younger than the Vryheid Formation and intruded into and through the sedimentary rocks of the Vryheid Formation. The dolerite intrusions typically occur as dykes and sills and are often responsible for the devolatisation of the coal adjacent to the dolerite intrusions.

The general lithological profile of the study area, up to, and including the No. 2 Coal Seam, comprises of:

- Soft overburden consisting of soils and weathered sandstone and some occasional highly weathered dolerite.
- Hard overburden consisting of fresh to slightly weathered dolerite, sandstone and shale units.
- No.5 Coal Seam (only present in some areas)
- Inter burden units of sandstone

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- No.4H and/or 4L Coal Seam with a thin layer of sandstone in between if both are present
- Karoo Sediments
- No. 2 Coal Seam

8.4.8.4. Aquifer Types (Primary, Weathered, Fractured, Karst)

There are three major aquifer types present within the extent of the study area, namely:

- shallow weathered zone perched aquifers
- shallow weathered zone Karoo aquifers
- deep fractured Karoo aquifers (zone below the weathered zone)

The shallow perched aquifers are essentially restricted to the soil (soft overburden) horizon and have a very limited vertical depth. These aquifers are however laterally very extensive and are exposed to unconfined atmospheric conditions.

The host rocks of the other two aquifer types are the Karoo sediments as well as the dolerite intrusions. The nature and physical parameters of these aquifers are dependent on the occurrence, geometry, size, spatial extent as well as the fracturing status (of both the dolerite and Karoo lithologies) associated with the intrusions. For example, dolerite dykes and sills may form aquifer boundaries or act as groundwater conduits, depending on their size as well as their weathering and fracturing conditions. The characteristics of all three aquifer systems may vary depending on the localised conditions.

It is important to note, that due to the complex nature of these dolerite intrusions, many different aquifer units or compartments exist. All these units are different, not only in terms of physical properties, but also in terms of geometry and size. This also implies that it is not always possible to unilaterally classify an aquifer zone, into any of the three categories listed above.

It is a known fact that different piezometric pressures exist both at depth, and for different aquifer units. The perched aquifer usually displays unconfined conditions, whilst the shallow weathered zone aquifer displays unconfined to semi-unconfined conditions, and the deep aquifer predominantly confined conditions. It is typical for Karoo type aquifers (both shallow weathered zone and deep) that the shallow part of an aquifer exists with a higher potential for exploitation, than the deeper aquifers.

Groundwater flow in all three aquifer types is essentially horizontal, however, interconnection between the aquifer types, can introduce non-horizontal flow components. The groundwater flow within the aquifers occurs primarily as a result of advection caused by gravity. Groundwater flow in underground sections, which are not fully flooded, is also gravitational and therefore controlled by the mine floor contours, and only become pressure controlled when fully flooded.

8.4.8.5. Aquifer Zones (Unsaturated, Saturated)

The thickness of the unsaturated zone is taken as the distance from the surface down to the groundwater level, whilst the thickness of the saturated zone is taken as the distance from the groundwater level down the interface between the weathered/fractured zone and the fresh lithologies. The weathering and fracture status of the geology penetrated, was recorded during the previous drilling programmes.

With reference to the available geological information from exploration boreholes, supplemented with data obtained during drilling of the geohydrological monitoring boreholes, the physical thicknesses for the three different aquifer types, are summarized in Table 8.4.8.5(a).

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Table 8.4.8.5(a): Aquifer Zone Thickness'

Aquifer Type	Aquifer Depths (mbgl)	Saturated Thickness (m)
Shallow Perched Aquifer	0 m to 6.4 m	-
Shallow Weathered Zone Aquifer	6.4 m to 15.2 m	3.9 m to 15 m
Deep Karoo Aquifer	15.2 m to 165 m	74 m to 108 m

Table 8.4.8.5(a) indicates that depths below the surface at which each of the aquifers occur. It is evident from the table that shallow perched aquifer is underlain by the shallow weathered zone aquifer which is further underlain by the deeper Karoo aquifer. The thickness of these aquifers is dependent on the water levels as well as the depth of the interface between the weathered/fractured zones and the fresh host rock lithologies.

In each instance where an impact on an aquifer is assessed, the potential and/or sensitivity of the aquifer(s) impacted on, will contribute towards the impact assessment made. It is therefore important to arrive at an overall aquifer classification, based on the base line information generated. The overall classifications of the aquifers present within the study area are therefore classified as medium potential aquifers, as these aquifers have a viable exploitation potential for small scale domestic and stock-watering purposes. The aquifers will, however, not support formal irrigation or water provision for extensive areas or communities.

8.4.8.6. Lateral Aquifer Boundaries (Physical, Hydraulic, Arbitrary)

The lateral extent of the groundwater zones within the study area is severely complex. The lateral extent of the perched aquifers is usually finite and varies as a function of the lateral extent of soil and clay lenses at the surface. Due to the scale of the investigation as well as the interconnectivity of the underground mining activities, the physical extent of the Karoo aquifers can be taken as infinite. Their lateral extent within the study area would naturally be highly dependent on the distribution and interconnectivity of the dolerite dykes and sills. In certain areas across the extent of the study area, these intrusives intersect one another and would have compartmentalised the adjacent aquifers. The degree and extent of compartmentalisation prior to mining would have been very localised and is currently undetermined, as these compartments have since been be affected to various degrees as a result of the underground mining activities.

In addition to the geological features, the maximum natural lateral extent of the groundwater zone (prior to mining) within the study area is limited by hydraulic boundaries. These include those boundaries formed by the major rivers and streams which act as groundwater discharge boundaries, topographical water sheds which act as no-flow boundaries and surface infiltration sources (tailings dams) which usually represent constant head influx boundaries.

However, when mining activities impact on the groundwater level distribution, these hydraulic boundaries become dynamic, resulting in an induced hydraulic boundary, usually manifesting as a cone of de-watering. It is important to realize from the discussion above, that aquifer boundaries are both physical and hydraulic in nature, both of which become dynamic in the mining environment.

8.4.8.7. Preferential Groundwater Flow Zones

In order to assess the groundwater flow directions within the study area, the groundwater level elevations in boreholes were used. Due to the nature of shallow weathered zone aquifers, the groundwater contours essentially mimic those of the surface topography.

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It can therefore be stated that the natural regional groundwater flow directions (in areas not impacted by mining), will be perpendicular to the surface topography contour lines and down towards the spruits and rivers.

The presence of the dolerite intrusions as well as the underground mining activities, do however affect the groundwater flow of the area. During underground mining operations, groundwater is removed from the aquifers and ultimately lowers the groundwater level of the aquifer. This is known as "dewatering" and may have a significant impact on the groundwater flow directions as well as the groundwater flow velocities. The degree of impact is related to the volume of groundwater extracted, the extent to which as well as the depth at which the dewatering takes place. Due to the scale of the study area as well as the impacts of the underground mining activities and dewatering, detailed groundwater flow directions and flow velocities will not be defined for the purpose of the groundwater baseline report.

The effect that the natural geological features may have on the groundwater flow zone will however be discussed. The dolerite intrusions present within the study area may act as groundwater flow barriers and may in fact cause preferential groundwater flow zone, or both. Fresh dolerite is impermeable and if the extent thereof is sufficiently continuous, groundwater will not be able to pass through the dolerite intrusives may from groundwater barriers. The interconnectivity of these impermeable dolerite intrusions may result in the compartmentalization of the adjacent aquifers. It is important to note here that due to the potential impact of the underground mining activities; the extents and degree of the compartmentalization cannot be determined. The highly zone adjacent to the dolerite intrusions and country rock (Karoo Sediments), known as the contact zone, may be highly fractured. This contact zone generally has a high secondary porosity and may form a preferential groundwater flow zone. The degree of fracturing as well as the interconnectivity of the fractures in this zone determines the effect that it may have as a preferential groundwater flow zone.

8.4.8.8. Hydraulic Aquifer Description

The hydraulic aquifer description relates to the parameters which determine the hydraulic groundwater properties, such as the occurrence, availability, storage and movement of the groundwater within the shallow weathered zone aquifer systems present within the study area. The hydraulic aquifer description will be based on the borehole yield information and geological logs obtained during drilling of the geohydrological boreholes, as well as from information generated during the profiling, sampling and aquifer testing conducted at the monitoring boreholes.

8.4.8.9. Aquifer Classification

The aquifer classification is done in accordance with the formal DWAF protocol "South African Aquifer System Management Classification, December 1995." Special attributes of aquifers related to structural features (such as fracturing along dyke/fault contact zones, or karst development) have been incorporated into the classification through the "Second Variable Classification".

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Classification is done in accordance with the following definitions for Aquifer System Management Classes:

Sole Aquifer System:

An aquifer which is used to supply 50 per cent or more of domestic water for a given area, and for which there is no reasonably available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial.

Major Aquifer System:

Highly permeable formations, usually with a known, or probable, presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (less than 150 mS/m Electrical Conductivity).

Minor Aquifer System:

These can be fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important for local supplies and in supplying base flow for rivers.

Non-Aquifer System:

These are formations with negligible permeability that are regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer unusable. However, groundwater flow through such rocks, although imperceptible, does take place, and needs to be considered when assessing the risk associated with persistent pollutants.

Aquifer System Management and Second Variable Classifications

Aquifer System Management Classification		
Class	**Points**	**Karoo Aquifers**
Sole Source Aquifer System:	6	-
Major Aquifer System:	4	-
Minor Aquifer System:	2	2
Non-Aquifer System:	0	-
Special Aquifer System:	0 – 6	-
Second Variable Classification		
Class	**Points**	**Karoo Aquifers**
High:	3	-
Medium:	2	-
Low:	1	1

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Aquifer System Management Classification Points = **3**

Groundwater Quality Management Classification

Aquifer System Management Classification		
Class	**Points**	**Karoo Aquifers**
Sole Source Aquifer System:	6	-
Major Aquifer System:	4	-
Minor Aquifer System:	2	2
Non-Aquifer System:	0	-
Special Aquifer System:	0 – 6	-
Aquifer Vulnerability Classification		
Class	**Points**	**Karoo Aquifers**
High:	3	-
Medium:	2	-
Low:	1	1

Aquifer System Management Classification Points = **3**

The indicated level of groundwater protection is derived from the Groundwater Quality Management Index (GQM Index).

