APPENDIX A

Document Limitations

DOCUMENT LIMITATIONS

This Document has been provided by Golder Associates Africa Pty Ltd ("Golder") subject to the following limitations:

i) This Document has been prepared for the particular purpose outlined in Golder's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

ii) The scope and the period of Golder's Services are as described in Golder's proposal, and are subject to restrictions and limitations. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Golder in regards to it.

iii) Conditions may exist which were undetectable given the limited nature of the enquiry Golder was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

iv) In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Golder's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.

vii) The Client acknowledges that Golder may have retained sub-consultants affiliated with Golder to provide Services for the benefit of Golder. Golder will be fully responsible to the Client for the Services and work done by all of its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from Golder and not Golder's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against Golder's affiliated companies, and their employees, officers and directors.

viii) This Document is provided for sole use by the Client and is confidential to it and its professional advisers. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Document.

GOLDER ASSOCIATES AFRICA (PTY) LTD

APPENDIX B

Letter of Invitation and Registration, Comment and Response Sheet

16 March 2018 Project No. 1776031_Let002_DSR_PP period

INVITATION TO REGISTER AND POVIDE COMMENTS: APPLICATION FOR ENVIRONMETAL AUTHORISATION FOR THE PROPOSED ROAD REALIGNMENT AND WATER USE LICENCE APPLICATION PROCESS FOR THE MAFUBE LIFE EXTENSION PROJECT, MPUMALANGA PROVINCE

DMR REFERENCE NUMBER: MP 30/5/1/2/3/2/1 (10026) EM
DARDLEA Reference number: 17/2/6/3 (101) N-1

INVITATION TO REGISTER AS AN INTERESTED AND AFFECTED PARTY

This letter serves to notify interested and affected parties (I&APs) that, in terms of the National Environmental Management Act (NEMA), (Act 107 of 1998), and the National Water Act (NWA), (Act 36 of 1998), Mafube Coal Mining (Pty) Ltd Life Extension Project (Mafube LifeX), are submitting an application for Environmental Authorisation (EA) along with an application for an integrated water use licence (IWULA) for the proposed realignment of section of three (3) district roads. Future mining activities will affect sections of the D684, D1048 and D1574 district roads.

Golder Associates Africa (Pty) Ltd, an independent environmental and engineering company, has been appointed to undertake the above authorisation processes on behalf of Mafube LifeX.

The Draft Scoping Report is available for public review and comment from **Friday, 16 March 2018 until Wednesday, 18 April 2018.**

The Draft Scoping Report contains:

- A description of the proposed road realignment activity, including all the proposed route alternative;
- An overview of the EIA process, including public participation;
- A description of the existing environment in the proposed project area;
- The identified environmental issues and potential impacts; and
- The proposed scope of specialist studies planned for the Impact Assessment phase.

AVAILABILITY OF THE DRAFT SCOPING REPORT FOR PUBLIC REVIEW

The Draft Scoping Report will be available for public review and comment from **Friday, 16 March 2018 until Wednesday 18 April 2018**. The Draft Scoping Report and on-line Registration and Comment Sheet can be downloaded from our website: http://www.golder.com/public. The Draft Scoping Report will also be made available for review at the following public places:

Name of Public Place	Contact Person	Contact Number	Address
Mafube LifeX project office	Chantelle Gerber	(011) 638 3479	Mafube LifeX Project Office, D684 road, Farm Springboklaagte
eMalahleni Main Library	Ms Johanette Rozmiarek	(013) 690 6232	Cnr. Hofmeyer and Elizabeth Avenue, eMalahleni
Golder Associates, Midrand	Antoinette Pietersen	(011) 254 4800	Golder Associates, Maxwell Office Park, Midrand
Golder Associates website	http://www.golder.com/public		

Golder Associates Africa (Pty) Ltd.
Building 1, Maxwell Office Park, Magwa Crescent West, Waterfall City, Midrand, 1685
P.O. Box 6001, Halfway House, 1685
Tel: [+27] (11) 254 4800 Fax: [+27] (0) 86 582 1561 www.golder.com
Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

Reg. No. 2002/007104/07 Directors: RGM Heath, MQ Mokulubete, SC Naidoo, GYW Ngoma
Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

Your comments are valuable

Please provide your comments by e-mail, post, fax or telephonically to the Golder Associates Public Participation Office at the contact details provided below.

Comments on the Draft Scoping Report must be submitted before or on Wednesday 18 April 2018. Comments received will be acknowledged and recorded in the Final Scoping Report, which must be submitted to the Department of Mineral Resources (DMR).

Register as an I&AP

Stakeholders are invited to register as I&APs, and to participate in the EIA/EMPr and IWULA process in any of the following ways:

- Completing the enclosed Registration and Comment Sheet or on-line via the Golder website and submitting it to the Public Participation Office; and
- Submitting any comments you may have or the request to be registered by mail, email, letter, fax or telephonically to the contact details indicated below.

INVITATION TO ATTEND A PUBLIC MEETING

Stakeholders are hereby also invited to attend a Public Meeting and the Draft Scoping Report will serve to focus the discussions at the meeting. Details of the Public Meeting:

Date: Wednesday 4 April 2018
Time: 11:00 – 13:00
Venue: Arnot Vroue Landbou-Unie Saal, Farm Springboklaagte, Middelburg District
RSVP: Before/on 4 April 2018, by contacting the Public Participation Office

Please contact me should you have any questions, would like more information, to obtain a copy of the Draft Scoping Report; or would like to contribute comments.

You can reach me at the following contact details:
P.O. Box 6001, Halfway House, 1685
Tel: +27(011) 254 4800/4805
Fax: +27(0)86 582 1561
E-mail: apietersen@golder.co.za

I look forward to your participation in the project.

Sincerely,

GOLDER ASSOCIATES AFRICA (PTY) LTD.

Tani Pietersen

Antoinette Pietersen
Stakeholder Engagement Specialist

Mariëtte Weideman
Project Manager

MW/AP/mw

CC: [Click here and type list of CCs]

Attachments: Registration and Comment Form
Locality Map

g:\projects\1776031 - mafube env input 2017\7.0 public participation\road eia_emp process\announcement letter\1776031_mafube road eia_ann letter_final_13.03.2018.docx

APPLICATION FOR ENVIRONMETAL AUTHORISATION FOR THE PROPOSED ROAD REALIGNMENT AND WATER USE LICENCE APPLICATION PROCESS FOR THE MAFUBE LIFE EXTENSION PROJECT, MPUMALANGA PROVINCE

DRAFT SCOPING REPORT AVAILABLE FOR PUBLIC REVIEW

Registration and Comment Sheet

16 March 2018 until 18 April 2018

Your comments are an important contribution to this permitting process. We would like to interact directly with you and encourage you to register as a stakeholder. By registering, we will be able to keep you updated as this project moves forward and respond to any questions or concerns that you may wish to raise.

PERSONAL DETAILS			
Name	**Surname**	**Title**	**Organisation / Department** ***(If applicable)***

CONTACT INFORMATION				
Cell Number	**Land Line Contact Number**		**Fax Number**	**Preferred Language**
		Office		
		Home		

E-mail	**Postal Address**	**Postal code**			

LANDOWNERS	
If your property falls within the boundary of the road construction area, please tell us your farm name and erf and portion number	

WOULD YOU LIKE TO REGISTER AS AN INTERESTED AND AFFECTED PARTY?		
Please register me as an interested and affected party for this project so that I may receive further information and notifications as the project develops	**YES**	**NO**

Preferred Method of Communication ***(Mark with an X)***	**POST**	**E-MAIL**	**FAX**

In terms of GNR 326 (EIA Regulations) I disclose below any direct business, financial, personal or other interest that I may have in the approval or refusal of the application:	**Date**	
	Signature	

For internal use to confirm capture of stakeholder details into the stakeholder database	
Stakeholder database reference number	
	Signature of data capturer

COMMENT(S)

You are welcome to use different pages should you so wish.

I have the following comments on the Draft Scoping Report and/or the public consultation process:

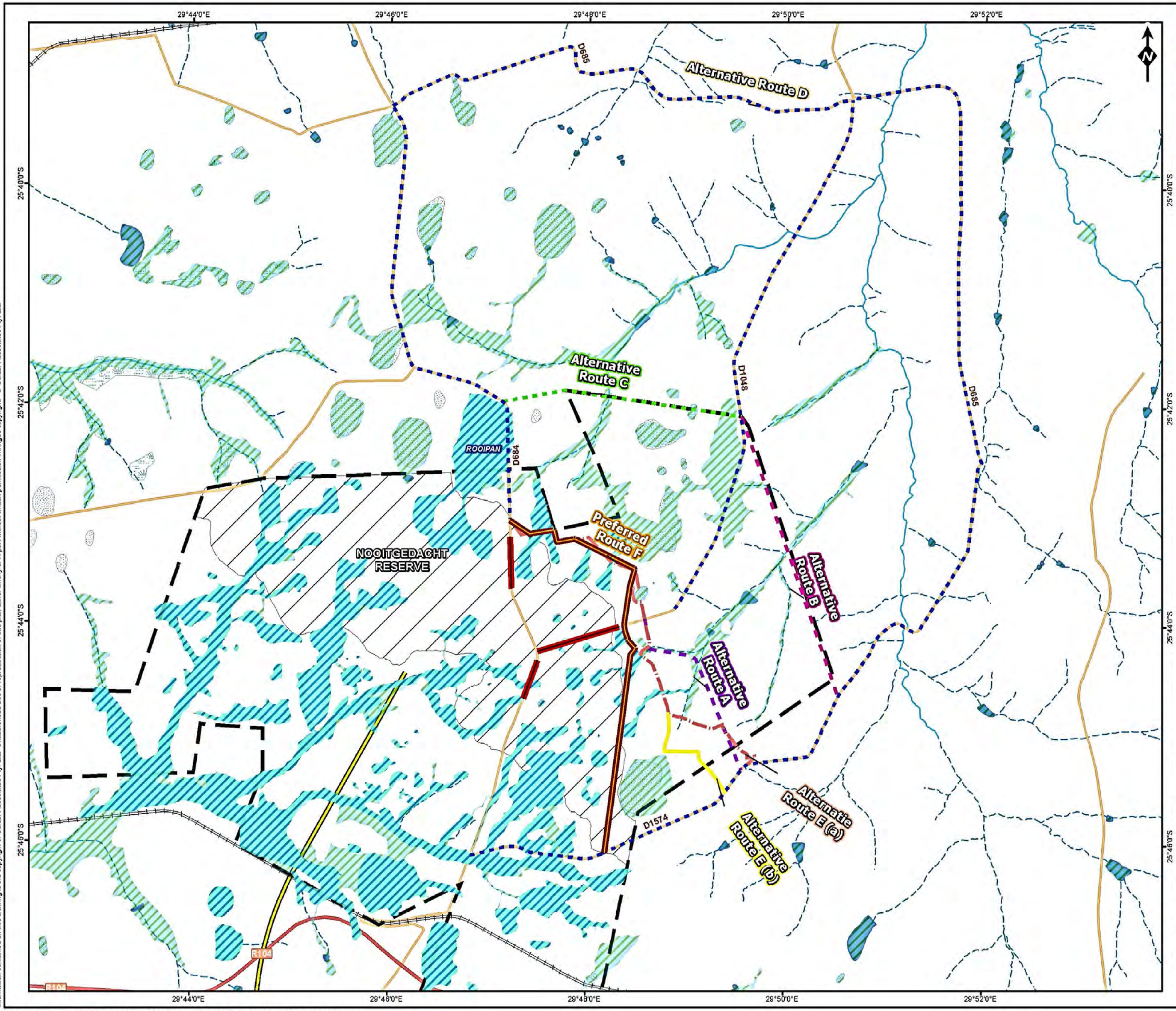
Please ask the following of my colleagues / friends to register as Interested and Affected Persons for this environmental authorisation process:

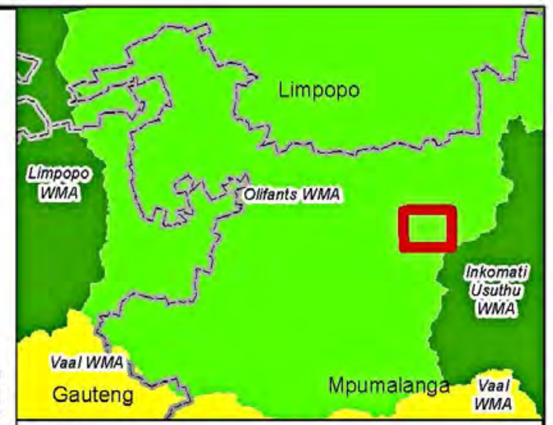
NAME	CONTACT DETAILS

PLEASE RETURN THE REGISTRATION AND COMMENT SHEET TO:

Golder Associates Africa
PUBLIC PARTICIPATION OFFICE
Antoinette Pietersen
P.O. Box 6001, Halfway House, 1685
Tel: +27(011) 254 4800/4805
Fax:+27(0)86 582 1561
E-mail: apietersen@golder.co.za
Website : http://www.golder.com

THANK YOU





LEGEND

- Affected Road Sections
- Alternative Route D
- Alternative Route
- Alternative Route B
- Alternative Route C
- Preferred Route F
- Alternative Route E (a)
- Alternative Route E (b)
- Wetlands (WCS 2015)
- Mafube (MRA)
- Railway
- Conveyor
- Dam
- Pan
- Marsh vlei

RESOURCES/NOTES

0 0.45 0.9 1.8 2.7 3.6
Kilometers

REFERENCE

Coordinate System: WGS Lo29

PROJECT

MAFUBE

TITLE

REALIGNMENT ROADS

PROJECT No. 1660730		REV 0
SCALE 1:60,000		A3
GIS	MM	2/10/2018
CHECK	KF	2/10/2018
REVIEW	MW	2/10/2018

Golder Associates
Johannesburg, South Africa

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6 July 2018 Project No. 1776031_Let002

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AND WATER USE LICENCE APPLICATION (IWULA) PROCESS FOR THE PROPOSED MAFUBE LIFE EXTENTION ROAD REALIGNMENT PROJECT, MPUMALANGA PROVINCE

DRAFT EIA REPORT AVAILABILE FOR PUBLIC COMMENT

(DMR REFERENCE NUMBER: MP 30/5/1/2/2/ 10026 MR)

- **Availability of Draft Environmental Impact Assessment (EIA) Report and Environmental Management Plan (EMP) for public review**
- **Call to register as an interested and affected party**

This letter serves to notify interested and affected parties (I&APs) that, in terms of the National Environmental Management Act (NEMA), (Act 107 of 1998), and the National Water Act (NWA), (Act 36 of 1998), Mafube Coal Mining (Pty) Ltd Life Extension Project (Mafube LifeX), submitted an Environmental Authorisation (EA) application for the proposed realignment of a section of three (3) district roads, which will be affected by their future mining operations. The project will also entail the submission of a Water Use Licence Application (WULA) to the Department of Water and Sanitation (DWS) for water uses associated with the road re-alignment. The affected roads are sections of the D684, D1048 and D1574 district roads.

The proposed project area is located in the Magisterial District of Steve Tshwete Local Municipality in the Mpumalanga Province, 39 km east of the town of Middelburg via the R104 regional road, and 45 km west of Belfast.

Stakeholders are invited to register as Interested and Affected Parties (I&APs) and submit their comments on the Draft Environmental Impact Assessment (EIA) Report that is available for public review and comment.

AVAILABILITY OF THE DRAFT EIA and EMP FOR PUBLIC REVIEW

Stakeholders are invited to register as I&APs and to participate in the EIA process by commenting on the findings of the environmental specialist studies and proposed mitigation measures presented in the Draft EIA Report, as well as the environmental management plan.

The Draft EIA Report will be available for public review and comment for a period of 30 days from Friday 6 July 2018 until Monday 6 August 2018. The report, as well as a Registration and Comment Sheet, will be available at the public places listed below and on the following website: https://www.golder.com/global-locations/africa/south-africa-public-documents/.

Name of Public Place	Contact Person	Contact Number	Address
Mafube LifeX project office	Chantelle Gerber	(011) 638 3479	Mafube LifeX Project Office, D684 road, Farm Springboklaagte
eMalahleni Main Library	Ms Johanette Rozmiarek	(013) 690 6232	Cnr. Hofmeyer and Elizabeth Avenue, eMalahleni
Golder Associates Africa, Midrand	Ms Antoinette Pietersen	(011) 254 4805	Building 1, Maxwell Office Park, Midrand

Your comments are valuable

Please provide your comments by e-mail, post, fax or telephonically to the Golder Associates Public Participation Office at the contact details provided below.

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

Comments on the Draft Environmental Impact Assessment (EIA) Report and Environmental Management Plan (EMP) must be submitted before or on Monday 6 August 2018. Comments received will be acknowledged and recorded in the Final EIA/EMP, which must be submitted to the DMR on or before Tuesday 4 September 2018.

REGISTER AS AN I&AP

Stakeholders who have not done so yet, are invited to register as I&APs, and to participate in the EIA/EMPr and IWULA process in any of the following ways:

- Completing the enclosed Registration and Comment Sheet and submitting it to the Public Participation Office; and
- Submitting any comments you may have or the request to be registered by mail, email, letter, fax or telephonically to the contact details indicated below.

Please contact me should you have any questions, would like more information, to obtain a copy of the Draft EIA/EMP Report; or would like to contribute comments.

You can reach me at the following contact details:
P.O. Box 6001, Halfway House, 1685
Tel: +27(011) 254 4805
Fax: +27(0)86 582 1561
E-mail: ppoffice@golder.co.za

I look forward to your participation in the project.

Sincerely,

Golder Associates Africa (Pty) Ltd.

Antoinette Pietersen Stakeholder Engagement Specialist	Mariëtte Weideman Project Manager

MW/AP/mw

Attachments: Registration and Comment Form
Locality Map

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APPLICATION FOR ENVIRONMETAL AUTHORISATION FOR THE PROPOSED ROAD REALIGNMENT AND WATER USE LICENCE APPLICATION PROCESS FOR THE MAFUBE LIFE EXTENSION PROJECT, MPUMALANGA PROVINCE

DRAFT EIA REPORT AVAILABLE FOR PUBLIC REVIEW

Registration and Comment Sheet

Golder Associates

6 July 2018 until 6 August 2018

Your comments are an important contribution to this permitting process. We would like to interact directly with you and encourage you to register as a stakeholder. By registering, we will be able to keep you updated as this project moves forward and respond to any questions or concerns that you may wish to raise.

PERSONAL DETAILS			
Name	**Surname**	**Title**	**Organisation / Department** ***(If applicable)***

CONTACT INFORMATION				
Cell Number	**Land Line Contact Number**		**Fax Number**	**Preferred Language**
		Office		
		Home		
E-mail	**Postal Address**			**Postal code**

LANDOWNERS	
If your property falls within the boundary of the road construction area, please tell us your farm name and erf and portion number	

WOULD YOU LIKE TO REGISTER AS AN INTERESTED AND AFFECTED PARTY?			
Please register me as an interested and affected party for this project so that I may receive further information and notifications as the project develops	**YES**	**NO**	
Preferred Method of Communication ***(Mark with an X)***	**POST**	**E-MAIL**	**FAX**

In terms of GNR 326 (EIA Regulations) I disclose below any direct business, financial, personal or other interest that I may have in the approval or refusal of the application:	**Date**	
	Signature	

For internal use to confirm capture of stakeholder details into the stakeholder database	
Stakeholder database reference number	
	Signature of data capturer

COMMENT(S)

You are welcome to use different pages should you so wish.

I have the following comments on the Draft Scoping Report and/or the public consultation process:

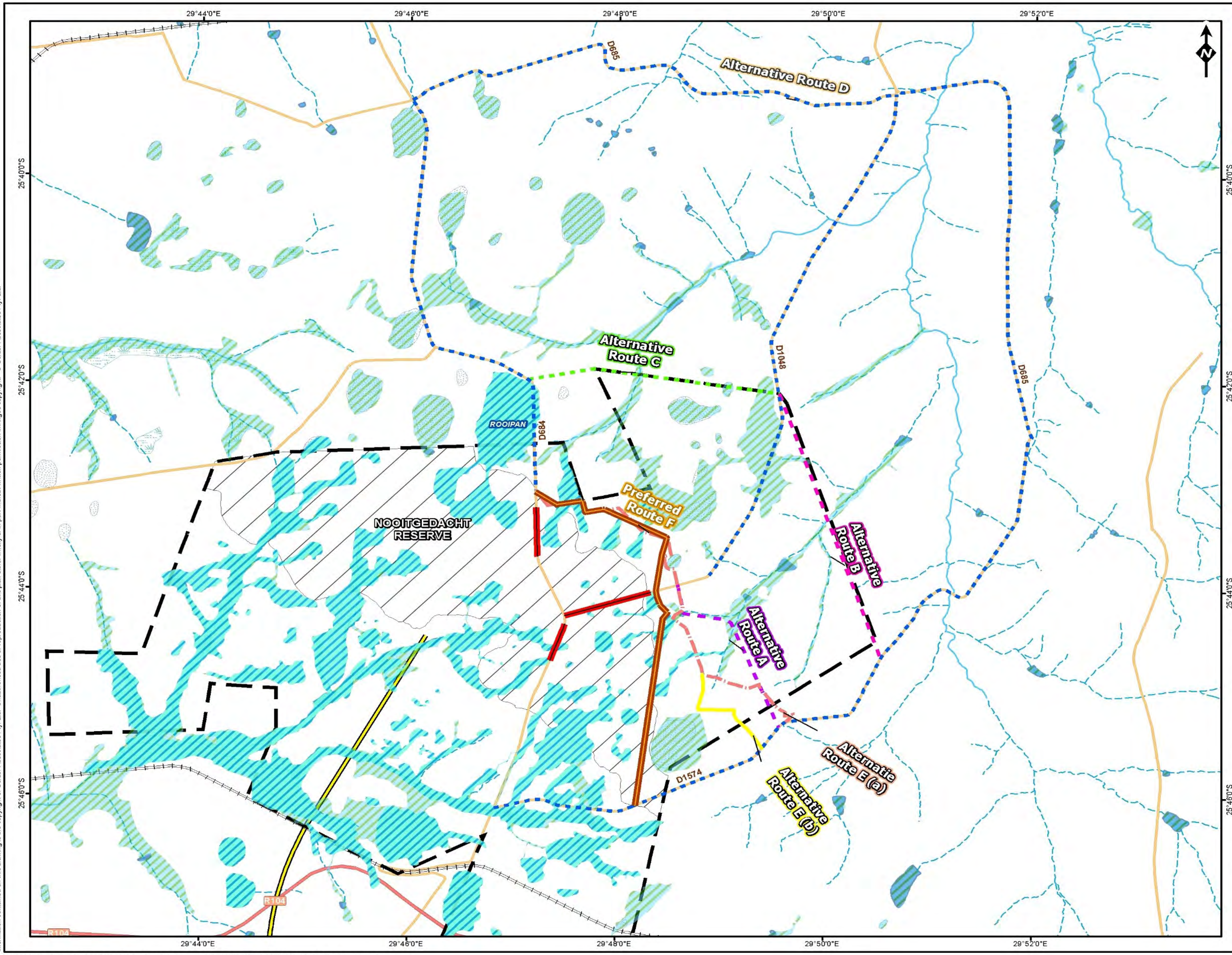
Please ask the following of my colleagues / friends to register as Interested and Affected Persons for this environmental authorisation process:

NAME	CONTACT DETAILS

PLEASE RETURN THE REGISTRATION AND COMMENT SHEET TO:

Golder Associates Africa
PUBLIC PARTICIPATION OFFICE
Antoinette Pietersen
P.O. Box 6001, Halfway House, 1685
Tel: +27(011) 254 4800/4805
Fax:+27(0)86 582 1561
E-mail: ppoffice@golder.co.za
Website : http://www.golder.com

THANK YOU



LEGEND

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- Alternative Route E (b)
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- Mafube (MRA)
- Railway
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- Dam
- Pan
- Marsh vlei

RESOURCES\NOTES

0 0.45 0.9 1.8 2.7 3.6
Kilometers

REFERENCE
Coordinate System: WGS Lo29

PROJECT
MAFUBE

TITLE
REALIGNMENT ROADS

PROJECT No. 1660730		REV 0
SCALE 1:60,000		A3
GIS	MM	2/10/2018
CHECK	KF	2/10/2018
REVIEW	MW	2/10/2018

Golder Associates
Johannesburg, South Africa

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APPENDIX C

Newspaper Advertisement

0900 LEGALS

0910 PUBLIC / LEGAL NOTICES

BOEDELKENNISGEWING
In die Boedel van Wyle **JACOBUS JOHANNES CONRADIE** Identiteitsnommer 400305 5008 080 getroud binne gemeenskap van goedere met **HESTER CECILIA CONRADIE** wat oorlede is op **1 OKTOBER 2016** **Boedel nr: 4022/2016** Kennis word hiermee gegee dat die Eerste en Finale Likwidasie- en Distribusierekening in bostaande boedel ten kantore van die Meester van die Hooggeregshof Nelspruit en die Landdroshof, Middelburg ter insae lê vir `n tydperk van 21 dae vanaf 16 MAART 2018. Indien geen besware daarteen by die Meester ingedien word binne gemelde tydperk nie, gaan die Eksekuteur oor tot die uitbetaling daarkragtens.
VAN DEVENTER & CAMPHER ING (namens EKSEKUTRISE) Walter Sisulustraat 48 Posbus 2125 MIDDELBURG 1050 E-pos:

jonina.p@vcampher.co.za VERW: Jonina Prinsloo /EPC001
SR092231

EMAKHAZENI LOCAL MUNICIPALITY
NOTICE OF A REZONING APPLICATION IN TERMS OF SECTION 66 OF THE EMAKHAZENI LOCAL MUNICIPALITY SPATIAL PLANNING AND LAND USE MANAGEMENT BY-LAW, 2015
We, ***SFP Townplanning (Pty) Ltd,*** being the authorized agent of the owner of **Portion 1 of the farm Waterloo No. 367-JT,** hereby give notice in terms of Section 66 of the Emakhazeni Local Municipality Spatial Planning and Land Use Management By-Law, 2015, that we have applied to the Emakhazeni Local Municipality for the amendment of the Emakhazeni Land Use Scheme, 2010 by the rezoning of the above mentioned property.
The property is located along Anford Road and is adjacent to the N4.
The rezoning is from **"Agriculture"** to **"Tourism and Accommodation"** in order to allow the development of a lodge.
Any objection(s) and/or comment(s), inlcuding the grounds for such objection(s) and/or comment(s) with full contact details, without which the Municipality cannot correspond with the person or body submitting the objection(s) and/or comment(s), shall be lodged with, or made in writing to:
The Municipal Manager, Planning and Social Development, Emakhazeni Local Municipality, P.O. Box 17, Emakhazeni, 1100 from **16 MARCH 2018,** untill 16 April 2018
(not less than 30 days after the date of the publication of the notice).
Full particulars and plans (if any) may be inspected during normal office hours at the Municipal offices as set out below, for a period of 30 days from the date of publication of the advertisement in the Provincial Gazette and Middelburg Observer..
Address of Municipal Offices
The Municipal Manager, Infrastructure, Planning And Social Development Department, Emakhazeni Local Municipality Offices, 25 Scheeper Street, Emakhazeni (Belfast), 1100
Name and Address of applicant:
SFP Townplanning (Pty) Ltd
Reg No. 2006/029076/07
371 Melk Street
Nieuw Muckleneuk
P.O. Box 908
Groenkloof
0027
Telephone No: 012 346 2340
Fax No: 012 346 0638
Email: admin@sfplan.co.za
Dates on which notice will be published: 16 March 2018
Closing date for any objections and/or comments: 16 April 2018
Reference: 6/2/R
Our Ref: F3607
SR092224

EMAKHAZENI PLAASLIKE MUNISIPALITEIT
KENNISGEWING VAN DIE AANSOEK OM HERSONERING IN TERME VAN ARTIKEL 66 VAN DIE EMAKHAZENI PLAASLIKE MUNISIPALITEIT RUIMTELIKE BEPLANNING EN GRONDGEBRUIKSBE-HEERVERORDENING, 2015
Ons, **SFP Stadsbeplanning (Edms) Bpk,** synde die gemagtigde agent van die eienaar van **Gedeelte 1 van die plaas Waterloo No. 367- JT,** gee hiermee ingevolge Artikel 66 van die Emakhazeni Plaaslike Munisipaliteit Ruimtelike Beplanning en Grondgebruiks-beheerverordening, 2015, kennis dat ons aansoek gedoen het by die Emakhazeni Plaaslike Munisipaliteit vir die wysiging van die Emakhazeni Grondgebruikskema, 2010, deur die hersonering van bogenoemde eiendom. Die eiendom is geleë langs Anfordweg en is aangresend aan die N4.
Die hersonering is van **"Landbou"** na **"Toerisme en Akkommodasie"** om die ontwikkeling van `n lodge toe te laat.
Enige beswaar (e) of kommentaar(e), met die gronde daarvoor met volledige kontakbesonderhede waarsonder die Munisipaliteit nie met die persoon of liggaam wat die kommentaar(e) of beswaar(e) ingedien het kan kommunikeer nie, moet binne nie minder nie as 30 dae na die datum van die publikasie van die kennisgewing ingedien of gerig word aan:
Die Munisipale Bestuurder: Beplanning en Maatskaplike Ontwikkeling, Emakhazeni Plaaslike Munisipaliteit, Posbus 17, Emakhazeni, 1100 vanaf **16 MAART 2018** *(die datum van die publikasie van die kennisgewing)* tot 16 April 2018
Volledige besonderhede en planne (as daar is) kan gedurende gewone kantoorure by die Munisipale kantore soos hierbo uiteengesit geïnspekteur word, vir `n tydperk van 30 dae vanaf die datum van publikasie van die kennisgewing in die Provinsiale Koerant en Middelburg Observer .
Adres van Munisipale Kantore:
Die Munisipale Bestuurder, Departement Infrastruktuur, Beplanning en Maatskaplike Ontwikkeling, Emakhazeni Plaaslike Munisipale Kantore, Sheeperstraat 25, Emakhazeni (Belfast), 1100
Naam en adres van aansoeker:
SFP Stadsbeplanning (Edms) Bpk
Reg No. 2006/029076/07
Melkstraat 371
Nieuw Muckleneuk
Posbus 908
Groenkloof
0027
Tel: 012 346 2340
Faks: 012 346 0638
Epos: admin@sfplan.co.za
Datum waarop kennisgewing gepubliseer word: 16 Maart 2018
Sluitingsdatum vir enige besware en/of kommentaar: 16 April 2018
Verwysing: 6/2/R
Ons verwysing: F3607
SR092225

NOTICE TO CREDITORS IN DECEASED ESTATES

All persons having claims against the undermentioned estate must lodge it with the Executor concerned within 30 days (or as indicated) from date of Publication hereof. Province: Mpumalanga
Estate Number: 015318/2017
Surname: MAHLANGU
First Names: MLAYIWA LUCAS
Date of Birth: 1952-08-10
ID Number: 5208105806081
Last Address: 594 PLEINT STREET,MHLUZI, MIDDELBURG, MPUMALANGA
Date of Death: 2017-09-28
Master`s Office: MASTER OF THE NORTH GAUTENG HIGH COURT
Name of Executor or Authorised Agent: MATLALA VON METZINGER ATTORNEYS
Address of Executor or Authorised Agent: 1 LANA STREET, WITBANK NEWS BUILDING, WITBANK EXTENSION 22
Period allowed for lodgement of claims, if other than 30 days:
Advertiser Name: MATLALA VON METZINGER ATTORNEYS
Advertiser Address: 1 LANA STREET, WITBANK NEWS BUILDING, WITBANK EXTENSION 22
Advertiser Email: Kgaloshi@mvmattorneys.co.za
Date Submitted: 2018-02-22
Advertiser Telephone: 013 656 6059
For Publication in the Government Gazette on: 2018 -03-16
LN043051

NOTICE DECEASED ESTATE
Debtors and Creditors in the undermentioned estate are required to lodge their claims and pay their debts with the undersigned within 30 days after the date of publication hereof:
Estate late: Baby Thandiwe Alphosinah Xaba
Estate Number: 004221 /2016
Identity Number: 4005060278087
Born on: 06 May 1940
Last known address: Stand 589 Mhluzi Location Middelburg
Died on: 22 January 2016
Marital status: Never married
MAPHANGA & ASSOCIATES INC
73 Walter Sisulu Street Middelburg, 1050
PO Box 22273 Middelburg, 1050
Email: **tony@maphangae.co.za**
Tel: 013 243 1303
Fax: 013 243 1650
Ref: **MR MAPHANGA/M01748 /MM**
OS006390

NOTICE DECEASED ESTATE
Debtors and Creditors in the undermentioned estate are required to lodge their claims and pay their debts with the undersigned within 30 days after the date of publication hereof:
Estate late: Cecil Nhlapo
Estate Number: 017473 /2016
Identity Number: 6212025429080
Born on: 02 December 1962
Last known address: Stand 10261 Mhluzi Location Middelburg
Died on: 31 May 1999
Marital status: Never married
MAPHANGA & ASSOCIATES INC
73 Walter Sisulu Street Middelburg, 1050
PO Box 22273 Middelburg, 1050
Email: **tony@maphangae.co.za**
Tel: 013 243 1303
Fax: 013 243 1650
Ref: **MR MAPHANGA/M01903 /MM**
OS006388

NOTICE DECEASED ESTATE
Debtors and Creditors in the undermentioned estate are required to lodge their claims and pay their debts with the undersigned within 30 days after the date of publication hereof:
Estate late: Nomakhondlo Sarah Duba
Estate Number: 010687 /2016
Identity Number: 4312040169083
Born on: 04 December 1943
Last known address: Stand 1658 Elle Street Mhluzi Location Middelburg
Died on: 11 June 2015
Marital status: Widow
MAPHANGA & ASSOCIATES INC
73 Walter Sisulu Street Middelburg, 1050
PO Box 22273 Middelburg, 1050
Email: **tony@maphangae.co.za**
Tel: 013 243 1303
Fax: 013 243 1650
Ref: **MR MAPHANGA/M01826 /MM**
OS006389

UNIVERSITY OF MPUMALANGA
Creating Opportunities

Tender Notice and Invitation to Tender

Framework Contracts for the Provision of Project Management, Architectural Services and Environmental Compliance Monitoring Services

The University of Mpumalanga invites tenders for the following professional services over a 3-year term without a guarantee of the quantum of work:
Tender No NIT0016: Project Management Services
Tender No NIT0018: Architectural Services
Tender No NIT0037: Environmental Compliance Monitoring Services
The contracts will be based on the NEC3 Professional Service Contract.
Tenderers who are Exempted Micro Enterprises (EME) or Qualifying Small Enterprises (QSE) are prequalified to submit tender offers for Tender Numbers NIT0018 and NIT0037 in accordance with the provisions of the Preferential Procurement Regulations, 2017.
Only tenderers who have suitable experience and suitably qualified personnel in providing similar services to those that are required are eligible to submit tenders.
Documents may be downloaded from the employer's website at www.ump.ac.za from 10:00 on 13 March 2018.
Queries relating to the issue of these documents may be submitted through the form on the tenders website, or addressed in writing to Mr Lucky Khoza at fax: 086 527 9201 or e-mail Lucky.Khoza@ump.ac.za
A compulsory clarification meeting with representatives of the employer for Tender Numbers NIT0016 and NIT0018 will take place at the entrance to the University of Mpumalanga's Mbombela Campus (coordinates: -25.437537, 30.98185) on 20 March from 10:00 to 13:00.
The closing time for receipt of tenders is 12:00 on 11 April 2018.
Telegraphic, telephonic, telex, facsimile, e-mail and late tenders will not be accepted.
Tenders may only be submitted on the tender documentation that is issued.
Requirements for sealing, addressing, delivery, opening and assessment of tenders are stated in the Tender Data.

Human Communications 140288

APPLICATION FOR ENVIRONMETAL AUTHORISATION FOR THE PROPOSED ROAD REALIGNMENT AND WATER USE LICENCE APPLICATION PROCESS FOR THE MAFUBE LIFE EXTENSION PROJECT, MPUMALANGA PROVINCE

INVITATION TO REGISTER AS AN INTERESTED AND AFFECTED PARTY AND COMMENT ON DRAFT SCOPING REPORT

In terms of the National Environmental Management Act (NEMA), (Act 107 of 1998), and the National Water Act (NWA), (Act 36 of 1998), Mafube Coal Mining (Pty) Ltd Life Extension Project (Mafube LifeX), is submitting an application for Environmental Authorisation (EA) along with an application for an Integrated Water Use Licence (IWUL) for the proposed realignment of section of three (3) district roads, which will be affected by their future mining activities. The affected roads are sections of the D684, D1048 and D1574 district roads.
The proposed project area is located in the Magisterial District of Steve Tshwete Local Municipality in the Mpumalanga Province, 39 km east of the town of Middelburg via the R104 regional road, and 45 km west of Belfast.
Golder Associates Africa (Pty) Ltd, an independent environmental and engineering company, has been appointed to undertake the above authorisation processes on behalf of Mafube LifeX. Stakeholders are invited to register as Interested and Affected Parties (I&APs) and to participate in the above process by commenting on the Draft Scoping Report and/or identifying issues of concern and suggestions for enhanced benefits.

The Draft Scoping Report will be available for public review and comment for a period of 30 days from 16 March 2018 until 18 April 2018. The report, as well as an on-line Registration and Comment Sheet, will be available at the public places listed below and on the following website: www.golder.com/public.