GQM Index = Aquifer System Management Classification x Aquifer Vulnerability Classification
= 3 x 3
= **9**

Indicated Level of Groundwater Protection

GQM Index	Level of Protection	Karoo Aquifers
<1	Limited	-
1 - 3	Low Level	-
3 - 6	Medium Level	-
6 - 10	High Level	9
>10	Strictly Non-Degradation	-

Aquifer Protection Classification

The ratings for the Aquifer System Management Classification and Aquifer Vulnerability Classification yield a Groundwater Quality Management Index of 9 for the Karoo Aquifers within the study area, indicating that High Level of groundwater protection is required.

8.4.8.10. Groundwater Use

Several borehole and spring hydrocensus surveys have been performed within the of the study area. The objective of the 2020 groundwater hydrocensus was to determine and verify the following information in order to update and supplement the previous groundwater hydrocensus' which have been undertaken within and adjacent to the Shondoni and Middelbult Colliery EMPr Area:

- Localities of all the landowner boreholes;
- Purpose and serviceability of the boreholes;
- Borehole construction details (borehole depth, casing type, casing thickness, casing diameter and collar height);
- Rest water levels within the boreholes;

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- Application/abstraction yields of the boreholes fitted with submersible pumps, mono pumps and powerheads; and
- Groundwater quality.

The 2020 groundwater hydrocensus was undertaken within and adjacent to the Shondoni and Middelbult Colliery EMPr boundary, during the period from 22 June 2020 to 21 July 2020. A total of 112 registered Portions across 15 Farms were included as part of the 2020 groundwater hydrocensus.

A total of 147 boreholes and fountains were identified and investigated during the 2020 groundwater hydrocensus (see Figure 8.4.8.10(a)). Of the 147 boreholes and fountains identified, 67 were in use, 58 were unused and 22 had been decommissioned or destroyed at the time of undertaking the 2020 groundwater hydrocensus.

Of the serviceable 121 boreholes and fountains identified 15 were equipped with windpumps, 55 were equipped with submersible pumps,3 was equipped with powerheads, 4 were equipped with mono pumps, and 44 were unequipped.

Groundwater levels were recorded in 71 boreholes with established water levels during the 2020 groundwater hydrocensus. The groundwater levels ranged in depth between 0.00 mbgl and 42.3 mbgl, with an average water level depth of 8.05 mbgl. The boreholes ranged greatly in depth between 10.0 mbgl and 120 mbgl with an average depth of 43.15 mbgl.

The water chemistry results were further classified according to the SANS 241-1:2015 Drinking Water Standard (Table 8.4.8.10(b)) and the Target Water Quality Limits specified in the South African Water Quality (SAWQ) Guideline for Livestock Watering (Table 8.4.8.10(c)) to provide an indication of the suitability thereof for domestic (drinking water) and livestock watering purposes.

From the classification of the groundwater chemistry results with the SANS 241 1:2015 Drinking Water Standard limits, the groundwater is generally suitable for drinking water purposes, but some parameters do exceed the operational and aesthetic thresholds such as TDS, Heterotrophic Plate Count (HPC) and Total Coliforms as a result of the elevated microbiological components, namely *E.coli*, Total Coliforms and Heterotrophic Plate Count. The Total Organic Carbons (TOC) concentrations in the groundwater samples also commonly exceeded the limits specified in the SANS 241 1:2015 Drinking Water Standard, but only a few samples have *E.coli* content.

The classification of the groundwater chemistry results with the SAWQ Guideline Target Water Quality Limits for Livestock Watering indicates that the groundwater is for the most part, suitable for livestock watering purposes except in 8 of the 98 samples taken. *E.coli*, TDS and F were the parameters that exceeded the SAWQ Guideline Target Water Quality Limits and is therefore not fit for livestock watering purposes in the 8 samples.

As assessment of the hydrochemical image of the water quality indicates that the groundwater sampled during the groundwater hydrocensus has a predominantly Na, Mg and Ca Bicarbonate hydro-chemical image with no clear dominant cation as the concentrations of Na, Ca and Mg being equal and with the dominant anion being M Alk (HCO_{3-} + CO_{3--}). This is evidently seen on the Piper and Durov Diagrams, depicted in Figure 8.4.8.10(b).

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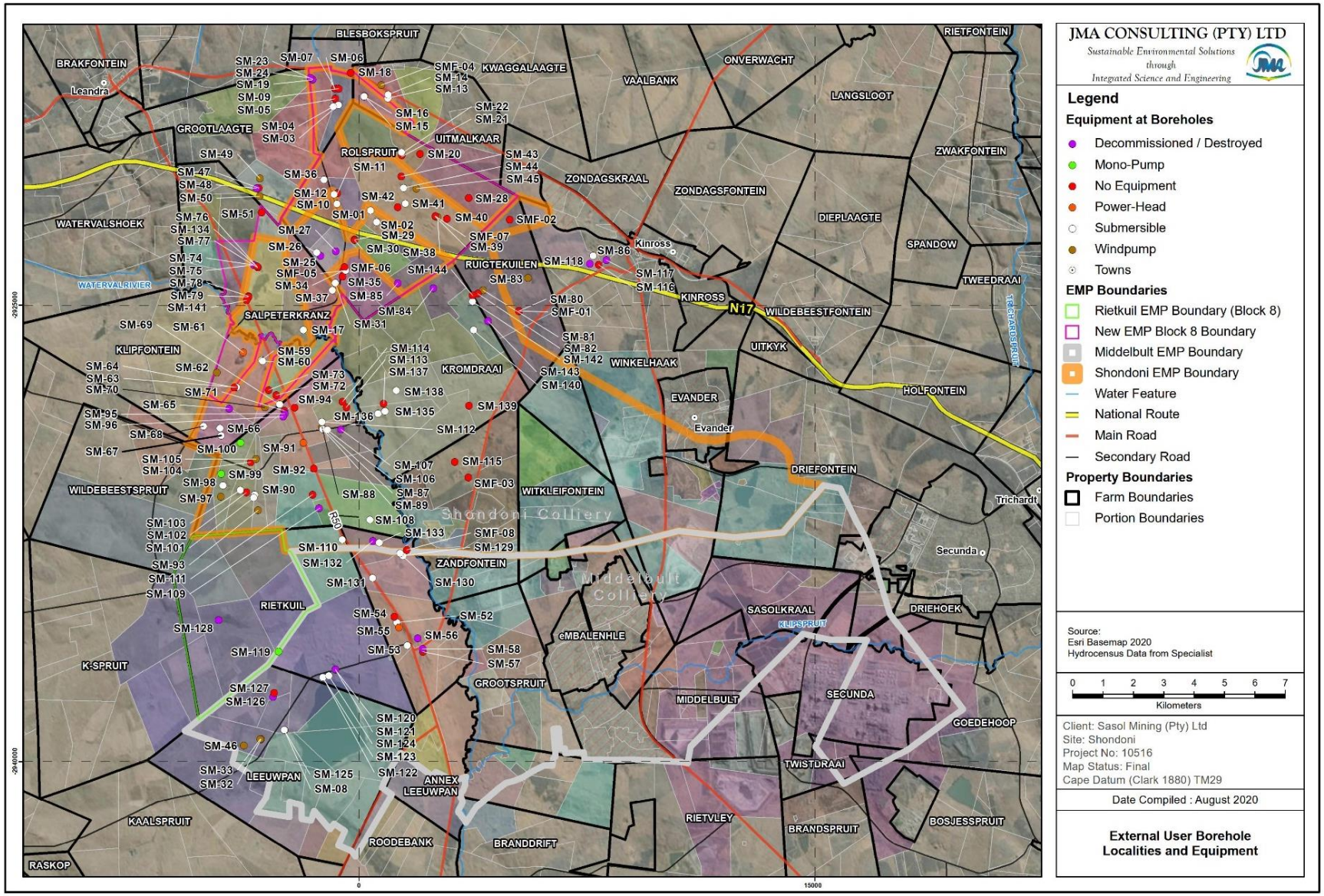

Figure 8.4.8.10(a): External User Borehole Localities

Table 8.4.8.10(a): Groundwater Sampling Information

Sample Number	Date Sampled	Time Sampled	Depth Sampled	Laboratory	Sample Number	Date Sampled	Time Sampled	Depth Sampled	Laboratory	Sample Number	Date Sampled	Time Sampled	Depth Sampled	Laboratory
SM-01	Pump	20200622	1009	Yanka	SM-49	20200630	1141	Pump	Yanka	SM-106	20200716	1253	Pump	Yanka
SM-02	Pump	20200622	1037	Yanka	SM-52	20200701	1213	Pump	Yanka	SM-108	20200709	1535	Pump	Yanka
SM-03	Pump	20200622	1222	Yanka	SM-53	20200701	1244	Pump	Yanka	SM-110	20200710	1034	Pump	Yanka
SM-04	Pump	20200622	1225	Yanka	SM-57	20200701	1345	75.00	Yanka	SM-111	20200710	1203	37.00	Yanka
SM-06	Pump	20200622	1232	Yanka	SM-59	20200703	0910	Pump	Yanka	SM-112	20200710	1425	Pump	Yanka
SM-09	17.00	20200622	1204	Yanka	SM-60	20200703	0920	Pump	Yanka	SM-114	20200710	1514	31.00	Yanka
SM-10	Pump	20200623	0940	Yanka	SM-61	20200703	1037	Pump	Yanka	SM-115	20200713	1253	10.00	Yanka
SM-11	7.00	20200623	0948	Yanka	SM-62	20200703	1055	Pump	Yanka	SM-116	20200713	1410	49.00	Yanka
SM-12	20.00	20200623	1005	Yanka	SM-63	20200703	1111	Pump	Yanka	SM-119	20200715	1019	Pump	Yanka
SM-14	80.00	20200624	1224	Yanka	SM-64	20200703	1141	65.00	Yanka	SM-120	20200715	1003	Pump	Yanka
SM-15	35.00	20200624	1254	Yanka	SM-66	20200703	1222	Pump	Yanka	SM-125	20200715	1216	23.00	Yanka
SM-16	Pump	20200624	1322	Yanka	SM-67	20200703	1233	Pump	Yanka	SM-127	20200715	1502	25.00	Yanka
SM-17	Pump	20200702	1012	Yanka	SM-68	20200703	1243	Pump	Yanka	SM-129	20200716	1002	30.00	Yanka
SM-18	17.00	20200623	1520	Yanka	SM-70	20200703	1313	Pump	Yanka	SM-130	20200716	1020	Pump	Yanka
SM-19	Pump	20200624	1426	Yanka	SM-72	20200703	1358	23.00	Yanka	SM-131	20200716	1105	Pump	Yanka
SM-20	20.00	20200624	0810	Yanka	SM-74	20200706	0814	Pump	Yanka	SM-133	20200716	1208	Pump	Yanka
SM-21	75.00	20200624	0844	Yanka	SM-76	20200706	0839	Pump	Yanka	SM-134	20200721	0801	23.00	Yanka
SM-22	20.00	20200624	0917	Yanka	SM-77	20200706	0845	8.00	Yanka	SM-135	20200721	0835	Pump	Yanka
SM-28	31.00	20200625	0942	Yanka	SM-78	20200706	0917	20.00	Yanka	SM-136	20200721	0859	Pump	Yanka
SM-31	38.00	20200625	1350	Yanka	SM-79	20200706	0936	17.00	Yanka	SM-137	20200721	0916	35.00	Yanka
SM-32	Pump	20200715	1340	Yanka	SM-82	20200707	1136	35.00	Yanka	SM-138	20200721	0937	Pump	Yanka
SM-34	10.00	20200625	1452	Yanka	SM-86	20200707	1503	25.00	Yanka	SM-139	20200721	1004	40.00	Yanka
SM-35	41.00	20200625	1541	Yanka	SM-87	20200708	1048	Pump	Yanka	SM-140	20191008	1104	35.00	Yanka
SM-36	35.00	20200626	1041	Yanka	SM-89	20200708	1101	Pump	Yanka	SM-141	20191105	1726	52.00	Yanka
SM-37	10.00	20200626	1143	Yanka	SM-90	20200708	1316	Pump	Yanka	SM-142	20191105	1434	23.00	Yanka
SM-38	Pump	20200629	1425	Yanka	SM-92	20200708	1158	27.00	Yanka	SM-144	20191105	0908	35.00	Yanka
SM-40	20.00	20200629	1442	Yanka	SM-97	20200709	1030	Pump	Yanka	SMF-01	20200707	1057	Surface	Yanka
SM-41	Pump	20200629	1507	Yanka	SM-99	20200709	1054	Pump	Yanka	SMF-02	20200707	1301	Surface	Yanka
SM-42	37.00	20200629	1522	Yanka	SM-100	20200709	1111	Pump	Yanka	SMF-04	20200622	1147	Pump	Yanka
SM-43	95.00	20200629	1601	Yanka	SM-101	20200709	1152	Pump	Yanka	SMF-05	20200625	1424	Surface	Yanka
SM-44	42.00	20200629	1626	Yanka	SM-102	20200709	1221	35.00	Yanka	SMF-06	20200625	1439	Surface	Yanka
SM-45	Pump	20200629	1638	Yanka	SM-103	20200709	1247	Pump	Yanka	SMF-07	20200629	1428	Surface	Yanka
SM-47	42.00	20200630	1113	Yanka	SM-104	20200709	1317	80.00	Yanka					

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Table 8.4.8.10 (b): Groundwater Quality (mg/l) – Assessment with reference to the SANS 241-1:2015 Drinking Water Standard (Sheet 1)

Sample No.		pH	EC	TDS	T.Alk	P Alk	M Alk	Total Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Col	Faec-Col	E - Coli
SANS 241-1:2015	Operational	5 - 9.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	1000	10	-	-
	Aesthetic	-	-	1 200	-	-	-	-	300	250	-	-	1.5	-	-	-	200	-	-	-	0.30	0.10	-	-	-	-	-	-	-	-	-	5.0	-	-	-	-	-	-
	Acute Health	-	-	-	-	-	-	-	-	500	≤ 11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20	10	-	-	-	0
	Chronic Health	-	-	-	-	-	-	-	-	-	-	-	-	1.50	-	-	-	-	-	-	2.0	0.40	0.01	0.003	0.05	-	2.00	0.01	0.07	0.04	-	-	-	-	-	-	-	-
SM - 01		7.50	82.3	502	275	0.00	275	362	22.5	80.1	15.7	<0.03	<0.45	<0.09	71.2	44.7	45.4	3.97	16.8	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	8.07	132	26	0	0
SM - 02		7.52	63.8	373	204	0.00	204	255	18.9	58.5	10.5	<0.03	<0.45	<0.09	56.6	27.5	40.9	1.26	20.7	<0.01	0.03	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.0	530	48	2	0
SM - 03		7.71	135	852	364	0.00	364	425	140	176	2.45	<0.03	<0.45	0.09	80.8	54.3	169	2.75	8.79	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	24.5	430	4	0	0
SM - 04		7.52	76.4	576	356	0.00	356	316	73.2	92.0	<0.35	<0.03	<0.45	<0.09	54.7	43.6	96.1	3.02	7.52	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	14.3	>3 000	12	0	0
SM - 06		7.56	105	644	335	0.00	335	536	48.7	178	<0.35	<0.03	<0.45	<0.09	108	64.8	41.0	2.47	10.7	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.0	108	42	2	2
SM - 09		6.95	187	1 260	434	0.00	434	1 009	143	298	44.6	<0.03	<0.45	<0.09	183	134	42.2	1.31	17.6	<0.01	0.01	0.17	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	19.7	>3 000	>300	>300	0
SM - 10		7.31	75.4	429	264	0.00	264	299	38.7	77.2	0.35	<0.03	<0.45	<0.09	65.5	32.9	52.1	2.84	9.36	<0.01	0.02	0.09	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	7.47	20	0	0	0
SM - 11		6.96	38.2	191	160	0.00	160	88	14.6	5.65	<0.35	0.16	19.9	0.25	18.3	10.2	5.62	10.3	8.93	<0.01	3.07	0.44	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	24.1	>3 000	>1500	>1500	0
SM - 12		7.57	67.6	387	246	0.00	246	291	22.0	79.6	<0.35	<0.03	<0.45	<0.09	61.2	33.5	40.2	2.54	8.23	<0.01	0.04	0.02	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.7	630	46	40	6
SM - 14		7.88	104	620	463	0.00	463	113	19.0	68.9	<0.35	<0.03	0.59	0.59	18.9	15.9	214	4.51	3.13	<0.01	0.03	0.02	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.1	550	0	0	0
SM - 15		7.54	89.6	524	336	0.00	336	269	19.4	112	<0.35	<0.03	<0.45	0.25	46.7	37.0	104	3.00	10.0	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	12.5	128	62	0	0
SM - 16		7.78	95.9	588	330	0.00	330	399	21.0	163	<0.35	<0.03	<0.45	<0.09	82.1	47.0	74.3	2.83	10.5	<0.01	0.01	0.04	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.6	48	4	0	0
SM - 17		7.49	69.8	402	279	0.00	279	294	34.2	49.3	<0.35	0.70	<0.45	<0.09	75.8	25.5	45.5	1.89	16.4	<0.01	0.08	0.06	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	14.2	68	0	0	0
SM - 18		7.61	85.1	500	271	0.00	271	362	23.4	142	3.39	<0.03	0.53	<0.09	59.0	52.1	39.4	6.03	17.4	<0.01	0.01	0.06	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	0.03	<0.01	13.5	1 100	0	0	0
SM - 19		7.54	71.1	405	275	0.00	275	304	15.5	78.0	2.78	<0.03	<0.45	<0.09	62.0	36.3	33.6	1.81	16.5	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	8.31	176	24	14	12
SM - 20		7.46	86.6	481	411	0.00	411	187	21.1	18.0	<0.35	<0.03	<0.45	0.34	36.2	23.4	132	2.83	8.18	<0.01	0.11	0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.6	1 480	36	22	2
SM - 21		7.16	178	1 112	320	0.00	320	770	176	235	44.0	0.06	0.47	<0.09	144	99.7	67.5	2.07	18.6	<0.01	<0.01	0.04	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	15.5	>3 000	>300	>300	104
SM - 22		7.12	118	717	274	0.00	274	489	35.7	148	36.7	<0.03	<0.45	<0.09	94.0	61.8	47.8	1.76	17.9	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.81	190	10	6	0
SM - 28		7.32	60.0	314	261	0.00	261	273	9.92	37.7	0.54	<0.03	<0.45	<0.09	49.6	36.2	18.8	0.65	14.5	<0.01	0.03	2.42	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	14.8	104	20	2	0
SM - 31		7.69	61.9	293	278	0.00	278	183	13.8	8.44	<0.35	<0.03	11.3	<0.09	26.6	28.4	29.8	4.57	2.11	<0.01	0.02	0.07	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	11.7	2 000	70	30	0
SM - 32		6.87	78.8	437	286	0.00	286	356	17.5	71.5	5.87	<0.03	<0.45	0.13	70.9	43.5	29.0	6.53	13.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.2	35	10	0	0
SM - 34		7.51	44.6	239	152	0.00	152	179	8.85	61.0	<0.35	<0.03	<0.45	<0.09	43.6	16.9	15.7	1.30	14.7	<0.01	0.20	0.07	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	7.50	>3 000	184	144	68
SM - 35		8.65	108	613	357	39.2	318	124	115	27.2	<0.35	<0.03	<0.45	5.30	15.0	21.1	207	8.05	10.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.8	>3 000	>300	166	154
SM - 36		8.02	86.4	464	363	0.00	363	86	45.6	10.2	<0.35	<0.03	<0.45	2.15	17.2	10.4	156	4.30	7.05	<0.01	0.03	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	31.8	780	4	0	0
SM - 37		7.53	89.9	430	249	0.00	249	288	17.6	66.8	11.4	<0.03	<0.45	<0.09	53.5	37.6	47.1	7.03	13.1	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.6	208	36	2	0
SM - 38		7.45	72.9	420	335	0.00	335	313	17.8	44.9	<0.35	0.24	<0.45	<0.09	63.4	37.6	53.2	1.79	12.6	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.6	96	18	0	0
SM - 40		7.53	71.7	404	368	0.00	368	236	18.0	3.77	<0.35	0.16	<0.45	<0.09	44.2	30.5	83.9	2.27	9.48	<0.01	<0.01	<0.01	<0.005	<0.002	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	18.1	520	2	0	0
SM - 41		7.34	73.1	425	337	0.00	337	315	16.8	48.7	<0.35	0.13	<0.45	<0.09	64.9	37.2	53.2	1.81	12.2	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	17.8	92	28	0	0
SM - 42		7.59	72.5	420	310	0.00	310	135	43.2	17.0	<0.35	0.11	<0.45	1.06	28.1	15.8	127	1.53	7.30	<0.01	0.08	0.11	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.0	>3 000	4	0	0
SM - 43		7.53	62.5	362	313	0.00	313	182	17.5	10.9	<0.35	0.08	<0.45	0.16	40.1	20.0	83.7	1.96	7.59	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	19.1	7 200	0	0	0
SM - 44		7.56	156	923	552	0.00	552	201	202	16.2	0.53	0.08	<0.45	1.07	39.4	25.0	302	3.60	7.57	<0.01	0.22	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	23.4	>3 000	0	0	0