Public Place	Contact Person	Contact Number	Address
Mafube LifeX project office	Chantelle Gerber	(011) 638 3479	Mafube LifeX Project Office, D684 road, Farm Spring-boklaagte
eMalahleni Main Library	Ms Johanette Rozmiarek	(013) 690 6232	Cnr. Hofmeyer and Elizabeth Avenue, eMalahleni
Golder Associates Africa, Midrand	Ms Antoinette Pietersen	(011) 254 4805	Building 1, Maxwell Office Park, Midrand

INVITATION TO ATTEND A PUBLIC MEETING:
Stakeholders are hereby also invited to attend a Public Meeting and the Draft Scoping Report will serve to focus the discussions at the meeting.
Details of the Public Meeting:
Date: Wednesday 4 April 2018
Time: 11:00 – 13:00
Venue: Arnot Vroue Landbou-Unie Saal, Farm Springboklaagte, Middelburg District
RSVP: Before/on 4 April 2018, by contacting the Public Participation Office

To register as an I&AP and/or obtain more information please contact:
Antoinette Pietersen
Public Participation Office:
Golder Associates Africa (Pty) Ltd.
PO Box 6001, Halfway House, 1685
Tel: (011) 254 4800
E-mail: apietersen@golder.co.za

Golder Associates

Avertisement Date :16 March 2018

m16mrt/golder associates/het

Tshwane University of Technology

Tenders are hereby invited for

TR09-2018: Construction of New Exit Gate at Pretoria West Campus of Tshwane University of Technology (TUT)

The proposed works consist of construction of new exit gate and the work includes reinforced concrete works, building work, steel & metalwork and the engineering services include structural, civil, electrical, electronic and mechanical at Pretoria West Campus of Tshwane University of Technology situated in Pretoria Campus.
Required CIDB Grading is 6GB or higher
A compulsory information session and site inspection will be held on Thursday, 22 March 2018 at 12:00 at Prestige Auditorium, Pretoria Campus.
Document enquiries: Lesego Mabidietsa, tel. (012) 382-6482 or e-mail: MabidietsaL@tut.ac.za

TR10-2018: Construction of New Student Residence at Soshanguve South Campus of Tshwane University of Technology (TUT)

The proposed works consist of construction of a multi-storey reinforced concrete building to accommodate students and the engineering services include electrical and mechanical installations at Soshanguve South Campus of Tshwane University of Technology situated in Soshanguve.
Required CIDB Grading is 6GB or higher
A compulsory information session and site inspection will be held on Thursday, 22 March 2018 at 10:00 at Tsebong Building 5, Room 217, Soshanguve South Campus.
Document enquiries: Lesego Mabidietsa, tel. (012) 382-6482 or e-mail: MabidietsaL@tut.ac.za

TR11-2018: Construction of New Student Residence at eMalahleni Campus of Tshwane Unive rsity of Technology (TUT)

The proposed works consist of construction of a multi-storey reinforced concrete building to accommodate students and the engineering services include electrical and mechanical installations at eMalahleni Campus of Tshwane University of Technology situated in eMalahleni.
Required CIDB Grading is 7GB or higher
A compulsory information session and site inspection will be held on Friday, 23 March 2018 at 10:00 at Building 06 Auditorium, eMalahleni Campus.
Document enquiries: Sizakele Mukwevho, tel. (012) 382-4555 or e-mail: Mukwevhosp@tut.ac.za

Respondents need to ensure that they are in possession of a full set of tender documents when attending the information session. Participants are requested to ensure that the person who would be authorised to complete the tender documents also attend the information session.
Tender documents may be purchased at non-refundable fee of R1 000.00 (VAT included). A deposit can be made at ABSA Bank using tender number as reference: **Branch code:** 632002; **Account number:** 0040000003; **Reference number:** Relevant tender number
Tender documents will only be issued once proof of payment is provided at the Tender Office, Room 1-G04, Building and Estate, 412 Esk a Mphahlele Drive, Pretoria but will be obtainable only from the date of this advert until 13:30 at the briefing session on Thursday, 22 March 2018 (for Tender No: TR09-2018), until 11:00 on Thursday, 22 March 2018 (for Tender No: TR10-2018) and until 11:30 on Friday, 23 March 2018 (for Tender No: TR11-2018)
No documents shall be issued after that date.
The Tshwane University of Technology (TUT) is committed to broad-based black economic empowerment. We strive to comply with the provisions of all relevant legislation. Details are included in the tender documents.
Closing date: Tuesday, 3 April 2018 at 10:00
Tender documents should be the original documents, submitted on paper (hard copy) and one copy of the original and placed in a new envelope, which should be sealed and marked with the appropriate tender number and description, and placed in the tender box at the entrance of TUT Technical Services, Eskia Mphahlele Drive, Pretoria 0001.
NB: Please note tender documents will be available from Wednesday, 14 March 2018.
No faxed, electronic or late documents will be accepted. Short-listed prospective tenderers will be subjected to a vetting process.
TUT reserves the right not to accept the lowest or any tender.
Direct link to the Tender Notice Board:
http://www.tut.ac.za/Other/tender/Pages/Services.aspx
Technical and specification-related enquiries: Mr Humphrey Mathibe, tel. (012) 382-4502 or e-mail: Mathibe MH@tut.ac.za

Tshwane University of Technology
We empower people

Human Communications 140338

0915 SALES IN EXECUTION

KENNISGEWING VAN GEREGTELIKE VERKOPING
IN DIE LANDDROSHOF VIR DIE DISTRIK VAN STEVE TSHWETE GEHOU TE MIDDELBURG SAAKNOMMER: 5356/17
In die saak tussen:
SINYAYOWETU TRADING ENTERPRISE 35 CC

EKSEKUSIESKULDEISER
en
YETHEMBE INVESTMENTS (PTY) LTD

EKSEKUSIESKULDENAA
UIT HOOFDE van `n Vonnis van bogenoemde Agbare Hof en `n Lasbrief tot Eksekusie op 17 JANUARIE 2018 die volgende goedere per publieke veiling vir kontant op VRYDAG op 13 APRIL 2018 te JOUBERTSTRAAT 3, MIDDELBURG om 12:00 verkoop word aan die hoogste bieër, naamlik:
2 x Direkteurs lessenaars
1 x Telefunken kleur TV
1 x Sony kleur TV
1 x Glas tafel met 8 wit stoele
8 x Skoot rekenaars
2 x Drukkers
2 x Kroeg yskaste
1 x Konferensie tafel met 8 stoele
2 x Hout liasseer kabinette
1 x Staal liasseer kabinette
1 x Wan mikrogolfoond

APPENDIX D

List of Registered I&APs

Contact	Title	Salutation	Surname	Stakeholder Category	Organisation
Steven Bloy	Mr	Steven	Bloy	Landowner	South32
Gawie Bosman		Gawie	Bosman	Landowner	Anglo Coal - Mafube Colliery
Adriaan Johannes Botha	Mr	Adriaan Johannes	Botha	Landowner	Anglo Coal - Mafube Colliery
Christofel Jacobus Botha	Mr	Christofel Jacobus	Botha	Affected Landowner	BAYVIEW MARI-LO CC
Christa Cass	Mrs	Christa	Cass	Affected Landowner	Postnet
Leon Cass	Mr	Leon	Cass	Affected Landowner	Arnot V L U
Cain M Chunda	Mr	Cain M	Chunda	Landowner	Mpumalanga Provincial Government
D de Waal	Dr	D	de Waal		Golder
Megan Dickson	Mrs	Megan	Dickson		Samancor Middelburg Ferrochrome
Gerrie du Toit	Mr	Gerrie	du Toit	Landowner	ALZU Enterprises
Gerrie du Toit	Mr	Gerrie	du Toit	Landowner	Statutis Trading(Pty) Ltd
Hannes Eserhuizen	Mr	Hannes	Eserhuizen	Landowner	Mafube Coal Mining (Pty) Ltd
C Hlatshwayo	Mrs	C	Hlatshwayo		Steve Tshwete Municipality
Jurie Human	Mr	Jurie	Human		Chrometec
Johannes Jurie Human	Mr	Johannes Jurie	Human	Landowner	Chrometec
Peter Kane-Berman	Mr	Peter	Kane-Berman	Landowner	Beestepan Boerdery
Leketso Khaile	Ms	Leketso	Khaile	Landowner	Inkomati Usuthu Catchement Management Agency
B Khenisa		B	Khenisa		Steve Tshwete Local Municipality
Sikhumbuzo Kholwane	Mr	Sikhumbuzo	Kholwane		Mpumalanga Provincial Government
Jona Khomo		Jona	Khomo	Landowner	Anglo Coal - Mafube Colliery
Irene Koenze	Ms	Irene	Koenze		Department of Environmental Affairs
Christo Laas	Mr	Christo	Laas	Landowner	Mafube Colliery
Lavhe Lalamani		Lavhe	Lalamani	Landowner	Anglo Coal - Mafube Colliery
Stephen Law	Mr	Stephen	Law	Affected Landowner	Environmental Monitoring Group (EMG)
L Legabi	Mrs	L	Legabi		Steve Tshwete Municipality
Solly Links	Mr	Solly	Links		Steve Tshwete Local Municipality
Anglo Operations Ltd		Anglo Operations Ltd	Ltd	Landowner	ANDRIES JACOBUS VAN WYK -TRUSTEES
Pfanelo Mabada		Pfanelo	Mabada	Landowner	Anglo Coal - Mafube Colliery
Philmon Mabena	Mr	Philmon	Mabena		Middelburg Employable Peoples' Structure (MEPS)
Noxolo Mabuza	Ms	Noxolo	Mabuza		Steve Tshwete Municipality
Stanford Macevele	Mr	Stanford	Macevele		Department of Water Affairs (DWA)
Sylvia Machimana	Ms	Sylvia	Machimana	Landowner	Inkomati Catchment Management Agency (ICMA)
Meshack Mahamba	Mr	Meshack	Mahamba		Steve Tshwete Municipality
Tsietsi Mahema	Mr	Tsietsi	Mahema		Department of Environmental Affairs
Peter Mahlangu	Mr	Peter	Mahlangu		Nkangala District Municipality
Vusi Mahlangu	Mr	Vusi	Mahlangu		Nkangala District Municipality
Monica Majola	Mrs	Monica	Majola		Steve Tshwete Local Municipality
Dancy Malatji	Mr	Dancy	Malatji		Mpumalanga Provincial Government: Department of Public Works, Roads and Transport
Samuel Nditsheni Maliaga	Mr	Samuel Nditsheni	Maliaga		Department of Water and Sanitation (DWS)
Sam Maluleka	Mr	Sam	Maluleka		Mpumulanga Department of Agriculture, Rural Development, Land and Environmental Affairs
Dunisani Maluleke	Ms	Dunisani	Maluleke		Department of Water and Sanitation (DWS)
The Manager			Manager	Affected Landowner	Atseun (Pty) Ltd
The Manager			Manager	Affected Landowner	Hooggenoeg Boerdery cc
Linah Manchidi	Ms	Linah	Manchidi		National Union of Mine Workers South Africa (NUM)
Johan Mangani	Mr	Johan	Mangani		Nkangala District Municipality
Sasekani Manzini	Ms	Sasekani	Manzini		Mpumalanga Provincial Government
Lydia Maphopha	Ms	Lydia	Maphopha		Department of Mineral Resources
Abraham Maphoso	Mr	Abraham	Maphoso		Department of Mineral Resources
Zanele Maphumulo	Ms	Zanele	Maphumulo		Department of Water Affairs (DWA)

Fikile Maseko		Fikile	Maseko		Nkangala District Municipality
R M Masemola	Mr	R M	Masemola		Steve Tshwete Municipality
Pat Mashiane	Mr	Pat	Mashiane		Department of Public Works
Angel Masia	Ms	Angel	Masia		Steve Tshwete Local Municipality
Boetie Mathe	Mr	Boetie	Mathe		Nkangala District Municipality
Joseph Matjila	Mr	Joseph	Matjila	Landowner	Exxaro Arnot Coal
Lebogang Matlala	Ms	Lebogang	Matlala		Department of Water and Sanitation (DWS)
Johan Matshiane	Cllr	Johan	Matshiane		Steve Tshwete Municipality
Terrence Matsie	Mr	Terrence	Matsie	Landowner	Anglo Coal - Mafube Colliery
Lindelani Mbulaheni	Mr	Lindelani	Mbulaheni		Department of Water Affairs
Thulane Mdakane	Mr	Thulane	Mdakane		Mpumalanga Provincial Government
Sibulelo Mekhule	Mr	Sibulelo	Mekhule		Middelburg Employable Peoples(Structure (MEPS)
Ningi Mlangeni	Ms	Ningi	Mlangeni		Mpumalanga Provincial Government
Benjamin Moduka	Mr	Benjamin	Moduka		Provincial Heritage Resources Authority
PS Mohlala	Mr	PS	Mohlala		Mpumalanga Provincial Government
Martha Mokonyane	Ms	Martha	Mokonyane		Department of Mineral Resources (DMR)
Edward Moripa	Mr	Edward	Moripa		Hlagisa Mining
Success Moripa	Mr	Success	Moripa		Hlagisa Mining
Victor Moshapo	Mr	Victor	Moshapo		Department of Mineral Resources (DMR)
Charity Mthimunye	Mrs	Charity	Mthimunye		Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)
Jabu Mthimunye	Mr	Jabu	Mthimunye		TRAC - MP
Refilwe Mtsweni	Ms	Refilwe	Mtsweni		Mpumalanga Provincial Government
Masala Mulaudzi	Mr	Masala	Mulaudzi		Department of Water Sanitation
Kesavan Muniappen		Kesavan	Muniappen		Anglo Coal - Mafube Colliery
Makgomo Mushwana	Ms	Makgomo	Mushwana		Department of Environmental Affairs
Brighton Ncube		Brighton	Ncube		Anglo Coal - Mafube Colliery
Rendani Ndou	Mr	Rendani	Ndou		Department of Water and Sanitation (DWS)
Mpho Nembilwi	Ms	Mpho	Nembilwi		Nkangala District Municipality
Aubrey Nhlabathi	Mr	Aubrey	Nhlabathi		Samancor Middelburg Ferrochrome
Stephen Nhlapo	Mr	Stephen	Nhlapo		Lekwa Combined Business Chamber
Themba Nkabinde	Mr	Themba	Nkabinde		Middelburg Employable Peoples' Structure (MEPS)
Michael Nkosi	Mr	Michael	Nkosi		Steve Tshwete Municipality
Thabang Ntjoboko	Mr	Thabang	Ntjoboko		Eskom
Thuledu Ntshingila	Mrs	Thuledu	Ntshingila		Mafube Coal Mining (Pty) Ltd
Tsietsi Peter Nyoni	Mr	Tsietsi Peter	Nyoni		Mpumalanga Provincial Government
Jan Olivier	Mr	Jan	Olivier		South African National Roads Agency Limited (SANRAL)
Anna-Marth Ott		Anna-Marth	Ott		Middelburg Chamber of Commerce
Michael Padi	Mr	Michael	Padi		Anglo Coal - Mafube Colliery
Stephan Pienaar	Mr	Stephan	Pienaar		Mpumalanga Provincial Government
Theddious Pongweni		Theddious	Pongweni		Anglo Coal - Mafube Colliery
Koos Pretorius	Dr	Koos	Pretorius		Federation for a Sustainable Environment
Gawie Roux	Mr	Gawie	Roux	Affected Landowner	
Johan Roux	Mr	Johan	Roux	Landowner	
Thuso Selepe	Mr	Thuso	Selepe		Steve Tshwete Local Municipality
Marcus Selepe	Mr	Marcus	Selepe		Inkomati Catchment Management Agency
Carolyn Ah Shene-Verdoorn	Mrs	Carolyn	Shene-Verdoorn	Landowner	Birdlife South Africa
Busi Shiba	Ms	Busi	Shiba		Mpumalanga Provincial Government
Vusi Shongwe	Mr	Vusi	Shongwe		Mpumalanga Provincial Government
Vusi Shongwe	Mr	Vusi	Shongwe		Middelburg Employable Peoples' Structure (MEPS)
Ingrid Sithole	Mrs	Ingrid	Sithole		Mafube Coal Mining (Pty) Ltd

Harold Skhosana	Mr	Harold	Skhosana		Department of Rural Development and Land Reform
Zolani Skosana	Mr	Zolani	Skosana		Mafube Coal Mine
Johannes Skosana	Cllr	Johannes	Skosana		Steve Tshwete Municipality
Maggie Millicent Skosana	Ms	Maggie Millicent	Skosana		Nkangala District Municipality
Koos Smit	Mr	Koos	Smit		Exxaro Arnot Coal
Cindy Smith	Mrs	Cindy	Smith		Mafube Coal Mining (Pty) Ltd
Billy Smith	Mr	Billy	Smith		Middelburg Bird Club
Elise Tempelhoff	Ms	Elise	Tempelhoff		Beeld Newspaper
Dineo Thwi	Mrs	Dineo	Thwi		Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)
Daphney Tshehla	Ms	Daphney	Tshehla		Anglo American
Aubrey Tshivhandekano	Mr	Aubrey	Tshivhandekano		Department of Mineral Resources (DMR)
Johann van Aswegen	Mr	Johann	van Aswegen		Department of Water Affairs
Marthinus Johannes		Marthinus Johannes			
Christiaan van der Merwe	Mr	Christiaan	van der Merwe	Landowner	Anglo Coal - Mafube Colliery
Charles van Wyk	Mr	Charles	van Wyk	Landowner	A J D van Wyk Farms
Mariette Weideman		Mariette	Weideman		Golder Associates
Louis /Anneke Wessels		Louis /Anneke	Wessels	Landowner	

APPENDIX E

Site Notices

APPLICATION FOR ENVIRONMETAL AUTHORISATION FOR THE PROPOSED ROAD REALIGNMENT AND WATER USE LICENCE APPLICATION PROCESS FOR THE MAFUBE LIFE EXTENSION PROJECT, MPUMALANGA PROVINCE

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The Draft Scoping Report will be available for public review and comment for a period of 30 days from **16 March 2018 until 18 April 2018**. The report, as well as an on-line Registration and Comment Sheet, will be available at the public places listed below and also on the following website: www.golder.com/public.

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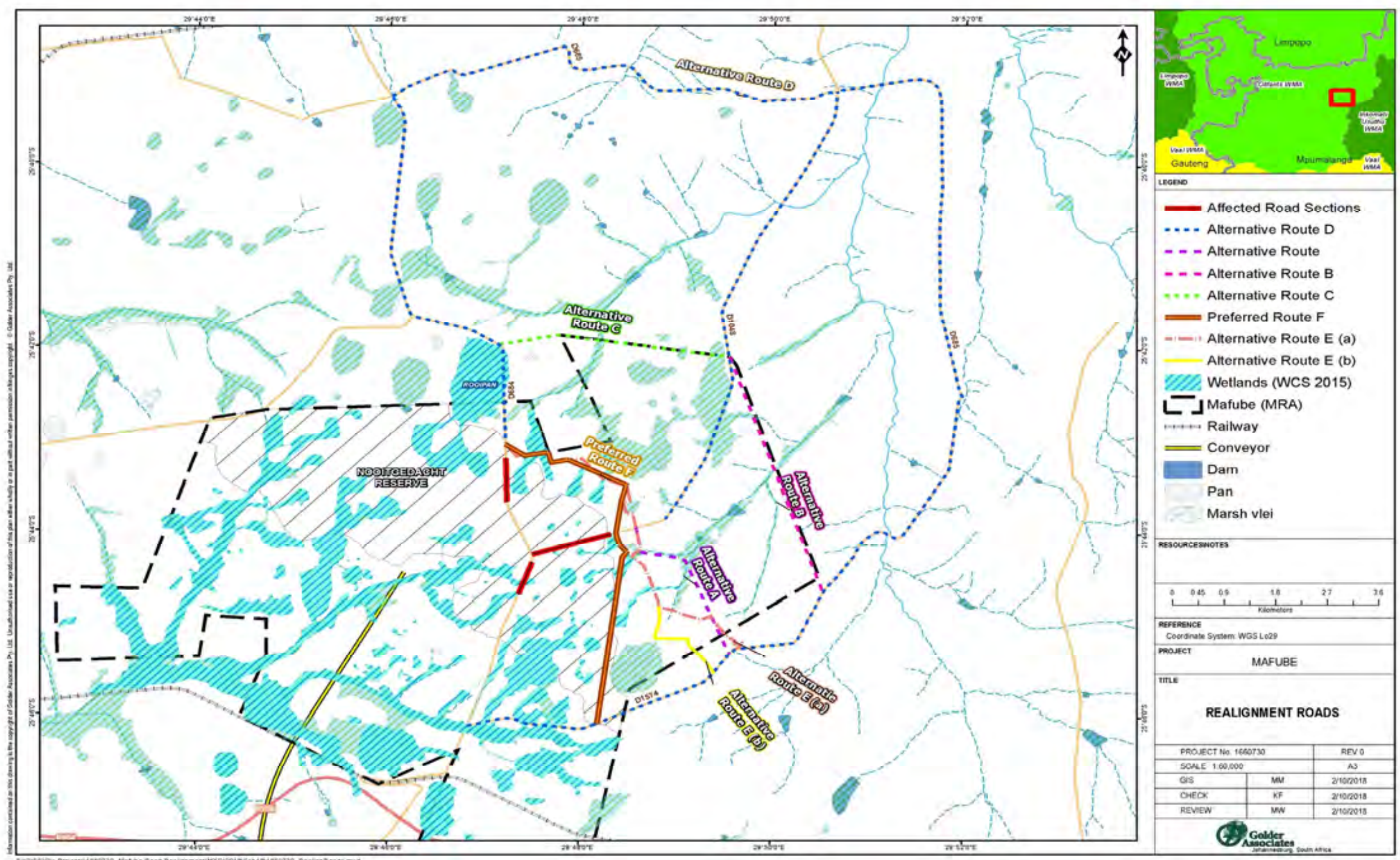
Mafube LifeX project office	Chantelle Gerber	(011) 638 3479	Mafube LifeX Project Office, D684 road, Farm Springboklaagte
eMalahleni Main Library	Johanette Rozmiarek	(011) 690 6232	Cnr. Hofmeyer and Elizabeth Avenue, eMalahleni
Colder Associates, Midrand	Antoinette Pietersen	(011) 254 4800	Golder House, Building 1, Maxwell Office Park Midrand
Golder Associates Website	http://www.golder.com/public		

INVITATION TO ATTEND A PUBLIC MEETING:

Stakeholders are hereby also invited to attend a Public Meeting and the Draft Scoping Report will serve to focus the discussions at the meeting. Details of the Public Meeting:

Date: Wednesday 4 April 2018 **Time:** 11:00 – 13:00 **Venue:** Arnot Vroue Landbou-Unie Saal, Farm Springboklaagte, Middelburg District

RSVP: Before/on 4 April 2018, by contacting the Public Participation Office



To register as an I&AP and/or obtain more information please contact:

Antoinette Pietersen

Public Participation Office:

Golder Associates Africa (Pty) Ltd.

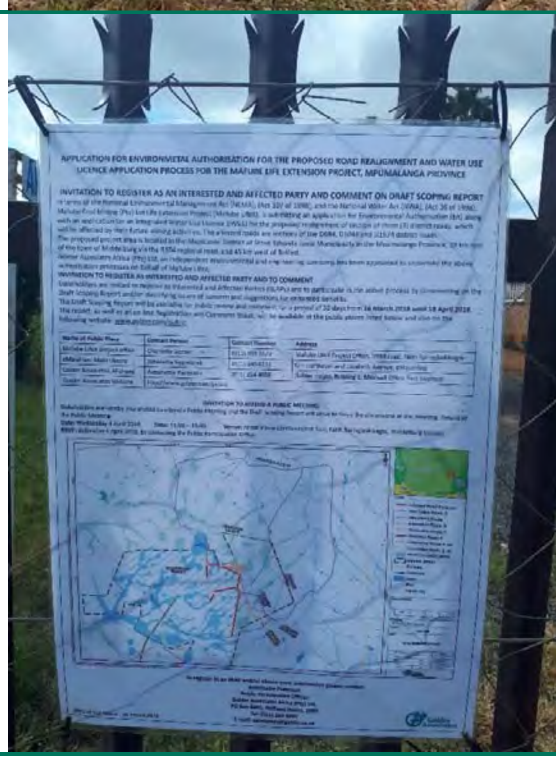
PO Box 6001, Halfway House, 1685

Tel: (011) 254 4805

E-mail: apietersen@golder.co.za

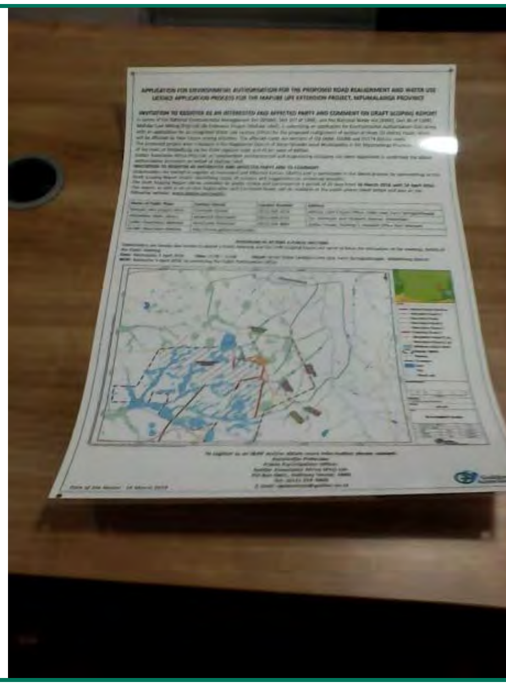
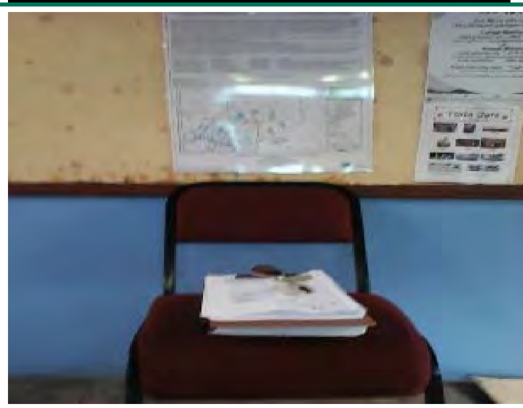
Date of Site Notice : 16 March 2018

Golder Associates

Map Reference Number	Description	Photos	Latitude	Longitude
1	Vrou Landbou Unie Hall		25°46'29.5"S	29°46'40.9"E
2	Mafube LifeX project office		25°46'19.3"S	29°46'45.4"E

Map Reference Number	Description	Photos	Latitude	Longitude
3	D1574 entrance road (start of the new road next to Eskom Power Line)		25°46'03.9"S	29°48'13.01"E
4	D1048 Middle of the new road		25°44'00.5"S	29°48'21.4"E

Map Reference Number	Description	Photos	Latitude	Longitude
5	Entrance to the Sikiluwe village		25°45'46.3"S	29°46'57.8"E
6	D684 road – end of the road (Across the road from Rooipan		25°43'11.9"S	29°47'13.2"E

Map Reference Number	Description	Photos	Latitude	Longitude
	DMR Mine Environmental Section Witbank		25°52'45.08"S	29°14'32.42"E
	Main Library Emalahleni		25°52'20.47"S	29°13'00.86"E

APPENDIX F

Comment and Response Report

No comments were received from I&APs.

APPENDIX G

Specialist Studies

October 2017

MAFUBE COAL MINING (PTY) LTD

Environmental Impact Assessment (EIA) for the Proposed Mafube Road Realignment Project- Air Quality Assessment

Submitted to:
Mafube Coal Mining (Pty) Ltd

REPORT

Report Number: 1776031-319914-12

Distribution:

1 x copy to Client
1 x copy to Golder Library

Golder Associates

ABBREVIATIONS AND ACRONYMS

Abbreviation	Explanation
%	Percentage
°C	Degrees Celsius
µg	Microgram
$\mu g/m^2$	Micrograms per square meter
AEL	Atmospheric emission license
CO	Carbon monoxide
DEA	Department of Environmental Affairs
DJF	December, January, February
E	East
EIA	Environmental impact assessment
ENE	East-north-east
ESE	East-south-east
g/s	Grams per second
Ha	Hectares
HP	High pressure
HPA	Highveld Priority Area
JJA	June, July, August
Km	Kilometre
km^2	Kilometre squared
LP	Low pressure
M	Meter
m/s	Meters per second
m^2	Meters square / square meters
MAM	March, April, May
Mamsl	Meters above mean sea level
Mg	Milligrams
$mg/m^2/day$	Milligrams per square meter per day
N	North
NAAQS	National Ambient Air Quality Standard
NE	North-east
NEM: AQA	National Environmental Management Act: Air Quality Act (Act no. 39 of 2004)
NNE	North-north-east
NNW	North-north-west
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NPI	National pollutant inventory

NW	North-west
O_3	Ozone
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 µm
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 µm
ROM	Run of mine
S	South
SAAQIS	South African Air Quality Information System
SAWS	South African Weather Service
SE	South-east
SO_2	Sulphur dioxide
SON	September, October, November
SO_x	Sulphur oxides
SSE	South-south-east
SSW	South-south-west
SW	South-west
t/pd	Tons per day
US EPA	United States Environmental Protection Agency
VOC	Volatile organic compound
W	West
WHO	World health organisation
WNW	West-north-west
WSW	West-south-west

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APPENDICES

1.0 PROJECT INTRODUCTION AND BACKGROUND

In 2011 Golder Associates Africa (Pty) Ltd (Golder) was appointed by Mafube Coal Mining (Pty) Ltd (Mafube) to conduct the Environmental Impact Assessment (EIA) process for the proposed Mafube Life Expansion project (Mafube LifeX), which included the mining operations at Nooitgedacht and Wildfontein in the Mpumalanga province of South Africa. An Environmental Management Programme (EMP) was also submitted to the Department of Mineral Resources (DMR) for approval as part of their mining rights application, as required under the Mineral and Petroleum Resources Act (Act No. 28 of 2002) (MPRDA).

Mafube Coal Mining (Pty) Ltd (Mafube) is a 50/50 Joint Venture involving Anglo American Thermal Coal (AATC) and Exxaro Coal Mpumalanga (Pty) Ltd. Environmental Authorisation for the Mafube LifeX EIA/EMP was granted by the Mpumalanga Department of Environmental Affairs and Tourism (MDEDET) in April 2013. The approval for the mining rights application was received on September 2013.

The Mafube LifeX operations are currently in the construction phase and full operational phase are planned to commence in May 2018.

In terms of the National Water Act (Act No. 36 of 1998) (NWA), an Integrated Water Use Licence application (IWULA) & Integrated Water and Waste Management Plan (IWWMP) was also required, and this application was submitted in December 2013.

During the feasibility phase investigations, it was assessed that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or realignment are required before this operation can commence. These roads falls under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

Mafube has appointed Golder Associates Africa (Pty) Ltd to conduct the EIA/EMP and public participation process.

An EIA application has been submitted to the Department of Mineral Resources (DMR) in terms of Regulations 326 published under NEMA (07 April 2017). This proposed project triggers a full scoping and environmental assessment EIA process for certain listed activities under NEMA, an Environmental Management Programme (EMP) based on the findings of the EIA and a Water Use Licence Application (IWULA). The public participation process will provide stakeholders with information about the proposed project, and several opportunities to comment throughout the EIA/EMP/WULA process.

2.0 SPECIALIST STUDY INTRODUCTION

This report presents the air quality study for the proposed Mafube LifeX Road Realignment project.

2.1 Methodology

The following key tasks were undertaken in this assessment:

- The review of legislative and regulatory requirements;
- The characterisation of the regional climate and local meteorology effecting air quality and dispersion;
- The assessment of the baseline ambient air quality, based on monitoring data;
- The review of adverse health effects associated with the anticipated emissions;
- The provision of a qualitative professional opinion of the anticipated impacts; and
- Recommendations for mitigation measures to reduce the impacts on sensitive receptors were also provided, as well as recommendations for air quality management / monitoring for implementation by Mafube.

3.0 PROJECT DESCRIPTION

This report focuses on the impacts associated with the preferred Alternative Route F. This alternative route has an approximate length of 5.0 km and runs along existing agricultural field boundaries and fields.

The properties and landowners details in Table 1 below, will be the properties directly affected by the construction of this Alternative route option. All farm portions affected by Alternative F, are/will be owned by Anglo Operation Limited / Mafube Coal Mining (Pty) Ltd.

Table 1: Alternative F - Properties and Landowner Details

Property Details	Landowner Details
Springboklaagte 416 JS Portion 1	Anglo Operations Limited
Springboklaagte 416 JS Portion 12	Anglo Operations Limited
Nooitgedacht 417 JS Portion 4	Hooggenoeg Boerdery CC
Nooitgedacht 417 JS Portion 14	Wessels Anneke
Nooitgedacht 417 JS Portion 15	Anglo Operations Limited
Roodepoort 418 JS Portion 8	Anglo Operations Limited
Roodepoort 418 JS Portion 9	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 10	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 11	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 13	Anglo Operations Limited

4.0 POLICY LEGAL AND ADMINISTRATIVE FRAMEWORK

4.1 National Environmental Management: Air Quality Act (Act no. 39 of 2004) (NEM: AQA)

The NEM: AQA has shifted the approach of air quality management from source-based control to the control of the receiving environment. The Act also devolved the responsibility of air quality management from the national sphere of government to the local municipal sphere of government (district and local municipal authorities). Local municipalities are thus tasked with baseline characterisation, management and operation of ambient monitoring networks, licensing of listed activities, and emission reduction strategies. The main objectives of the Act are to protect the environment by providing reasonable legislative and other measures that (i) prevent air pollution and ecological degradation, (ii) promote conservation and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development in alignment with Sections 24a and 24b of the Constitution of the Republic of South Africa.

4.2 Ambient air quality standards

The South African National Ambient Air Quality Standards (NAAQS) for common pollutants prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area (Table 2). If the standards are exceeded, the ambient air quality is defined as poor and potential adverse health impacts are likely to occur.

Table 2: South African National Ambient Air Quality Standards

Pollutant	Averaging Period	Limit Value ($\mu g/m^3$)	Limit Value (ppb)	Frequency of Exceedance	Compliance Date
Nitrogen dioxide - NO_2 [(a)]	1 hour	200	106	88	Immediate
	1 year	40	21	0	

Pollutant	Averaging Period	Limit Value (µg/m³)	Limit Value (ppb)	Frequency of Exceedance	Compliance Date
Particulate matter - PM_{10} (b)	24 hour	75	-	4	Immediate
	1 year	40	-	0	
Ozone - O_3 (c)	8 hours (running)	120	61	11	Immediate
Lead - Pb (d)	1 year	0.5	-	0	Immediate
Carbon monoxide - CO (e)	1 hour	30 000	26 000	88	Immediate
	8 hour (calculated on 1 hourly averages)	10 000	8 700	11	
Benzene (C_6H_6) (f)	1 year	5	1.6	0	Immediate
Sulphur dioxide - SO_2 (g)	10 minute	500	191	526	Immediate
	1 hour	350	134	88	
	24 hours	125	48	4	
	1 year	50	19	0	
Particulate matter $PM_{2.5}$ (h)	24 hours	40		4	Immediate
	24 hours	25		4	1 January 2030
	1 year	20		0	Immediate
	1 year	15		0	1 January 2030

Notes:

a. *The reference method for the analysis of NO2 shall be ISO 7996*
b. *The reference method for the determination of the particulate matter fraction of suspended particulate matter shall be EN 12341*
c. *The reference method for the analysis of ozone shall be the UV photometric method as described in ISO 13964*
d. *The reference method for the analysis of lead shall be ISO 9855*
e. *The reference method for analysis of CO shall be ISO 4224*
f. *The reference methods for benzene sampling and analysis shall be either EPA compendium method TO-14 A or method TO-17*
g. *The reference method for the analysis of SO2 shall be ISO 6767*
h. *The reference method for the analysis of PM2.5 shall be EN14907*

4.3 National Dust Control Regulations

On 1 November 2013, the National Dust Control Regulations were promulgated under NEM: AQA, and published in the Government Gazette No. 36974. The dust fall standard defines acceptable dust fall rates in terms of the presence of residential areas (Table 3).

Table 3: Acceptable dust fall rates

Restriction areas	Dust fall rate (mg/m^2/day over a 30 day average)	Permitted frequency of exceedance
Residential areas	Dust fall < 600	Two per annum (not in sequential months)
Non-residential areas	600 < Dust fall < 1200	Two per annum (not in sequential months)

4.4 Priority area

Sections 18 to 20 of NEM: AQA deal with the establishment of Priority Areas in so-called “hot-spot” areas of South Africa where ambient air quality standards are often exceeded or may often be exceeded. The establishment of a Priority Area is intended to achieve the following:

- It effectively allows for the concentration of limited air quality management capacity (human, technical and financial) for dealing with acknowledged problem areas in order to obtain measurable air quality improvements in the short, medium and long term;
- It prescribes a cooperative governance regime by effectively handing-up air quality management authority to the tier of government that can provide leadership and coordination; and
- It allows for “cutting edge” air quality management methodologies that take into account all contributors to the air pollution problem, i.e. air-shed air quality management.