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Table 8.4.8.10(b): Groundwater Quality (mg/l) – Assessment with reference to the SANS 241-1:2015 Drinking Water Standard (Sheet 2)

Sample No.		pH	EC	TDS	T.Alk	P Alk	M Alk	Total Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Col	Faec-Col	E - Coli
SANS 241-1:2015	Operational	5 - 9.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	1000	10	-	-
	Aesthetic	-	-	1 200	-	-	-	-	300	250	-	-	1.5	-	-	-	200	-	-	-	0.30	0.10	-	-	-	-	-	-	-	-	-	5.0	-	-	-	-	-	-
	Acute Health	-	-	-	-	-	-	-	-	500	≤ 11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20	10	-	-	-	0
	Chronic Health	-	-	-	-	-	-	-	-	-	-	-	-	1.50	-	-	-	-	-	-	2.0	0.40	0.01	0.003	0.05	-	2.00	0.01	0.07	0.04	-	-	-	-	-	-	-	-
SM - 45		7.41	81.5	522	294	0.00	294	381	20.5	96.7	12.8	0.06	<0.45	<0.09	77.7	45.5	47.0	1.37	16.1	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.8	400	20	0	0
SM - 47		7.94	80.8	495	378	0.00	378	147	11.1	55.2	0.57	0.09	<0.45	0.10	31.3	16.7	149	1.39	10.6	0.05	0.11	0.01	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.6	>3 000	84	64	2
SM - 49		8.05	76.7	464	357	0.00	357	44	8.99	46.8	<0.35	0.05	<0.45	0.33	11.0	4.07	177	1.42	9.31	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.0	88	0	0	0
SM - 52		7.67	83.8	484	364	0.00	364	173	57.6	8.44	<0.35	0.03	<0.45	0.21	39.4	18.0	139	3.41	12.3	<0.01	0.03	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.8	1 520	0	0	0
SM - 53		7.45	113	664	453	0.00	453	281	96.1	32.5	<0.35	<0.03	<0.45	<0.09	69.3	26.2	165	3.04	16.7	<0.01	0.14	0.05	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.9	13	2	0	0
SM - 57		7.31	78.4	461	403	0.00	403	285	14.7	21.3	<0.35	0.10	0.76	<0.09	68.5	27.8	58.6	26.9	6.87	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	17.0	>3 000	>300	80	34
SM - 59		7.41	56.9	344	198	0.00	198	248	27.0	61.2	5.06	<0.03	<0.45	<0.09	55.6	26.6	30.0	2.66	17.7	<0.01	0.03	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.0	370	0	0	0
SM - 60		7.31	65.3	409	205	0.00	205	300	33.6	66.2	12.7	<0.03	<0.45	<0.09	67.2	32.2	27.9	2.68	19.2	<0.01	0.05	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.28	460	0	0	0
SM - 61		7.04	87.1	466	318	0.00	318	265	73.5	22.7	1.53	<0.03	<0.45	0.23	52.8	32.4	78.5	8.39	5.44	<0.01	<0.01	0.02	<0.005	<0.002	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	0.20	<0.01	12.1	152	0	0	0
SM - 62		7.36	87.6	524	350	0.00	350	272	62.4	40.2	1.75	<0.03	<0.45	<0.09	65.1	26.5	103	8.91	9.74	<0.01	0.06	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.08	<0.01	14.9	4	2	0	0
SM - 63		7.33	77.1	387	269	0.00	269	201	19.1	39.7	5.47	<0.03	<0.45	<0.09	43.3	22.5	64.0	13.0	10.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	11.6	13	0	0	0
SM - 64		7.31	66.1	369	302	0.00	302	231	20.6	12.6	3.37	<0.03	<0.45	<0.09	48.8	26.5	51.9	12.4	9.01	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.4	>30 000	0	0	0
SM - 66		7.16	57.5	320	226	0.00	226	203	16.4	44.3	0.85	<0.03	<0.45	<0.09	45.4	21.7	50.1	2.44	8.66	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.60	8	0	0	0
SM - 67		7.00	64.6	331	185	0.00	185	207	26.3	78.5	1.35	<0.03	<0.45	<0.09	45.4	22.8	39.5	1.49	10.7	<0.01	<0.01	0.04	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	8.06	31	0	0	0
SM - 68		7.16	46.3	251	181	0.00	181	176	17.6	28.5	0.77	<0.03	<0.45	<0.09	39.5	18.7	32.5	2.05	7.88	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6.82	62	4	0	0
SM - 70		7.89	80.1	434	299	0.00	299	284	25.7	64.6	2.15	<0.03	<0.45	<0.09	52.8	37.0	60.7	4.58	22.0	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	11.3	7	6	0	0
SM - 72		7.44	159	968	219	0.00	219	718	349	43.2	29.8	<0.03	<0.45	<0.09	167	73.5	57.4	14.4	15.6	<0.01	0.01	0.03	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.36	1 720	6	0	0
SM - 74		7.59	63.7	381	293	0.00	293	205	9.29	51.0	0.42	<0.03	<0.45	<0.09	41.9	24.4	74.1	2.17	13.6	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	11.1	8	0	0	0
SM - 76		7.53	62.8	379	273	0.00	273	255	9.38	64.8	1.06	<0.03	<0.45	<0.09	53.0	29.9	51.4	1.87	14.9	<0.01	0.03	0.02	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.4	9	0	0	0
SM - 77		7.38	51.0	308	199	0.00	199	226	9.41	59.8	3.33	0.06	0.45	<0.09	49.5	24.8	27.9	1.93	15.2	<0.01	0.06	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	8.24	>3 000	22	2	0
SM - 78		7.28	115	706	372	0.00	372	514	65.6	43.2	31.4	<0.03	<0.45	<0.09	109	58.8	54.6	12.6	12.8	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.5	>3 000	62	0	0
SM - 79		7.50	80.9	489	328	0.00	328	349	30.7	71.1	5.51	<0.03	<0.45	<0.09	79.9	36.4	39.9	9.83	16.5	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.9	>3 000	34	10	0
SM - 82		7.45	86.0	532	349	0.00	349	351	21.0	101	3.08	<0.03	<0.45	0.22	67.4	44.4	72.0	3.05	12.5	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	7.36	680	0	0	0
SM - 86		7.38	80.5	467	310	0.00	310	360	24.3	76.4	5.00	<0.03	<0.45	<0.09	51.0	56.5	31.3	18.8	22.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	8.14	1 860	0	0	0
SM - 87		7.38	59.9	329	223	0.00	223	242	9.47	23.5	9.25	<0.03	<0.45	<0.09	68.9	16.9	25.4	10.3	19.7	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	6.14	430	14	2	2
SM - 89		7.51	73.5	394	263	0.00	263	262	15.0	36.9	9.17	<0.03	<0.45	<0.09	64.8	24.3	46.7	7.76	18.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	3.88	>3 000	16	0	0
SM - 90		7.78	76.0	411	270	0.00	270	355	40.8	59.6	1.73	0.44	<0.45	0.14	60.8	49.2	27.8	1.25	17.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	15.1	35	0	0	0
SM - 92		7.53	80.7	464	344	0.00	344	323	12.1	68.9	1.31	<0.03	<0.45	0.42	65.8	38.5	61.8	3.86	21.4	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	12.7	280	10	6	0
SM - 97		7.97	68.0	390	274	0.00	274	220	21.4	46.2	3.23	0.17	<0.45	0.24	33.5	33.2	75.2	1.13	13.8	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	20.2	1 320	4	0	0
SM - 99		7.45	64.7	352	322	0.00	322	336	15.9	18.4	<0.35	0.06	<0.45	0.17	54.3	48.6	20.8	0.24	24.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.01	<0.01	22.6	680	>300	>300	0

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Sample No.		pH	EC	TDS	T.Alk	P Alk	M Alk	Total Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Col	Faec-Col	E - Coli
SANS 241-1:2015	Operational	5 - 9.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	1000	10	-	-
	Aesthetic	-	-	1 200	-	-	-	-	300	250	-	-	1.5	-	-	-	200	-	-	-	0.30	0.10	-	-	-	-	-	-	-	-	-	5.0	-	-	-	-	-	-
	Acute Health	-	-	-	-	-	-	-	-	500	≤ 11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20	10	-	-	-	0
	Chronic Health	-	-	-	-	-	-	-	-	-	-	-	-	1.50	-	-	-	-	-	-	2.0	0.40	0.01	0.003	0.05	-	2.00	0.01	0.07	0.04	-	-	-	-	-	-	-	-
SM - 100		7.58	69.6	378	313	0.00	313	282	9.56	43.4	<0.35	<0.03	<0.45	<0.09	50.3	38.0	45.9	3.06	10.4	<0.01	0.01	0.02	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	14.3	82	0	0	0

Table 8.4.8.10 (b): Groundwater Quality (mg/l) – Assessment with reference to the SANS 241-1:2015 Drinking Water Standard (Sheet 3)