The Mafube LifeX project is located within the Highveld Priority Area (HPA) (Figure 1). The Highveld area in South Africa is widely accepted as having a poor air quality with elevated concentrations of criteria pollutants. The elevated concentrations are attributed to the dense concentration of industrial and non-industrial sources within the Highveld area. The Minister of Environmental Affairs and Tourism therefore declared the Highveld Priority Area (HPA) on 23 November 2007. Since the declared area overlaps provincial boundaries, the Department of Environmental Affairs (DEA) functions as the lead agent in the management of the priority area (DEA, 2011).

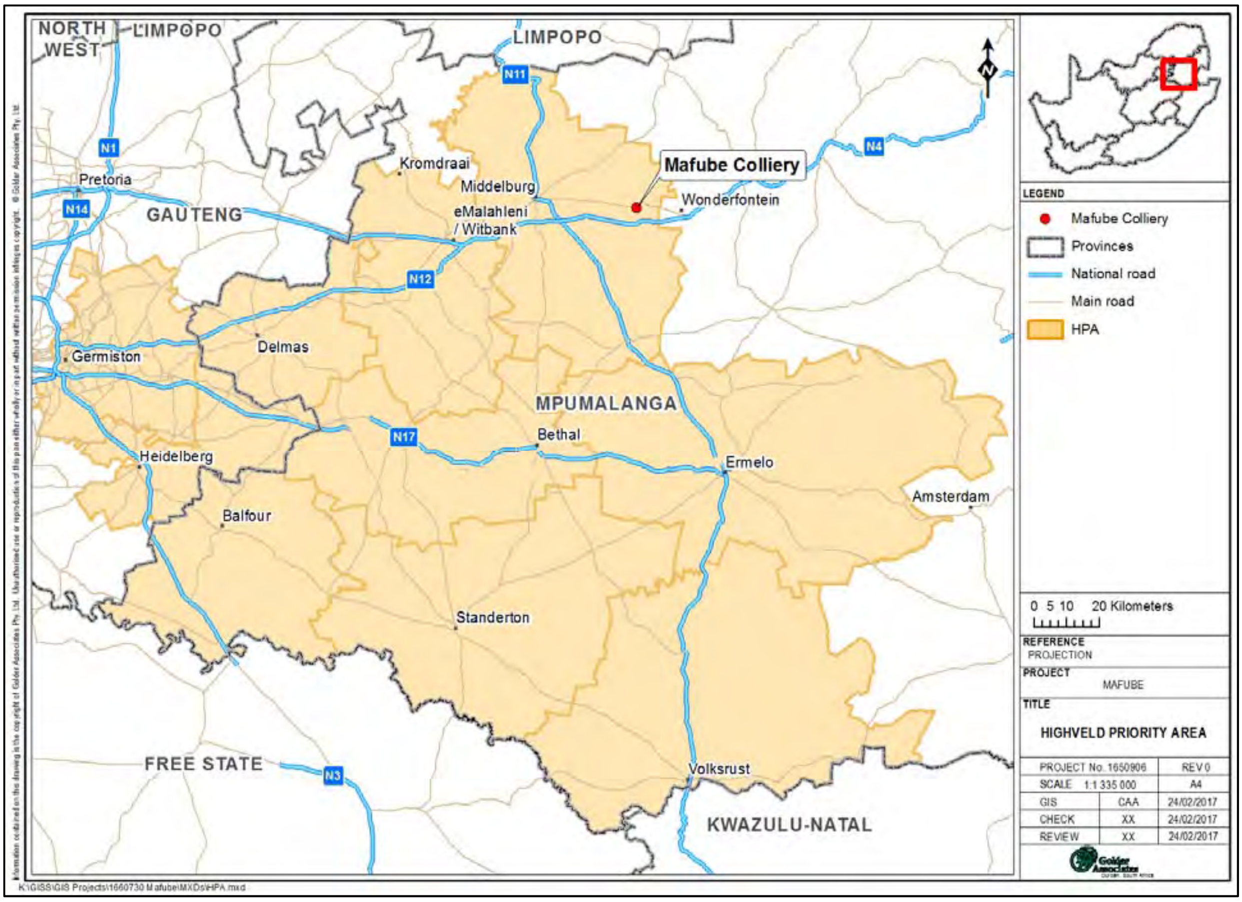


Figure 1: Location of Mafube within the HPA

5.0 BASELINE

5.1 Topography

The Mafube LifeX project is located on gently undulating terrain which, ranges from approximately 1480 to 1900 meters above mean sea level (mamsl).

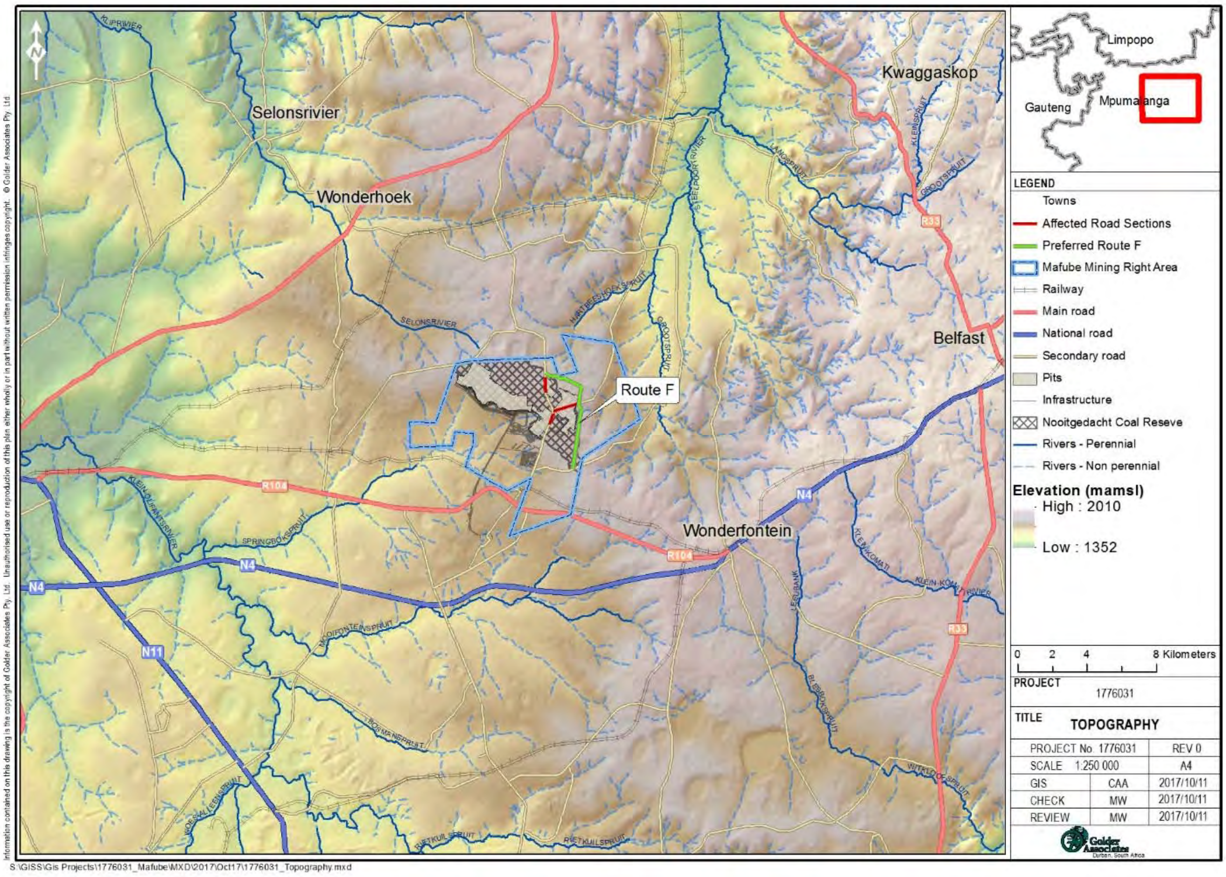


Figure 2: Topography in the vicinity of the Mafube operations

5.2 Land use and sensitive receptors

Current land use in the vicinity of the proposed route comprises cultivated land and pasture. With the development of the LifeX project, large portions of the cultivated land west of the proposed route will mined (Figure 3: East Pit 2 and 3).

Receptors in the vicinity of the proposed route include wetlands, low density (dispersed) households and farm complexes. A school is located approximately 1 km north of the proposed route, adjacent to the existing route D684. Sikhululiwe is the closest village, approximately 2 km east of the proposed route.

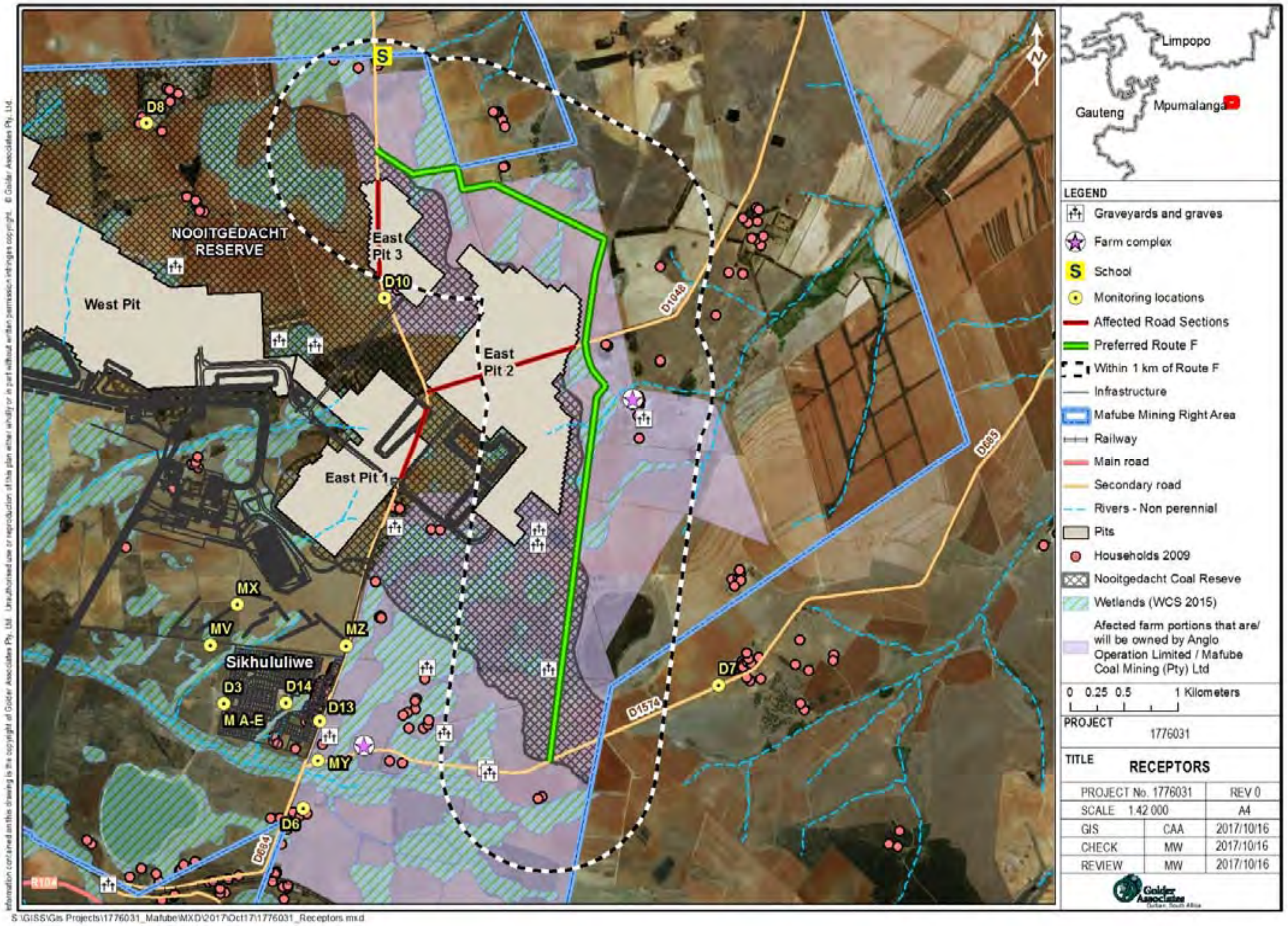


Figure 3: Potential receptors in close proximity (<1 km) to the proposed Route F.

5.3 Regional climate

The Mafube LifeX project is situated in the subtropical high-pressure belt. The mean circulation of the atmosphere over the subcontinent is anticyclonic throughout the year (except for near the surface). The synoptic patterns affecting the typical weather experienced in the region owe their origins to the subtropical, tropical and temperate features of the general atmospheric circulation over Southern Africa.

The subtropical control is brought via the semi-permanent presence of the South Indian Anticyclone (HP cell), Continental High (HP cell) and the South Atlantic Anticyclone (LP cell) in the high pressure belt located approximately 30°S of the equator. The tropical controls are brought via tropical easterly flows (LP cells) (from the equator to the southern mid-latitudes) and the occurrence of the easterly wave and lows (Preston-Whyte and Tyson, 1997). The temperature control is brought about by perturbations in the westerly wave, leading the development of westerly waves and lows (LP cells) (i.e. cold front from the polar region, moving into the mid-latitudes) (Preston-Whyte and Tyson, 1997).

Seasonal variations in the positioning and intensity of the HP cells determine the extent to which the westerly waves and lows impact the atmosphere over the region. In winter, the high pressure belt intensifies and moves northwards while the westerly waves in the form of a succession of cyclones or ridging anticyclones move eastwards around the South African coast or across the country. The positioning and intensity of these systems are thus able to significantly impact the region. In summer, the anticyclonic HP belt weakens and shifts southwards and the influence of the westerly wave and lows weakens.

Anticyclones (HP cells) are associated with convergence in the upper levels of the troposphere, strong subsidence throughout the troposphere, and divergence near the surface of the earth. Air parcel subsidence, inversions, fine conditions and little to no rainfall occur as a result of such airflow circulation patterns (i.e. relatively stable atmospheric conditions). These conditions are not favourable for air pollutant dispersion, especially with regard to emissions emitted close to the ground.

Westerly waves and lows (LP cells) are characterised by surface convergence and upper-level divergence that produce sustained uplift, cloud formation and the potential for precipitation. Cold fronts, which are associated with the westerly waves, occur predominantly during winter. The passage of a cold front is characterised by pronounced variations in wind direction and speed, temperature, humidity, pressure and distinctive cloud bands (i.e. unstable atmospheric conditions). These unstable atmospheric conditions bring about atmospheric turbulence which creates favourable conditions for air pollutant dispersion.

The tropical easterlies and the occurrence of easterly waves and lows affect Southern Africa mainly during the summer months. These systems are largely responsible for the summer rainfall pattern and the north easterly wind component that occurs over the region (Schulze, 1986; Preston-Whyte and Tyson, 1988).

In summary, the convective activity associated with the easterly and westerly waves disturbs and hinders the persistent inversion which sits over Southern Africa. This allows for the upward movement of air pollutants through the atmosphere leading to improved dispersion and dilution of accumulated atmospheric pollution.

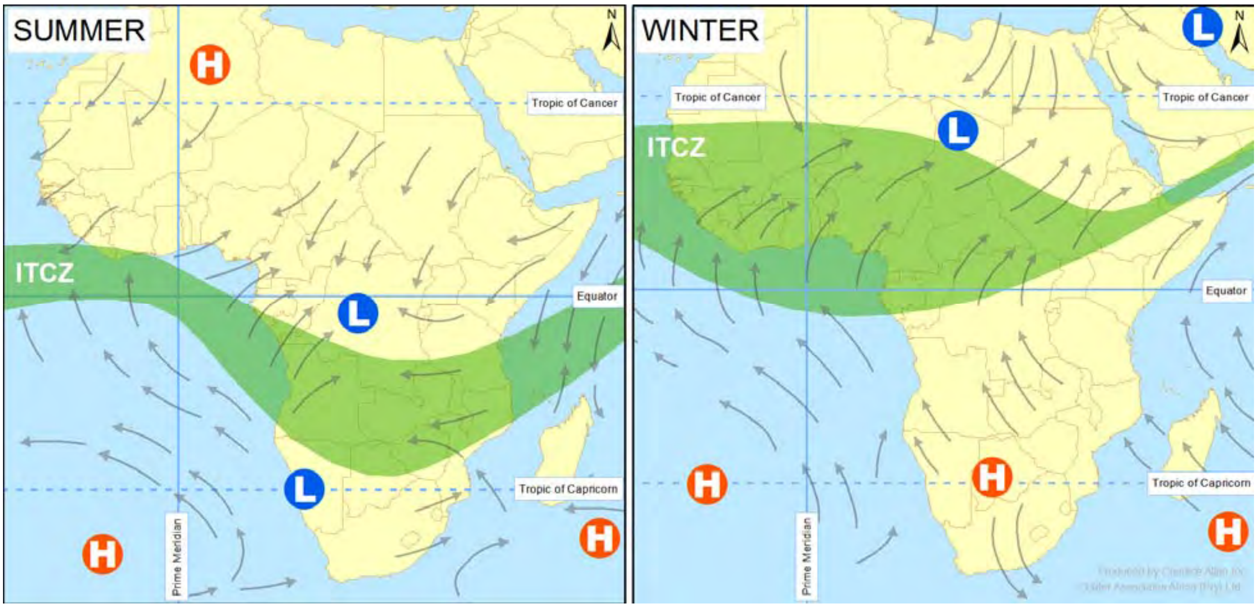


Figure 4: Seasonal circulation patterns affecting the regional climate

5.4 Boundary layer conditions

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere and is directly affected by the earth's surface. The earth's surface affects the boundary layer through the retardation of air flow created by frictional drag, created by the topography, or as result of the heat and moisture exchanges that take place at the surface.

During the day, the atmospheric boundary layer is characterised by thermal heating of the earth's surface, converging heated air parcels and the generation of thermal turbulence, leading to the extension of the mixing layer to the lowest elevated inversion. These conditions are normally associated with elevated wind speeds, hence a greater dilution potential for the atmospheric pollutants.

During the night, radiative flux divergence is dominant due to the loss of heat from the earth's surface. This usually results in the establishment of ground based temperature inversions and the erosion of the mixing layer. As a result, night times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds, hence less dilution potential.

The mixed layer ranges in depth from a few metres during night time to the base of the lowest elevated inversion during unstable, daytime conditions. Elevated inversions occur for a variety of reasons, however typically the lowest elevated inversion on the Highveld is located at a mean height above ground of 1550 m during winter months with a 78 % frequency of occurrence. During summer, the mean subsidence inversion occurs at about 2600 m with a 40 % frequency. Atmospheric stability is frequently categorised into one of six stability classes. These are briefly described in Table 4.

Table 4: Atmospheric stability classes

Designation	Stability Class	Atmospheric Condition
A	Very unstable	Calm wind, clear skies, hot daytime conditions
B	Moderately unstable	Clear skies, daytime conditions
C	Unstable	Moderate wind, slightly overcast daytime conditions
D	Neutral	High winds or cloudy days and nights
E	Stable	Moderate wind, slightly overcast night-time conditions
F	Very stable	Low winds, clear skies, cold night-time conditions

The atmospheric boundary layer is normally unstable during the day as a result of the turbulence due to the sun's heating effect on the earth's surface. The thickness of this mixing layer depends predominantly on the intensity of solar radiation, growing gradually from sunrise to reach a maximum at about 5 to 6 hours after sunrise. This situation is more pronounced during the winter months due to strong night-time inversions and a slower developing mixing layer. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

For elevated releases, the highest ground level concentrations would occur during unstable, daytime conditions. The wind speed resulting in the highest ground level concentration depends on the plume buoyancy. If the plume is considerably buoyant (high exit gas velocity and temperature) together with a low wind, the plume will reach the ground relatively far downwind. With stronger wind speeds, on the other hand, the plume may reach the ground closer, but due to the increased ventilation, it would be more diluted. A wind speed between these extremes would therefore be responsible for the highest ground level concentrations. In contrast, the highest concentrations for ground level, or near-ground level releases would occur during weak wind speeds and stable (night-time) atmospheric conditions.

5.5 Trends in temperature and precipitation

Average monthly maximum and minimum temperatures for Middelburg (approximately 30 km's from the project site) are given in Figure 5. The temperature profile depicts what is typically expected for the Highveld. The highest temperatures in the region are experienced during the summer months of December, January, February and the lowest during the winter months of June, July and August. The average daily maximum temperatures range from approximately 27.2 °C in January to approximately 18.5 °C in June, with minima ranging from approximately 13.7 °C in January to approximately -1.8°C in June (Schulze, 1989).

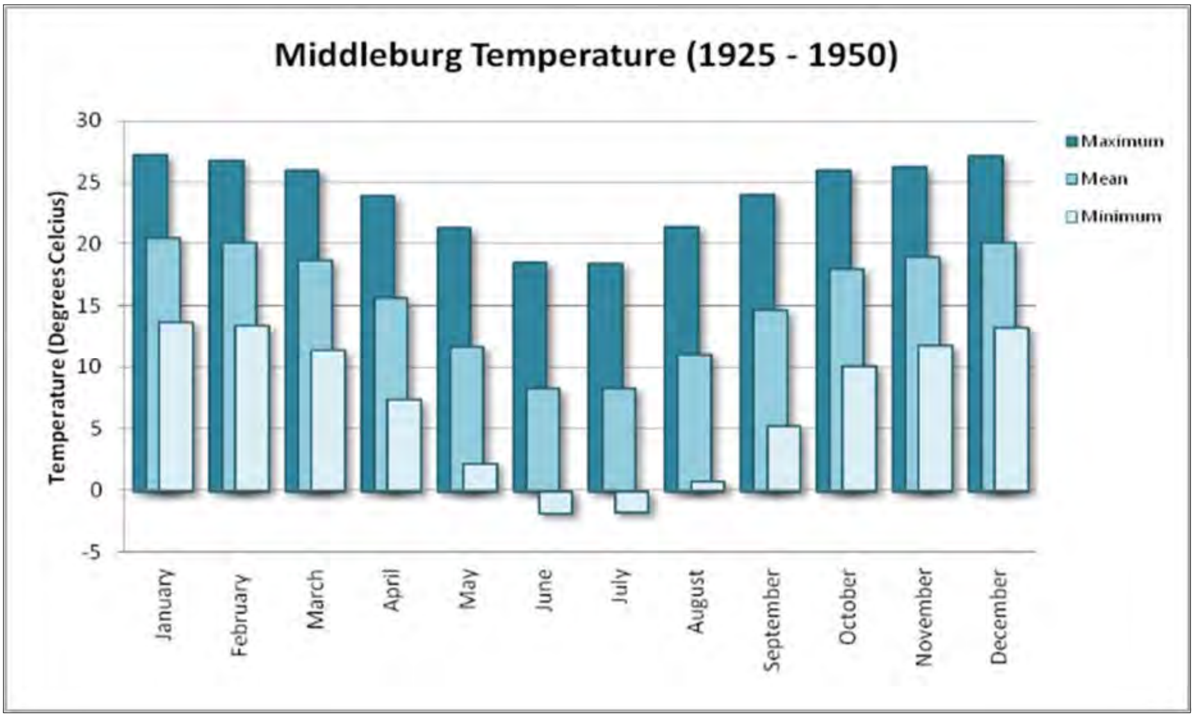


Figure 5: Long-term maximum, mean and minimum temperatures for Middelburg (1925 – 1950)

Middleburg located in the summer rainfall region of South Africa and thus receives most of its rainfall during this period. Long-term monthly average rainfall is represented graphically in Figure 6. The mean annual precipitation is approximately 735 mm (Schulze, 1989).

Precipitation in the Highveld is often characterised by intense thunderstorms, which occur mainly in the late afternoon, from October to March, with the maximum in January. These thunderstorms, although brief, are accompanied by thunder, lightning and occasional hail, and are generally followed by clear skies (DEA, 2012).

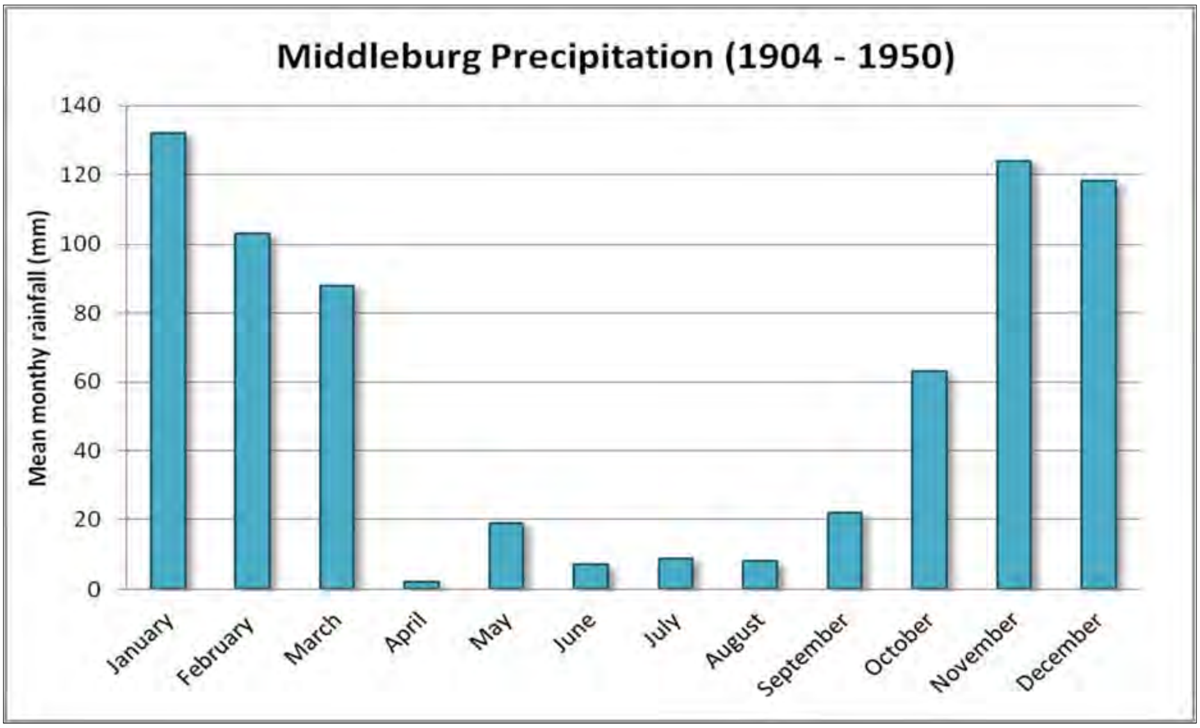


Figure 6: Long-term mean monthly precipitation in Middelburg (1904 – 1950)

5.6 Wind speed and direction

5.6.1 Meteorological overview

The meteorological overview was based on the analysis of South African Weather Service (SAWS) meteorological data from the DEA Highveld station in Middelburg (25°47'45.87"S 29°27'46.08"E) from 2013 - 2015[1]. The station is located approximately 30 km from the Mafube. Typically, data is considered representative within 20 km, however due to the relatively simple terrain between The Mafube LifeX project and Middleburg and the lack of an alternative data source; it is assumed the Middelburg data is representative of the local conditions at Mafube.

5.6.2 Wind roses for 2013 - 2015

Wind roses summarize the characteristics of the wind field at a specified location by representing their strength, direction and frequency. Calm conditions are defined as wind speeds of less than 1 m/s which are represented as a percentage of the total winds in the centre circle. Each directional branch on a wind rose represents wind originating from that specific cardinal direction (16 cardinal directions). Each cardinal branch is divided into segments of different colours which represent different wind speed classes. For the current wind roses, wind speed is represented on a scale from blue to red, with dark blue indicating low wind speeds (1 – 2 m/s) and red representing high wind speeds (in excess of 10 m/s)[2]. Each circle in the wind rose represents a percentage frequency of occurrence.

Winds predominantly originate along the north-westerly and south-easterly sectors in the region. Wind speeds are low, averaging 1.6 m/s with calm conditions (<1 m/s) 32 % of the time.

[1] 96% data availability for the period 01/01/2013 to 31/12/2015

[2] These wind speed classes and associated colours are specific to the MM5 modelled data wind roses only

5.6.3 Diurnal wind roses

Diurnal variations in wind speed and direction are shown in Figure 8.

5.6.4 Seasonal wind roses

Seasonal variations in wind speed and direction are shown in Figure 9.

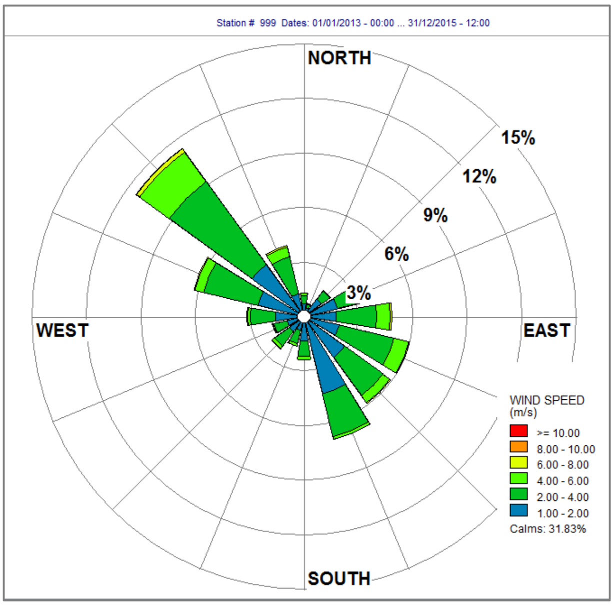
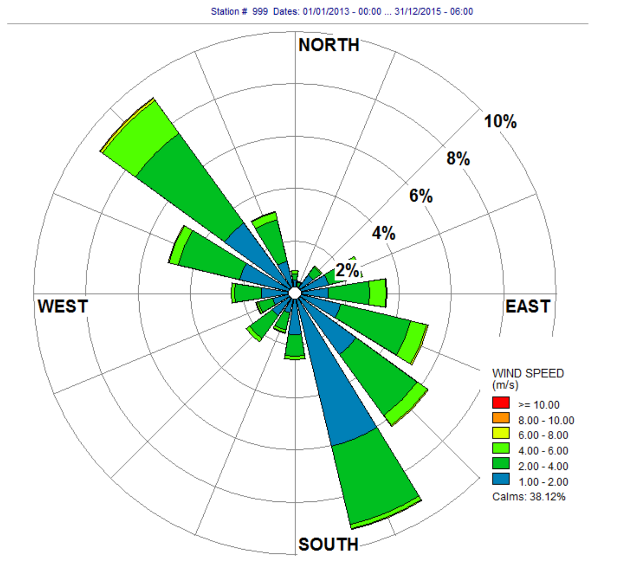
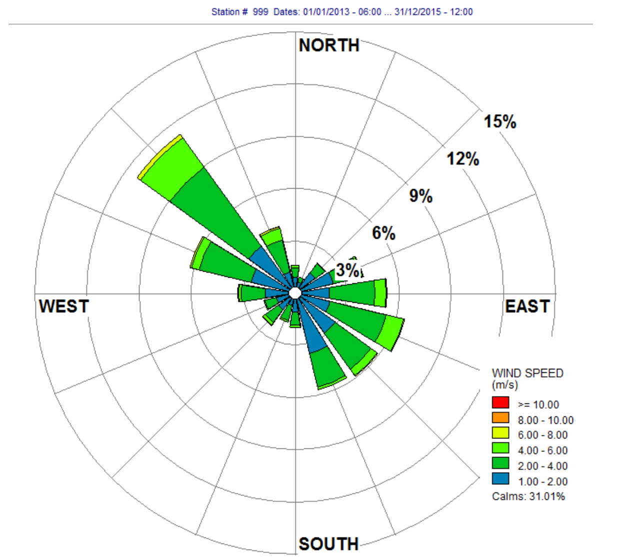


Figure 7: Average wind rose for Middelburg for 01 January 2013 to 31 December 2015



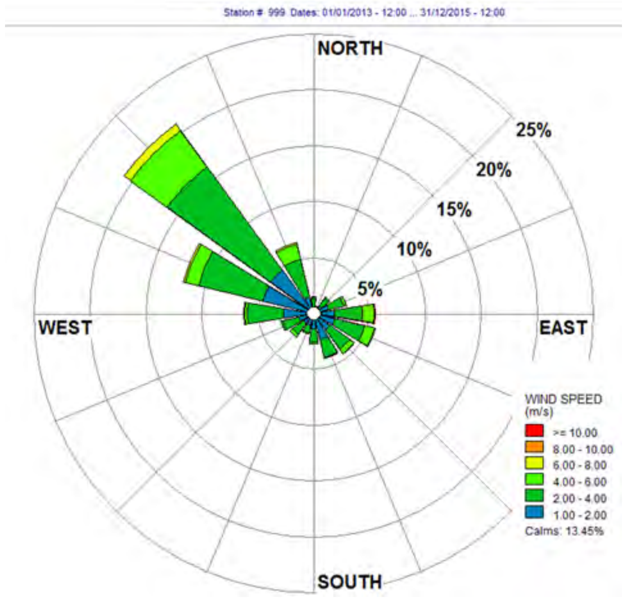
00:00 to 05:59

Wind dominant NW and SE sectors



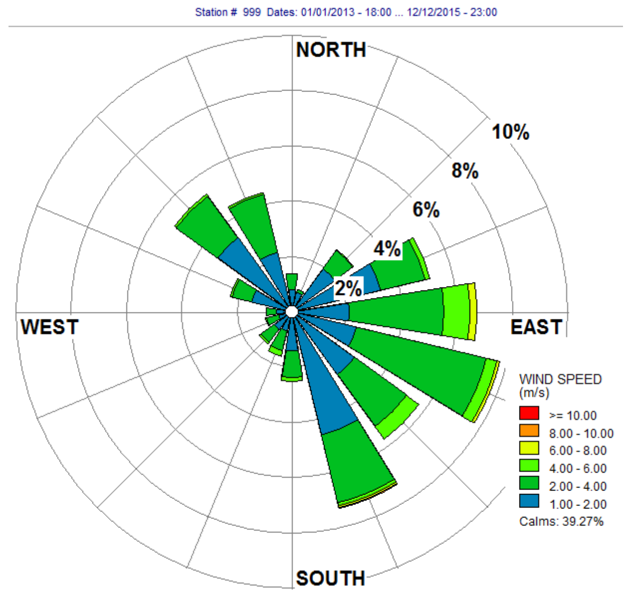
06:00 to 11:59

Wind dominant NW SE sectors



12:00 to 17:59

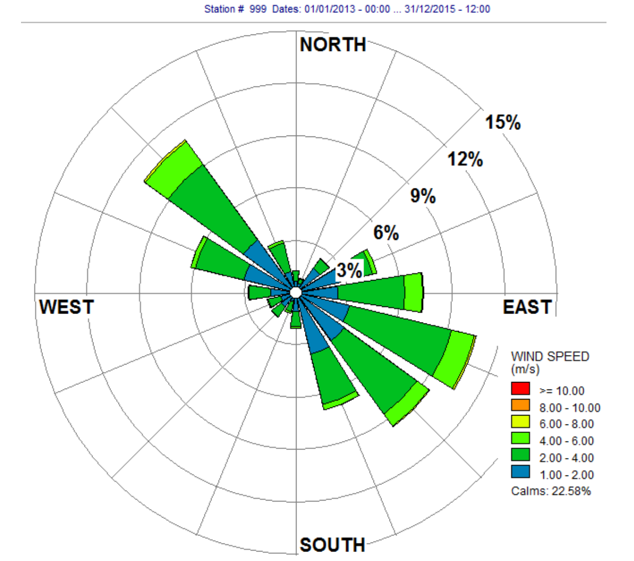
Wind dominant NW sector and to a lesser degree and SE sector



18:00 to 23:59

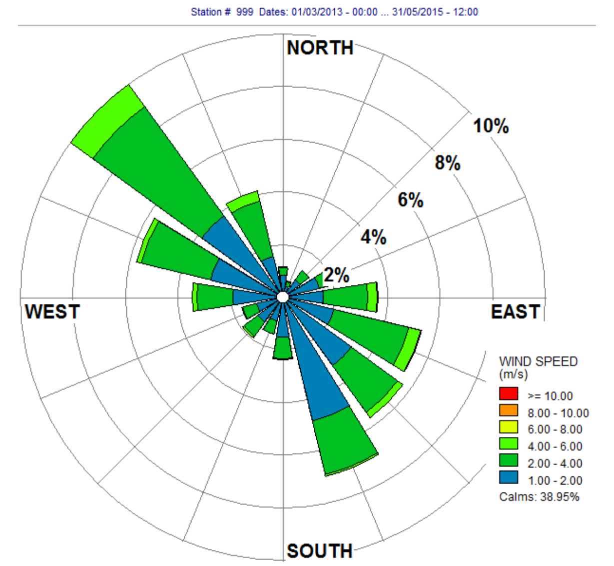
Wind dominant SE to E sectors and to a lesser degree and NW sector

Figure 8: Diurnal wind roses for Middelburg with predominant wind directions for 01 January 2013 to 31 December 2015



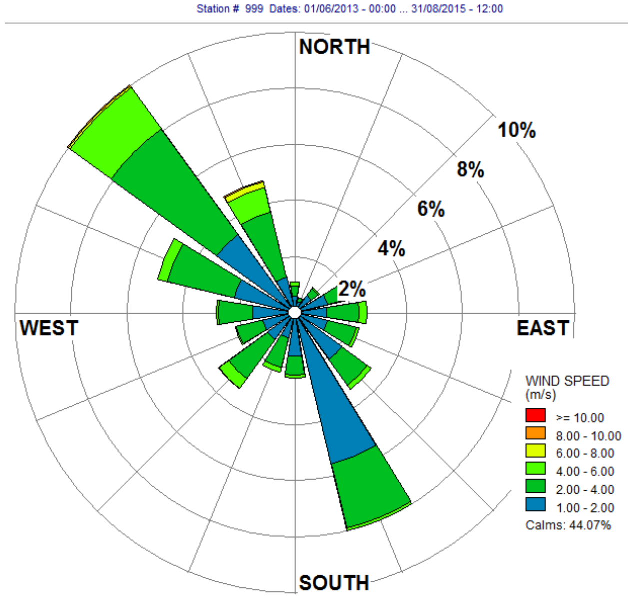
Summer (December, January and February)

Wind dominant SE and NW sectors



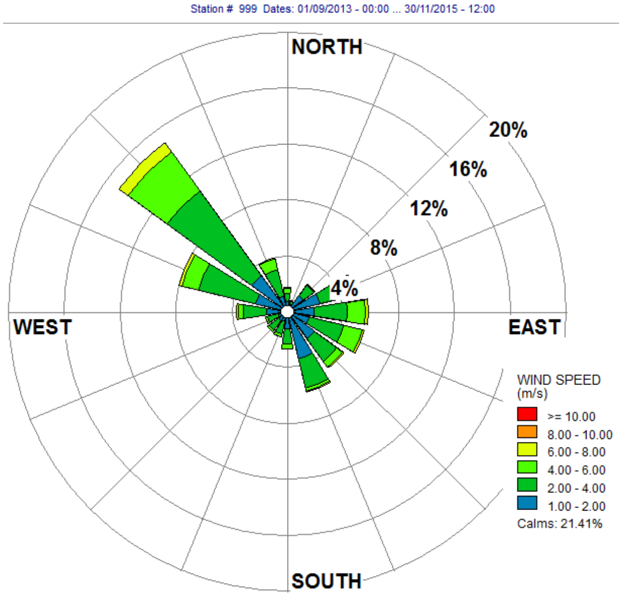
Autumn (March, April and May)

Wind dominant SE and NW sectors



Winter (June, July and August)

Wind dominant NW and to a lesser degree from the SE sector



Spring (September, October and November)

Wind dominant NW and to a lesser degree from the SE sector

Figure 9: Seasonal wind roses for Middelburg with predominant wind directions for 01 January 2013 to 31 December 2015

5.7 Regional ambient air quality

According to the HPA Baseline Assessment (2010), Steve Tshwete Local Municipality is considered a hotspot area where ambient air quality is poor and ambient PM_{10} and SO_2 concentrations regularly exceed the national ambient air quality standards (NAAQS). These exceedances are the cumulative result of emissions from industries, domestic fuel burning, motor vehicle emissions, mining and cross-boundary transport of pollutants (into the HPA). According to the Baseline document (2010), The Mafube LifeX project falls in an area where on average fewer than 3 exceedances of the daily PM_{10} air quality standard are predicted, (less than the allowable 4 exceedances per year)(Figure 10).

A cumulative study conducted for Eskom in 2006 predicted elevated PM_{10} concentrations to occur in the region, with background maximum daily concentrations between 25 µg/m³ and 75 µg/m³ and an annual average concentration of about 10 µg/m³.

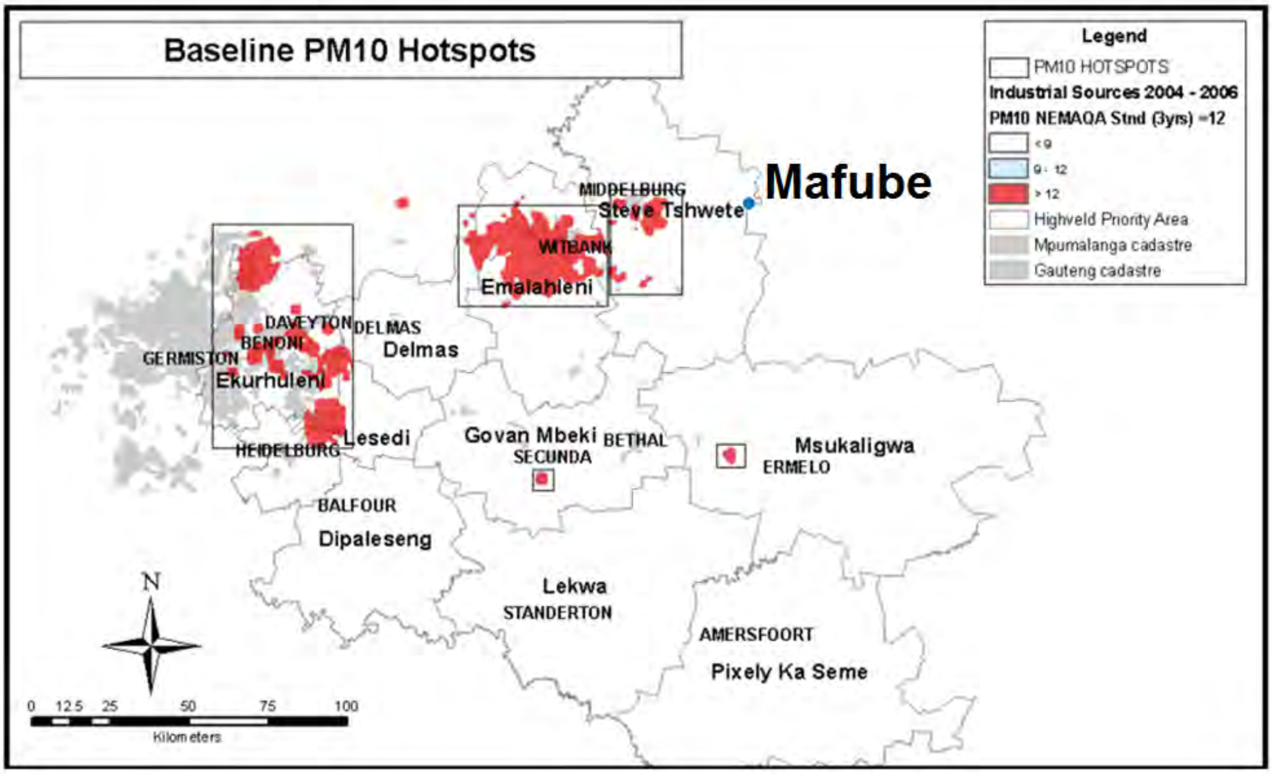


Figure 10: Baseline PM_{10} hotspots within the HPA (adapted from the HPA Baseline Assessment, 2010)

5.7.1 Sources of emissions

The current air pollution sources of concern in the vicinity of the Mafube LifeX project include:

- Other mines and quarries;
- Heavy vehicles using dirt roads;
- Vehicles' exhaust emissions;
- Coal fired power stations;
- Domestic fuel burning; and
- Agriculture.

These sources and associated emissions are further discussed in the sections that follow.

5.7.1.1 Mining activities

Coal mining operations are prominent emission sources in the HPA. Mining operations include activities that result in the entrainment/suspension of particulate matter, including but not limited to:

- The use of vehicles on unpaved and paved roads for transporting coal, personnel, waste rock etc.;
- Blasting;
- Overburden stripping;
- Coal and overburden materials handling;
- Crushing and screening of coal; and
- Wind entrainment from stockpiles, waste rock dumps and tailings storage facilities.

Dust emissions occur at several points in the storage cycle, such as coal loading onto haul trucks in the mine, discharge onto the Run of Mine (RoM) stockpile, and disturbances by strong wind currents, and load-out from the stockpile (Cowherd et al., 1988). Factors which influence the rate of wind erosion include surface compaction, moisture content, vegetation, and shape of storage pile, particle size distribution, wind speed and rain.

When fresh coal is loaded onto a stockpile, the potential for particulate emissions is at a maximum. Fine coal particles are easily disaggregated and released to the atmosphere upon exposure to air currents, either from the coal transfer itself or from wind erosion (USEPA, 2006).

Gases emitted from coal stockpiles include Volatile organic compounds (VOC's); carbon oxides, hydrocarbons, sulphuric gases and hydrogen. The potential sources of these gases include degassing, low temperature oxidation and, in extreme cases, spontaneous combustion.

Coal beds contain reservoirs of gases, mainly carbon dioxide (CO_2) and methane (CH_4). These gases are stored on the internal surfaces of organic matter or within the molecular structure of the coal. From the moment that coal is exposed to air, it is subject to low temperature oxidation (weathering) by atmospheric oxygen. This process can be sustained if the heat produced by the exothermic oxidation cannot be sufficiently dissipated by heat transfer within the stockpile. Temperatures are therefore generally higher and atmospheric pressures lower than those occurring in the coal beds. These conditions are ideal for degassing. In addition to the CO_2 and CH_4 emitted in the degassing process, dimethylsulphide (DMS) is emitted from lignite (IEA Clean Coal Centre, 2013).

Spontaneous combustion is caused when coal oxidizes and airflow is insufficient to dissipate the heat. During combustion, the reaction between the coal and the air produces oxides of carbon, including CO_2, oxides of sulphur (SO_x), and various oxides of nitrogen (NOx). Because of the hydrogenous and nitrogenous components of coal, hydrides and nitrides of carbon and sulphur are also produced during the combustion process. These include hydrogen cyanide (HCN), sulphur nitrate (SNO_3) and other toxic substances including: arsenic, lead, mercury, nickel, vanadium, beryllium, cadmium, barium, chromium, copper, molybdenum, zinc, selenium and radium (World Coal Institute, 2008).

5.7.1.2 Vehicle emissions

Air pollution generated from vehicle emissions may be grouped into primary and secondary pollutants. Primary pollutants are those emitted directly to the atmosphere as exhaust emissions, whereas secondary pollutants are formed in the atmosphere as a result of atmospheric chemical reactions, such as hydrolysis, oxidation, or photochemical reactions. The primary pollutants emitted typically include CO_2, CO, hydrocarbons (including benzene, 1.2-butadiene, aldehydes and polycyclic aromatic hydrocarbons (PAHs)), SO_2, NO_x and particulates. Secondary pollutants formed in the atmosphere typically include NO_2, photochemical oxidants such as O_3, hydrocarbons, sulphuric acid, sulphates, nitric acid, and nitrate aerosols (USEPA, 1995).

The quantity of pollutants emitted by a vehicle depends on specific vehicle related factors such as vehicle weight, speed and age; fuel-related factors such as fuel type (petroleum or diesel), fuel formulation (oxygen, sulphur, benzene and lead replacement agents) and environmental factors such as altitude, humidity and temperature (Samaras and Sorensen, 1999).

Pollutants emitted from heavy off-highway vehicles include: particulate matter (PM), NO_X, CO and SO_2. CO is produced as a result of incomplete combustion, while NO_x results from the oxidation of nitrogen at high temperature and pressure in the combustion chamber. SO_2 is derived from the combustion of sulphur in diesel. PM is produced from the incomplete combustion of the diesel, additives in fuels and lubricants, and oil breakdown products that accumulate in the engine lubricant.

5.7.1.3 Vehicle entrainment of dust on unpaved roads

Dust entrainment on unpaved roads is a significant source of local dust emissions in the region Figure 11. Particulate emissions from paved roads occur when loose, spilt material on the road surface becomes suspended as vehicles travel across the road surface and/or when fine particulates are blown from the transported load. At industrial and construction sites the surface loading is continually replenished by carry-over of material from unpaved roads and spillage from vehicles. Various field studies have shown that even paved roadways can be major sources of atmospheric particulate matter (USEPA, 1995).

Figure 11: Dust generated on D648 by an heavy (left) and light (right) motor vehicles (Golder, 2016)

5.7.1.4 Power generation

As a result of the high temperature combustion process, air pollutants released by coal-fired power stations primarily include fine particulates (PM_{10} and $PM_{2.5}$), SO_2, NO_x, nitric oxide (NO), NO_2, CO, CO_2, nitrous oxide (N_2O), and trace amounts of mercury.

The non-combustible portion of the fuel remains as solid waste. The coarser, heavier waste is called bottom ash and is extracted from the burner, and the lighter, finer portion is fly ash, usually emitted as particulates through the stack and resulting in the formation of particulate matter which is liberated to the atmosphere via a stack (post scrubbing at most power stations).

5.7.1.5 Domestic fuel burning

Both formal and informal housing are noted throughout the region. It is therefore highly likely that households within these communities will use coal, wood and paraffin for space heating and/or cooking purposes. Emissions from these communities are therefore anticipated to impact the region, especially during the winter period due to the increased demand for space heating and occasional temperature inversion conditions.

Domestic fuel burning of coal emits a large amount of gaseous and particulate pollutants, including sulphur dioxide, heavy metals, total and respirable particulates, inorganic ash, carbon monoxide, polycyclic aromatic hydrocarbons (PAHs), and benzo(a)pyrene. Pollutants arising due to the combustion of wood include respirable particulates, NO_2, CO, PAHs, particulate benzo(a)pyrene and formaldehyde. The main pollutants emitted from the combustion of paraffin are NO_2, particulates, CO and PAHs.

5.7.1.6 Agriculture

The area largely comprises large-scale, commercial crop farming. Crop farming may result in increased particulate emissions during the dry winter period due to seasonal wild fires, fallow farmlands, and large scale field ploughing.

5.7.2 Local ambient air quality monitoring

Dust fallout monitoring has been undertaken in the vicinity of the Mafube operations since 2014. Table 5 and Figure 13 display annual average dust fallout results measured at Mafube between 2014 and 2017. Results show annual average dust fallout remained below the 600 mg/m^2/day residential area threshold at all locations, with the exception of D7 (2016), D9 (2015 and 2016) and D13 (2016 and 2017).

Monthly results for January 2017 to June 2017 are shown in in Figure 14. Dust fallout levels were typically below the residential area threshold, although above average levels were recorded in January and April 2017. The highest dust fallout levels were at D13, exceeding the 600 mg/m^2/day residential area threshold from January 2017 to May 2017.

D6 and D10 are located adjacent to the D684 which will be rerouted. Due to the relative isolation of the monitoring points[3], dust entrainment from vehicles driving on the D684 is considered to be the primary emissions source. It is therefore anticipated that, once operational, dust levels immediately adjacent the proposed route are likely to be similar to those measured at D6 and D10.

Dust fallout levels recorded at D6 and D10 since 2015 are presented in Figure 15. Just one exceedance of the residential area threshold (600 mg/m^2/day) was recorded at each location: at D10 in June 2016 and at D6 in November 2016. Average dust fallout levels were higher at D10 than at D6, at 501 mg/m^2/day and 399 mg/m^2/day, respectively. A seasonal trend was observed at D6, with dust fallout levels increasing during the summer months and decreasing during the winter months.

Table 5: Annual average dust-fallout results 2014 – 2017.

Site	2014	2015	2016	2017
MZ	245	405	N/A	N/A
MX	168	314	N/A	N/A
D3-N	121	138	389	N/A
D3-E	131	148	386	N/A
D3-S	127	190	453	N/A
D3-W	135	187	566	N/A
MA	414	155	N/A	N/A
MB	434	159	N/A	N/A
MC	500	235	N/A	N/A
MD	365	80	N/A	N/A
ME	92	52	N/A	N/A
MY	303	291	N/A	N/A

[3] S3, D13, D14, MA-E, MV, MX, MY, MZ are located within the Sikhululiwe Village and therefore may be influenced by other emissions sources.

Site	2014	2015	2016	2017
MV	N/A	280	N/A	N/A
D3	188	268	435	N/A
D10	N/A	324	545	N/A
D6	N/A	525	448	304
D7	N/A	305	**840**	441
D8	N/A	229	368	314
D9	N/A	**1328**	**1201**	N/A
D11	N/A	316	384	154
D12	N/A	161	289	229
D13	N/A	N/A	**1061**	**1191**
D14	N/A	N/A	478	356
D8-E	N/A	112	554	216
D8-W	N/A	114	481	215
D8-N	N/A	98	447	208
D8-S	N/A	119	476	176
D6-E	N/A	309	334	228
D6-W	N/A	279	355	307
D6-N	N/A	275	304	222
D6-S	N/A	325	324	205
D14-E	N/A	N/A	396	192
D14-W	N/A	N/A	407	174
D14-N	N/A	N/A	265	173
D14-S	N/A	N/A	472	158
Network Recovery	98%	91%	87%	84%

Notes:
Red indicates exceedances.

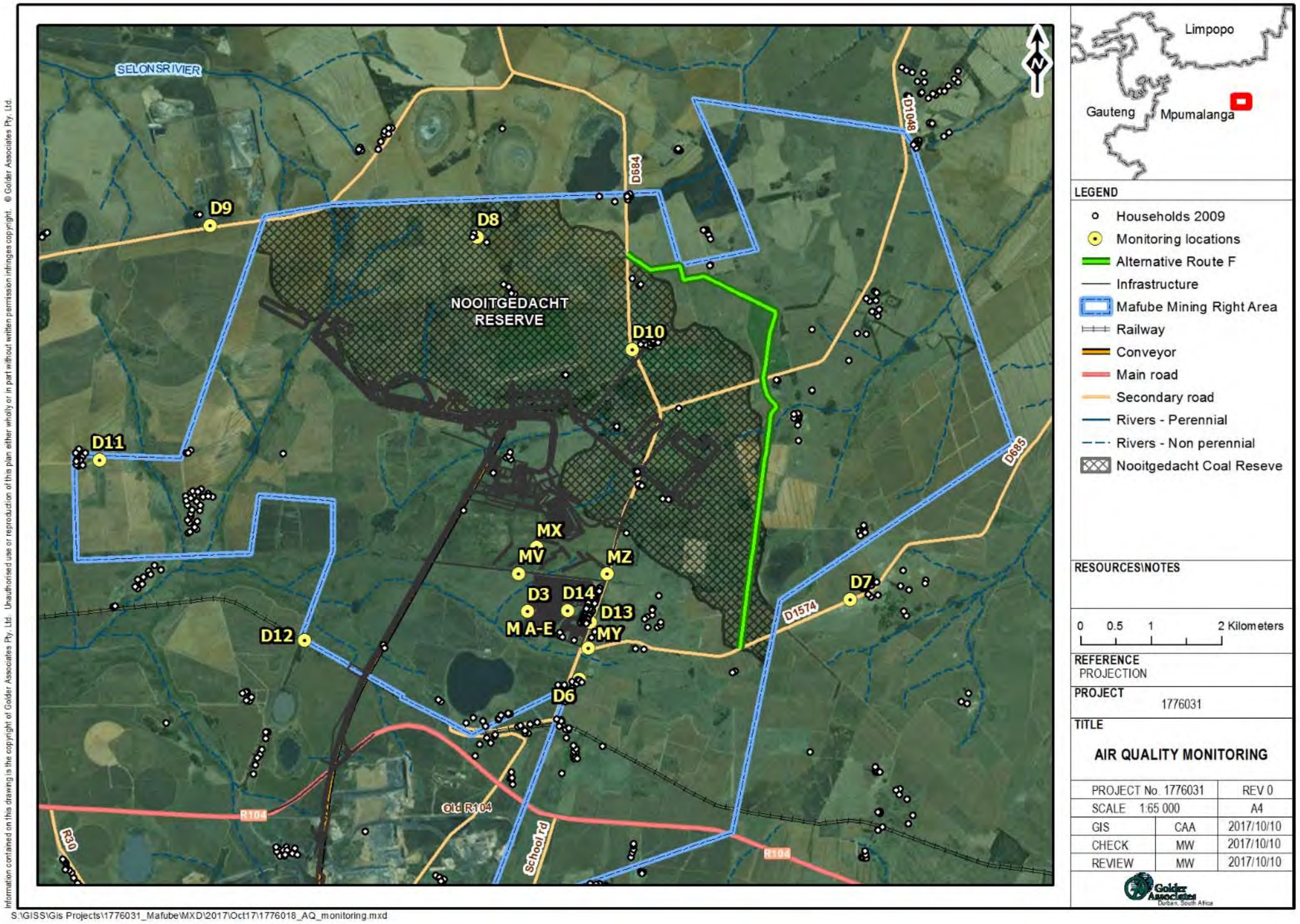


Figure 12: Dust fallout monitoring in the vicinity of the Mafube operations

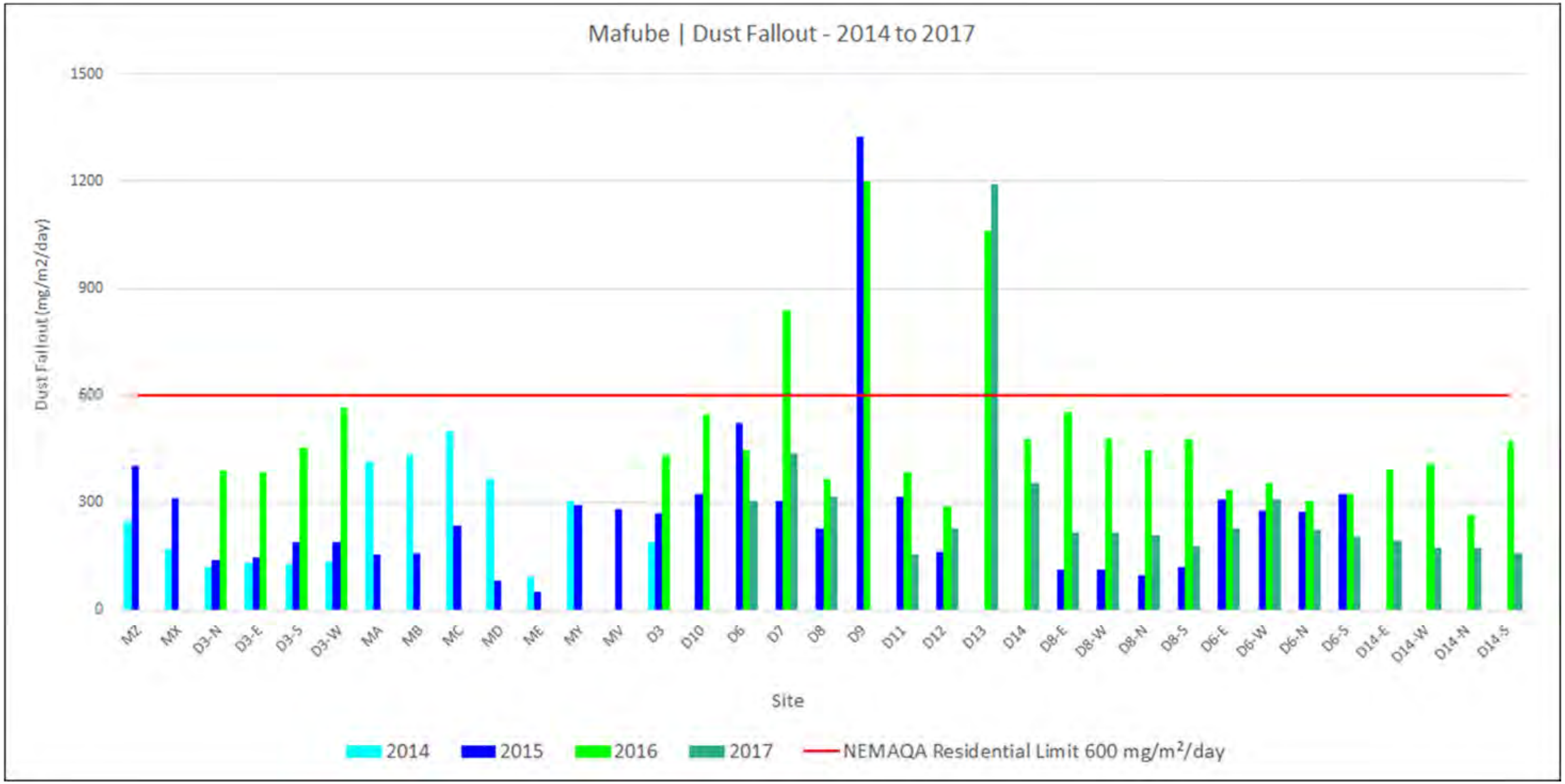


Figure 13: Annual average dust-fallout results 2014 – 2017.

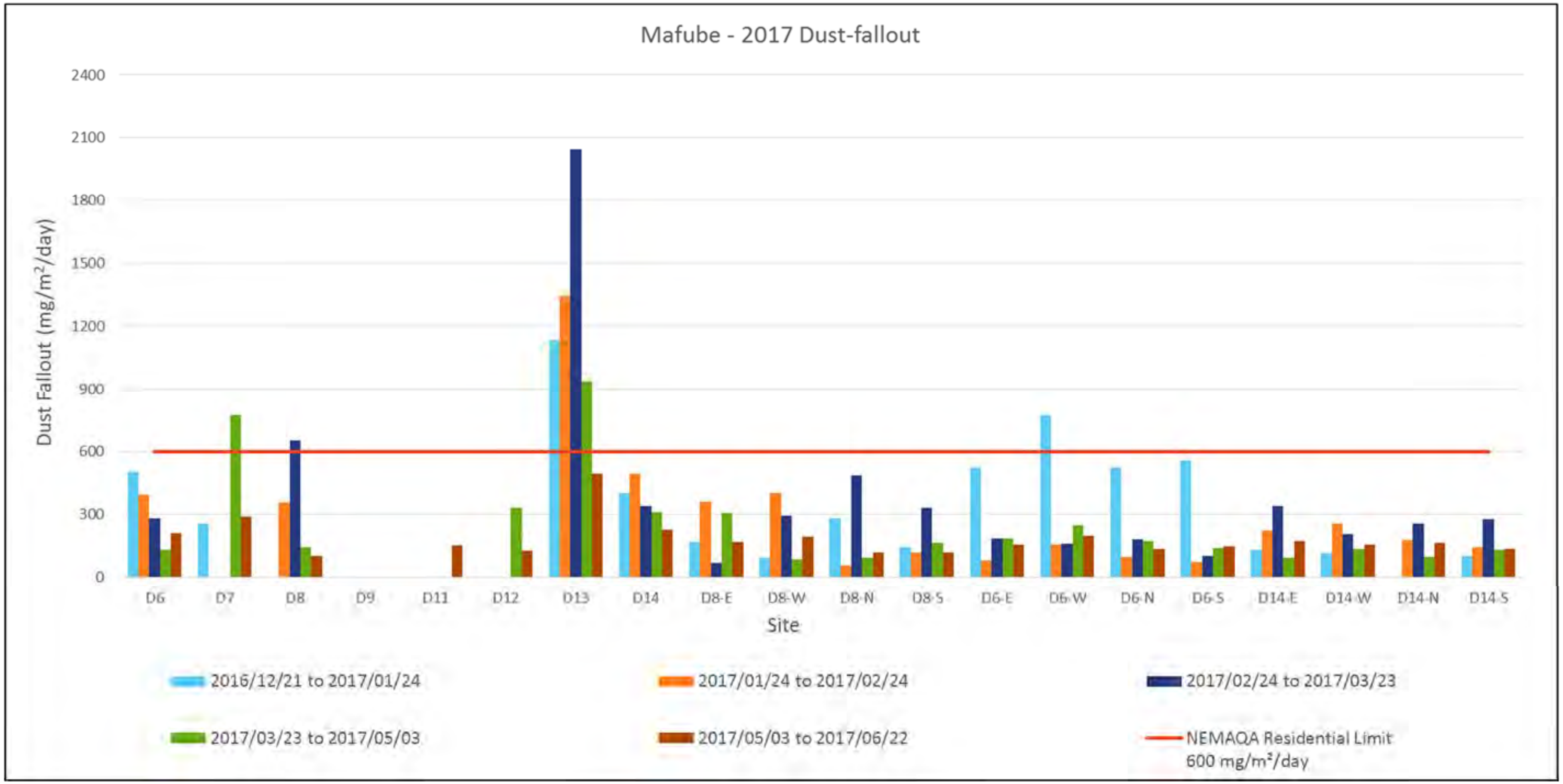


Figure 14: Monthly dust fallout results for January 2017 - June 2017

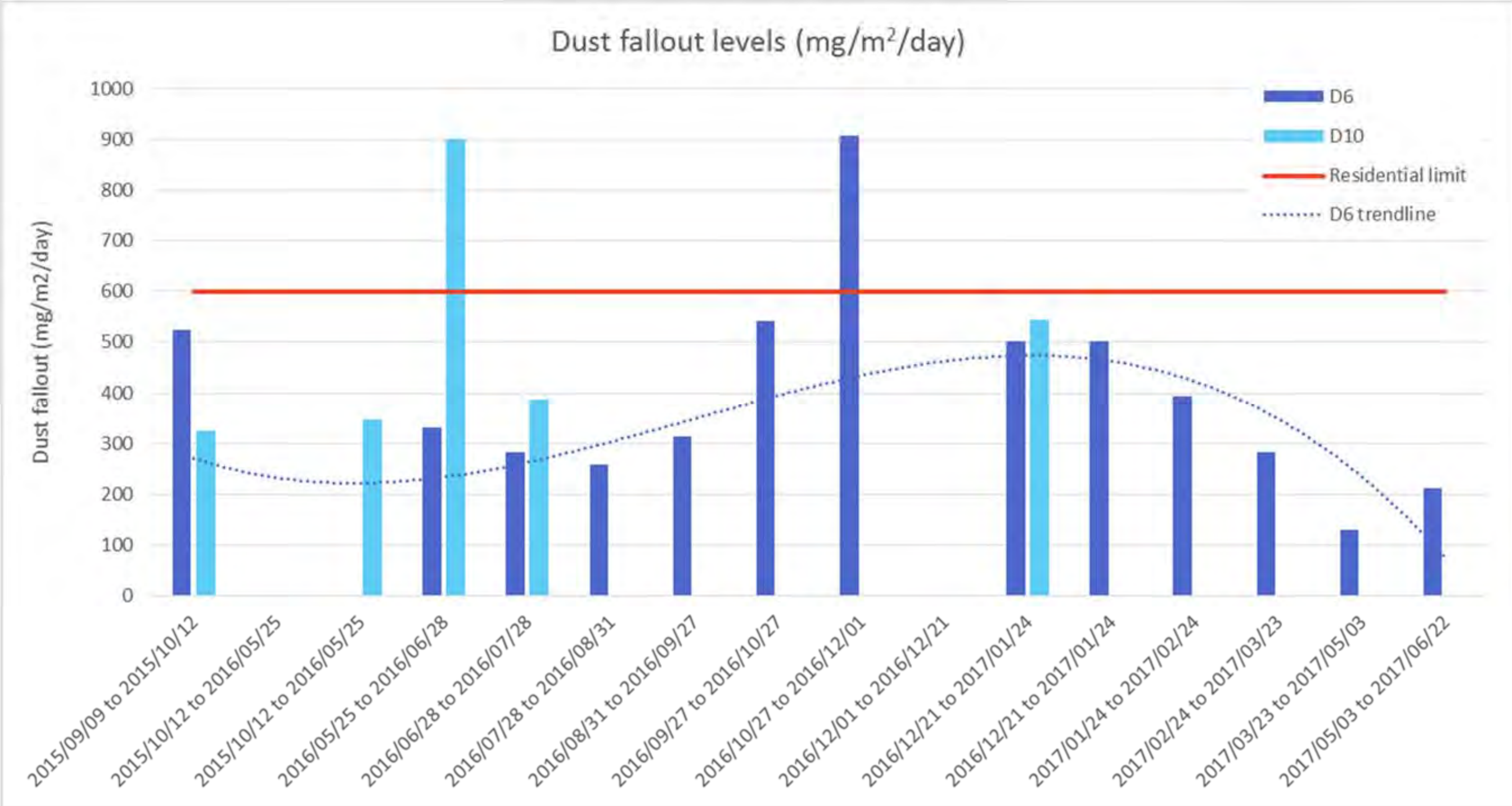


Figure 15: Dust fallout levels (mg/m2/day) measured at D6 and D10 from September 2015 - June 2017

6.0 ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Methodology for Assessing Impact Significance

The significance of identified impacts was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Table 6: Impact assessment factors

Occurrence		**Severity**	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude of impact

To assess these factors for each impact, the following four ranking scales are used:

Table 7: Impact assessment scoring methodology

Magnitude	**Duration**
10- Very high/unknown	5- Permanent (>10 years)
8- High	4- Long term (7 - 10 years, impact ceases after site closure has been obtained)
6- Moderate	3- Medium-term (3 months- 7 years, impact ceases after the operational life of the activity)
4- Low	2- Short-term (0 - 3 months, impact ceases after the construction phase)
2- Minor	1- Immediate
Scale	**Probability**
5- International	5- Definite/Unknown
4- National	4- Highly Probable
3- Regional	3- Medium Probability
2- Local	2- Low Probability
1- Site Only	1- Improbable
0- None	0- None

Significance Points= (Magnitude + Duration + Scale) x Probability.

Table 8: Significance of impact based on point allocation

Points	**Significance**	**Description**
SP>60	High environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 - 60	Moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP<30	Low environmental significance	Impacts with little real effect and which will not have an influence on or require modification of the project design.

Points	Significance	Description
+	Positive impact	An impact that is likely to result in positive consequences/effects.

For the methodology outlined above, the following definitions were used:

- Magnitude is a measure of the degree of change in a measurement or analysis (e.g., the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorization of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely-recognised standards are to be used as a measure of the level of impact;
- Scale/Geographic extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- Duration refers to the length of time over which an environmental impact may occur: i.e. immediate/transient, short-term (0 to 7 years), medium term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent; and
- Probability of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

6.2 Project Phases

The environmental impacts of the project were assessed for the:

- Pre-construction phase;
- Construction phase;
- Operational phase; and
- Closure and rehabilitation phase.

6.3 Detailed description of Potential Impacts during all phases of the proposed Road Realignment project

6.4 Impact Assessment Summary

All the predicted environmental impacts resulting from the proposed project activities are described in Table 9 along with their significance ratings before and after mitigation.

6.4.1 Pre-construction (land clearing) and construction

The degeneration of the ambient air quality due to increased nuisance dust and fine particulate levels is likely to occur as a result of land clearing, ground excavation and materials handling activities (tipping, loading and offloading) associated with the construction of the road. Daily dust emissions will vary according to the level of activity, the type of operation and the meteorological conditions. The construction phase impacts may be intense however short-lived and largely limited to the immediate vicinity of the activity. It is for these reasons; the impact is likely to have a moderate environmental significance before mitigation. With mitigation, these impacts may be reduced to a low environmental significance.

Similarly, the movement of construction vehicles are likely to cause an increase in the entrainment of dust and fine particulate matter on unpaved roads. These emissions are likely to be short lived and largely restricted to the construction site, although nearby receptors are likely to be impacted. This impact was therefore assigned a moderate environmental significance before mitigation. With mitigation, these impacts may be reduced to a low environmental significance.

An increase in CO, NO_2, SO_2, and fine particulate levels are anticipated to occur as a result of heavy vehicle exhaust emissions. Vehicle exhaust emissions are likely to result in primary and secondary pollutants. Primary pollutants are those emitted directly to the atmosphere as exhaust emissions whereas, secondary pollutants are formed in the atmosphere as a result of atmospheric chemical reactions, such as hydrolysis, oxidation, or photochemical reactions. The quantity of pollutants emitted by a vehicle depends on specific vehicle related factors such as vehicle weight, speed and age; fuel-related factors such as fuel type (petroleum or diesel), fuel formulation (oxygen, sulphur, benzene and lead replacement agents) and environmental factors such as altitude, humidity and temperature (Samaras and Sorensen, 1999).

The impact of these emissions, are anticipated to have a low environmental significance before mitigation as the impacts will be restricted to the construction phase and site. Due to the limited efficacy of the potential mitigation measures associated with vehicle emissions at this scale, the environmental significance after mitigation is likely to remain low.

6.4.2 Operation

Given that the proposed Route F is a new route passing through vegetated (cultivated/ pasture) land, it is anticipated that the operation of the route will alter baseline dust fallout levels notably. Considering the results of the baseline monitoring adjacent to the D684 which will be rerouted (at D6 and D10), dust emissions are however likely to remain below the residential area threshold (600 mg/m^2/day) at the receptor locations, provided traffic does not increase significantly. Receptors closest to the proposed route will experience the greatest impacts. It is anticipated that under normal conditions, the impact radius will be limited to the immediate vicinity of the road (i.e. within 100 m). Dust may travel further during periods of high winds, peak traffic and dry periods.

Elevated ambient dust concentrations are generally considered to be a nuisance, however health impacts such as allergic inflammatory reactions, nasal congestion, and respiratory problems may be triggered in vulnerable individuals.

The diversion of traffic away from the Sikhululiwe Village is anticipated to reduce ambient dust loads at the Village. Dust levels at the School (approximately 1 km north of Route F) are not anticipated to change as the D684 route adjacent the school will remain the same.

6.4.3 Decommissioning

It is assumed that the road will not be decommissioned and will remain open to the public post the Mafube LifeX closure. Impacts will therefore continue so long as the road is in use. Impacts will cease once the area is revegetated.

Table 9: Impact significance rating

Description of impact	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation
Construction												
Dust fallout and particulate emissions resulting from land clearing, ground excavation and materials handling	8	2	1	4	44	Moderate	6	2	1	3	27	Low
Dust fallout and particulate emissions resulting from construction vehicle movement	8	2	1	4	44	Moderate	6	2	1	3	27	Low
Trace gas emissions resulting from construction vehicle exhaust	4	2	1	4	28	Low	3	2	1	3	18	Low
Operation												
Dust fallout and particulate emissions resulting from vehicle entrainment of dust, affecting ambient air quality along Route F	6	4	2	4	48	Moderate	4	4	2	3	30	Moderate
Decommissioning												
N/A	-	-	-	-	-	N/A	-	-	-	-	-	N/A

7.0 ENVIRONMENTAL MANAGEMENT PROGRAMME

This Environmental Management Programme (EMPr) addresses the management of potential environmental impacts related to the proposed road realignment project. The EMPr is used for managing, mitigating, and monitoring of the environmental impacts associated with construction, operational and rehabilitation phases of the realigned route.