Sample No.		pH	EC	TDS	T.Alk	P Alk	M Alk	Total Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Col	Faec-Col	E - Coli
SANS 241-1:2015	Operational	5 - 9.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	1000	10	-	-
	Aesthetic	-	-	1 200	-	-	-	-	300	250	-	-	1.5	-	-	-	200	-	-	-	0.30	0.10	-	-	-	-	-	-	-	-	-	5.0	-	-	-	-	-	-
	Acute Health	-	-	-	-	-	-	-	-	500	≤ 11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20	10	-	-	-	0
	Chronic Health	-	-	-	-	-	-	-	-	-	-	-	-	1.50	-	-	-	-	-	-	2.0	0.40	0.01	0.003	0.05	-	2.00	0.01	0.07	0.04	-	-	-	-	-	-	-
SM - 101		7.48	85.0	454	294	0.00	294	350	57.4	64.8	0.65	<0.03	<0.45	0.09	56.9	50.4	42.5	2.39	13.9	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	18.7	1 520	34	0	0
SM - 102		7.30	113	660	487	0.00	487	411	71.3	44.0	<0.35	1.99	5.10	0.11	78.0	52.4	102	6.12	16.5	<0.01	0.02	0.45	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	30.3	>3 000	>300	>300	150
SM - 103		8.42	97.1	555	358	43.8	314	6	71.5	48.6	<0.35	0.05	12.6	0.73	0.98	0.76	198	2.08	7.52	0.05	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	19.6	460	82	0	0
SM - 104		7.50	88.7	478	267	0.00	267	320	76.9	33.9	10.4	<0.03	<0.45	<0.09	59.1	41.8	56.2	4.21	17.8	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.64	>3 000	>300	>300	4
SM - 106		7.53	69.6	373	264	0.00	264	263	17.0	31.6	7.92	<0.03	<0.45	<0.09	60.5	27.2	34.3	8.83	12.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.70	2 120	38	0	0
SM - 108		7.62	87.6	500	284	0.00	284	373	59.7	62.3	7.14	<0.03	<0.45	0.24	73.7	45.8	48.9	7.49	24.8	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	18.6	14	6	0	0
SM - 110		7.57	84.0	470	381	0.00	381	294	13.0	56.4	2.35	<0.03	<0.45	0.10	48.1	42.3	64.0	7.12	18.1	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	17.7	330	6	0	0
SM - 111		7.29	77.5	411	278	0.00	278	327	29.9	81.6	0.38	<0.03	<0.45	<0.09	59.3	43.4	22.4	5.82	25.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	18.9	>3 000	>300	>300	>300
SM - 112		7.42	68.3	402	265	0.00	265	247	13.7	44.8	8.94	<0.03	<0.45	<0.09	69.5	17.9	50.6	7.27	18.5	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	8.60	860	36	0	0
SM - 114		7.24	93.8	498	336	0.00	336	292	90.2	17.5	<0.35	<0.03	2.19	0.22	68.0	29.6	82.8	5.02	8.75	<0.01	0.04	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	17.2	>3 000	78	58	56
SM - 115		7.23	51.4	306	76.8	0.00	76.8	211	29.0	63.6	16.8	<0.03	<0.45	<0.09	41.1	26.3	13.1	12.0	14.5	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	6.06	>3 000	110	90	0
SM - 116		7.00	327	2 063	529	0.00	529	1 584	552	389	35.7	<0.03	<0.45	<0.09	322	189	134	1.36	15.6	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	27.0	>3 000	>300	>300	88
SM - 119		7.25	69.4	345	244	0.00	244	213	33.4	32.0	0.47	0.90	2.84	<0.09	49.7	21.7	45.1	8.28	9.21	<0.01	0.06	0.04	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	37.1	>3 000	8	4	0
SM - 120		7.42	58.0	333	194	0.00	194	265	30.8	10.2	14.4	<0.03	<0.45	<0.09	70.7	21.4	9.34	9.91	11.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	8.22	330	134	120	82
SM - 125		7.28	62.1	343	240	0.00	240	254	20.8	21.4	7.60	<0.03	<0.45	<0.09	53.1	29.5	32.8	7.97	8.81	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	7.72	1 760	124	100	0
SM - 127		6.59	70.6	370	89.6	0.00	89.6	256	77.5	63.0	12.4	<0.03	<0.45	<0.09	48.5	32.7	17.7	21.6	12.8	<0.01	<0.01	0.04	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	8.16	2 000	44	28	0
SM - 129		7.12	104	542	374	0.00	374	388	95.1	8.59	4.90	<0.03	<0.45	<0.09	72.5	50.3	66.1	2.94	8.67	<0.01	<0.01	0.04	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	11.5	920	20	0	0
SM - 130		7.67	97.7	493	346	0.00	346	354	59.6	23.9	7.43	<0.03	<0.45	<0.09	66.9	45.5	53.3	3.15	9.73	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	10.6	480	116	84	0
SM - 131		7.77	83.2	464	394	0.00	394	370	15.3	40.2	2.11	<0.03	<0.45	0.16	65.3	50.2	44.3	2.59	7.42	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.9	54	22	0	0
SM - 133		7.42	97.6	536	332	0.00	332	430	51.6	54.2	10.9	<0.03	<0.45	<0.09	80.0	55.9	39.5	7.19	16.0	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.0	27	0	0	0
SM - 134		7.26	59.9	334	257	0.00	257	254	8.31	51.3	1.97	<0.03	<0.45	<0.09	56.7	27.3	24.8	2.26	10.3	<0.01	<0.01	0.03	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	11.5	1 140	44	0	0
SM - 135		7.45	89.5	518	349	0.00	349	426	33.5	89.0	3.86	<0.03	<0.45	0.13	86.5	51.1	29.8	1.68	8.70	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	14.3	580	30	0	0
SM - 136		7.50	80.1	440	396	0.00	396	166	28.3	3.06	<0.35	<0.03	0.98	0.47	36.5	18.3	112	3.27	7.42	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	16.8	94	6	0	0
SM - 137		7.43	92.0	538	340	0.00	340	421	33.9	101	6.08	0.04	<0.45	0.13	91.8	46.5	32.1	1.07	10.8	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.9	1 920	158	40	0
SM - 138		7.45	79.3	454	314	0.00	314	233	20.6	78.3	1.86	<0.03	<0.45	0.13	49.1	26.8	80.0	2.62	4.97	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.4	19	2	0	0
SM - 139		7.45	123	701	590	0.00	590	186	7.90	67.8	<0.35	<0.03	<0.45	0.40	30.4	26.8	213	0.62	12.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	24.0	117	4	0	0
SM - 140		7.92	175	1 021	334	0.00	334	326	318	135	<0.35	<0.03	0.51	0.49	56.5	44.8	253	11.40	18.2	0.15	0.06	0.01	-	-	-	-	-	-	-	-	-	-	11.1	>3000	44	-	14
SM - 141		8.18	83.1	434	341	0.00	341	51.6	20.2	31.7	0.72	<0.03	0.45	0.26	10.4	6.2	155	1.75	8.2	<0.01	0.06	<0.01	-	-	-	-	-	-	-	-	-	-	-	10.5	>3000	18	-	6.0
SM - 142		7.74	87.3	481	366	0.00	366	184	16.4	60.0	1.73	<0.03	<0.45	0.18	36.8	22.4	115	2.34	11.6	<0.01	0.02	<0.01	-	-	-	-	-	-	-	-	-	-	-	10.4	2 400	0	-	0
SM - 144		7.61	85.2	454	378	0.00	378	217	17.4	38.5	0.37	<0.03	<0.45	0.15	43.7	26.2	96	2.86	11.7	<0.01	<0.01	0.03	-	-	-	-	-	-	-	-	-	-	-	11.6	1 200	0	-	0
SMF - 01		7.60	195	1 074	575	0.00	575	805	336	6.85	<0.35	<0.03	<0.45	0.12	146	107	120	13.3	16.4	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	60.7	20 800	>1500	300	200

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Table 8.4.8.10 (b): Groundwater Quality (mg/l) – Assessment with reference to the SANS 241-1:2015 Drinking Water Standard (Sheet 4)

Sample No.		pH	EC	TDS	T.Alk	P Alk	M Alk	Total Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Col	Faec-Col	E - Coli
SANS 241-1:2015	Operational	5 - 9.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	1000	10	-	-
	Aesthetic	-	-	1 200	-	-	-	-	300	250	-	-	1.5	-	-	-	200	-	-	-	0.30	0.10	-	-	-	-	-	-	-	-	-	5.0	-	-	-	-	-	-
	Acute Health	-	-	-	-	-	-	-	-	500	≤ 11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20	10	-	-	-	0
	Chronic Health	-	-	-	-	-	-	-	-	-	-	-	-	1.50	-	-	-	-	-	-	2.0	0.40	0.01	0.003	0.05	-	2.00	0.01	0.07	0.04	-	-	-	-	-	-	-	-
SMF - 02		7.64	252	1 671	681	0.00	681	972	245	458	<0.35	0.16	<0.45	<0.09	127	159	266	6.69	13.0	<0.01	0.04	<0.01	<0.005	<0.002	<0.01	<0.01	0.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	84.1	>30 000	170	90	0
SMF - 04		7.35	61.5	390	211	0.00	211	308	34.2	94.5	0.43	0.20	<0.45	<0.09	62.8	36.7	30.1	1.58	14.2	<0.01	<0.01	0.93	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	25.2	>3 000	>1500	>1500	24
SMF - 05		8.09	61.5	325	249	0.00	249	218	19.5	46.1	<0.35	<0.03	<0.45	<0.09	36.5	30.8	38.7	3.71	1.31	<0.01	0.04	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.6	330	8	4	2
SMF - 06		7.33	61.0	343	216	0.00	216	170	10.3	45.6	9.61	<0.03	<0.45	<0.09	39.1	17.6	55.8	2.18	15.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6.04	140	0	0	0
SMF - 07		8.16	76.3	463	327	0.00	327	306	27.1	79.2	<0.35	0.04	<0.45	<0.09	53.7	41.7	62.2	2.45	1.98	<0.01	0.07	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	17.6	33	14	0	0

Note:
- Values indicated in **green** are less than the specified SANS 241-1:2015 limit.
- Values indicated in **yellow** exceed the specified SANS 241-1:2015 limit for operational risks.
- Values indicated in **orange** exceed the specified SANS 241-1:2015 limit for aesthetic risks.
- Values indicated in **purple** exceed the specified SANS 241-1:2015 limit for acute health risks.
- Values indicated in **red** exceed the specified SANS 241-1:2015 limit for acute health risks.
- Values indicated in **black** do not have a specified SANS 241-1:2015 limit.
- Values indicated in grey measured below the detection limit.