7.1 Objectives

- To reduce dust and fine particulate emissions as far as it is possible using appropriate, reasonable and feasible measures for mitigation and management; and
- To monitor project related emissions impact on the environment and receptors; and
- To ensure compliance with relevant national regulations.

7.2 Environmental Management and Mitigation Measures Identified

7.2.1 Avoid

- Contractors should take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, pre-notification of Interested and Affected Parties (I&APs)); and
- Avoidance of dust track-on onto paved routes used to transport construction materials.

7.2.2 Minimize

- Wet suppression during materials handling activities;
- Wind speed reduction through sheltering (where possible);
- Wet suppression on all construction access roads;
- Institute speed control measures to reduce vehicle entrainment of dust;
- Wind speed reduction through sheltering such as trees (where possible); and
- All construction vehicles and other equipment should be maintained and serviced regularly to ensure that exhaust particulate emissions are kept to a minimum.

7.3 Potential Cumulative Impacts Identified

The Mafube LifeX project will be a significant source of dust emissions in the local environment once operational. Even if the dust emissions resulting from Route F are within the residential area limits, the comparatively significant contribution of the LifeX project may result in exceedances of the NAAQS at receptor locations.

Furthermore, dust and fine particulate emissions associated with open fields during harvesting season may also contribute to the cumulative ambient atmospheric dust load, potentially resulting in exceedances of the NAAQS at receptor locations.

7.4 Potential Impacts to be mitigated in their respective phases

Potential impacts and the respective mitigation measures are provided in Table 10 and Table 11.

Table 10: Recommendations for mitigation and monitoring during the construction phase

Potential Impact	Mitigation, management and control measure(s)
Degeneration of the ambient air quality due to increased dust and PM_{10} levels from land clearing, ground	■ Continue baseline dust fallout monitoring;

Potential Impact	Mitigation, management and control measure(s)
excavation and materials handling activities (tipping, loading and offloading).	■ Contractors should take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, pre-notification of Interested and Affected Parties (I&APs)); ■ Wet suppression during materials handling activities; and ■ Wind speed reduction through sheltering (where possible).
Degeneration of the ambient air quality due to increased dust and PM_{10} levels from the entrainment of dust on unpaved roads.	■ Wet suppression on construction access roads; ■ Rigorous speed control; and ■ Avoidance of dust track-on onto paved routes used to transport construction materials.
Degeneration of the ambient air quality due to increased NO_2, SO_2, CO, and fine particulate levels from primary and secondary vehicle emissions.	■ All construction vehicles and other equipment should be maintained and serviced regularly to ensure that exhaust particulate emissions are kept to a minimum; and ■ Parking construction vehicles off travelled roadways.

Table 11: Recommendations for mitigation and monitoring during the operational phase

Potential Impact	Mitigation, management and control measure(s)
Fugitive dust and fine particulate emissions	■ Speed control; ■ Expand the dust fallout monitoring network by two sampling points, the proposed locations of which are shown in Figure 16. These points will serve to determine the roads impact at the closest receptor locations and wetland areas in the northern portion of the mine rights area; ■ Wind speed reduction through sheltering (where possible); and ■ Dust related complaints should be directed to the site management. Complaints and any actions arising from a complaint will be recorded in a complaints register to be maintained by site management.

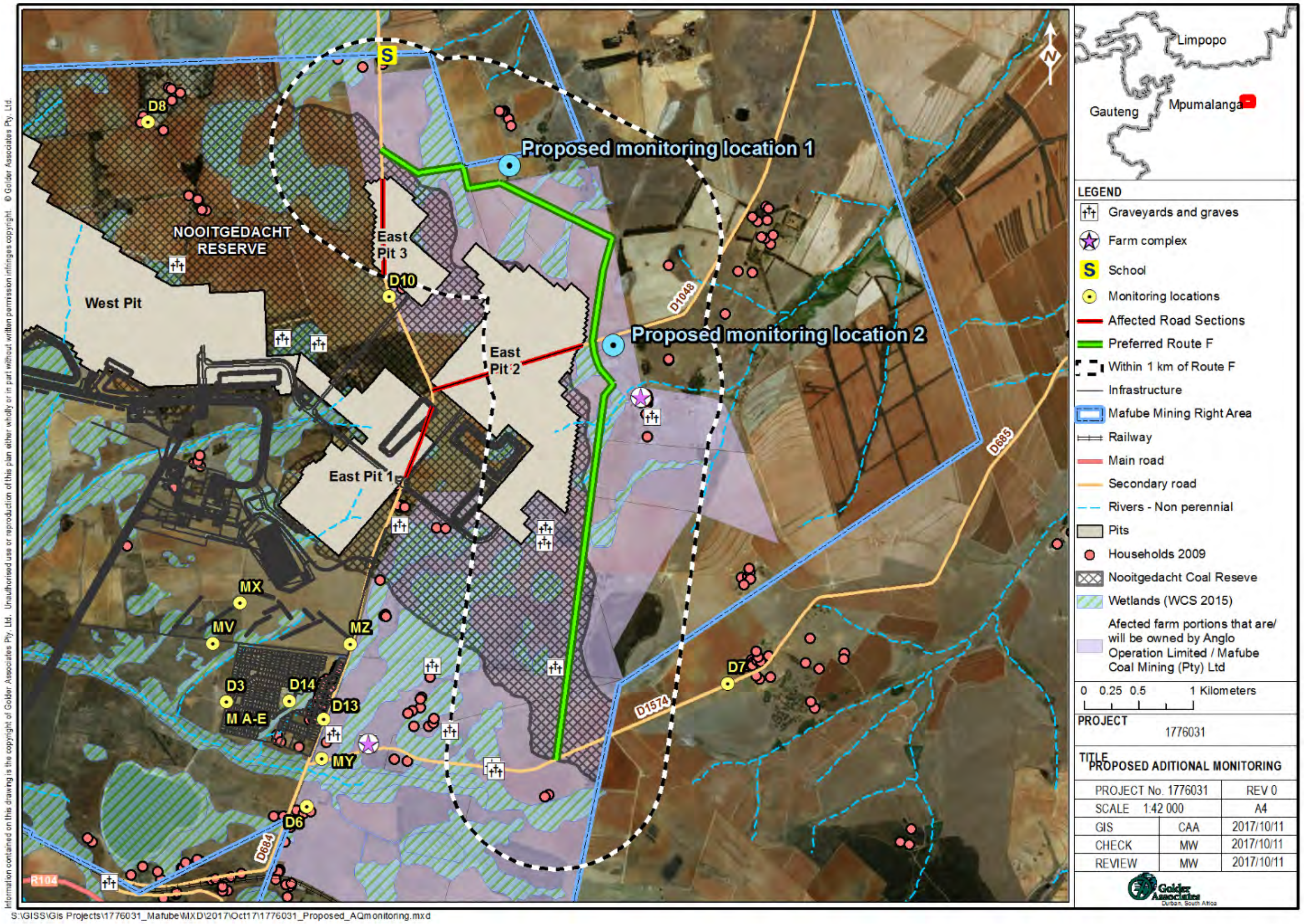


Figure 16: Proposed additional monitoring locations

7.5 Summary of Mitigation and Management measures for the Operational, Decommissioning and Closure phases

Table 12: Summary of Mitigation and Management measures

Detailed Mitigation Measures	Mitigation Type (Modify, remedy, control or stop)	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
■ Contractors should take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, pre-notification of Interested and Affected Parties (I&APs)); and ■ Wind speed reduction through sheltering (where possible).	Control through management and monitoring	Measures to be implemented during construction phase	< 600 mg/m^2/day at the closest receptor	NAAQS	ECO/ Construction manager
■ Wet suppression on construction access roads; ■ Rigorous speed control; and ■ Avoidance of dust track-on onto paved roads.	Control through management and monitoring	Measures to be implemented during construction phase	< 600 mg/m^2/day at the closest receptor	NAAQS	ECO/ Construction manager
■ All construction vehicles and other equipment should be maintained and serviced regularly to ensure that exhaust particulate emissions are kept to a minimum; and ■ Parking construction vehicles off travelled roadways.	Control through management and monitoring	Measures to be implemented during construction phase	< 600 mg/m^2/day at the closest receptor	NAAQS	ECO/ Construction manager
■ Speed control; ■ Wind speed reduction through sheltering (where possible); and ■ Dust related complaints should be directed to the site management. Complaints and any actions arising from a complaint will be recorded in a complaints register to be maintained by site management.	Control through management and monitoring	Measures to be implemented when required	< 600 mg/m^2/day at the closest receptor	NAAQS	Environmental / SHE officer

7.6 Mechanisms for monitoring compliance

Recommendations for monitoring are provided in Table 13

Table 13: Recommendations for monitoring

Source Activity	**Impacts requiring monitoring programmes**	**Functional requirements for monitoring**	**Roles and responsibilities (for the execution of the monitoring programme)**	**Monitoring and reporting frequency and time periods for implementing impact management actions**
Construction of Route F (including land clearing, materials transfer, grading etc.)	Dust and fine particulate emissions	Dust buckets erected at proposed locations 1 and 2 (Figure 16)	Mafube Environmental/ SHE officer	Buckets should be exposed for a period of approximately 30 days. Monthly reports should be generated to monitor compliance.
Operation (use) of Route F	Dust and fine particulate emissions	Dust buckets erected at proposed locations 1 and 2 (Figure 16)	Mafube Environmental/ SHE officer	Buckets should be exposed for a period of approximately 30 days. Monthly reports should be generated to monitor compliance.

8.0 DATA GAPS AND ASSESSMENT SHORTCOMINGS

This assessment is purely qualitative. In order to increase the confidence level of this assessment, Golder recommends Mafube undertake simple dispersion modelling to gain an understanding of the spatial extent of the impact of the Route F dust emissions.

9.0 CONCLUSION

Given that the proposed Route F is a new route passing through vegetated (cultivated/ pasture) land, it is anticipated that the use of the road will alter local baseline dust fallout levels notably in the immediate vicinity of the proposed route. When the lands are fallow, the road will act as an additional source of particulate matter in the local environment, having a cumulative impact on nearby receptors. Considering the results of the baseline monitoring adjacent to the existing D684, however, dust emissions are likely to remain below the residential area threshold (600 mg/m^2/day) at the receptor locations.

The diversion of traffic away from the Sikhululiwe Village is anticipated to reduce ambient dust loads at the Village. Dust levels at the School (approximately 1 km north of Route F) are not anticipated to change as the D684 route adjacent the school will remain the same.

Cumulative impacts will need to be carefully monitored and managed. The Mafube LifeX project will be a significant source of dust emissions in the local environment once operational. Even if the dust emissions resulting from Route F are within the residential area limits, the comparatively significant contribution of the LifeX project may result in exceedances of the NAAQS at receptor locations.

Furthermore, dust and fine particulate emissions associated with open fields during harvesting season may also contribute to the cumulative ambient atmospheric dust load, potentially resulting in exceedances of the NAAQS at receptor locations.

10.0 REFERENCES

Cowherd C, Muleski GE and Kinsey JS, 1988: Control of Open Fugitive Dust Sources, EPA-450/3-88-008, US Environmental Protection Agency, Research Triangle Park, North Carolina

Department of Environmental Affairs,2006: Government Gazette No. 28732. GNR. 365

Department of Environmental Affairs, 2010. The Highveld Priority Area Air Quality Baseline Assessment Report, 2010

IEA Clean Coal Centre, 2013: Gaseous emissions from coal stockpiles No 13/1 January 2013. Available at: http://www.iea-coal.org.uk/documents/83117/8683/Gaseous-emissions-from-coal-stockpiles,-CCC/213

ILO, 1965: Guide to the prevention and suppression of dust in mining, tunnelling, and quarrying. Geneva, Switzerland: World Health Organization, International Labour Office.

NERDDC, 1988: Air Pollution from Surface Coal Mining, Volume 2, Emission Factors and Model Refinement, National Energy Research and Demonstration Council, Project 921.

Samaras, Z., and Sorensen, S.C., 1999: Mobile sources, In J. Fenger, O. Hertel and F. Palmgren (eds), urban air pollution – European aspects, Kluwer Academic Publishers, Denmark

The National Environmental Management: Air Quality Act (Act no. 39 of 2004) (NEM: AQA);

The South African Ambient Air Quality Standards for common pollutants, published in the Government Gazette, No. 32816 on 24 December 2009;

US EPA, 2004: Air Quality Criteria for Particulate Matter. U.S. Washington, DC: US, Environmental Protection Agency.

USEPA AP-42, 2006: Chapter 13.2.2 Unpaved Roads

USEPA AP-42, 2006: Chapter 13.2.4 Aggregate Handling and Storage Piles;

USEPA AP-42, 1998: Chapter 11.9 Western Surface Coal Mining;

World Coal Institute, 2008: Environmental Impacts of Coal Mining Available at: http://www.worldcoal.org,

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APPENDIX A

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September 2017

MAFUBE COAL MINING (PTY) LTD

Environmental Impact Assessment (EIA) for the Proposed Mafube Road Realignment Project - Noise Impact Assessment

Submitted to:
Mafube Coal Mining (Pty) Ltd

REPORT

Report Number. 1776031-319915-13

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Golder Associates

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APPENDICES

1.0 PROJECT INTRODUCTION AND BACKGROUND

In 2011 Golder Associates Africa (Pty) Ltd (Golder) was appointed by Mafube Coal Mining (Pty) Ltd (Mafube) to conduct the Environmental Impact Assessment (EIA) process for the proposed Mafube Life Expansion project (Mafube LifeX), which included the mining operations at Nooitgedacht and Wildfontein in the Mpumalanga province of South Africa. An Environmental Management Programme (EMP) was also submitted to the Department of Mineral Resources (DMR) for approval as part of their mining rights application, as required under the Mineral and Petroleum Resources Act (Act No. 28 of 2002) (MPRDA).

Mafube Coal Mining (Pty) Ltd (Mafube) is a 50/50 Joint Venture involving Anglo American Thermal Coal (AATC) and Exxaro Coal Mpumalanga (Pty) Ltd. Environmental Authorisation for the Mafube LifeX EIA/EMP was granted by the Mpumalanga Department of Environmental Affairs and Tourism (MDEDET) in April 2013. The approval for the mining rights application was received on September 2013.

The Mafube LifeX operations are currently in the construction phase and full operational phase are planned to commence in May 2018.

In terms of the National Water Act (Act No. 36 of 1998) (NWA), an Integrated Water Use Licence application & Waste Water Management Plan was also required, and this application was submitted in December 2013 and currently a waste licence application is being compiled by Golder

During the feasibility phase investigations, it was assessed that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or re-alignment are required before this operation can commence. These roads falls under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

Mafube has appointed Golder Associates Africa (Pty) Ltd to conduct the EIA/EMP and public participation process.

An EIA application has been submitted to the Department of Mineral Resources (DMR) in terms of Regulations 326 published under NEMA (07 April 2017). This proposed project triggers a full scoping and environmental assessment EIA process for certain listed activities under NEMA, an Environmental Management Programme (EMP) based on the findings of the EIA and a Water Use Licence Application (IWULA). The public participation process will provide stakeholders with information about the proposed project, and several opportunities to comment throughout the EIA/EMP/WULA process.

2.0 SPECIALIST STUDY INTRODUCTION

This report presents the noise impact study for the proposed Mafube LifeX Road Realignment project.

2.1 Methodology

The following key tasks were undertaken in this assessment:

- The review of legislative and regulatory requirements;
- The characterisation of the regional noise levels based on available data and previous studies conducted in the region;
- The review of the anticipated nuisance effects associated with the anticipated noise emission levels;
- The provision of a qualitative professional opinion of the anticipated impacts; and
- Recommendations for mitigation measures to reduce the impacts on sensitive receptors were also provided, as well as recommendations for air quality management / monitoring for implementation by Mafube.

2.2 Terminology

Noise is defined as unwanted sound. The range of sound audible to humans is from 0 dB to 140 dB, from the threshold of audibility to the threshold of pain, respectively. The frequency response of the human ear is usually taken to cover the range from 20 Hz to 20,000 Hz. The human ear's response to sound is not equal across all frequencies; it is more sensitive in the mid-frequency range than in the low and high frequencies. In order to compensate for this in sound measurement equipment, a weighting (filter) is applied. The weighting which is most widely used and which correlates best with the human response to noise is the A-weighting. This is an internationally accepted standard for noise measurements to represent the human subjective response to sound.

For steady-state noise levels an increase or decrease of 1 dB(A) is not perceptible to most people under normal conditions, although this may be perceptible under laboratory conditions. An increase of 3 dB(A) is normally just perceptible under normal conditions. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/decrease of 10 dB(A) corresponds to a doubling or halving in the perceived loudness. Typical sound levels (dB(A)) are shown in Figure 1 for reference. The sound intensity relative to the sound level and pressure is also shown in Figure 1 and provides an indication of the logarithmic nature of perceived loudness.

External noise levels are rarely steady, but rise and fall according to surrounding activities. In an attempt to produce a figure that relates to this variable noise level to the subjective response a number of noise metrics may be used. The relevant noise parameter to this assessment is the L_{Aeq} level;

The L_{Aeq} level is the 'equivalent continuous A-weighted sound pressure level, expressed in decibels'. The L_{Aeq} is defined as:

"The value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time".

It is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of many other forms of environmental noise.

Table of sound levels L and corresponding sound pressure and sound intensity

Examples	Sound Pressure Level L_p dBSPL	Sound Pressure p N/m² = Pa	Sound Intensity I W/m²
Jet aircraft, 50 m away	140	200	100
Threshold of pain	130	63.2	10
Threshold of discomfort	120	20	1
Chainsaw, 1m distance	110	6.3	0.1
Disco, 1 m from speaker	100	2	0.01
Diesel truck, 10 m away	90	0.63	0.001
Curbside of busy road, 5 m	80	0.2	0.0001
Vacuum cleaner, distance 1 m	70	0.063	0.00001
Conversational speech, 1m	60	0.02	0.000001
Average home	50	0.0063	0.0000001
Quiet library	40	0.002	0.00000001
Quiet bedroom at night	30	0.00063	0.000000001
Background in TV studio	20	0.0002	0.0000000001
Rustling leaf	10	0.000063	0.00000000001
Threshold of hearing	0	0.00002	0.000000000001

Figure 1: Typical sound levels and relative intensity (source: http://wikis.evergreen.edu/computing/index.php/Sound_in Air)

3.0 PROJECT DESCRIPTION

This report focuses on the impacts associated with the preferred Alternative Route F. This alternative route has an approximate length of 5.0 km and runs along existing agricultural field boundaries and fields.

The properties and landowners details in Table 1 below, will be the properties directly affected by the construction of this Alternative route option. All farm portions affected by Alternative F, are/will be owned by Anglo Operation Limited / Mafube Coal Mining (Pty) Ltd.

Table 1: Alternative F - Properties and Landowner Details

Property Details	Landowner Details
Springboklaagte 416 JS Portion 1	Anglo Operations Limited
Springboklaagte 416 JS Portion 12	Anglo Operations Limited
Nooitgedacht 417 JS Portion 4	Hooggenoeg Boerdery CC
Nooitgedacht 417 JS Portion 14	Wessels Anneke
Nooitgedacht 417 JS Portion 15	Anglo Operations Limited
Roodepoort 418 JS Portion 8	Anglo Operations Limited
Roodepoort 418 JS Portion 9	Hooggenoeg Boerdery CC

Property Details	Landowner Details
Roodepoort 418 JS Portion 10	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 11	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 13	Anglo Operations Limited

4.0 POLICY LEGAL AND ADMINISTRATIVE FRAMEWORK

The SANS Method for environmental noise impact assessment (SANS 10328:2008) provides a method for evaluating the noise impact of a proposed development. It is an umbrella document and makes many references to SANS 10103:2008 The measurement and rating of environmental noise with respect to annoyance and to speech communication (SANS 10103:2008).

The SANS 10103 Code of Practice provides typical ambient noise rating levels ($L_{Req,T}$) in various districts. The outdoor ambient noise levels recommended for the districts are shown in Table 2 below.

It is probable that the noise is annoying or otherwise intrusive to the community or to a group of persons if the rating level of the ambient noise under investigation exceeds the applicable rating level of the residual noise (determined in the absence of the specific noise under investigation), or the typical rating level for the ambient noise for the applicable environment given in Table 2 (Table 2 of SANS 10103).

Table 2: Typical Rating Levels for Ambient Noise

Type of district	Equivalent continuous rating level ($L_{Req.T}$) for noise (dB(A))					
	Outdoors			Indoors, with open windows		
	Day-night $L_{R,dn}$	Day-time $L_{Req,d}$	Night-time $L_{Req,n}$	Day-night $L_{R,dn}$	Day-time $L_{Req,d}$	Night-time $L_{Req,n}$
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

Notes:

1) *If the measurement or calculation time interval is considerably shorter than the reference time intervals, significant deviations from the values given in the table might result.*

2) *If the spectrum of the sound contains significant low frequency components, or when an unbalanced spectrum towards the low frequencies is suspected, special precautions should be taken, and specialist advice should be obtained. In this case the indoor sound levels might significantly differ from the values given in Column 5 to 7.*

3) *In districts where outdoor $L_{R,dn}$ exceeds 55 dB, residential buildings (e.g. dormitories, hotel accommodation and residences) should preferably be treated acoustically to obtain indoor $L_{Req,T}$ values.*

4) *For industrial districts, the $L_{R,dn}$ concept does not necessarily hold. For industries legitimately operating in an industrial district during the entire 24 h day/night cycle, $L_{Req,d}$ =, $L_{Req,n}$ = 70 dB can be considered as typical and normal.*

5) *The values given in columns 2 and 5 in this table are equivalent continuous rating levels and include corrections for tonal character, impulsiveness of the noise and the time of day.*

6) *The values given in columns 3, 4, 6 and 7 in this table are equivalent continuous rating levels and include corrections for tonal character and impulsiveness of the noise.*

7) *The noise from individual noise sources produced, or caused to be produced, by humans within natural quiet spaces such as national parks, wilderness areas and bird sanctuaries should not exceed a maximum A-weighted sound pressure level of 50 dBA at a distance of 15 m from each individual source.*

SANS 10103 provides criteria, for evaluating the community or group response to a noise source, these are presented in Table 3.

Table 3: SANS 10103 Categories of community or group response

Excess, $\Delta L_{Req,T}$ dB(A)	Category	Description
0 to 10	Little	Sporadic complaints
5 to 15	Medium	Widespread complaints
10 to 20	Strong	Threats of community or group action
>15	Very Strong	Vigorous community or group action

SANS 10103 provides three methods for determining the excess level ($\Delta L_{Req,T}$) of a proposed development:

- $\Delta L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the Residual noise (determined in the absence of the Rated noise, i.e. the specific noise under investigation);
- $\Delta L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the typical Rating level for the applicable district as determined from Table 2 of SANS 10103:2008; or
- $\Delta L_{Req,T}$ = Expected increase in $L_{Req,T}$ of ambient noise in an area because of a proposed development under investigation.

5.0 BASELINE DATA

5.1 Topography

The Mafube LifeX project is located on gently undulating terrain which, ranges from approximately 1480 to 1900 meters above mean sea level (mamsl).

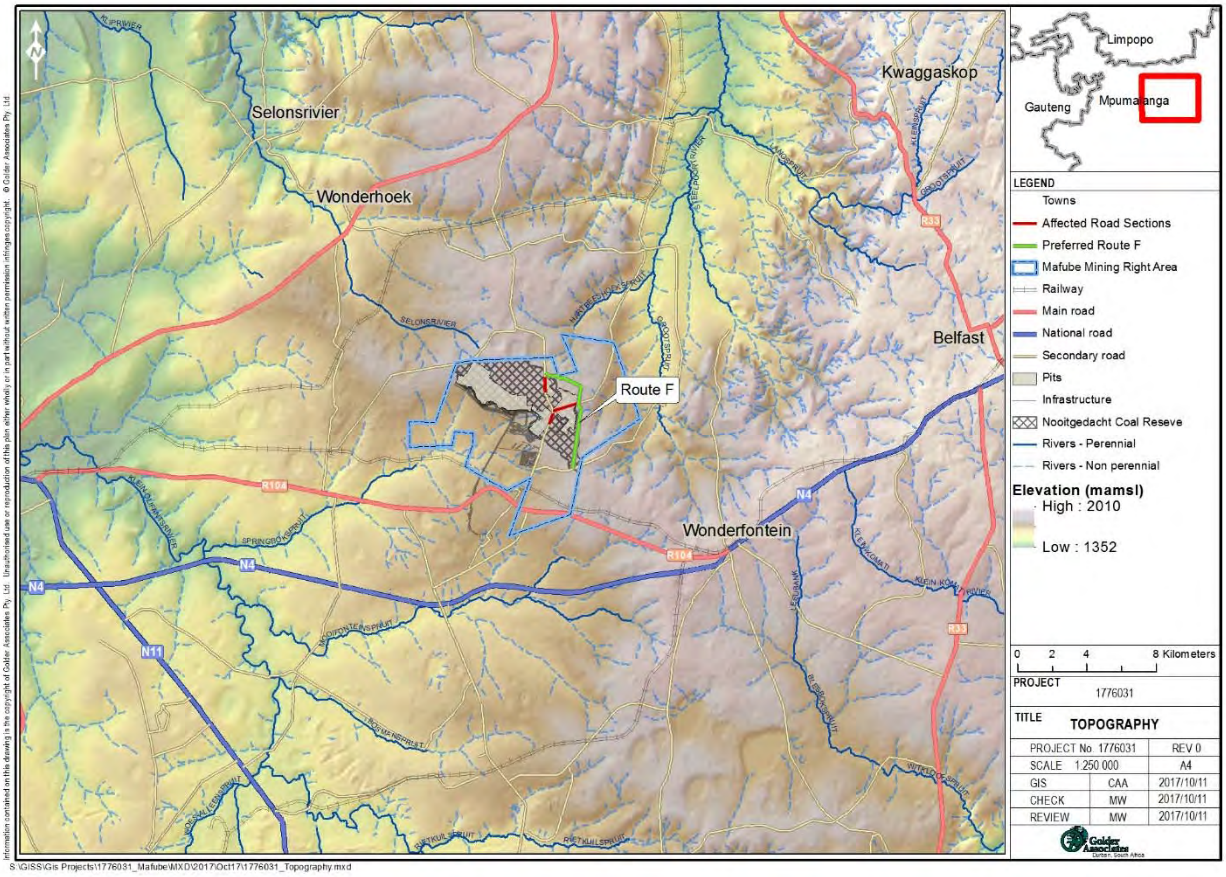

Figure 2: Topography in the vicinity of the Mafube operations

5.2 Land use and sensitive receptors

Current land use in the vicinity of the proposed route comprises cultivated land and pasture. With the development of the LifeX project, large portions of the cultivated land west of the proposed route will mined (Figure 3: East Pit 2 and 3).

Receptors in the vicinity of the proposed route include wetlands, low density (dispersed) households and farm complexes. A school is located approximately 1 km north of the proposed route, adjacent to the existing route D684. Sikhululiwe is the closest village, approximately 2 km east of the proposed route.

Figure 3: Potential receptors in close proximity (<1 km) to the proposed Route F.

5.3 Baseline noise environment

Measurements and auditory observations were taken in May 2007 and December 2011 by Jongens Keet Associates at 13 in order to establish the ambient noise conditions of the study area (. The following results were presented in the Final Report (JKA602r005 dated 28 June 2012):

- Residual noise levels at the various farmhouses and farm labourers' dwellings are relatively low (quiet). Daytime ambient conditions across the area range from about 38 dBA to 48 dBA near the main road. Evening conditions range from about 30 dBA to 39 dBA, while the night-time ambient levels fall even lower to about 25 dBA in places. These are acceptable rural residential conditions (SANS 10103).
- Residual noise levels at the schools meet the noise standards required for educational purposes, namely does not exceed 50 dBA during school hours.

The monitoring results from Points 4, 5 and 6 are particularly relevant to this study. Point 5 provides the an indication of the baseline noise levels at Route F, while points 4 and 6 provide an indication of the potential future noise regime likely to be experienced during the operational phase of Route F (Table 4).

The average L_{Aeq} at points 4 and 6 was 42.1 dBA, approximately 3 dB lower than the typical rural residential noise level rating of 45 dBA.

Noise levels at point 5 were comparatively higher, averaging 43.8 dBA.

Table 4: Noise measurements made by Jongens Keet Associates in 2007 and 2011

Site	Location	Dates	Daytime			Night time		
			L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
4	At Sikhululiwe Village, just west of Road D684	May 2007	38.8	47.6	29.6	35.5	41.2	29.9
		December 2011	43.8	58.4	28.5	-	-	-
5	At a farm house on farm Roodepoort 418-JS, approximately 600 m east of Road D684	May 2007	40.8	58.0	31.1	34.8	44.7	31.7
		December 2011	46.8	64.9	31.4	-	-	-
6	At school and houses just east of Road D684	May 2007	40.2	53.7	29.7	-	-	-
		December 2011	45.6	57.5	29.3	-	-	-

In addition to the baseline monitoring, Jongens Keet Associates the prevailing 24-hour residual noise level related to the average daily traffic (ADT) flows on the main roads through the area were also calculated. The noise levels generated from the traffic on these roads were calculated using the *South African National Standard SANS 10210 Calculating and Predicting Road Traffic Noise* and 2011 traffic data. The results for the D684 are shown in Table 5.

According to these calculations, the road traffic along the D684 results in the degradation of the noise climate by up to 100 m from the road centreline.

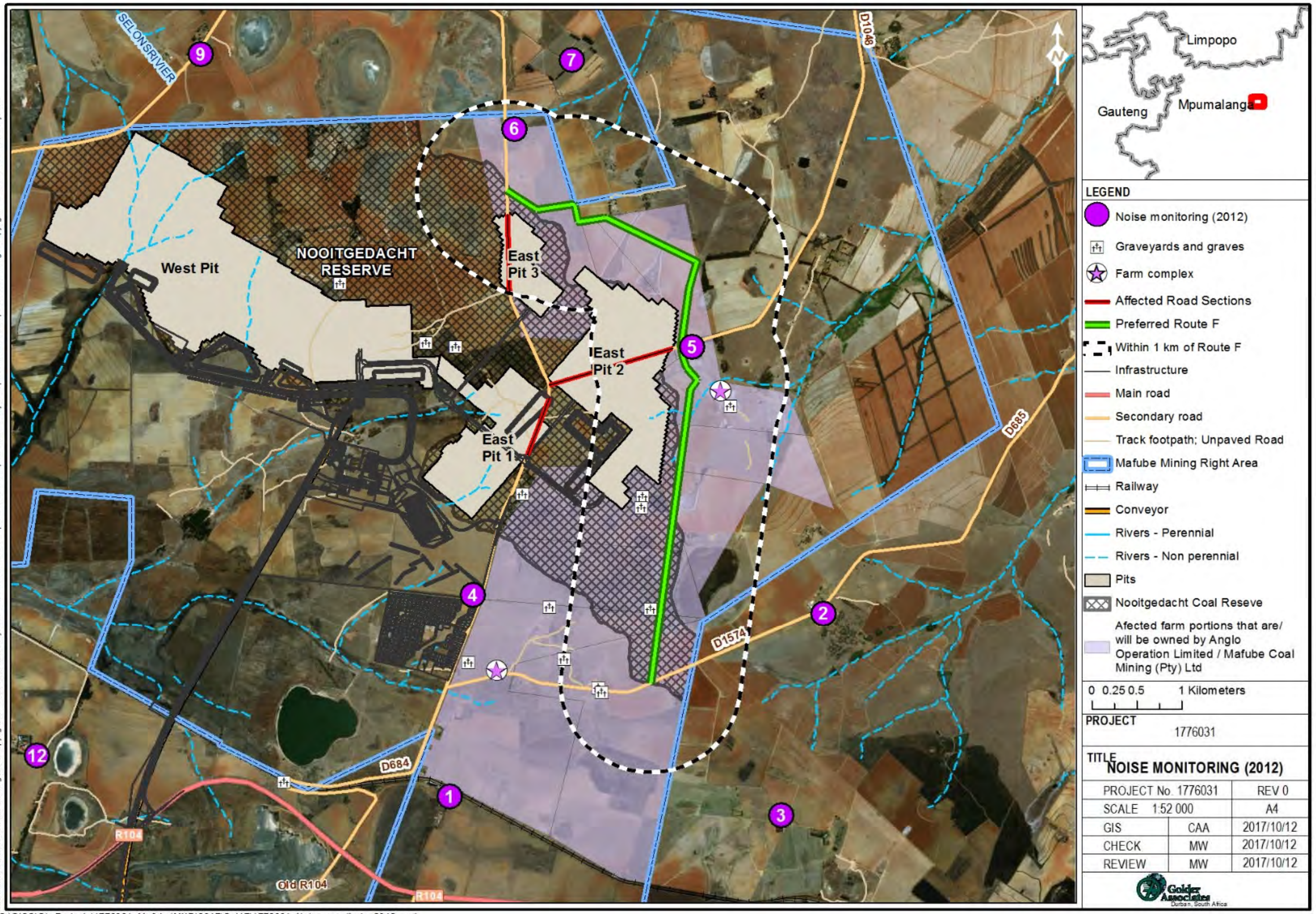

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Figure 4: Baseline noise monitoring locations (Jongens Keet Associates, 2012)

Table 5: Calculated noise climate alongside the D684 (Jongens Keet Associates, 2012)

Road	Offset from D684 centreline														
	25 m			50 m			100 m			250 m			500 m		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
D684N	46	37	47	43	34	44	40	31	40	36	27	36	32	23	32
D684S	51	42	51	48	39	48	45	36	45	40	31	41	36	27	37

Note: Red text indicates exceedance of the typical noise level rating for a rural residential district during the day (L_d = 45 dB) or night (L_n = 35 dB) period.

6.0 ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Methodology for Assessing Impact Significance

The significance of identified impacts was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Table 6: Impact assessment factors

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude of impact

To assess these factors for each impact, the following four ranking scales are used:

Table 7: Impact assessment scoring methodology

Magnitude	Duration
10- Very high/unknown	5- Permanent (>10 years)
8- High	4- Long term (7 - 10 years, impact ceases after site closure has been obtained)
6- Moderate	3- Medium-term (3 months- 7 years, impact ceases after the operational life of the activity)
4- Low	2- Short-term (0 - 3 months, impact ceases after the construction phase)
2- Minor	1- Immediate
Scale	**Probability**
5- International	5- Definite/Unknown
4- National	4- Highly Probable
3- Regional	3- Medium Probability
2- Local	2- Low Probability
1- Site Only	1- Improbable
0- None	0- None

Significance Points= (Magnitude + Duration + Scale) x Probability.

Table 8: Significance of impact based on point allocation

Points	Significance	Description
SP>60	High environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 - 60	Moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP<30	Low environmental significance	Impacts with little real effect and which will not have an influence on or require modification of the project design.

Points	Significance	Description
+	Positive impact	An impact that is likely to result in positive consequences/effects.

For the methodology outlined above, the following definitions were used:

- Magnitude is a measure of the degree of change in a measurement or analysis (e.g., the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorization of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely-recognised standards are to be used as a measure of the level of impact;
- Scale/Geographic extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- Duration refers to the length of time over which an environmental impact may occur: i.e. immediate/transient, short-term (0 to 7 years), medium term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent; and
- Probability of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

6.2 Project Phases

The environmental impacts of the project were assessed for the:

- Pre-construction phase;
- Construction phase;
- Operational phase; and
- Closure and rehabilitation phase.

6.3 Detailed description of Potential Impacts during all phases of the proposed Road Realignment project

6.4 Impact Assessment Summary

All the predicted environmental impacts resulting from the proposed project activities are described in Table 9 along with their significance ratings before and after mitigation.

6.4.1 Pre-construction (land clearing) and construction phase

The noise levels created by construction equipment will vary greatly depending on factors such as the type of equipment, the specific model, the operation being performed and the condition of the equipment. The equivalent sound level (L_{eq}) of the constriction activity also depends on the fraction of time that the equipment of operated over the time period of construction. Construction equipment can be broken down into two classes (British Standard, 1997; South Australian EPA, 2014, and U.S. Department of Transportation, 2006):

- Stationary Equipment: Stationary equipment consists of equipment that generates noise from one general area and includes items such as pumps, generators, compressors, etc. These types of equipment operate at a constant noise level under normal operation and are classified as non-impact equipment. Other types of stationary equipment such as jackhammering or blasting operations, produce variable and sporadic noise levels and often produce impact-type noises. Impact equipment is equipment that generates impulsive noise, where impulsive noise is defined as noise of short duration (generally less than one second), high intensity, abrupt onset, rapid decay, and often rapidly changing spectral composition. For impact equipment, the noise is produced by the impact of a mass on a surface, typically repeating over time; and

- Mobile Equipment: Mobile equipment such as dozers, scrapers, graders, etc., may operate in a cyclic fashion in which a period of full power is followed by a period of reduced power. Other equipment such as compressors, although generally considered to be stationary when operating, can be readily relocated to another location for the next operation.

It is anticipated that the construction of the road will generate noise in excess of the ambient noise standards[1] and pose an annoyance to those in close proximity to the activity particularly with regards to impact noise which is considered more intrusive than continuous noise.

6.4.2 Operation

Given that the proposed Route F is a new route passing through vegetated (cultivated/ pasture) land, it is anticipated that the operation of the route will alter baseline noise levels notably. Based on the results of the baseline monitoring adjacent to the D684, as well as the calculated current[2] D684 traffic noise, it is anticipated that the deterioration of the noise environment will be limited to within 100 m of the proposed route. Residential area levels[1] are expected to prevail beyond 100 m, provided traffic volumes do not increase significantly from the current baseline. Noise may travel further during peak traffic and under certain meteorological conditions.

While, elevated noise levels may be considered to be a nuisance within 100 m of the road, there are no receptors identified within this area (Figure 5). Route F will be a public road, therefore the implementation of mitigation measures is restricted by Mafube's limited influence on the vehicles using this route.

The divergence of traffic away from the Sikhululiwe Village is anticipated to have a positive impact on noise levels recorded at the Village.

6.4.3 Decommissioning

It is assumed that the road will not be decommissioned and will remain open to the public post the Mafube LifeX closure. Impacts will therefore continue so long as the road is in use.

---

[1] Residential: 45 dBA (day) and 35 dBA (night)

[2] It is assumed traffic volumes have not changed significantly from 2011 to present

Table 9: Impact significance rating

Description of impact	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation
Construction												
Degeneration of the prevailing noise environments at a receptor due to construction noise	6	2	2	4	40	Moderate	4	2	2	4	32	Moderate
Operation												
Degeneration of the prevailing noise environment at a receptor (>100 m from the roadway) due to traffic noise	4	4	1	4	36	Moderate	2	4	2	3	24	Low
Decommissioning												
N/A	-	-	-	-	-	N/A	-	-	-	-	-	N/A

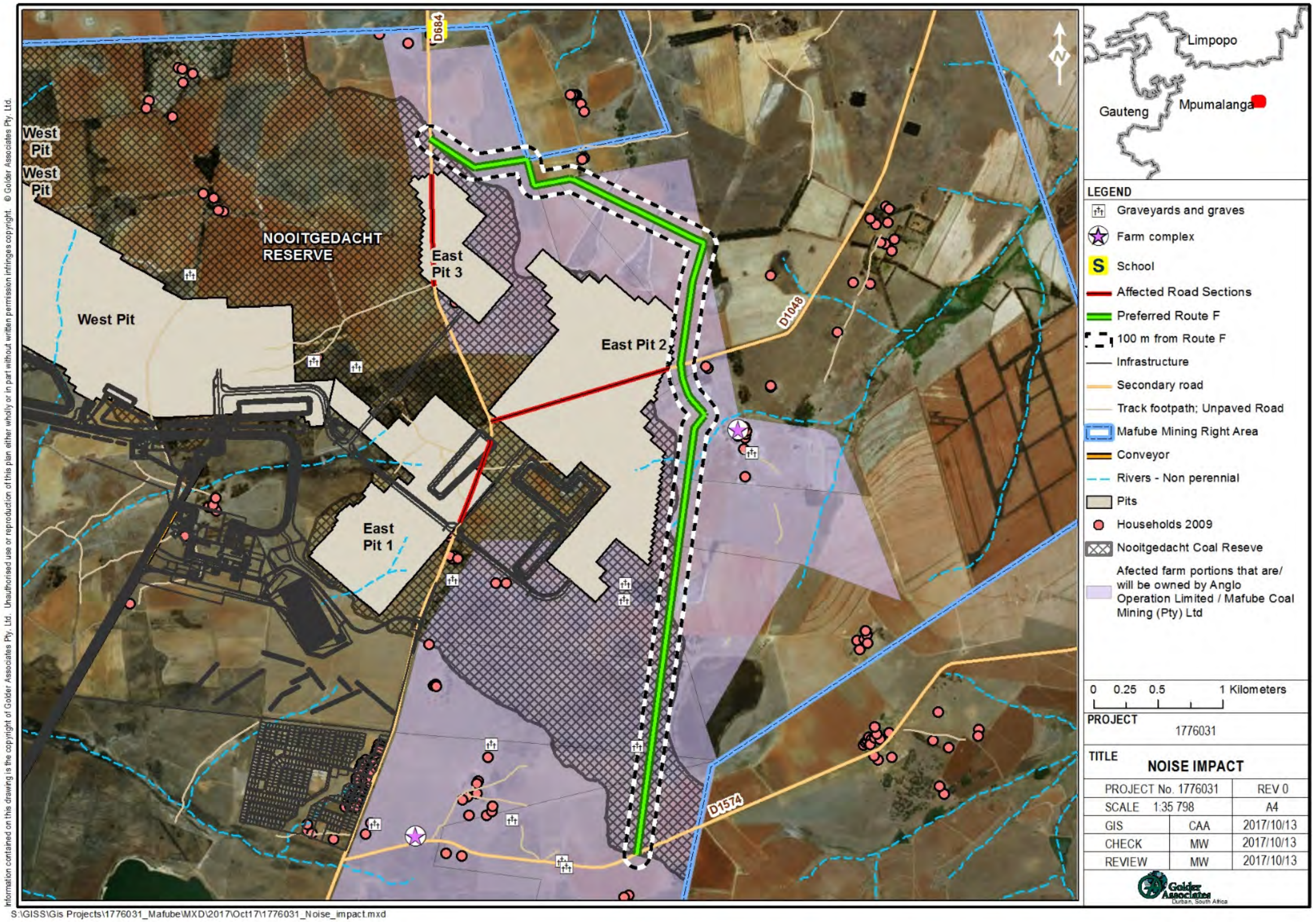

Figure 5: Anticipated noise impact radius

7.0 ENVIRONMENTAL MANAGEMENT PROGRAMME

This Environmental Management Programme (EMPr) addresses the management of potential environmental impacts related to the proposed road realignment project. The EMPr is used for managing, mitigating, and monitoring of the environmental impacts associated with construction, operational and rehabilitation phases of the realigned route.

7.1 Objectives

- To reduce noise emissions as far as it is possible using appropriate, reasonable and feasible measures for mitigation and management; and
- To monitor project related noise emissions impact on receptors; and
- To ensure compliance with relevant national regulations.

7.2 Environmental Management and Mitigation Measures Identified

7.2.1 Avoid

- Avoid night-time construction activities.

7.2.2 Minimize

- Notify neighbours prior to commencing activities that will generate significant noise.
- A complaints reporting procedure should be established and all complaints logged.
- Reroute truck traffic away from residential areas where possible.
- Shut down or throttle down equipment whenever they are not in actual use.
- Combine noisy operations to occur in the same time period.
- Keep noise generating equipment such as generators and air compressors as far away from noise sensitive receptors where possible.
- Select quieter equipment where possible.
- Use newer equipment where possible.
- Ensure equipment is well maintained.
- Ensure personel are trained to carry out their respective tasks.
- Use screening (such as trees) where receptors experience annoyance.
- Enforce vehicle speed control.

7.3 Potential Cumulative Impacts Identified

The Mafube LifeX project will be a significant source of noise and vibration in the local environment once operational. Even if the noise resulting from Route F alone does not pose an annoyance at the receptor, the addition of the comparatively significant contribution of the LifeX project may.

7.4 Potential Impacts to be mitigated in their respective phases

7.4.1 Construction phase

- Notify neighbours prior to commencing activities that will generate significant noise. Good communication can prevent complaints from arising, and resolve concerns before there is a problem. A phone number where a project representative can be reached should be provided prior to the work commencing;

- A complaints reporting procedure should be established and all complaints logged. Investigations into the cause of the complaints should be initiated and appropriate mitigation measures applied timeously;
- Reroute truck traffic away from residential areas where possible;
- Keep noise generating equipment such as generators and air compressors as far away from noise sensitive receptors as possible;
- Shut down or throttle down equipment (such as backhoes, cranes, bobcats, loaders and generators) whenever they are not in actual use;
- Combine noisy operations to occur in the same time period. The total noise level produced will not be significantly greater than the level produced if the operations were performed separately;
- Avoid night-time construction activities. Sensitivity to noise increases during night-time hours;
- Select quieter equipment where possible. For example, while most compressors are powered by diesel or gasoline engines, many are contained or have baffles to help abate noise levels. Electric compressors are significantly quieter than diesel or gasoline engine powered compressors.
- Use newer equipment where possible as it is generally quieter than old equipment for many reasons, including technological advancements and the lack of worn, loose, or damaged components.
- Ensure equipment is well maintained. Poor maintenance of equipment typically causes excessive noise levels. Faulty or damaged mufflers and loose engine parts such as screws, bolts, or metal plates contribute to increased noise levels. Removal of noise-reducing attachments and devices such as mufflers, silencers, covers, guards, vibration isolators, etc., will, to varying degrees, increase noise emission levels. Old equipment may be made quieter by simple modifications, such as adding new mufflers or sound absorbing materials. Loose and worn parts should be fixed as soon as possible; and
- Ensure personel are trained to carry out their respective tasks. Careless or improper operation or inappropriate use of equipment can increase noise levels. Poor loading, unloading, excavation, and hauling techniques are examples of how lack of adequate guidance and training may lead to increased noise levels.

7.4.2 Operational phase

As the road will be open to the public, options for noise mitigation during the operational phase are limited to screening (such as trees) where receptors experience annoyance; vehicle speed control, and good road maintenance.

A complaints log should be maintained and noise compliance monitoring should be undertaken at receptor locations, should receptors raise concerns regarding Route F noise contributions.

7.5 Summary of Mitigation and Management measures for the Operational, Decommissioning and Closure phases

Table 10: Summary of Mitigation and Management measures

Detailed Mitigation Measures	Mitigation Type (Modify, remedy, control or stop)	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
■ Avoid night time construction ■ Notify neighbours prior to commencing activities that will generate significant noise. ■ A complaints reporting procedure should be established and all complaints logged. ■ Reroute truck traffic away from residential areas where possible. ■ Shut down or throttle down equipment whenever they are not in actual use. ■ Combine noisy operations to occur in the same time period. ■ Keep noise generating equipment such as generators and air compressors as far away from noise sensitive receptors as possible. ■ Select quieter equipment where possible. ■ Use newer equipment where possible. ■ Ensure equipment is well maintained. ■ Ensure personnel are trained to carry out their respective tasks.	Control through management and noise control	Measures must be implemented when required	Impacts minimised at receptor locations	Measures should aim to reduce noise emissions to ensure the noise intrusion is less than 3 dB(A) at the nearest receptor location	ECO/ Construction manager
■ Use screening (such as trees) where receptors experience annoyance. ■ Enforce vehicle speed control.	Control through management and noise control	Measures must be implemented when required	Impacts minimised at receptor locations	Measures should aim to reduce noise emissions to ensure the noise intrusion is less than 3 dB(A) at the nearest receptor location	Environmental/ SHE officer

7.6 Mechanisms for monitoring compliance

Table 11: Recommendations for monitoring

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (for the execution of the monitoring programme)	Monitoring and reporting frequency and time periods for implementing impact management actions
Construction of Route F (including land clearing, materials transfer, grading etc.)	Noise	A complaints log should be maintained and noise compliance monitoring should be undertaken at receptor locations, should receptors raise concerns regarding construction noise	Mafube Environmental/ SHE officer	Monitoring should be performed on an ad hoc basis as required
Operation (use) of Route F	Noise	A complaints log should be maintained and noise compliance monitoring should be undertaken at receptor locations, should receptors raise concerns regarding Route F noise contributions	Mafube Environmental/ SHE officer	Monitoring should be performed on an ad hoc basis as required

8.0 DATA GAPS AND ASSESSMENT SHORTCOMINGS

- This assessment is based on outdated baseline monitoring data (> 6 years old); and
- This assessment is purely qualitative. In order to increase the confidence level of this assessment, Golder recommends Mafube undertake simple noise propagation modelling to gain an understanding of the spatial extent of the impact of the Route F traffic noise.

9.0 CONCLUSION

Given that the proposed Route F is a new route passing through vegetated (cultivated/ pasture) land, it is anticipated that the operation of the route will alter baseline noise levels notably. Based on the results of the baseline monitoring adjacent to the D684, as well as the calculated current D684 traffic noise, it is anticipated that the deterioration of the noise environment will be limited to within 100 m of the proposed route. Residential area levels (45 dBA during the day and 35 dBA during the night) are expected to prevail beyond 100 m, provided traffic volumes do not increase significantly from the current baseline. Noise may travel further during peak traffic and under certain meteorological conditions.

Sikhululiwe may experience a decrease in noise associated with vehicle traffic due to the diversion of the D684. Noise levels at the school however are anticipated to remain the same as the D684 route adjacent the school will not be altered.

As the road will be open to the public, options for noise mitigation during the operational phase are limited to screening (such as trees) where receptors experience annoyance; and vehicle speed control.

A complaints log should be maintained and noise compliance monitoring should be undertaken at receptor locations, should receptors raise concerns regarding Route F noise contributions.

10.0 REFERENCES

British Standard (1997) Noise and Vibration Control on Construction and Open Sites. Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration Control. BS 5228. ICS 17.140.20; 17.160; 91.200.

International Finance Corporation (IFC) 2007 Environmental Health and Safety Guidelines for Noise management.

South Africa (1992). Noise control regulations in terms of Section 25 of the Environment Conservation Act, 1989 (Act 73 of 1989). (R154, 1992) Government Gazette 13717:14-22, January 10 (Regulation Gazette No. 4807).

South African Standard - Code of practice, SANS 10328:2008, Methods for Environmental Noise Impact Assessments.

South African Standard - Code of practice, SANS 10357:2004, The Calculation of Sound Propagation by the Concawe Method.

South African Standard - Code of practice, SANS ISO 8297:1994, Acoustics - Determination of sound power levels of multisource industrial plants for evaluation of sound pressure levels in the environment - Engineering method.

South Australian Environmental Protection Agency (2014) Construction Noise Information Sheet. EPA 425/14. Updated April 2014.

U.S. Department of Transportation, (2006) Federal Highway Administration: Construction Noise Handbook. DOT-VNTSC-FHWA-06-02, August 2006.

Report Signature Page

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APPENDIX A

Detailed Methodology

APPENDIX A

GLOSSARY OF TERMS
AND
NOISE IMPACT CRITERIA

APPENDIX A: GLOSSARY OF TERMS AND NOISE IMPACT CRITERIA

A1. GLOSSARY OF TERMS

In order to ensure that there is a clear interpretation of this report the following meanings should be applied to the acoustic terminology:

- **Ambient sound level** or **ambient noise** means the totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far. Note that ambient noise includes the noise from the noise source under investigation. The use of the word *ambient* should however always be clearly defined (compare with *residual noise*).
- **A-weighted sound pressure, in Pascals**: The root-mean-square sound pressure determined by use of frequency-weighting network A.
- **A-weighted sound pressure level (SPL) (noise level) (L_{pA}), in decibels**: The sound pressure level of A-weighted sound pressure is given by the equation:

  $L_{pA} = 10 \log (p_A/p_o)^2$ where:

  p_A is the A-weighted sound pressure, in Pascals; and

  p_o is the reference sound pressure (p_o = 20 micro Pascals (μPa))

  Note: The internationally accepted symbol for sound pressure level, dB(A), is used.
- **Controlled areas** as specified by the National Noise Control Regulations are areas where certain noise criteria are exceeded and actions to mitigate the noise are required to be taken. Controlled areas as related to roads, airports and factory areas are defined. These Regulations presently exclude the creation of *controlled areas* in relation to railway noise.
- **dB(A)** means the value of the sound pressure level in decibels, determined using a frequency weighting network A. (The “A”-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Disturbing noise** means a noise level that exceeds the outdoor equivalent continuous rating level for the time period and neighbourhood as given in Table 2 of SANS 10103:2004. For convenience, the latter table is reproduced in this appendix as Table A1.
- **Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$)** means the value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, has the same mean-square sound pressure as a sound under consideration whose level varies with time.
- **Equivalent continuous rating level ($L_{Req,T}$)** means the equivalent continuous A-weighted sound pressure level during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day.

- **Equivalent continuous day/night rating level ($L_{R,dn}$)** means the equivalent continuous A-weighted sound pressure level during a reference time interval of 24-hours, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day. (An adjustment of +10dB is added to the night-time rating level).
- **Integrating sound level meter** means a device that integrates a function of the root mean square value of sound pressure over a period of time and indicates the result in dBA.
- **Noise** means any acoustic phenomenon producing any aural sensation perceived as disagreeable or disturbing by an individual or group. Noise may therefore be defined as any *unwanted* sound or sound that is *loud, unpleasant or unexpected*.
- **Noise climate** is a term used to describe the general character of the environment with regard to sound. As well as the ambient noise level (quantitative aspect), it includes the qualitative aspect and the character of the fluctuating noise component.
- **Noise Control Regulations** means the regulations as promulgated by the National Department of Environmental Affairs.
- **Noise impact criteria** means the standards applied for assessing noise impact.
- **Noise level** means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation, and, if the alleged disturbing noise has a discernible pitch, for example, a whistle, buzz, drone or music, to which 5dBA has been added. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Noise nuisance** means any sound which disturbs or impairs or may disturb or impair the convenience or peace of any reasonable person considering the location and time of day. This applies to a disturbance which is not quantitatively measurable such as barking dogs, etc. (compared with disturbing noise which is measurable).
- **Residual sound level** means the ambient noise that remains at a position in a given situation when one or more specific noises are suppressed (compare with *ambient noise*).
- **Sound** means the aural sensation caused by rapid, but very small, pressure variations in the air. In quantifying the subjective aural sensation, "loudness", the letters dBA after a numeral denote two separate phenomena:
    - "dB", short for *decibel*, is related to the human's subjective response to the change in amplitude (or largeness) of the pressure variations.
    - The "A" denotes the ear's different sensitivity to sounds at different frequencies. The ear is very much less sensitive to low (bass) frequency pressure variations compared to mid-frequencies.

The level of environmental sound usually varies continuously with time. A human's subjective response to varying sounds is primarily governed by the total sound energy received. The total sound energy is the average level of the fluctuating sound, occurring during a period of time, multiplied by the total time period. In order to compare the effects of different fluctuating sounds, one compares the average sound level over the time period with the constant level of a steady, non-varying sound that will produce the same energy during the same time period. The average energy of sound varying in amplitude is thus equivalent to the continuous, non-varying sound. The two energies are equivalent.

- **Sound exposure level or SEL** means the level of sound accumulated over a given time interval or event. Technically the sound exposure level is the level of the time-integrated mean square A-weighted sound for stated time or event, with a reference time of one second.
- **Sound (pressure) level** means the reading on a sound level meter taken at a measuring point.
- **SANS 10103** means the latest edition of the South African National Standard SANS 10103 titled *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*.
- **SANS 10210** means the latest edition of the South African National Standard SANS 10210 titled *Calculating and Predicting Road Traffic Noise*.
- **SANS 10328** means the latest edition of the South African National Standard SANS 10328 titled *Methods for Environmental Noise Impact Assessments*.
- **SANS 10357** means the latest edition of the South African National Standard SANS 10357 titled *The Calculation of Sound Propagation by the Concawe Method*.
- Refer also to the various South African National Standards referenced above and the Noise Control Regulations for additional and, in some instances, more detailed definitions.

TABLE A1: TYPICAL NOISE RATING LEVELS FOR AMBIENT NOISE IN DISTRICTS (NOISE ZONES)

Type of District	Equivalent Continuous Rating Level for Noise ($L_{Req,T}$) (dBA)					
	Outdoors			Indoors with open windows		
	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)	Day-night ($L_{R,dn}$)	Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts (little road traffic)	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS						
d) Urban districts (some workshops, business premises and main roads)	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

TABLE A2: NOISE LEVELS/RANGES OF NOISE LEVELS THAT MAY BE EXPECTED IN SOME TYPICAL ENVIRONMENTS

Noise Level dB(A)	Typical Environment	Subjective Description
140	30m from jet aircraft during take-off	
130	Pneumatic chipping and riveting (operator's position)	Unbearable
>120	Hearing damage possible even for short exposure	
120	Large diesel power generator	
105-120	Low level military aircraft flight	
110-120	100 m from jet aircraft during take-off	
110	Metal workshop (grinding work), circular saw	
105-110	High speed train at 300 km/h (peak pass-by level at 7,5m)	
90-100	Printing press room	Very noisy
95-100	Passenger train at 200km/h (peak pass-by level at 7,5m).	Very noisy
95-100	Freight train at 100 km/h (peak pass-by level at 7,5 m)	Very noisy
90-100	Discotheque (indoors)	
75-100	7,5 m from passing motorcycle (50 km/h)	
75-80	10 m from edge of busy freeway (traffic travelling at 120 km/h)	
80-95	7,5 m from passing truck (50 km/h)	
80	Kerbside of busy street	
70	Blaring radio	Noisy
70	3 m from vacuum cleaner	Noisy
60-80	7,5 m from passing passenger car (50 km/h)	
65	Normal conversation	
65	Large busy office	
60	Supermarket/small office	
50	Average suburban home (day conditions)	Quiet
40	Library	
40-45	Average suburban home (night-time)	
30-35	Average rural home (night-time)	
25-30	Slight rustling of leaves	
20	Background in professional recording studio	Very quiet
20	Forest (no wind)	
0-20	Experienced as complete quietness	
0	Threshold of hearing at 1000 Hz	

A2. NOISE IMPACT CRITERIA

The international tendency is to express noise exposure guidelines in terms of absolute noise levels. These guidelines imply that in order to ascertain an acceptable living environment, ambient noise in a given type of environment should not exceed a specified absolute level. This is the approach provided by the environmental guidelines of the World Bank and World Health Organisation, which specify 55dBA during the day (06:00 to 22:00) and 45dBA during the night (22:00 to 06:00) for residential purposes, determined over any hour. SANS 10103 conforms to the described international tendency. The recommended standards to be applied are summarised in Table A1.

Communities generally respond to a change in the ambient noise levels in their environment, and the guidelines set out in SANS 10103 provide a good indication for estimating their response to given increases in noise. The suggested severity criteria for the noise impacts are summarised in terms of the above guidelines in Table A3.

TABLE A3: CATEGORIES OF COMMUNITY/GROUP RESPONSE (CRITERIA FOR THE ASSESSMENT OF THE SEVERITY OF NOISE IMPACT)

Increase in Ambient Noise Level (dBA)	Estimated Community/Group Response	
	Category	Description
0 – 10	Little	Sporadic complaints
5 – 15	Medium	Widespread complaints
10 - 20	Strong	Threats of community/group action
Greater than 15dBA	Very strong	Vigorous community/group action

Changes in noise level are perceived as follows:

- *3dBA:* For a person with average hearing acuity, an increase in the general ambient noise level of 3dBA will be just detectable.
- *5dBA:* For a person with average hearing acuity an increase of 5dBA in the general ambient noise level will be significant, that is he or she will be able to identify the source of the intruding noise. According to SANS 10103 the community response for an increase of less than 5dBA will be 'little' with 'sporadic complaints'. For an increase of equal or more than 5dBA the response changes to 'medium' with 'widespread complaints'.
- *10dBA:* A person with average hearing will subjectively judge an increase of 10dBA as a doubling in the loudness of the noise. According to SANS 10103 the estimated

community reaction will change from ‘medium’ with ‘widespread complaints’ to ‘strong’ with ‘threats of community action’.

In the National Noise Control Regulations which are applicable in Mpumalanga Province, an intruding noise is defined as ‘disturbing’ if it causes the ambient noise level to rise by 7dBA or more.

APPENDIX B

Additional Data

APPENDIX B:

DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

APPENDIX B: DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

B1. GENERAL

The technical details of the noise measurement survey and general *noise climate* investigation related to the potential noise impact of the construction of and operations at the planned Nooitgedacht and Wildfontein Opencast Sections of the Mafube Colliery near Middelburg, Mpumalanga Province are dealt with in this Appendix.

The noise impact assessment was undertaken in accordance with the requirements of the South African National Standard SANS 10328 *Methods for Environmental Noise Impact Assessments*. Noise measurements were taken at thirteen main monitoring sites in the study area in order to establish the residual (existing) *noise climate*.

B2. STANDARDS AND MEASUREMENT EQUIPMENT

The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the South African National Standard SANS 10103:2008, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication*. A Type 1 Integrating Sound Level Meter, a Rion NA-28, was used for the noise measurements. The meter was calibrated at an accredited acoustical laboratory within the last 12 months. The calibration status of the meter was also checked before and after completion of the total measurement period of the day. A calibrated signal with a sound pressure level of 94,0dB at 1 kHz was applied to the meter. A Rion Sound Calibrator NC-74 was used.

For all measurements taken to establish the ambient noise levels, the equivalent noise level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) during that measurement period were recorded. The frequency weighting setting was set on “A” and the time weighting setting of the meters were set on *Impulse* (I). Measurement periods of a minimum of 10 minutes were used. In addition, the variation in instantaneous sound pressure level (SPL) over a short period was also measured at some of the Sites. For these latter measurements the time weighting setting of the meter was also set on *Impulse* (I).

At all the measurement sites, the meters were set up with the microphone height at 1,3 metres above ground level and well clear of any reflecting surfaces (a minimum of 3 metres clearance). For all measurements, a standard windshield cover (as supplied by the manufacturers) was placed on the microphone of the meter.

At the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and the noise, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

At each measurement site a portable recording weather station, a Kestrel 4000 Pocket Weather Tracker (Serial No. 569322) was set up in the vicinity of the sound level meter and the wind speed, temperature, humidity, barometric pressure, and altitude were recorded. The wind direction was determined by means of a compass; and the cloud cover was noted by direct observation.

B3. MEASUREMENT DATA

B3.1. Measurement Sites

Noise measurements to establish current ambient noise conditions were taken at thirteen (13) main sites in the study area, as indicated in Figure B1 and Table B1. General auditory observations were taken at these sites as well as at a number of sites in the study area.

B3.2. Measurement Dates/Times

General observation of the noise conditions in the study area as well as the site specific sound pressure level (noise) measurements and observations were taken on Monday 12 December 2011 from 10h00 to 16h30. In addition, data from an earlier measurement survey, taken on Wednesday, 30 May 2007 from 13h00 and 17h00, and on Thursday 31 May 2007 during the daytime period from 10h00 to 18h00 and in the evening/night from 20h00 to 23h30 are included

B3.3. Noise Measurement Details

The results of the residual noise condition measurement survey are summarised in Table B1. The equivalent sound pressure (noise) level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) are indicated. Note that the equivalent sound pressure (noise) level may, in layman's terms, be taken to be the average noise level over the given period. This "average" is also referred to as the residual noise level (excluding the impacting noise under investigation) or the ambient noise level (if the impacting noise under investigation is included).

TABLE B1: MEASURED CURRENT RESIDUAL NOISE LEVELS IN THE MAFUBE COAL MINE STUDY AREA

Site No	Location Description	GPS Co-ordinates	Dates	Measured Sound Pressure Level (dBA)					
				Daytime Period			Evening Period		
				L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
1	At farmhouse on farm Springboklaagte 416-JS just east of Arnot Station and south of the railway line. The site lies to the south of the new mine.	S25°46.803' E29°46.825'	May 2007	46.3	58.7	36.0	36.6	44.7	31.2
			Dec 2011	48.3	59.2	42.5	-	-	-
2	At farmhouse on farm Roodepoort 418-JS (farm "Daydream") just north of Road D1574, approximately 4 200m east of Road D684. The site lies to the east of the new mine.	S25°45.588' E29°49.369'	May 2007	45.1	60.4	33.5	30.2	37.1	25.5
			Dec 2011	47.0	60.6	29.2	-	-	-
3	At farmhouse on farm Wildfontein 420-JS. The site is approximately 2 000m south of Road D1564. The site lies to the south east of the new mine.	S25°46.920' E29°49.484'	May 2007	38.2	55.6	26.9	32.6	40.7	26.2
			Dec 2011	37.1	53.6	21.7	-	-	-
4	At Sikhululiwe Village on farm Springboklaagte 416-JS just west of Road D684 and approximately 200m north of the intersection with Road D1574. The site lies to the south of the mine.	S25°45.976' E29°46.873'	May 2007	38.8	47.6	29.6	35.5	41.2	29.9
			Dec 2011	43.8	58.4	28.5	-	-	-
5	At farmhouse on farm Roodepoort 418-JS. The site is just south of Road D1048, approximately 1 600m east of Road D684. The site lies to the east of the new mine.	S25°43.975' E29°48.490'	May 2007	40.8	58.0	31.1	34.8	44.7	31.7
			Dec 2011	46.8	64.9	31.4	-	-	-
6	On farm Nooitgedacht 417-JS, at school and houses just east of Road D684. The site lies to the east of the new mine.	S25°42.623' E29°47.196'	May 2007	40.2	53.7	29.7	-	-	-
			Dec 2011	45.6	57.5	29.3	-	-	-
7	At farmhouse on farm Panplaats 395-JS. The site is approximately 800m east of Road D684. The site lies to the east of the mine.	S25°42.270' E29°47.375'	May 2007	43.2	56.7	38.0	32.8	42.2	27.6
			Dec 2011	-	-	-	-	-	-
8	At farm labourer dwellings on farm Olifantslaagte 378-JS, just north of Road D2779. The site lies to the north of the new mine.	S25°39.451' E29°44.872'	May 2007	43.8	53.2	25.6	-	-	-
			Dec 2011	-	-	-	-	-	-
9	At farm labourer dwellings on farm Panplaats 395-JS just north of Road D435. The site lies just north of the new mine.	S25°42.097' E29°45.251'	May 2007	41.5	57.1	27.2	36.4	47.2	26.1
			Dec 2011	39.8	52.6	33.3	-	-	-
10	At farm labourer dwellings on farm Zonnebloem 396-JS. The site lies just north of Road D435. The site lies to the north west of the new mine.	S25°42.846' E29°43.624'	May 2007	45.2	51.7	38.9	35.1	41.7	29.4
			Dec 2011	-	-	-	-	-	-

Site No	Location Description	GPS Co-ordinates	Dates	Measured Sound Pressure Level (dBA)					
				Daytime Period			Evening Period		
				L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
11	Near farmhouse on the farm Patattafontein 412-JS. The site is approximately 2 000m east of Road D435. The site lies to the east of the new mine.	S25°44.693’ E29°41.994’	May 2007	39.8	45.7	32.6	38.8	44.2	33.6
			Dec 2011	39.6	55.2	23.2	-	-	-
12	At farmhouse on farm Zevenfontein 415-JS. The site lies approximately 1 600m north of Road R104. The site lies to the south of the new mine.	S25°46.523’ E29°44.162’	May 2007	41.3	49.1	25.7	36.7	42.1	29.7
			Dec 2011	37.6	54.0	25.5	-	-	-
13	On Farm Panplaats 398-JS just east of Road 684, opposite survey trigonometrical beacon No. 50.	S25°40.224’ E29°46.088’	May 2007	-	-	-	-	-	-
			Dec 2011	41.7	56.1	29.7	-	-	-

B3.4. Noise Climate Related to the 24 hour Road Traffic

In order to complement the short-term noise measurements in the study area, the existing 24-hour residual noise level related to the average daily traffic (ADT) flows on the main roads through the area were also calculated. The main roads affecting the noise climate of the area are as follows (also refer to Figure 1 in the main noise impact assessment report):

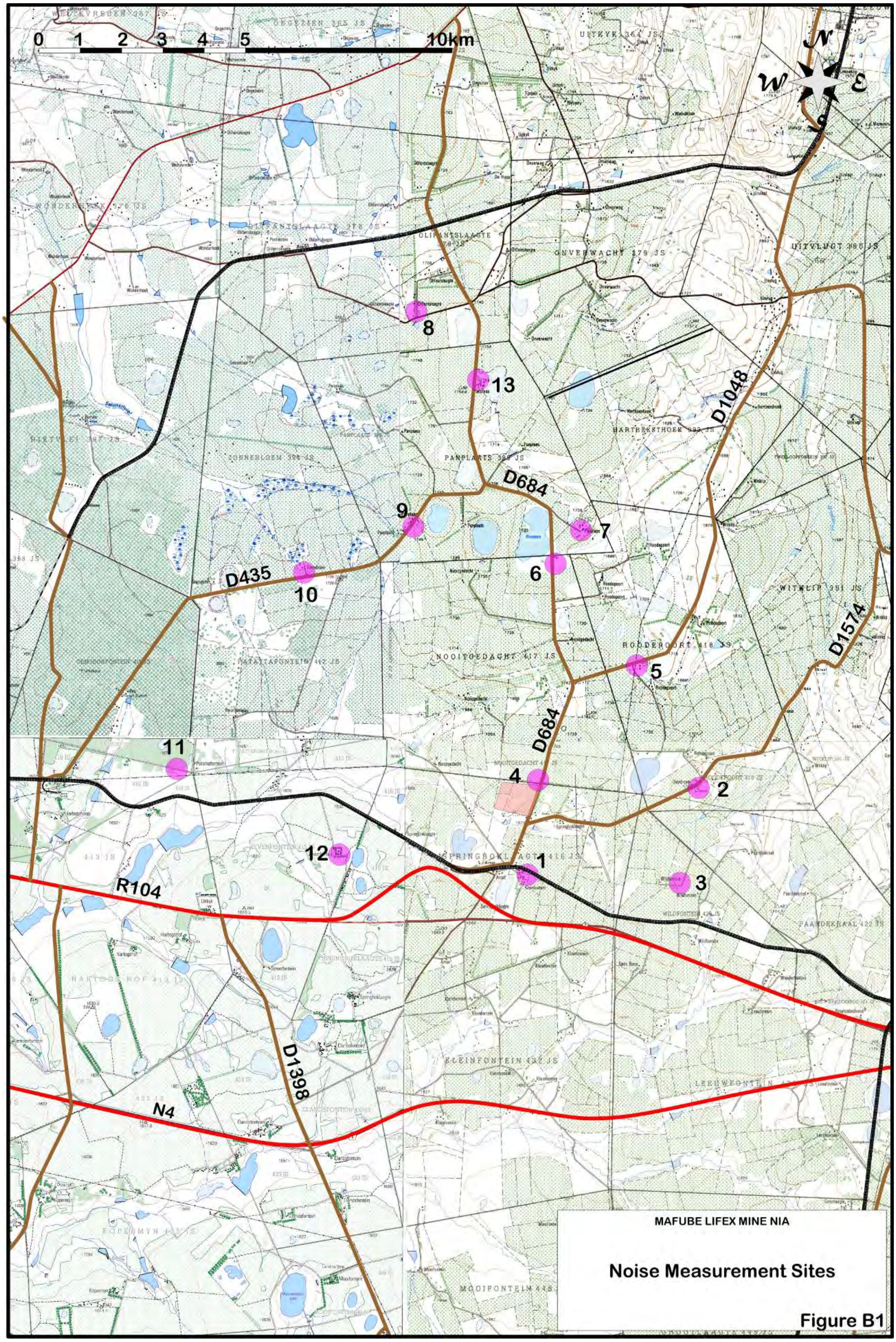
i) National Road N4 – National Freeway aligned in an east-west direction through the southern sector of the study area.
ii) Road P154/4 (Route R104) – major Provincial road aligned in an east-west direction through the southern-central sector of the study area.
iii) Road D1398 – Provincial road linking National Road N4 to Route R104.
iv) Road D684 (North) – north-south aligned District road linking northwards from District Road D435.
v) Road D684 (South) - north-south aligned District road linking northwards from Arnot Station to Road D1048.
vi) Road D435 – District road aligned in an east-west direction from Road D684 through to Pan Station.
vii) Road D1574 – east-west aligned route linking eastwards from Road D684.
viii) Road D1048 – east-west aligned route linking eastwards from Road D684.
ix) Road D2779 – east-west aligned route through the northern sector of the study area.

These calculated noise values provide an accurate base for the SANS 10103 descriptors. The noise levels generated from the traffic on these roads were calculated using the South African National Standard SANS 10210 *Calculating and Predicting Road Traffic Noise*. Typical situations were used for the calculation site. The Year 2011 traffic data were used as the baseline for the calculations. These volumes of traffic were extrapolated from earlier year counts. The traffic data were obtained from the Mpumalanga Department of Transport Road Asset Management System.

The noise levels at various offsets from the relevant road centrelines were established and are summarised in Table B2. The noise descriptors used are those prescribed in SANS 10103:2008, namely:

i) Daytime equivalent continuous rating (noise) level ($L_{Req,d}$) (L_d used in table), namely for the period from 06h00 to 22h00).
ii) Night-time equivalent continuous rating (noise) level ($L_{Req,n}$) (L_n used in table), namely for the period from 22h00 to 06h00).
iii) Day-night equivalent continuous rating (noise) level ($L_{R,dn}$) (L_{dn} used in table), namely for the 24 hour period from 06h00 to 06h00).