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Table 8.4.8.10 (c): Groundwater Quality – Assessment with reference to the 1996 SAWQ Guideline for Livestock Watering (Sheet 1)

Sample No.	pH	EC	TDS	T.Alk	P.Alk	M Alk	Tot.Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Coli	Faec-Coli	E - Coli
TWQR	-	-	≤ 1 000	-	-	-		≤ 1 500	≤ 1 000	≤ 100	-	-	≤ 2	≤ 1 000	≤ 500	≤ 2 000	-	-	≤ 5	≤ 10	≤ 10	≤ 1	≤ 0.01		≤ 1		≤ 0.1	≤ 2	≤ 50	≤ 1	≤ 20		-	-	-		≤ 200
SM - 01	7.50	82.3	502	275	0.00	275	362	22.5	80.1	15.7	<0.03	<0.45	<0.09	71.2	44.7	45.4	3.97	16.8	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	8.07	132	26	0	0
SM - 02	7.52	63.8	373	204	0.00	204	255	18.9	58.5	10.5	<0.03	<0.45	<0.09	56.6	27.5	40.9	1.26	20.7	<0.01	0.03	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.0	530	48	2	0
SM - 03	7.71	135	852	364	0.00	364	425	140	176	2.45	<0.03	<0.45	0.09	80.8	54.3	169	2.75	8.79	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	24.5	430	4	0	0
SM - 04	7.52	76.4	576	356	0.00	356	316	73.2	92.0	<0.35	<0.03	<0.45	<0.09	54.7	43.6	96.1	3.02	7.52	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	14.3	>3000	12	0	0
SM - 06	7.56	105	644	335	0.00	335	536	48.7	178	<0.35	<0.03	<0.45	<0.09	108	64.8	41.0	2.47	10.7	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.0	108	42	2	2
SM - 09	6.95	187	1 260	434	0.00	434	1 009	143	298	44.6	<0.03	<0.45	<0.09	183	134	42.2	1.31	17.6	<0.01	0.01	0.17	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	19.7	>3000	>300	>300	0
SM - 10	7.31	75.4	429	264	0.00	264	299	38.7	77.2	0.35	<0.03	<0.45	<0.09	65.5	32.9	52.1	2.84	9.36	<0.01	0.02	0.09	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	7.47	20	0	0	0
SM - 11	6.96	38.2	191	160	0.00	160	88	14.6	5.65	<0.35	0.16	19.9	0.25	18.3	10.2	5.62	10.3	8.93	<0.01	3.07	0.44	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	24.1	>3000	>1500	>1500	0
SM - 12	7.57	67.6	387	246	0.00	246	291	22.0	79.6	<0.35	<0.03	<0.45	<0.09	61.2	33.5	40.2	2.54	8.23	<0.01	0.04	0.02	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.7	630	46	40	6
SM - 14	7.88	104	620	463	0.00	463	113	19.0	68.9	<0.35	<0.03	0.59	0.59	18.9	15.9	214	4.51	3.13	<0.01	0.03	0.02	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.1	550	0	0	0
SM - 15	7.54	89.6	524	336	0.00	336	269	19.4	112	<0.35	<0.03	<0.45	0.25	46.7	37.0	104	3.00	10.0	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	12.5	128	62	0	0
SM - 16	7.78	95.9	588	330	0.00	330	399	21.0	163	<0.35	<0.03	<0.45	<0.09	82.1	47.0	74.3	2.83	10.5	<0.01	0.01	0.04	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.6	48	4	0	0
SM - 17	7.49	69.8	402	279	0.00	279	294	34.2	49.3	<0.35	0.70	<0.45	<0.09	75.8	25.5	45.5	1.89	16.4	<0.01	0.08	0.06	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	14.2	68	0	0	0
SM - 18	7.61	85.1	500	271	0.00	271	362	23.4	142	3.39	<0.03	0.53	<0.09	59.0	52.1	39.4	6.03	17.4	<0.01	0.01	0.06	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	0.03	<0.01	13.5	1100	0	0	0
SM - 19	7.54	71.1	405	275	0.00	275	304	15.5	78.0	2.78	<0.03	<0.45	<0.09	62.0	36.3	33.6	1.81	16.5	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	8.31	176	24	14	12
SM - 20	7.46	86.6	481	411	0.00	411	187	21.1	18.0	<0.35	<0.03	<0.45	0.34	36.2	23.4	132	2.83	8.18	<0.01	0.11	0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.6	1480	36	22	2
SM - 21	7.16	178	1 112	320	0.00	320	770	176	235	44.0	0.06	0.47	<0.09	144	99.7	67.5	2.07	18.6	<0.01	<0.01	0.04	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	15.5	>3000	>300	>300	104
SM - 22	7.12	118	717	274	0.00	274	489	35.7	148	36.7	<0.03	<0.45	<0.09	94.0	61.8	47.8	1.76	17.9	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.81	190	10	6	0
SM - 28	7.32	60.0	314	261	0.00	261	273	9.92	37.7	0.54	<0.03	<0.45	<0.09	49.6	36.2	18.8	0.65	14.5	<0.01	0.03	2.42	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	14.8	104	20	2	0
SM - 31	7.69	61.9	293	278	0.00	278	183	13.8	8.44	<0.35	<0.03	11.3	<0.09	26.6	28.4	29.8	4.57	2.11	<0.01	0.02	0.07	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	11.7	2000	70	30	0
SM - 32	6.87	78.8	437	286	0.00	286	356	17.5	71.5	5.87	<0.03	<0.45	0.13	70.9	43.5	29.0	6.53	13.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.2	35	10	0	0
SM - 34	7.51	44.6	239	152	0.00	152	179	8.85	61.0	<0.35	<0.03	<0.45	<0.09	43.6	16.9	15.7	1.30	14.7	<0.01	0.20	0.07	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	7.50	>3000	184	144	68
SM - 35	8.65	108	613	357	39.2	318	124	115	27.2	<0.35	<0.03	<0.45	5.30	15.0	21.1	207	8.05	10.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.8	>3000	>300	166	154
SM - 36	8.02	86.4	464	363	0.00	363	86	45.6	10.2	<0.35	<0.03	<0.45	2.15	17.2	10.4	156	4.30	7.05	<0.01	0.03	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	31.8	780	4	0	0
SM - 37	7.53	89.9	430	249	0.00	249	288	17.6	66.8	11.4	<0.03	<0.45	<0.09	53.5	37.6	47.1	7.03	13.1	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.6	208	36	2	0
SM - 38	7.45	72.9	420	335	0.00	335	313	17.8	44.9	<0.35	0.24	<0.45	<0.09	63.4	37.6	53.2	1.79	12.6	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.6	96	18	0	0
SM - 40	7.53	71.7	404	368	0.00	368	236	18.0	3.77	<0.35	0.16	<0.45	<0.09	44.2	30.5	83.9	2.27	9.48	<0.01	<0.01	<0.01	<0.005	<0.002	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	18.1	520	2	0	0
SM - 41	7.34	73.1	425	337	0.00	337	315	16.8	48.7	<0.35	0.13	<0.45	<0.09	64.9	37.2	53.2	1.81	12.2	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	17.8	92	28	0	0
SM - 42	7.59	72.5	420	310	0.00	310	135	43.2	17.0	<0.35	0.11	<0.45	1.06	28.1	15.8	127	1.53	7.30	<0.01	0.08	0.11	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.0	>3000	4	0	0
SM - 43	7.53	62.5	362	313	0.00	313	182	17.5	10.9	<0.35	0.08	<0.45	0.16	40.1	20.0	83.7	1.96	7.59	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	19.1	7200	0	0	0
SM - 44	7.56	156	923	552	0.00	552	201	202	16.2	0.53	0.08	<0.45	1.07	39.4	25.0	302	3.60	7.57	<0.01	0.22	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	23.4	>3000	0	0	0
SM - 45	7.41	81.5	522	294	0.00	294	381	20.5	96.7	12.8	0.06	<0.45	<0.09	77.7	45.5	47.0	1.37	16.1	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.8	400	20	0	0
SM - 47	7.94	80.8	495	378	0.00	378	147	11.1	55.2	0.57	0.09	<0.45	0.10	31.3	16.7	149	1.39	10.6	0.05	0.11	0.01	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.6	>3000	84	64	2

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Sample No.	pH	EC	TDS	T.Alk	P.Alk	M Alk	Tot.Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Coli	Faec-Coli	E - Coli
TWQR	-	-	≤ 1 000	-	-	-		≤ 1 500	≤ 1 000	≤ 100	-	-	≤ 2	≤ 1 000	≤ 500	≤ 2 000	-	-	≤ 5	≤ 10	≤ 10	≤ 1	≤ 0.01		≤ 1		≤ 0.1	≤ 2	≤ 50	≤ 1	≤ 20		-	-	-		≤ 200
SM - 49	8.05	76.7	464	357	0.00	357	44	8.99	46.8	<0.35	0.05	<0.45	0.33	11.0	4.07	177	1.42	9.31	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.0	88	0	0	0

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Table 8.4.8.10 (c): Groundwater Quality – Assessment with reference to the 1996 SAWQ Guideline for Livestock Watering (Sheet 2)