The noise levels given are for generalised and the unmitigated conditions. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point.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D1574
R104
D1398
N4
MAFUBE LIFEX MINE NIA
Noise Measurement Sites
Figure B1

TABLE B2: EXISTING NOISE CLIMATE ADJACENT TO RELEVANT ROADS (YEAR 2011 TRAFFIC)

Road	Noise Climate Alongside the Main Roads at Given Offset from Centreline (SANS 10103 Indicator) (dBA)																																
	25m Offset			50m Offset			100m Offset			250m Offset			500m Offset			1000m Offset			1500m Offset			2000m Offset			2500m Offset			3000m Offset			4000m Offset		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
N4	68.5	62.6	70.3	65.5	59.6	67.3	62.3	56.4	64.1	57.9	52.0	59.7	54.1	48.2	55.9	49.6	43.7	51.4	46.5	40.6	48.3	44.3	38.4	46.1	42.4	36.5	44.2	41.0	35.1	42.8	38.5	32.6	40.3
P154/4	63.1	54.2	63.5	60.1	51.2	60.5	56.9	48.0	57.3	52.5	43.6	52.9	48.7	39.8	49.1	44.2	35.3	44.6	41.1	32.2	41.5	38.9	30.0	39.3	37.0	28.1	37.4	35.6	26.7	36.0	33.1	24.2	33.5
D1398	57.9	49	58.3	54.9	46.0	55.3	51.7	42.8	52.1	47.3	38.4	47.7	43.5	34.6	43.9	39.0	30.1	39.4	35.9	27.0	36.3	33.7	24.8	34.1	31.8	22.9	32.2	30.4	21.5	30.8	27.9	19.0	28.3
D684N	46.1	37.2	46.5	43.1	34.2	43.5	39.9	31.0	40.3	35.5	26.6	35.9	31.7	22.8	32.1	27.2	18.3	27.6	24.1	15.2	24.5	21.9	13.0	22.3	20.0	11.1	20.4	18.6	9.7	19.0	16.1	7.2	16.5
D684S	50.7	41.8	51.1	47.7	38.8	48.1	44.5	35.6	44.9	40.1	31.2	40.5	36.3	27.4	36.7	31.8	22.9	32.2	28.7	19.8	29.1	26.5	17.6	26.9	24.6	15.7	25.0	23.2	14.3	23.6	20.7	11.8	21.1
D435	59	50.1	59.4	56.0	47.1	56.4	52.8	43.9	53.2	48.4	39.5	48.8	44.6	35.7	45.0	40.1	31.2	40.5	37.0	28.1	37.4	34.8	25.9	35.2	32.9	24.0	33.3	31.5	22.6	31.9	29.0	20.1	29.4
D1574	47.0	38.1	47.4	44.0	35.1	44.4	40.8	31.9	41.2	36.4	27.5	36.8	32.6	23.7	33.0	28.1	19.2	28.5	25.0	16.1	25.4	22.8	13.9	23.2	20.9	12.0	21.3	19.5	10.6	19.9	17.0	8.1	17.4
D1048	40.2	31.3	40.6	37.2	28.3	37.6	34.0	25.1	34.4	29.6	20.7	30.0	25.8	16.9	26.2	21.3	12.4	21.7	18.2	9.3	18.6	16.0	7.1	16.4	14.1	5.2	14.5	12.7	3.8	13.1	10.2	1.3	10.6
D2779	38.9	30.0	39.3	35.9	27.0	36.3	32.7	23.8	33.1	28.3	19.4	28.7	24.5	15.6	24.9	20.0	11.1	20.4	16.9	8.0	17.3	14.7	5.8	15.1	12.8	3.9	13.2	11.4	2.5	11.8	8.9	0.0	9.3

B3.5. Noise Climate Related to Railway Traffic

There are three main railway lines through the area.

i) The Middelburg – Derwent – Arnot – Wonderfontein – Belfast line is aligned in a west to east direction through the centre of the study area. There are, at present, 11 trains on this line per day.

ii) The Derwent – Stoffberg line is aligned in a south-west to north-east direction through the north-western quadrant of the study area. There are, at present, 5 trains on this line per day.

iii) The Wonderfontein – Pullen's Hope line is aligned through the south-east quadrant of the study area. There are, at present, 6 trains on this line per day.

With the pass-by of each train past a noise sensitive receptor there will be a fluctuation in sound pressure level ranging from the normal background noise for the area (residual noise level) to a maximum as the train passes and then reducing again to the residual level as the train moves away from the receiver point. The approximate maximum noise levels that will be experienced with the pass-by of a train at various offsets from the railway line and for various typical cross-section types are given in Table B3. Note that the noise levels for the sections at-grade and the sections on fill are the same. The values given are the unmitigated noise levels.

TABLE B3: TYPICAL MAXIMUM NOISE LEVELS FOR OPERATIONAL CONDITIONS ALONG THE RAILWAY LINE

Offset (m)	Maximum Pass-by Noise Level (L_{Amax}) (dBA)		
	At-grade/Fill Section	Cutting Section	
		3m Depth	7m Depth
25	93,3	81,5	77,9
50	88,3	75,7	71,1
100	82,2	69,3	64,3
200	75,6	62,6	57,4
300	71,9	58,9	53,4
500	66,5	53,5	48,0

i) The operations of the trains have the potential to adversely influence the noise climate of the areas along the railway corridors to a larger or lesser extent for significant distances from the tracks. The propagated noise will be attenuated with distance from the source, the nature of the ground cover on the intervening ground, and from screening by the natural topography and buildings. The wheel-rail generated noise is enhanced where the train is travelling on elevated structure.

ii) The character (qualitative aspect) of the railway operational noise will have many facets. The component of noise that will predominate at maximum operating speed will be the wheel-rail interaction noise. The noise from diesel locomotives will be much higher than that from electric locomotives. The noise from the locomotives will be slightly louder than that from the wagons. With the pass-by of each train, the perceived noise at any one receiver point within the area of influence of the train will fluctuate relatively rapidly from the normal background (ambient) noise level of the area to peak at the maximum, will then fall slightly once the locomotives have passed the closest point to the receiver to remain fairly constant at this level until the whole train has passed by the near-ground and then will fall back to the area's ambient level as the train moves into the far distance. This whole cycle can take place over a period of several minutes, depending on the length and the speed of the train.

iii) The noise of the braking systems may sometimes be audible. There will possibly be some "flange squeal" (rail-wheel interaction) heard in areas where there are tight-radius track curves. There will also be mechanical banging sounds from the wagon couplings when the trains slow down or accelerate.

iv) It is normally mandatory that a train sounds a warning horn at at-grade crossings with roads. Noise from these horn soundings can be as loud as 105dBA at 30 metres and 84dBA at 350 metres from the train.

v) The noise impact from a train relates normally to the nuisance (annoyance) impact as the train passes.

B3.6. Prevailing Noise Climate

In overview, the existing situation with respect to the *noise climate* in the study area was found to be as follows:

i) In general the residual noise levels in the study area are low (that is, the area is very quiet). The noise levels are typically representative of a rural area (farming community).

ii) The main sources of noise in the area are from traffic on the roads through the area, the railway lines and from various collieries, namely:

   a. Mafube Colliery on the Farm Springboklaagte to the south of the planned open cast pits.
   b. Elcoal Mining on the farm Elandsfontein 433 JS to the west of Road D1398 and south of Road R104.
   c. Kopermyne Colliery which lies on the farm Kopermyn 435 JS and lies just to the north of National Road N4 and west of Road D1398.
   d. Vuna Colliery is being developed on the Farm Zonnebloem 396 JS to the north-west of the planned open cast pits.

iii) The existing *noise climate* alongside the relevant roads are degraded with regard to residential living for up to the following distances:

a. National Road N4	-	2200 metres
b. Road P154/4 (Route R104)	-	1000 metres
c. Road D1398	-	250 metres
d. Road D684N	-	25 metres
e. Road D684S	-	100 metres
f. Road D435	-	500 metres
g. Road D1754	-	50 metres

iv) Residual noise levels at the various farmhouses and farm labourer dwellings are relatively low (quiet). Daytime ambient conditions across the area range from about 38dBA to 45dBA near the main road. Evening conditions range from about 30dBA to 39dBA, while the night-time ambient levels fall even lower to about 25dBA in places. These are acceptable rural residential conditions (SANS 10103).

v) Residual noise levels at the school just to the south of Arnot railway siding meet the noise standards required for educational purposes.

APPENDIX C

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Golder Associates

October 2017

MAFUBE COAL MINING (PTY) LTD

Environmental Impact Assessment (EIA) for the Proposed Mafube Road Realignment Project- Biodiversity Study

Submitted to:
Mafube Coal Mining (Pty) Ltd

REPORT

Report Number. 1776031

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ABBREVIATIONS AND ACRONYMS

Abbreviation / Acronym	Explanation
CBA	Critical Biodiversity Area
DWS	Department of Water and Sanitation
IUCN	International Union for the Conservation of Nature
MBSP	Mpumalanga Biodiversity Sector Plan
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas

1.0 INTRODUCTION

Golder Associates Africa (Pty) Ltd (Golder) was appointed to conduct an ecological impact assessment of the proposed road realignment project in the Mafube LifeX Mining Rights Area (MRA), in Mpumalanga Province, South Africa.

This document presents the findings of impact assessment and associated management recommendations.

2.0 STUDY METHODOLOGY

Note: *Data on aquatic ecosystems in the Mafube LifeX MRA was included in the ecology scoping report for the proposed realignment project. However, no surface water systems/strictly aquatic ecosystems are located within the preferred road realignment route study area. The impact assessment thus focused on terrestrial and wetland ecology.*

2.1 Terrestrial Ecology

The terrestrial ecology study comprised two components, a desk-top literature review and a field survey / walk-down of the proposed road realignment corridor. The tasks associated with these are discussed below.

2.1.1 Literature Review

Existing specialist studies for the Mafube LifeX Project were reviewed to develop a baseline description of flora and fauna communities. These include:

- The 2011/2012 terrestrial ecology assessment t for the Mafube LifeX Mining Rights Area (Golder, 2012 - Report No. 11616366-11332-6);
- Survey for Plant of Conservation Importance in infrastructure footprint areas at Mafube Colliery – Stage 1 (Golder, 2016); and
- Alien Invasive Species Management Plan for the Mafube Mining Rights Area, 2017 (Golder, 2017 - Report No. 1776031-314542-1).

Where applicable, these data were updated to reflect current conservation plans (e.g. MBSP, 2013), conservation statuses (e.g. Red List status) and invasive listing categories (as per NEMBA Alien and Invasive Species Lists, 2016).

2.1.2 Field Survey / Road Walk-down

The walk down of the proposed road corridor was conducted on the 10th August 2017. The main aim of the walk down from a terrestrial ecology perspective was to:

- Develop an on-ground characterisation of the habitat types affected by the proposed road development;
- Identify any important ecological features or sites.

Notes were made on general characteristics, plant species composition, habitat condition and evidence of disturbances along and adjacent to the corridor. The presence of flora species of conservation importance was also recorded.

Note: The walk down was conducted during the dry season. Many plant species were therefore dormant, and it is anticipated that some would not be readily visible or identifiable.

2.2 Wetland Ecology

Several comprehensive wetland studies have been previously conducted for the entire Mafube mining rights area (WCS, 2015). The results of these studies were reviewed and used to inform the current assessment. As the role of wetlands in delivery of ecosystem services has not been reported since 2011, an updated assessment of wetland ecosystem service delivery was conducted using the WET-Health tool (see Section 3.4).

2.2.1 Wetland Delineation and Classification

The previously-conducted wetland boundary delineation and classification (WCS, 2015) was deemed to be sufficient for the purposes of the current assessment. The procedure utilised in delineation of the wetland boundary was in accordance with the guidelines set out by the Department of Water Affairs and Forestry (DWAF, 2005).

Wetlands were classified based on their hydro-geomorphic (HGM) characteristics i.e. on the position of the wetland in the landscape, as well as the way in which surface water and/or ground water moves into, through and out of the wetland systems.

2.2.2 Wetland Health Assessment (Present Ecological State)

The results of the most recent wetland health assessments (WCS 2015; WCS, 2013) were reviewed for wetlands within the Study Area. Those assessments used the WET-Health assessment tool described in Macfarlane *et al.,* (2008) for valley bottom and hillslope seepage type wetlands, and a specifically-developed method for determining the present ecological state of pans and depressions (WCS, 2013).

Hillslope Seepage Wetlands

A rapid field survey of the Study Area was conducted in August 2017 to determine whether any new significant drivers of change that could influence the hydrological, geomorphological and vegetation components of ecological integrity of hillslope seepage wetlands, and thus their PES score and category, was conducted on 10 August 2017.

Pans and Depressions

The present ecological state of pans and depressions in the study area was determined as part of the pan offset study for the Mafube mining rights area, conducted at baseline (WCS, 2013). The PES scores for pans and depressions were derived from an assessment method developed by WCS (in lieu of WET-Health which is applicable to valley bottom and hillslope seepage systems only), which incorporated analysis of aspects including diatom assemblages, and water and sediment quality parameters. The PES scores derived for pans as part of the pan offset study (WCS, 2013) were not updated and were considered appropriate for the purposes of this assessment.

A summary of the impact categories and scores, and associated Present Ecological State (PES) categories is provided in **Table 1**.

Table 1: Present Ecological State (PES) categories for describing the integrity of wetlands (Macfarlane *et al.,* 2008)

Impact Category	Description	PES Category
None	Unmodified, or approximates natural condition	**A**
Small	Largely natural with few modifications, but with some loss of natural habitats	**B**
Moderate	Moderately modified, but with some loss of natural habitats	**C**
Large	Largely modified. A large loss of natural habitat and basic ecosystem function has occurred	**D**
Serious	Seriously modified. The losses of natural habitat and ecosystem functions are extensive	**E**
Critical	Critically modified. Modification has reached a critical level and the system has been modified completely with almost complete loss of natural habitat	**F**

2.2.3 Wetland Ecological Importance and Sensitivity

An EIS category was determined for each identified wetland unit as part of the previous baseline studies using the scoring system described in DWAF (1999), in order to establish a baseline of the current state of the wetlands, and to provide an indication of the conservation value and sensitivity of the wetlands. The results of the EIS assessments were reflected in the placement of each wetland unit into a category based on the assessment scores. A description of the EIS categories is provided in Table 2.

Table 2: Wetland EIS categories

Ecological Importance and Sensitivity (EIS)	Category
Very high	**A**
Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	
High	**B**
Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	
Moderate	**C**
Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	
Low/marginal	**D**
Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	

2.2.4 Wetland Ecosystem Services

An updated wetland ecosystem services assessment was conducted for the wetlands in the Study Area, in order to establish a baseline of the current level of provisioning of ecosystem services by each wetland type, to beneficiaries of those services.

The ecosystem services assessment was undertaken using the Level 2 Wet-EcoServices assessment tool (Kotze *et. al.,* 2009). This tool provides a scoring system for assessing the level of ecosystem service provision, through establishing both the effectiveness of a wetland in providing ecosystem services, and the opportunity for the wetland to provide ecosystem services based on its catchment and downstream characteristics of the wetland. These scores are then combined to determine the likely extent to which a benefit is being supplied, with a maximum achievable score of 4 (Table 3).

Table 3: Classes for determining the likely extent to which a benefit is being supplied based on the overall score for that benefit

Score	**<0.5**	**0.5-1.2**	**1.3-2.0**	**2.1-2.8**	**>2.8**
Rating of the extent to which a benefit is being supplied	Low	Moderately low	Intermediate	Moderately high	High

Following the scoring process, the scores for each wetland HGM type were depicted on a spider diagram to clearly illustrate the level of delivery of each ecosystem service.

3.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The following national and provincial legislation was consulted:

- National Environmental Management Act (Act No. 107 of 1998) (NEMA);
- National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA), specifically:
  - ToPS – National lists of critically endangered, endangered, vulnerable and protected species (2013) (NEMBA ToPS List, 2013);
  - National list of threatened terrestrial ecosystems for South Africa (2011) (NEMBA Threatened Ecosystems, 2011);
  - National list of alien and invasive species (2016);
- Environment Conservation Act (Act No. 73 of 1989), specifically the Lists of declared weeds and invader plants (CARA, 1983);
- National Water Act (Act No. 36 of 1998); and
- Mpumalanga Nature Conservation Act (Act No. 10 of 1998) (ref. Mpumalanga Nature Conservation Act, 1998), incl. Mpumalanga Biodiversity Sector Plan (2013).

4.0 BASELINE - TERRESTRIAL ECOLOGY

4.1 Biophysical Environment – Regional Context

The study area is located in the grassland biome, which covers approximately 28% of South Africa and is the dominant biome of the central plateau and inland areas of the eastern subcontinent (Manning, 2009; SANBI, 2013). Grasslands are typically situated in moist, summer rainfall regions that experience between 400 mm and 2000 mm of rainfall per year. Vegetation consists of a dominant field-layer comprising grasses and herbaceous perennials, with little- to no woody plants.

South Africa's grassland ecosystems are aggregated into five groups, with the study area forming part of the 'Mesic Highveld Grasslands' grouping (*sensu* SANBI 2013). These grasslands occur at mid-altitudes and experience warm, wet summers (MAP 700-1200 mm) and cold winters. They are typically highly productive sourveld[1] grasslands that are dominated by long-lived perennial grasses (SANBI, 2013). Fire is common in Mesic Highveld Grasslands and, coupled with frequent winter frost, maintains these ecosystems in a relatively treeless form (SANBI, 2013; Tainton, 1999). Apart from their importance as rich stores of biodiversity, grasslands are critically important water production landscapes, constituting about half of South Africa's Strategic Water Source Areas (SANBI, 2013).

Based on Mucina and Rutherford (2006) delineation of South Africa's vegetation, the study area is characterised by five vegetation types, namely:

- Rand Highveld Grassland;
- Eastern Highveld Grassland;
- Eastern Temperate Freshwater Wetlands;
- Lydenburg Montane Grassland; and
- Sekhukhune Montane Grassland.

[1] Grasslands where vegetation becomes unacceptable to grazers during the dry season and thus do not provide year-round grazing, unless supplemented by salt licks (Tainton, 1999).

4.2 National and Provincial Conservation Considerations

- In line with the Mpumalanga Biodiversity Sector Plan (2013) and the identification of Critical Biodiversity Areas (CBA), much of the study area comprises ‘Modified Land’ (both old and current agricultural fields) and ‘Other Natural Areas’. Small patches of CBA Optimal and CBA Irreplaceable are present though – Figure 2.
- At a national level, the NEMBA Threatened Ecosystems, (2011) recognises both Rand Highveld Grassland and Eastern Temperate Freshwater Wetlands as Vulnerable ecosystems - Figure 3; and
- The Steenkampsberg Important Bird Area (IBA) is located to the east of the study area.

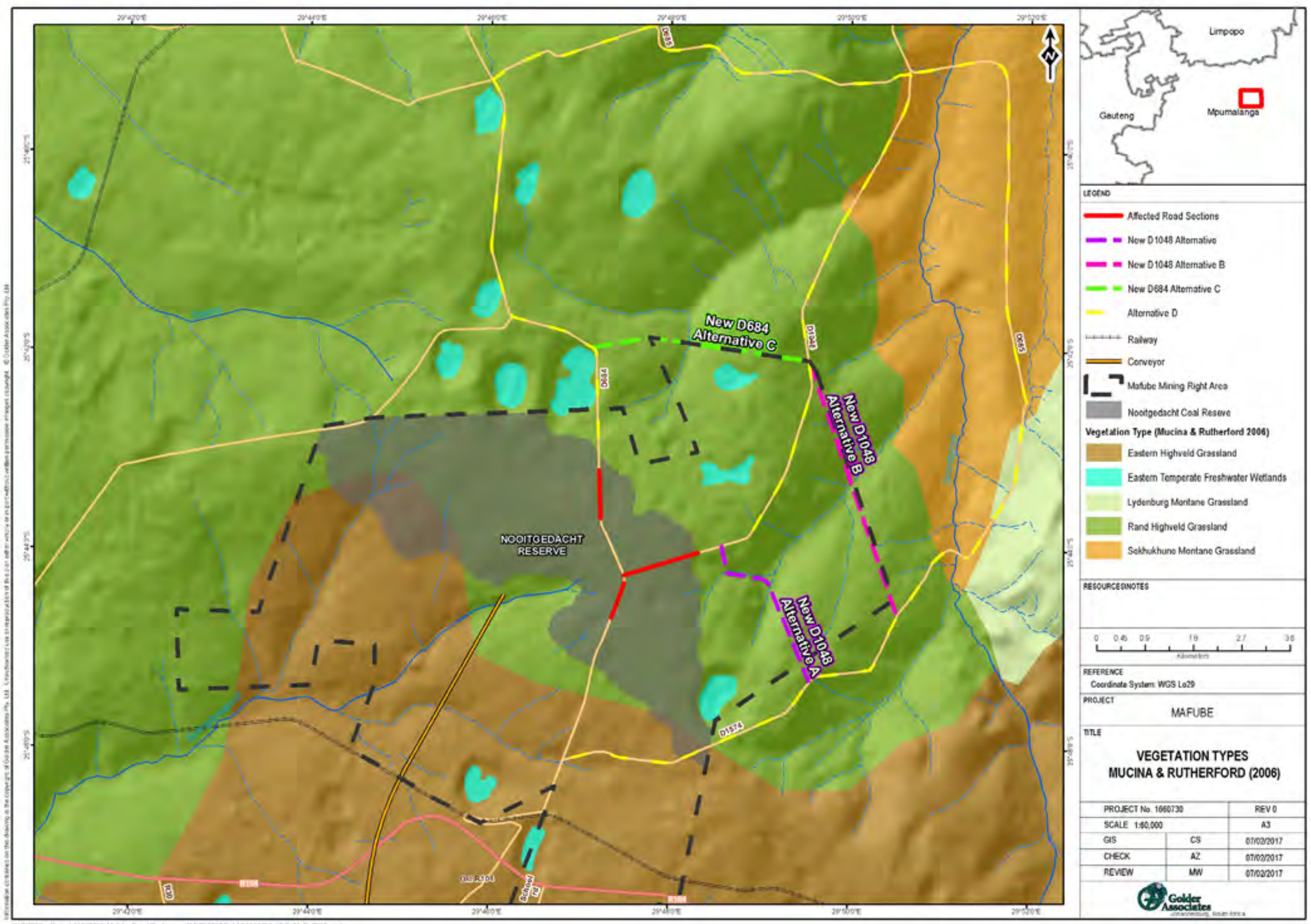


Figure 1: Study area and proposed road alternatives in relation to the regional vegetation types (Mucina & Rutherford, 2006).

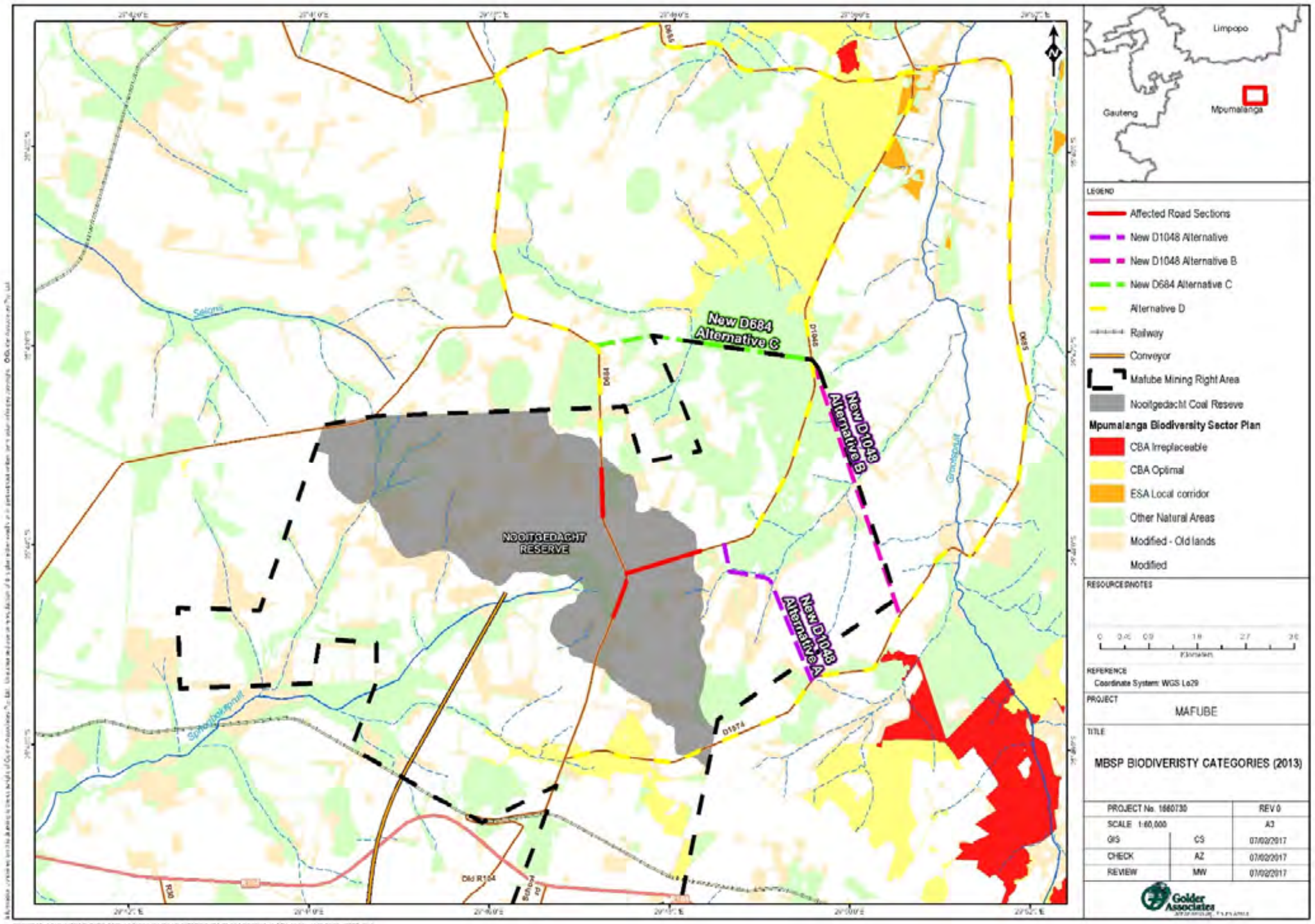


Figure 2: Characterisation of the study area and surrounds in terms of the Mpumalanga Biodiversity Sector Plan (2013).

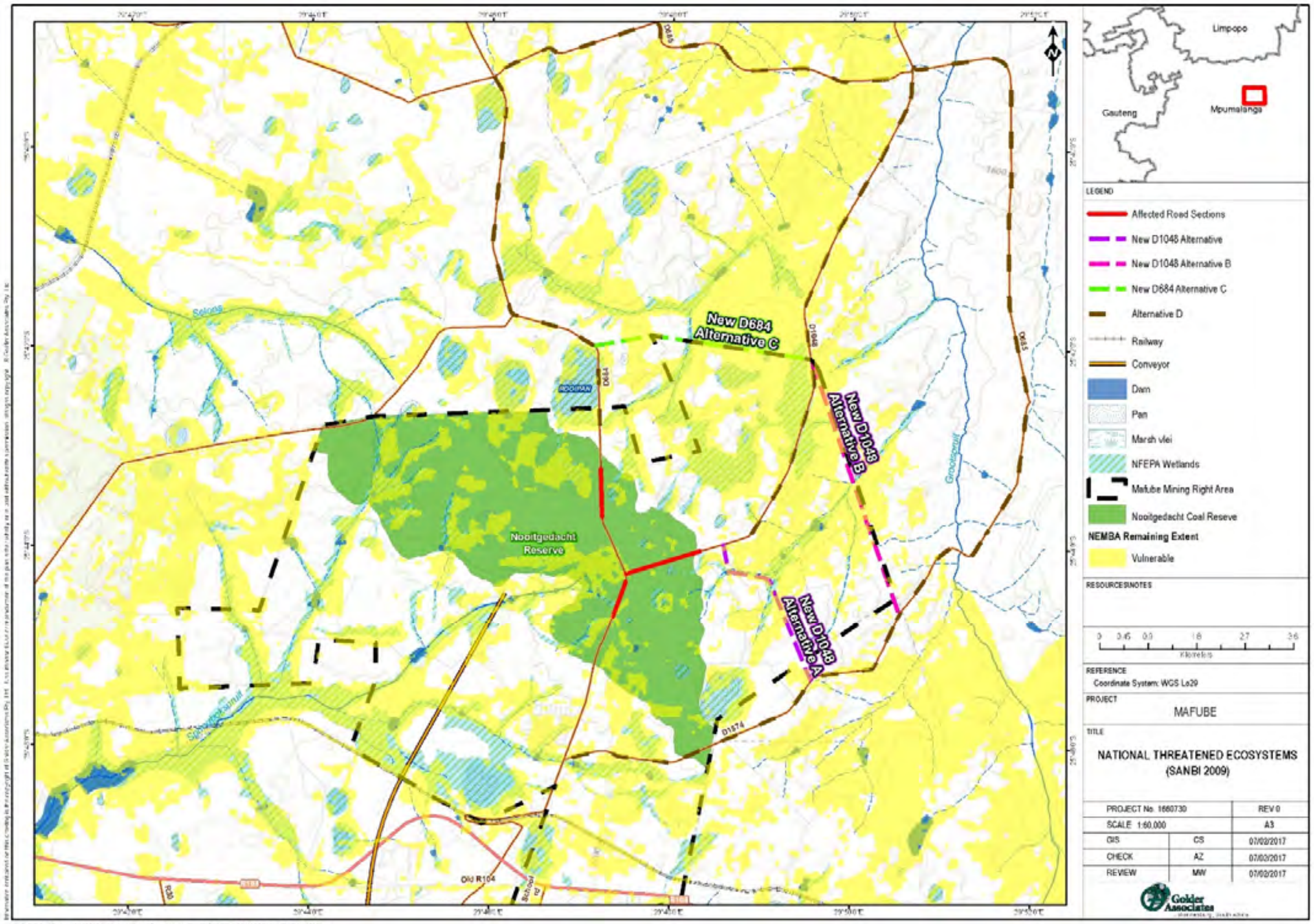


Figure 3: Study area and proposed road alternatives in relation to the NEMBA South African threatened ecosystems.

4.3 Listed Alien Invasive Species

An alien invasive species assessment of the entire Mafube LifeX project was undertaken in March 2017. The assessment identified 42 alien invasive plant species listed under Conservation of Agricultural Resources Act (CARA) (Act No. 43 of 1983) and the National Environmental Management: Biodiversity Act (2004) (NEMBA)(Act No. 10 of 2004) – see Table 4.

Of these, a number were recorded along the proposed road corridor during the walk down, including *Acacia dealbata, Argemone ochroleuca* subsp. *ochroleuca, Datura* spp.*, Eucalyptus grandis, Verbena bonariensis* and *Xanthium strumarium.*

Table 4: Inventory of CARA and NEMBA listed alien invasive species recorded in the Mafube LifeX Study Area

Scientific Name	Common Name	Afrikaans Name	Growth Form	CARA Category	NEMBA Category
Acacia baileyana	Bailey's Wattle	Bailey-se-wattel	Tree	3	3
Acacia melanoxylon	Blackwood	Swarthout	Tree	2	2
Acacia dealbata	Silver Wattle	Silwerwattel	Tree	1	2
Acacia decurrens	Green Wattle	Groenwattel	Tree	2	2
Acacia elata	Pepper Tree Wattle	Elataboom	Tree	3	1b
Acacia mearnsii	Black Wattle	Swartwattel	Tree	2	2
Acer buergerianum	Chinese maple	Chinese esdoring	Tree	X3	3
Agave americana	American Aloe	Blou-aalwyn	Succulent	X2	-
Argemone ochroleuca subsp. *ochroleuca*	White-flowered Mexican Poppy	Witblom-bloudissel	Herbaceous plant	1	1b
Callistemon viminalis	Weeping Bottlebrush	-	Tree	-	1b
Canna indica	Garden Canna	Tuinkanna	Herbaceous plant	1	1b
Cereus jamacaru	Queen of the Night	Nagblom	Cactus	1	1b
Cinnamomum camphora	Camphor Tree	Kanferboom	Tree	1	1b
Cotoneaster franchetii	Orange Cotoneaster	Pronkbessiebossie	Shrub	1	1b
Datura ferox	Large thorn apple	Grootstinkblaar	Herbaceous plant	1	1b
Datura stramonium	Common thorn apple	Gewone stinkblaar	Herbaceous plant	1	1b
Eriobotrya japonica	Loquat	Lukwart	Tree	3	-
Eucalyptus grandis	Saligna Gum	Bloekom	Tree	2	1b, 2 or not listed
Gleditsia triacanthos	Honey locust	Soetpeulboom	Tree	2	1b
Ligustrum japonicum	Japanese Wax-leaved Privet	Japanse Liguster	Tree	1	1b
Melia azedarach	Syringa	Sering	Tree	3	1b
Mirabilis jalapa	Four-o'clocks	Vieruurtjies	Herbaceous plant	X3	1b
Morus alba	White Mulberry	Witmoerbei	Tree	3	3
Opuntia ficus-indica	Sweet prickly Pear	Boereturksvy	Cactus	1	1b
Phytolacca dioica	Belhambra	Bobbejaandruifboom	Tree	3	3
Phytolacca octandra	Inkberry	Inkbessie	Herbaceous plant	1	1b
Pinus patula	Patula Pine	Treurden	Tree	2	2
Pinus pinaster	Cluster Pine	Trosden	Tree	2	1b or 2
Populus alba (*P.* x *canescens*)	White/Grey Polar	Wit/Vaalpopulier	Tree	2	2
Populus deltoides	Match Polar	Vuurhoutjiepopulier	Tree	X3	-
Pyracantha angustifolia	Yellow-fire Thorn	Geelbranddoring	Shrub	3	1b

Scientific Name	Common Name	Afrikaans Name	Growth Form	CARA Category	NEMBA Category
Pyracantha coccinea	Red Firethorn	-	Shrub	3	1b
Robinia pseudoacacia	Black Locust	Witakasia	Tree	2	1b
Salix babylonica	Weeping Willow	Treurwilger	Tree	2	-
Schinus molle	Pepper tree	Peperboom	Tree	X3	-
Sesbania punicea	Red Sesbania	Rooisesbania	Tree	1	1b
Tamarix sp.	Tamarisk	Tamarisk	Woody shrub / tree	3	1b
Tipuana tipu	Tipua Tree	Tipoeboom	Tree	3	3
Ulmus parviflora	Chinese Elm	Chinese Iep	Tree	X3	-
Verbena bonariensis	Wild Verbena	-	Herbaceous plant	-	1b
Xanthium strumarium	Large Cocklebur	Kankerroos	Herbaceous plant	1	1b
*Celtis australis**	Nettle Tree	Netelboom	Tree	X3	3
X indicates a proposed category					
*Possible hybrid with the indigenous *Celtis africana*.					

4.4 Plants of Conservation Importance

Plant species of conservation importance that occur or potentially occur in the study area as per available literature and the field programme are listed in Table 5.

Table 5: Plant species of conservation importance that occur or potentially occur in the Mafube LifeX MRA

Family	Scientific name	Conservation Status		
		Regional IUCN Red List (2015)	NEMBA ToPS List (2013)	Mpumalanga Protected Species (1998)
AGAPANTHACEAE	*Agapanthus campanulatus* subsp. *patens*	Least Concern	-	Protected
AMARYLLIDACEAE	*Brunsvigia radulosa*	Least Concern		Protected
AMARYLLIDACEAE	*Boophone disticha*	Declining	-	Protected
AMARYLLIDACEAE	*Crinum bulbispermum*	Declining		Protected
AMARYLLIDACEAE	*Crinum graminicola*	Least Concern	-	Protected
AMARYLLIDACEAE	*Nerine gracilis*	Near Threatened	-	Near Threatened
APOCYNACEAE	*Brachystelma chloranthum*	Least Concern	-	Protected
APOCYNACEAE	*Ceropegia rendallii*	Least Concern	-	Protected
APOCYNACEAE	*Miraglossum davyi*	Vulnerable	-	Protected
ASPHODELACEAE	*Aloe ecklonis*	-	-	Protected
ASPHODELACEAE	*Aloe greatheadii* var. *davyana*	Least Concern	-	Protected
ASPHODELACEAE	*Aloe lineata*	-	-	Protected
ASPHODELACEAE	*Aloe longibracteata*	-	-	Protected
ASPHODELACEAE	*Aloe masculata*	-	-	Protected
ASPHODELACEAE	*Aloe mutabilis*	-	-	Protected
ASPHODELACEAE	*Aloe reitzii* var. *reitzii*	Near Threatened	-	Near Threatened
ASPHODELACEAE	*Kniphofia typhoides*	Near Threatened	-	Protected
AQUIFOLIACEAE	*Ilex mitis* var. *mitis*	Declining	-	Protected
ARACEAE	*Zantedeschia albomaculata* subsp. *albomaculata*	Least Concern	-	Protected
ASTERACEAE	*Callilepis leptophylla*	Declining	-	-
GESNERIACEAE	*Streptocarpus latens*	Rare	-	Rare

Family	Scientific name	Conservation Status		
		Regional IUCN Red List (2015)	**NEMBA ToPS List (2013)**	**Mpumalanga Protected Species (1998)**
GESNERIACEAE	*Streptocarpus denticulatus*	Vulnerable	-	Vulnerable
HYACINTHACEAE	*Drimia altissima*	Declining	-	Declining
HYACINTHACEAE	*Eucomis autumnalis*	Declining	-	Protected
HYACINTHACEAE	*Eucomis montana*	Declining	-	Protected
HYACINTHACEAE	*Eucomis pallidiflora* subsp. *pallidiflora*	Least Concern	-	Protected
HYACINTHACEAE	*Merwilla plumbea*	Near Threatened	-	Near Threatened
IRIDACEAE	*Gladiolus longicollis* subsp. *longicollis*	Least Concern	-	Protected
IRIDACEAE	*Gladiolus paludosus*	Least Concern	-	Protected
IRIDACEAE	*Gladiolus papilio*	Least Concern	-	Protected
IRIDACEAE	*Gladiolus elliotii*	Least Concern		Protected
IRIDACEAE	*Gladiolus crassifolius*	Least Concern		Protected
IRIDACEAE	*Gladiolus pole-evansii*	Rare	-	Protected
IRIDACEAE	*Gladiolus vernus*	Least Concern	-	Protected
IRIDACEAE	*Gladiolus woodii*	Least Concern	-	Protected
IRIDACEAE	*Hesperantha coccinea*	Least Concern	-	Protected
MESEMBRYANTHEMACEAE	*Delosperma lydenburgense*	Least Concern	-	Protected
MESEMBRYANTHEMACEAE	*Delosperma obtusum*	Least Concern	-	Protected
MESEMBRYANTHEMACEAE	*Khadia carolinensis*	Vulnerable	-	Protected
OLEACEAE	*Olea capensis* subsp. *enervis*	Least Concern	-	Protected
ORCHIDACEAE	*Disa cooperi*	Least Concern	-	Protected
ORCHIDACEAE	*Disa versicolor*	Least Concern	-	Protected
ORCHIDACEAE	*Eulophia ovalis var. bainesii*	Least Concern	-	Protected
ORCHIDACEAE	*Eulophia ovalis var. ovalis*	Least Concern	-	Protected
ORCHIDACEAE	*Eulophia zeyheri*	Least Concern	-	Protected
ORCHIDACEAE	*Habenaria dregeana*	Least Concern	-	Protected
ORCHIDACEAE	*Habenaria bicolor*	Near Threatened	-	Protected
ORCHIDACEAE	*Habenaria kraenzliniana*	Near Threatened	-	Protected
ORCHIDACEAE	*Satyrium hallackii* subsp. *ocellatum*	Least Concern	-	Protected
ORCHIDACEAE	*Satyrium parviflorum*	-	-	Protected
ORCHIDACEAE	*Eulophia cooperi*	Least Concern	-	Protected
SCROPHULARIACEAE	*Jamesbrittenia macrantha*	Near Threatened	-	Near Threatened
ZAMIACEAE	*Encephalartos lanatus*	Vulnerable	Protected	Specially protected

Conservation statuses: SANBI (2015), NEMBA ToPS List (2013) and Mpumalanga Nature Conservation Act (1998).