Sample No.	pH	EC	TDS	T.Alk	P.Alk	M Alk	Tot.Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Coli	Faec-Coli	E - Coli
TWQR	-	-	≤ 1 000	-	-	-		≤ 1 500	≤ 1 000	≤ 100	-	-	≤ 2	≤ 1 000	≤ 500	≤ 2 000	-	-	≤ 5	≤ 10	≤ 10	≤ 1	≤ 0.01		≤ 1		≤ 0.1	≤ 2	≤ 50	≤ 1	≤ 20		-	-	-		≤ 200
SM - 52	7.67	83.8	484	364	0.00	364	173	57.6	8.44	<0.35	0.03	<0.45	0.21	39.4	18.0	139	3.41	12.3	<0.01	0.03	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.8	1520	0	0	0
SM - 53	7.45	113	664	453	0.00	453	281	96.1	32.5	<0.35	<0.03	<0.45	<0.09	69.3	26.2	165	3.04	16.7	<0.01	0.14	0.05	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16.9	13	2	0	0
SM - 57	7.31	78.4	461	403	0.00	403	285	14.7	21.3	<0.35	0.10	0.76	<0.09	68.5	27.8	58.6	26.9	6.87	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	17.0	>3000	>300	80	34
SM - 59	7.41	56.9	344	198	0.00	198	248	27.0	61.2	5.06	<0.03	<0.45	<0.09	55.6	26.6	30.0	2.66	17.7	<0.01	0.03	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.0	370	0	0	0
SM - 60	7.31	65.3	409	205	0.00	205	300	33.6	66.2	12.7	<0.03	<0.45	<0.09	67.2	32.2	27.9	2.68	19.2	<0.01	0.05	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.28	460	0	0	0
SM - 61	7.04	87.1	466	318	0.00	318	265	73.5	22.7	1.53	<0.03	<0.45	0.23	52.8	32.4	78.5	8.39	5.44	<0.01	<0.01	0.02	<0.005	<0.002	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	0.20	<0.01	12.1	152	0	0	0
SM - 62	7.36	87.6	524	350	0.00	350	272	62.4	40.2	1.75	<0.03	<0.45	<0.09	65.1	26.5	103	8.91	9.74	<0.01	0.06	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.08	<0.01	14.9	4	2	0	0
SM - 63	7.33	77.1	387	269	0.00	269	201	19.1	39.7	5.47	<0.03	<0.45	<0.09	43.3	22.5	64.0	13.0	10.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	11.6	13	0	0	0
SM - 64	7.31	66.1	369	302	0.00	302	231	20.6	12.6	3.37	<0.03	<0.45	<0.09	48.8	26.5	51.9	12.4	9.01	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.4	>30000	0	0	0
SM - 66	7.16	57.5	320	226	0.00	226	203	16.4	44.3	0.85	<0.03	<0.45	<0.09	45.4	21.7	50.1	2.44	8.66	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.60	8	0	0	0
SM - 67	7.00	64.6	331	185	0.00	185	207	26.3	78.5	1.35	<0.03	<0.45	<0.09	45.4	22.8	39.5	1.49	10.7	<0.01	<0.01	0.04	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	8.06	31	0	0	0
SM - 68	7.16	46.3	251	181	0.00	181	176	17.6	28.5	0.77	<0.03	<0.45	<0.09	39.5	18.7	32.5	2.05	7.88	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6.82	62	4	0	0
SM - 70	7.89	80.1	434	299	0.00	299	284	25.7	64.6	2.15	<0.03	<0.45	<0.09	52.8	37.0	60.7	4.58	22.0	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	11.3	7	6	0	0
SM - 72	7.44	159	968	219	0.00	219	718	349	43.2	29.8	<0.03	<0.45	<0.09	167	73.5	57.4	14.4	15.6	<0.01	0.01	0.03	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.36	1720	6	0	0
SM - 74	7.59	63.7	381	293	0.00	293	205	9.29	51.0	0.42	<0.03	<0.45	<0.09	41.9	24.4	74.1	2.17	13.6	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	11.1	8	0	0	0
SM - 76	7.53	62.8	379	273	0.00	273	255	9.38	64.8	1.06	<0.03	<0.45	<0.09	53.0	29.9	51.4	1.87	14.9	<0.01	0.03	0.02	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.4	9	0	0	0
SM - 77	7.38	51.0	308	199	0.00	199	226	9.41	59.8	3.33	0.06	0.45	<0.09	49.5	24.8	27.9	1.93	15.2	<0.01	0.06	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	8.24	>3000	22	2	0
SM - 78	7.28	115	706	372	0.00	372	514	65.6	43.2	31.4	<0.03	<0.45	<0.09	109	58.8	54.6	12.6	12.8	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.5	>3000	62	0	0
SM - 79	7.50	80.9	489	328	0.00	328	349	30.7	71.1	5.51	<0.03	<0.45	<0.09	79.9	36.4	39.9	9.83	16.5	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10.9	>3000	34	10	0
SM - 82	7.45	86.0	532	349	0.00	349	351	21.0	101	3.08	<0.03	<0.45	0.22	67.4	44.4	72.0	3.05	12.5	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	7.36	680	0	0	0
SM - 86	7.38	80.5	467	310	0.00	310	360	24.3	76.4	5.00	<0.03	<0.45	<0.09	51.0	56.5	31.3	18.8	22.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	8.14	1860	0	0	0
SM - 87	7.38	59.9	329	223	0.00	223	242	9.47	23.5	9.25	<0.03	<0.45	<0.09	68.9	16.9	25.4	10.3	19.7	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	6.14	430	14	2	2
SM - 89	7.51	73.5	394	263	0.00	263	262	15.0	36.9	9.17	<0.03	<0.45	<0.09	64.8	24.3	46.7	7.76	18.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	3.88	>3000	16	0	0
SM - 90	7.78	76.0	411	270	0.00	270	355	40.8	59.6	1.73	0.44	<0.45	0.14	60.8	49.2	27.8	1.25	17.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	15.1	35	0	0	0
SM - 92	7.53	80.7	464	344	0.00	344	323	12.1	68.9	1.31	<0.03	<0.45	0.42	65.8	38.5	61.8	3.86	21.4	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	12.7	280	10	6	0
SM - 97	7.97	68.0	390	274	0.00	274	220	21.4	46.2	3.23	0.17	<0.45	0.24	33.5	33.2	75.2	1.13	13.8	<0.01	0.02	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	20.2	1320	4	0	0
SM - 99	7.45	64.7	352	322	0.00	322	336	15.9	18.4	<0.35	0.06	<0.45	0.17	54.3	48.6	20.8	0.24	24.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.01	<0.01	22.6	680	>300	>300	0
SM - 100	7.58	69.6	378	313	0.00	313	282	9.56	43.4	<0.35	<0.03	<0.45	<0.09	50.3	38.0	45.9	3.06	10.4	<0.01	0.01	0.02	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	14.3	82	0	0	0
SM - 101	7.48	85.0	454	294	0.00	294	350	57.4	64.8	0.65	<0.03	<0.45	0.09	56.9	50.4	42.5	2.39	13.9	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	18.7	1520	34	0	0
SM - 102	7.30	113	660	487	0.00	487	411	71.3	44.0	<0.35	1.99	5.10	0.11	78.0	52.4	102	6.12	16.5	<0.01	0.02	0.45	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	30.3	>3000	>300	>300	150
SM - 103	8.42	97.1	555	358	43.8	314	6	71.5	48.6	<0.35	0.05	12.6	0.73	0.98	0.76	198	2.08	7.52	0.05	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	19.6	460	82	0	0
SM - 104	7.50	88.7	478	267	0.00	267	320	76.9	33.9	10.4	<0.03	<0.45	<0.09	59.1	41.8	56.2	4.21	17.8	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.64	>3000	>300	>300	4
SM - 106	7.53	69.6	373	264	0.00	264	263	17.0	31.6	7.92	<0.03	<0.45	<0.09	60.5	27.2	34.3	8.83	12.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.70	2120	38	0	0

Sample No.	pH	EC	TDS	T.Alk	P.Alk	M Alk	Tot.Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Coli	Faec-Coli	E - Coli
TWQR	-	-	**≤ 1 000**	-	-	-		**≤ 1 500**	**≤ 1 000**	**≤ 100**	-	-	**≤ 2**	**≤ 1 000**	**≤ 500**	**≤ 2 000**	-	-	**≤ 5**	**≤ 10**	**≤ 10**	**≤ 1**	**≤ 0.01**		**≤ 1**		**≤ 0.1**	**≤ 2**	**≤ 50**	**≤ 1**	**≤ 20**		-	-	-		**≤ 200**
SM - 108	7.62	87.6	500	284	0.00	284	373	59.7	62.3	7.14	<0.03	<0.45	0.24	73.7	45.8	48.9	7.49	24.8	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	18.6	14	6	0	0

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Table 8.4.8.10(c): Groundwater Quality – Assessment with reference to the 1996 SAWQ Guideline for Livestock Watering (Sheet 3)

Sample No.	pH	EC	TDS	T.Alk	P.Alk	M Alk	Tot.Hardness	Cl	SO_4	NO_3	PO_4	NH_4	F	Ca	Mg	Na	K	Si	Al	Fe	Mn	As	Cd	Cr	Co	Cu	Pb	Ni	Se	V	Zn	CN^-	TOC	HPC	Tot-Coli	Faec-Coli	E - Coli
TWQR	-	-	≤ 1 000	-	-	-		≤ 1 500	≤ 1 000	≤ 100	-	-	≤ 2	≤ 1 000	≤ 500	≤ 2 000	-	-	≤ 5	≤ 10	≤ 10	≤ 1	≤ 0.01		≤ 1		≤ 0.1	≤ 2	≤ 50	≤ 1	≤ 20		-	-	-		≤ 200
SM - 110	7.57	84.0	470	381	0.00	381	294	13.0	56.4	2.35	<0.03	<0.45	0.10	48.1	42.3	64.0	7.12	18.1	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	17.7	330	6	0	0
SM - 111	7.29	77.5	411	278	0.00	278	327	29.9	81.6	0.38	<0.03	<0.45	<0.09	59.3	43.4	22.4	5.82	25.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	18.9	>3000	>300	>300	>300
SM - 112	7.42	68.3	402	265	0.00	265	247	13.7	44.8	8.94	<0.03	<0.45	<0.09	69.5	17.9	50.6	7.27	18.5	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	8.60	860	36	0	0
SM - 114	7.24	93.8	498	336	0.00	336	292	90.2	17.5	<0.35	<0.03	2.19	0.22	68.0	29.6	82.8	5.02	8.75	<0.01	0.04	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	17.2	>3000	78	58	56
SM - 115	7.23	51.4	306	76.8	0.00	76.8	211	29.0	63.6	16.8	<0.03	<0.45	<0.09	41.1	26.3	13.1	12.0	14.5	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	6.06	>3000	110	90	0
SM - 116	7.00	327	2 063	529	0.00	529	1 584	552	389	35.7	<0.03	<0.45	<0.09	322	189	134	1.36	15.6	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	27.0	>3000	>300	>300	88
SM - 119	7.25	69.4	345	244	0.00	244	213	33.4	32.0	0.47	0.90	2.84	<0.09	49.7	21.7	45.1	8.28	9.21	<0.01	0.06	0.04	<0.005	<0.002	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	37.1	>3000	8	4	0
SM - 120	7.42	58.0	333	194	0.00	194	265	30.8	10.2	14.4	<0.03	<0.45	<0.09	70.7	21.4	9.34	9.91	11.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	8.22	330	134	120	82
SM - 125	7.28	62.1	343	240	0.00	240	254	20.8	21.4	7.60	<0.03	<0.45	<0.09	53.1	29.5	32.8	7.97	8.81	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	7.72	1760	124	100	0
SM - 127	6.59	70.6	370	89.6	0.00	89.6	256	77.5	63.0	12.4	<0.03	<0.45	<0.09	48.5	32.7	17.7	21.6	12.8	<0.01	<0.01	0.04	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	8.16	2000	44	28	0
SM - 129	7.12	104	542	374	0.00	374	388	95.1	8.59	4.90	<0.03	<0.45	<0.09	72.5	50.3	66.1	2.94	8.67	<0.01	<0.01	0.04	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	11.5	920	20	0	0
SM - 130	7.67	97.7	493	346	0.00	346	354	59.6	23.9	7.43	<0.03	<0.45	<0.09	66.9	45.5	53.3	3.15	9.73	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	10.6	480	116	84	0
SM - 131	7.77	83.2	464	394	0.00	394	370	15.3	40.2	2.11	<0.03	<0.45	0.16	65.3	50.2	44.3	2.59	7.42	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.9	54	22	0	0
SM - 133	7.42	97.6	536	332	0.00	332	430	51.6	54.2	10.9	<0.03	<0.45	<0.09	80.0	55.9	39.5	7.19	16.0	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.0	27	0	0	0
SM - 134	7.26	59.9	334	257	0.00	257	254	8.31	51.3	1.97	<0.03	<0.45	<0.09	56.7	27.3	24.8	2.26	10.3	<0.01	<0.01	0.03	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	11.5	1140	44	0	0
SM - 135	7.45	89.5	518	349	0.00	349	426	33.5	89.0	3.86	<0.03	<0.45	0.13	86.5	51.1	29.8	1.68	8.70	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	14.3	580	30	0	0
SM - 136	7.50	80.1	440	396	0.00	396	166	28.3	3.06	<0.35	<0.03	0.98	0.47	36.5	18.3	112	3.27	7.42	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	16.8	94	6	0	0
SM - 137	7.43	92.0	538	340	0.00	340	421	33.9	101	6.08	0.04	<0.45	0.13	91.8	46.5	32.1	1.07	10.8	<0.01	0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.9	1920	158	40	0
SM - 138	7.45	79.3	454	314	0.00	314	233	20.6	78.3	1.86	<0.03	<0.45	0.13	49.1	26.8	80.0	2.62	4.97	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.4	19	2	0	0
SM - 139	7.45	123	701	590	0.00	590	186	7.90	67.8	<0.35	<0.03	<0.45	0.40	30.4	26.8	213	0.62	12.2	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	24.0	117	4	0	0
SM-140	7.92	175	1 021	334	0.00	334	326	318	135	<0.35	<0.03	0.51	0.49	56.5	44.8	253	11.40	18.2	0.15	0.06	0.01	-	-	-	-	-	-	-	-	-	-	11.1	>3000	44	-	14
SM-141	8.18	83	434	341	0.00	341	52	20.2	31.7	0.72	<0.03	0.45	0.26	10.4	6.2	155	1.75	8.2	<0.01	0.06	<0.01	-	-	-	-	-	-	-	-	-	-	-	10.5	>3000	18	-	6
SM-142	7.74	87	481	366	0.00	366	184	16.4	60.0	1.73	<0.03	<0.45	0.18	36.8	22.4	115	2.34	11.6	<0.01	0.02	<0.01	-	-	-	-	-	-	-	-	-	-	-	10.4	2400	0	-	0
SM-144	7.61	85	454	378	0.00	378	217	17.4	38.5	0.37	<0.03	<0.45	0.15	43.7	26.2	96	2.86	11.7	<0.01	<0.01	0.03	-	-	-	-	-	-	-	-	-	-	-	11.6	1200	0	-	0
SMF - 01	7.60	195	1 074	575	0.00	575	805	336	6.85	<0.35	<0.03	<0.45	0.12	146	107	120	13.3	16.4	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	60.7	20800	>1500	300	200
SMF - 02	7.64	252	1 671	681	0.00	681	972	245	458	<0.35	0.16	<0.45	<0.09	127	159	266	6.69	13.0	<0.01	0.04	<0.01	<0.005	<0.002	<0.01	<0.01	0.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	84.1	>30000	170	90	0
SMF - 04	7.35	61.5	390	211	0.00	211	308	34.2	94.5	0.43	0.20	<0.45	<0.09	62.8	36.7	30.1	1.58	14.2	<0.01	<0.01	0.93	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	25.2	>3000	>1500	>1500	24
SMF - 05	8.09	61.5	325	249	0.00	249	218	19.5	46.1	<0.35	<0.03	<0.45	<0.09	36.5	30.8	38.7	3.71	1.31	<0.01	0.04	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13.6	330	8	4	2
SMF - 06	7.33	61.0	343	216	0.00	216	170	10.3	45.6	9.61	<0.03	<0.45	<0.09	39.1	17.6	55.8	2.18	15.3	<0.01	<0.01	<0.01	<0.005	<0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6.04	140	0	0	0
SMF - 07	8.16	76.3	463	327	0.00	327	306	27.1	79.2	<0.35	0.04	<0.45	<0.09	53.7	41.7	62.2	2.45	1.98	<0.01	0.07	<0.01	<0.005	<0.002	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	17.6	33	14	0	0

Note:

Values indicated in **green** are less than the specified Target Water Quality Limit in the 1996 SAWQ Guideline for Livestock Watering.

- Values indicated in **red** exceed the specified Target Water Quality Limit in the 1996 SAWQ Guideline for Livestock Watering.
- Values indicated in **black** do not have a specified Target Water Quality Limit in the 1996 SAWQ Guideline for Livestock Watering.
- Values indicated in grey measured below the detection limit.

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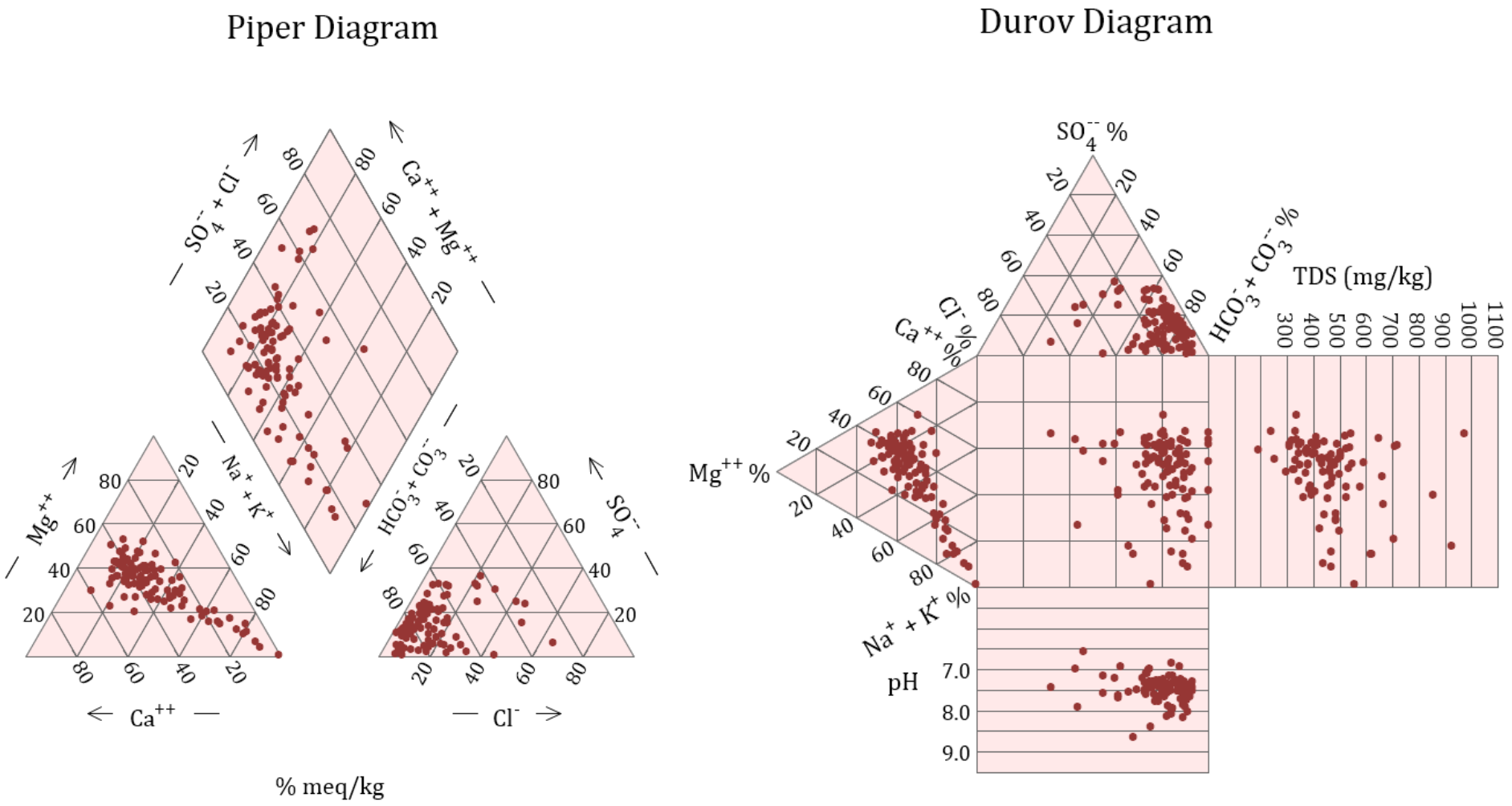

Figure 8.4.8.10 (b): Groundwater Hydrochemical Signatures (Piper and Durov Diagrams)

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8.4.9. Surface Water Aspects

Specialist consultants from Inprocon Consultants cc were requested to conduct a detailed Surface Water specialist study in support of the proposed project.

The relevant Specialist Report is:

Sasol Mining (Pty) Ltd Surface Water Baseline Study Shondoni Colliery, August 2020

The information provided below represents a concise summary of the baseline description compiled for the Shondoni Colliery area.

8.4.9.1. Hydrological Setting

Shondoni Colliery, including the new Block 8 North Reserve Area, is situated adjacent to the northern watershed of quaternary C12D as shown in Figures 3.3(d) and (e) of this report.

Shondoni Colliery is located in the relatively flatter lower area whereas the new Block 8 Reserve Area is located on the northern side in the relatively steeper area adjacent to the quaternary watershed.

The general topography in the project area is relatively flat, slightly undulating and varies in elevation between 1700 mamsl at the northern boundary to 1500 mamsl at the southern boundary where the Waterval River exits Shondoni Colliery; a cross fall of about 200 m over a length of about 16 km. The catchment slopes in the project area generally vary from 3% to 10% towards the drainage lines.

One major drainage line, the Rolspruit, flows through the middle of the new Block 8 North Reserve Area into the Waterval River, whereas four main drainage lines flow through Shondoni Colliery, namely Wildebeesspruit (near the western boundary), Waterval River (near the middle), Grootspruit (near the middle) and a tributary of Grootspruit (near the eastern boundary). The relevant sub-catchments of these drainage lines are shown in Figure 8.4.9.1(a) below. For the purposes of this report only sub-catchments A1, A2, B, C1, C2 and D are applicable.

From a hydrological runoff perspective the vegetation present in the project area vary from light bush to grasslands in the upper areas, with mainly grasslands and agricultural land in the lower flatter areas. The surface area consists mainly of permeable to semi-permeable clayey/sandy soil cover with relatively few impermeable areas such as tarred roads, industrial areas and rocky outcrops.

From topographical and current Google Earth maps it is evident that the natural surface topography has been moderately altered over the past few years as a result of the various anthropogenic and mining activities in the area. Several mine dumps, ash dumps and stockpiles are evident in the greater project area.

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