4.5 Fauna Communities

Data on fauna communities for the Mafube LifeX MRA, as presented in this section, is summarised from existing specialist reports.

4.5.1 Mammals

Based on available literature, 63 mammal species potentially occur in the central grasslands of Mpumalanga Province. Eleven species were recorded in the study area during the 2011/2012 field programme, including Scrub Hare (*Lepus saxatilis*), Porcupine *(Hystrix africaeaustralis*), Black-backed Jackal *(Canis mesomelas*), Slender Mongoose (*Atiliax paludinosus*), Yellow Mongoose (*Cynictis penicillata*), African Wild Cat (*Felis lybica*), Aardvark (*Orycteropus afer*), Common Duiker (*Sylvicapra grimmia*), Steenbok (*Raphicerus campestris*), Red Veld Rat (*Aethomys chrysophilus*) and Four-striped Mouse (*Rhabdomys pumilio*).

The low diversity, particularly of small mammals is attributed to the disturbed nature of much of the Mafube LifeX MRA.

Table 6: Red List and protected mammal species that may occur in the Mafube LifeX MRA

Scientific name	Common name	Conservation Status		
		Red List (2016)	NEMBA TOPS List (20137)	Mpumalanga Protected Species (1998)
Chrysospalax villosus	Rough-haired Golden Mole	Vulnerable	Critically Endangered	-
Amblysomus robustus	Robust Golden Mole	Vulnerable	Endangered	-
Amblysomus septentrionalis	Highveld Golden Mole	Near Threatened	-	-
Dasymys incomtus	Water Rat	Near Threatened	-	-
Vulpes chama	Cape Fox	-	Protected	-
Aonyx capensis	Cape-clawless Otter	Near Threatened	Protected	Protected
Leptailurus serval	Serval	Near Threatened	Protected	
Proteles cristatus	Aardwolf	-	-	Protected
Parahyaena brunnea	Brown Hyaena	Near Threatened	Protected	-
Mellivora capensis	Honey Badger	-	Protected	Protected
Ourebia ourebi	Oribi	Endangered	Endangered	Protected
Raphicerus campestris	Steenbok	-	-	Protected
Pelea capreolus	Grey Rhebok	Near Threatened	Protected	Protected
Lutra maculicollis	Spotted-necked Otter	Vulnerable	Protected	Protected
Felis nigripes	Black-footed Cat	Vulnerable	Protected	Protected
Atelerix frontalis	South African Hedgehog	Near Threatened	Protected	Protected
Orycteropus afer	Aardvark	-	Protected	Protected
Redunca fulvorufula	Mountain Reedbuck	-	-	Protected

4.5.2 Birds

Approximately 305 bird species have been recorded in the relevant quarter degree squares in which the Mafube LifeX MRA is located according to SIBIS:SABIF (2009) database.

Common birds recorded in the grassland and woodlot communities in the study area include Longtailed Widow (*Euplectes progne*), Hadeda Ibis (*Bostrychia hagedash*), Familiar Chat (*Cercomela familiaris*), Pied crow (*Corvus albus*), Black-shouldered kite (*Elanus caeruleus*), Red-billed Quelea (*Quelea quelea*), Fiscal Shrike (*Lanius collaris*), Laughing Dove (*Streptopelia senegalensis*) and the Cape Turtle Dove (*Streptopelia capicola*). In the pan and wetland environments water birds such as the Red-knobbed Coot (*Fulica cristata*), White-breasted Cormorant (*Phalacrocorax carbo*), Yellow-billed Duck (*Anas undulata*), Willow Warbler (*Phylloscopus trochilus*), Spurwinged Goose (*Plectropterus gambensis*) and the Knob-billed Duck (*Sarkidiornis melanotos*) were common.(Golder, 2012)

Greater flamingo (*Phoenicopterus ruber*) have also been recorded pans in the in the Mafube LifeX MRA. This species is listed as Near Threatened. Some additional birds of conservation importance that may occur in the study area are listed in Table 7.

Table 7: Red List and protected bird species that may occur in the Mafube LifeX MRA

Scientific name	Common name	Conservation Status		
		Red List (2016)	NEMBA TOPS List (2013)	Mpumalanga Protected Species (1998)
Alcedo semitorquata	Half-collared Kingfisher	Near Threatened	-	Protected
Anthropoides paradiseus	Blue Crane	Near Threatened	Vulnerable	Protected
Balearica regulorum	Grey Crowned Crane	Endangered	Vulnerable	Protected
Bugeranus carunculatus	Wattled Crane	Critically Endangered	Critically Endangered	Protected

Scientific name	Common name	Conservation Status		
		Red List (2016)	NEMBA TOPS List (2013)	Mpumalanga Protected Species (1998)
Ciconia nigra	Black Stork	Vulnerable	-	Protected
Circus ranivorus	African Marsh Harrier	Endangered	-	Protected
Eupodotis caerulescens	Blue Korhaan	-	-	Protected
Geronticus calvus	Southern Bald Ibis	Vulnerable	Vulnerable	Protected
Glareola nordmanni	Black-winged Pratincole	Near Threatened	-	Protected
Lissotis melanogaster	Black-bellied Korhaan	-	-	Protected
Neotis denhami	Denham's Bustard	Vulnerable	Vulnerable	Protected
Phoenicopterus minor	Lesser Flamingo	Near Threatened	Protected	Protected
Phoenicopterus ruber	Greater Flamingo	Near Threatened	Protected	Protected
Sagittarius serpentarius	Secretarybird	Vulnerable	-	Protected
Spizocorys fringillaris	Botha's Lark	Endangered	-	Endangered
Tyto capensis	Grass Owl	Vulnerable	-	Protected

4.5.3 Herpetofauna

Based on available literature 48 reptile and 18 amphibian species potentially occur in the study area. Two species potentially occurring in the study area; namely Breyer's Long-tailed Seps (*Tetradactylus breyeri*) and the Striped Harlequin Snake (*Homoroselaps dorsalis*), are listed as Vulnerable and Near Threatened, respectively (Bates *et al.*, 2014), while 13 species are considered endemic (Bates *et al.*, 2014) - listed in Table 8.

The Giant Bullfrog (*Pyxicephalus adspersus*) is listed as Near Threatened on the regional IUCN Red List (Minter *et al.*, 2004) and as protected in Mpumalanga Province. Although not recorded during this study, Giant Bullfrog have been recorded at sites designated as highly significant by the MBSP, which occur in the south-west of the MRA (see Golder, 2012).

Table 8: Reptiles of conservation importance potentially occurring in the Mafube LifeX MRA

Family	Scientific name	Common name	Status	Red List (2014)
Agamidae	*Agama aculeata distanti*	Eastern Ground Agama	Endemic	-
Colubridae	*Philothamnus natalensis*	Natal Green Snake	Endemic	-
Cordylidae	*Pseudocordylus melanotus melanotus*	Common Crag Lizard	Endemic	-
	Smaug vandami	Van Dam's Dragon Lizard	Endemic	-
	Platysaurus orientalis orientalis	Sekhukhune Flat Lizard	Endemic	-
	Chamaesaura aenea	Coppery Grass Lizard	Endemic	Near threatened
Gekkonidae	*Lygodactylus nigropunctatus*	Black-spotted Dwarf Gecko	Endemic	-
	Lygodactylus ocellatus ocellatus	Spotted Dwarf Gecko	Endemic	-
	Pachydactylus affinis	Transvaal Gecko	Endemic	-
Gerrhosauridae	*Tetradactylus breyeri*	Breyer's Long-tailed Seps	Endemic	Vulnerable
Lamprophiidae	*Homoroselaps lacteus*	Spotted Harlequin Snake	Endemic	-
	Lamprophis aurora	Aurora House Snake	Endemic	-
	Lycodonomorphus inornatus	Olive Ground Snake	Endemic	-
	Duberria lutrix lutrix	South African Slug-eater	Endemic	-
	Homoroselaps dorsalis	Striped Harlequin Snake	Endemic	Near Threatened
Scincidae	*Acontias gracilicauda*	Thin-tailed Legless Skink	Endemic	-

Source: Bates *et al.*(2014)

4.6 Affected Habitat Units - Findings of the Walk Down

Three primary habitat types were identified during the walk down of the proposed road corridor. These are briefly discussed in Sections 4.6.1 and 4.6.2, with accompanying photographs. A habitat unit map of the road corridor is provided in Figure 7

4.6.1 Modified Habitat

Modified habitats are defined as areas that have been altered by human activity and may contain large portions of non-native plants and animals (e.g. agricultural landscapes).

Cultivated Land

Cultivated fields characterise the majority of the proposed road corridor. At the time of the walk down, maize had recently been harvested from the fields and they were standing fallow (Figure 4). Accordingly they were almost completely denuded of vegetation.

The senescent remains of several alien weeds were observed, including *Amaranthus hybridus, Cosmos bipinnatus* and *Xanthium strumarium.* This is a modified habitat unit, with low ecological integrity and low conservation importance.

Figure 4: Cultivated field currently lying fallow

Eucalyptus – Acacia Woodlots

The proposed road corridor bisects, or traverses in close proximity to, four woodlots that are dominated by alien invasive tree species, mostly *Acacia dealbata* (Figure 5), but also *Eucalyptus grandis*.

Acacia dealbata, commonly known as Silver wattle, is highly invasive and listed under the National Environmental Management: Biodiversity Act (NEMBA) as a Category 2 invasive species. It produces large quantities of seed, germinates easily after fire, and can rapidly establish in both terrestrial and riparian habitats. *Eucalyptus grandis* is also a NEMBA listed species (Category 1b, 2 or not listed)[2].

Other flora taxa recorded included grasses such as *Eragrostis chloromelas, Eragrostis curvula* and *Eragrostis plana,* and pioneer alien weeds including mostly *Bidens pilosa, Riccardia brasiliensis* and *Tagetes minuta.*

Considering the dominance of listed alien invasive species, this habitat unit is considered modified and has a low ecological integrity and low conservation importance.

Figure 5: Patch of Acacia dealbata trees occurring along the proposed road route, on the edges of a cultivated field.

4.6.2 Natural Habitat

Historic agricultural activities have caused some degree of disturbances across the broader Mafube LifeX study area, and very little pristine habitat remains. This notwithstanding, we define natural habitats where key processes, composition, and structure are largely intact.

Open Grassland/Wetland

The proposed road traverses across several patches of natural habitat that are characterised by dry terrestrial grassland and moist grassland (wetland) (Figure 6). These habitat patches are generally associated with areas where either high soil moisture levels or rocky /shallow soils prevent or hamper cultivation. As such, they are typically small, often elongated and surrounded by transformed or modified land.

[2] Category1b in riparian areas; Category 2 in plantations/woodlots; Not listed in cultivated fields (> 50 m from untransformed land) or within 50 m of farm house.

Based on the dry season walk down, grass species common in areas of moist grassland on hillslope seeps include *Andropogon huilensis, Arundinella nepalensis, Cynodon dactylon, Eragrostis gummiflua, E. plana* and *Imperata cylindrica.*

In drier areas, frequently recorded grasses include *inter alia*, *Eragrostis chloromelas, E. curvula, E. racemosa, Hyparrhenia hirta* and *Themeda triandra,* while the woody encroaching shrub *Seriphium plumosum* is also commonly scattered throughout grassland areas.

The senescent leaf remains of a *Gladiolus* plant were noted during the walk down - all *Gladiolus* species are protected in Mpumalanga Province (Mpumalanga Nature Conservation Act, 1998). No other plants of conservation importance were observed during the dry season road corridor walk down.

Patches of grassland/wetland are grazed by cattle, and often show signs of overgrazing - the proliferation of *Seriphium plumosum* and *Eragrostis* grasses is often indicative of overgrazed grassland. Moreover, as many patches are surrounded by cultivated fields they have also been impacted at their periphery by ploughing and alien weeds (*Bidens pilosa* and *Tagetes minuta* common) establishment.

Despite these disturbances, patches of natural grassland/wetland are important habitat for flora and fauna. This is especially so considering the highly modified and fragmented nature of the local landscape.

Figure 6: Hillslope seeps supporting moist grassland that are being crossed in places by the proposed road corridor, are generally heavily grazed and trampled by cattle.

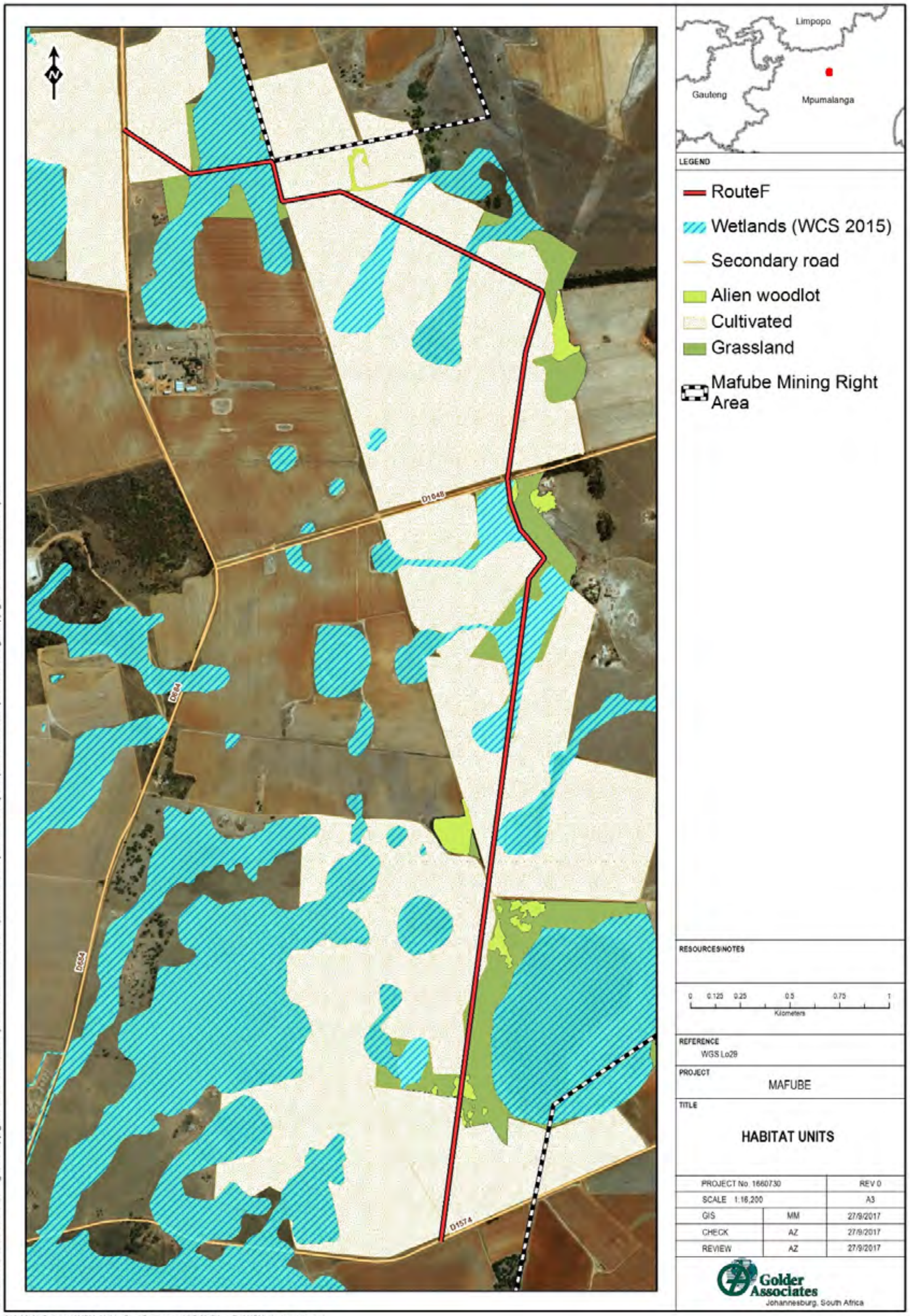


Figure 7: Habitat units along the preferred road realignment corridor (Route Alternative F).

5.0 BASELINE - WETLAND ECOLOGY

A description of the wetlands within the study area in terms of their classification, the assessment of their health (PES), level of ecosystem service provision, and ecological importance and sensitivity (EIS) are outlined in the sections that follow.

5.1 Wetland Delineation and Classification

The wetlands within the Study Area are shown on Figure 8, and are numbered and classified in Table 9. Of these, seven wetlands, including six hillslope seepages and one pan, will be directly affected by the route alignment as currently proposed (Figure 8). Photographs of wetlands directly affected by the route corridor are provided in Appendix B.

Table 9: Classification of wetlands within the Study Area

No.	Wetland Classification	Wetland ID	Position Relative to Route	
			Crossed by route corridor	Within 500 m of route corridor
1	Pan	(Ma_Pan_15)	✓	
2	Depression	(Ma_Dep_15)		Approx. 200 m west of route
3	Pan	(Ma_Pan_01)		Approx. 170 m west of route
4a	Hillslope seepage	(Ma_HS_63)	✓	
4b	Depression	(Ma_Dep_57)		Approx. 50 m east of route
5	Hillslope seepage	(Ma_HS_62)	✓	
6	Hillslope seepage	(Ma_HS_61)	✓	
7	Pan	(Ma_Pan_29)		Approx. 130 m east of route
8	Hillslope seepage	(Ma_HS_57)	✓	
9	Hillslope seepage	(Ma_HS_56)	✓	
10	Hillslope seepage	(Ma_HS_53)	✓	

5.2 Present Ecological State (PES)

The PES scores for each of the wetlands in the Study Area, based on the original baseline studies (WCS 2013, WCS 2015) and the walkover done in 2017 are presented in Table 10.

Most of the wetlands are Category C Moderately Modified, or Category D Largely Modified, which means that a moderate to large loss of natural habitat and basic ecosystem function has occurred in the wetlands. Factors contributing to the modified state of the wetlands within the Study Area and surrounding sub-catchments include:

- Intensive crop cultivation;
- Alien vegetation encroachment;
- Impoundments including earthen dam walls and roads;
- Confined flow through spillways and culverts;
- Soil erosion and eroding surfaces such as head-cuts and nick-points; and
- Livestock grazing and trampling.

No significant new drivers of change affecting wetland health were observed within the wetlands or their immediate catchments during the 2017 survey, therefore the PES categories for all of the hillslope seepage wetlands remain unchanged since the baseline work completed for the Mafube wetland mitigation and management strategy (WCS, 2015).

Table 10: PES categories of wetlands within the Study Area (WCS, 2015)

Wetland No.	HGM Unit	Wetland ID	PES Category	Crossed by Route Corridor
1	Pan	(Ma_Pan_15)	D	✓
2	Depression	(Ma_Dep_15)	C	
3	Pan	(Ma_Pan_01)	C	
4a	Hillslope seepage	(Ma_HS_63)	C	✓
4b	Depression	(Ma_Dep_57)	C	
5	Hillslope seepage	(Ma_HS_62)	C	✓
6	Hillslope seepage	(Ma_HS_61)	D	✓
7	Pan	(Ma_Pan_29)	D	
8	Hillslope seepage	(Ma_HS_57)	C	✓
9	Hillslope seepage	(Ma_HS_56)	C	✓
10	Hillslope seepage	(Ma_HS_53)	C	✓

5.3 Ecological Importance and Sensitivity (EIS)

The EIS categories for each of the wetlands in the Study Area, based on the most recent baseline updates (WCS 2013, WCS 2015) are presented in Table 6. The EIS categories are Low/marginal for the two smallest pans and depressions in the Study Area, neither of which will be directly affected by the proposed route. All other wetlands being crossed by the proposed route corridor are of moderate ecological importance and sensitivity, largely as a result of their location within the upper catchment of the Grootspruit which is listed as a “Fish Support Area” (NFEPA, 2011).

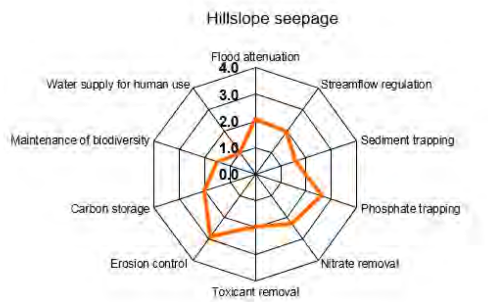
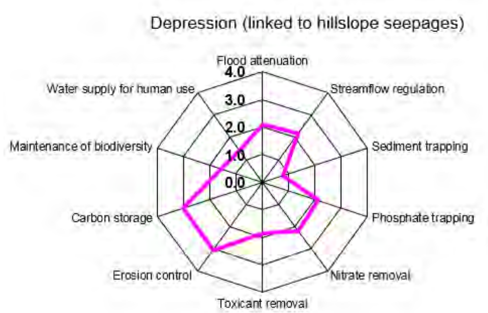
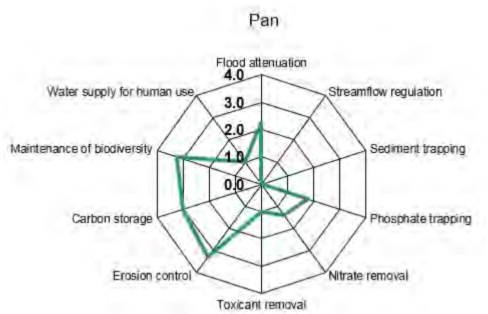
Table 11: EIS categories of wetlands within the Study Area (WCS, 2015)

Wetland No.	HGM Unit	Wetland ID	EIS	Crossed by Route Corridor
1	Pan	(Ma_Pan_15)	Moderate	✓
2	Depression	(Ma_Dep_15)	Low/marginal	
3	Pan	(Ma_Pan_01)	Moderate	
4a	Hillslope seepage	(Ma_HS_63)	Moderate	✓
4b	Depression	(Ma_Dep_57)	Moderate	
5	Hillslope seepage	(Ma_HS_62)	Moderate	✓
6	Hillslope seepage	(Ma_HS_61)	Moderate	✓
7	Pan	(Ma_Pan_29)	Low/marginal	
8	Hillslope seepage	(Ma_HS_57)	Moderate	✓
9	Hillslope seepage	(Ma_HS_56)	Moderate	✓
10	Hillslope seepage	(Ma_HS_53)	Moderate	✓

5.4 Wetland Ecosystem Services

The provision of ecosystem services varies according to wetland type within the Study Area. A summary of the roles that the wetlands play in ecosystem service delivery is given in Table 12.

Table 12: Ecosystem services supplied by wetlands in the study area

Spider diagram of ecosystem service importance	**Wetland role in delivery of ecosystem services**
	■ Hillslope seepages within the study area play an intermediate role in streamflow regulation and sediment trapping ■ Their role in phosphate trapping and nitrate removal is pronounced given the context of agricultural cultivation of their catchment ■ Maintenance of their integrity is important in control of erosion to downstream areas
	■ Depressions linked to hillslope seepages have a moderately high contribution to streamflow regulation ■ Their role in phosphate trapping and nitrate removal is pronounced given the context of agricultural cultivation of the catchment ■ Increased surface roughness and vegetation cover associated with depressions makes a moderately high contribution to carbon storage and erosion control
	■ Play a limited role in flood attenuation through capture of runoff and reduction of surface water that would otherwise reach stream systems ■ Limited importance for sediment trapping reduces opportunity to contribute meaninfuly to phosphate trapping or nitrate removal ■ Increased surface roughness and vegetation cover associated with depressions makes a moderately high contribution to carbon storage and erosion control, and also contributes to biodiversity support

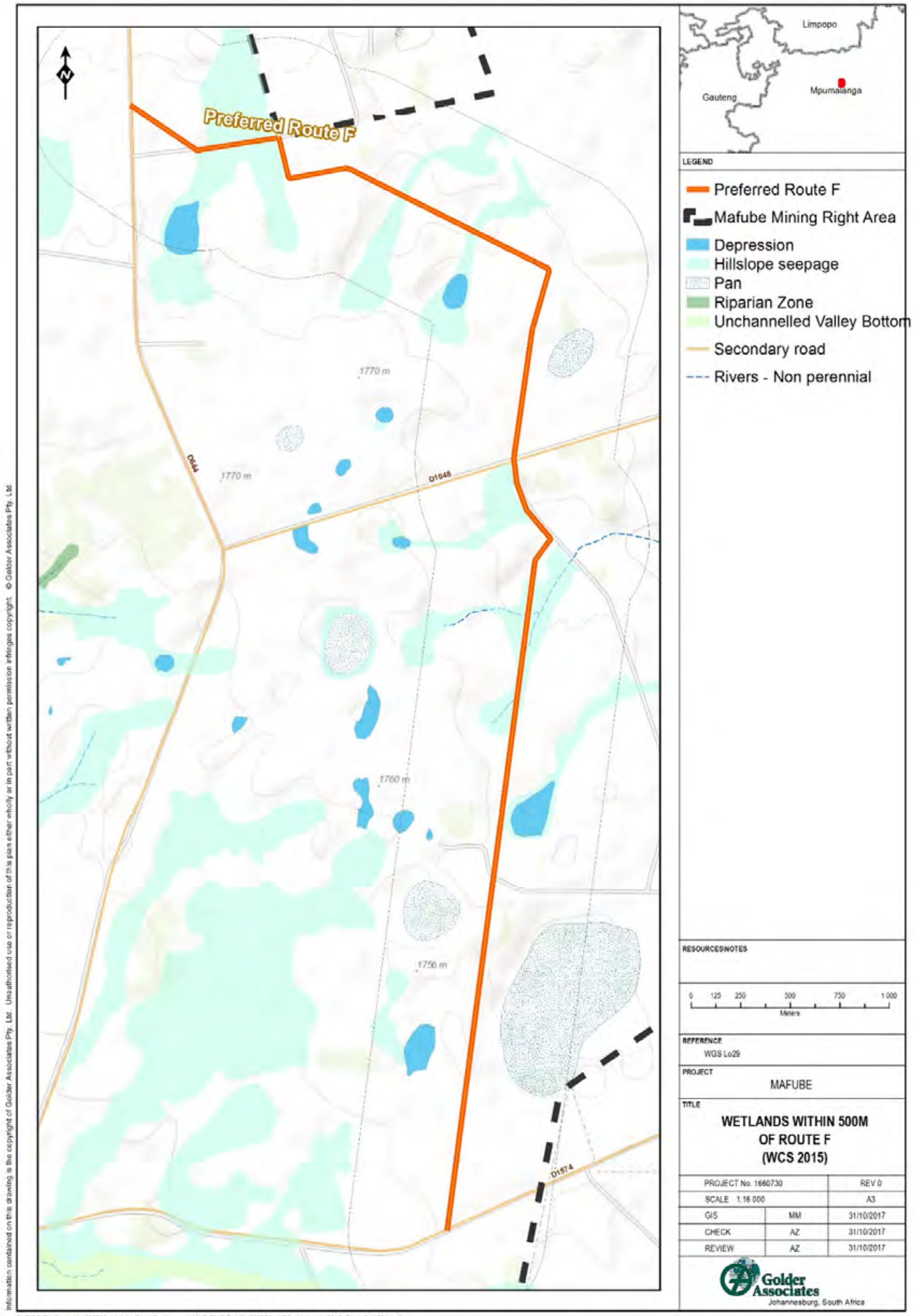


Figure 8: Wetland HGM Units within 500 m of Route F

6.0 ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Methodology for Assessing Impact Significance

The significance of identified impacts was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Table 13: Impact assessment factors

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude of impact

To assess these factors for each impact, the following four ranking scales are used:

Table 14: Impact assessment scoring methodology

Magnitude	Duration
10- Very high/unknown	5- Permanent (>10 years)
8- High	4- Long term (7 - 10 years, impact ceases after site closure has been obtained)
6- Moderate	3- Medium-term (3 months- 7 years, impact ceases after the operational life of the activity)
4- Low	2- Short-term (0 - 3 months, impact ceases after the construction phase)
2- Minor	1- Immediate
Scale	**Probability**
5- International	5- Definite/Unknown
4- National	4- Highly Probable
3- Regional	3- Medium Probability
2- Local	2- Low Probability
1- Site Only	1- Improbable
0- None	0- None

Significance Points= (Magnitude + Duration + Scale) x Probability.

Table 15: Significance of impact based on point allocation

Points	Significance	Description
SP>60	High environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 - 60	Moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP<30	Low environmental significance	Impacts with little real effect and which will not have an influence on or require modification of the project design.
+	Positive impact	An impact that is likely to result in positive consequences/effects.

For the methodology outlined above, the following definitions were used:

- Magnitude is a measure of the degree of change in a measurement or analysis (e.g., the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorization of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely-recognised standards are to be used as a measure of the level of impact;
- Scale/Geographic extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- Duration refers to the length of time over which an environmental impact may occur: i.e. immediate/transient, short-term (0 to 7 years), medium term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent; and
- Probability of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

6.2 Project Phases

The environmental impacts of the project were assessed for the:

- Pre-construction phase;
- Construction phase;
- Operational phase; and
- Closure and rehabilitation phase.

6.3 Project Activities

Vegetation clearing and earth works during the construction phase are the major project activities that are likely to negatively affect on-site ecology. The following disturbance footprints have been used to assess potential ecological impacts:

- A temporary 25 m wide construction corridor;
- A permanent, 8 m wide road footprint (within the 25 m corridor) Description of Potential Ecological Impacts

Ecological impacts that may result from the proposed road realignment project are discussed in Section 6.3.1 through to Section 6.3.9. The results of the impact rating are provided in Section Table 16.

6.3.1 Loss and disturbance of terrestrial habitat

Vegetation clearing and earth works during the construction phase will result in the loss and disturbance of grassland patches occurring within the proposed road construction corridor, which will negatively impact the integrity and functioning of remaining grasslands. This impact occurs during the construction phase. Approximately one hectare (1 ha) of dry grassland habitat will be cleared during construction and another 1.9 ha will be disturbed.

Prior to mitigation, the significance of this impact is rated as **moderate**, but with mitigation, it can be reduced to a **low** significance.

6.3.2 Loss and disturbance of wetland habitat

Construction of the conveyor and associated servitude along the preferred route will lead to the permanent loss of 1.2 ha of wetland habitat due to clearing of wetland vegetation, and disturbance of approx. 2.3 ha of wetland habitat adjacent to the road footprint.

Ideally, wetland crossings should be avoided and minimised – this is particularly relevant to the pan Ma_Pan_15, the top of whose basin would be crossed by the route as currently proposed. The potential significance of the loss and disturbance of wetland habitat is considered **moderate** prior to mitigation, as although local in extent, effects will be permanent, remaining for the lifetime of the road use.

Provided that the basin of pan Ma_Pan_15 is avoided, and the remaining mitigation measures are implemented as part of the construction phase and maintained for the operational lifetime of the road, the potential impacts may be reduced to **low** significance post-mitigation.

6.3.3 Interruption of wetland hydrology

The proposed route corridor crosses six wetlands and cuts the top of one wetland (Figure 8). The excavations for road foundations during construction, and the presence of a sealed tar road crossing the wetlands for the lifetime of the road, will interrupt surface and/or subsurface flows, potentially leading to flow concentration (downstream of the crossings), changes in flow pathways, flow impoundment (upstream of the crossings), increased surface water runoff and increased risk of erosion within the wetland via gullies. Additionally, any activity or infrastructure that impedes or alters the natural subsurface flow in the catchments could have indirect, but potentially significant, effects on the wetlands.

The potential significance of such impacts on the affected wetlands is determined to be **high**, as effects would be permanent, local in extent and could affect a larger area of wetland downstream of the road, resulting in a High magnitude score. Provided that the mitigation measures are implemented prior to commencement of construction and are maintained for the operational lifetime of the Project, the extent of impact and impact magnitude can be reduced, resulting in a residual impact of **low** significance post-mitigation.

6.3.4 Wetland erosion

Erosion of wetland soils could occur as a result of vegetation and topsoil removal during construction, which could result in additional loss of wetland habitat in those wetlands being crossed by the proposed road route. Vegetation clearance and removal will lead to reduced surface roughness within the servitude which could further exacerbate soil erosion. The presence of the road and associated surface water runoff could cause flow concentrations that exacerbate wetland erosion downstream/downslope of the road, for the lifetime of the road operation.

Erosion of wetland soils will lead to habitat deterioration and changes in the natural wetland hydrology. These effects may be expressed as flow concentrations, lowering of the water table and possible desiccation in hillslope seepage wetlands. In affected pan systems, erosion of wetland soils could lead to the development of channels in the pan basin as a result of flow concentrations, with associated increased transport of sediment to the pan floor.

The magnitude of change to wetland health is potentially high, permanent, and may affect wetlands on a local scale, beyond the immediate footprint of the proposed Project activities. This amounts to a potential impact of **high** significance prior to mitigation.

With the application of the recommended mitigation measures, the magnitude of change in wetland health as a result of erosion can be reduced to minor, effects can be restricted to the site only, and the duration of effects will be in the medium term, lasting for the duration of construction and operation. The overall impact post-mitigation is predicted to be one of **low** significance.

6.3.5 Wetland water quality deterioration

During the construction phase, the water quality in the wetland may deteriorate as a consequence of vegetation removal and increased risk of eroded soils and sediments being transported after rainfall events. Contaminants from machinery and materials being used for road construction could enter the wetland and contribute to water quality changes. During operation, sediment-loaded and otherwise contaminated stormwater runoff from the road surface may be discharged to the wetlands that will be crossed by the road.

Potential impacts on water quality in the wetlands have a **moderate** impact score without mitigation, as the effects may be long-term, would occur on a local scale and result in a high magnitude of deterioration as a result of entry of coal and other contaminants to the wetlands and subsequently the downstream water courses. The implementation of the recommended mitigation measures is required to avoid and minimise adverse impacts on water quality of wetlands and associated downstream riparian systems. Provided that the mitigation measures are implemented, the extent of potential impacts can be reduced to a site-only scale; the duration of impacts can be reduced to the length of construction activities, and the probability of the impact ever occurring can be reduced to low. In this scenario, a post-mitigation impact of **low** significance is predicted.

6.3.6 Loss of wetland biodiversity

Construction of the proposed road and its presence during operation will lead to a direct loss of wetland habitat and vegetation communities within the footprint and disturbance of adjacent communities, which is likely to affect flora and fauna species relying on these habitats. The wetlands that will be traversed by the proposed route are mostly considered to be of moderate Ecological Importance and Sensitivity; playing a role in biodiversity support largely as a result of their location within the catchment of the Grootspruit which is listed as a “Fish Support Area” (Section 5.3).

The potential significance of the loss of biodiversity is assessed as being **moderate** prior to mitigation, with effects being permanent and occurring on a local scale to the Project. The implementation of the recommended mitigation measures reduces the magnitude of the impact and the extent of potential impacts to the site only, resulting in a residual impact of **low** significance post-mitigation.

6.3.7 Establishment of alien invasive species

Disturbances caused by vegetation clearing and earth works will create conditions conducive to the establishment and colonisation of alien invasive vegetation. If left uncontrolled, alien species infestations can spread into adjacent natural grassland, suppressing or replacing indigenous vegetation. This impact will persist throughout all phases of the proposed project.

Several highly invasive alien species, including *Datura strumarium* and *Xanthium strumarium* have been documented in the Mafube study area. It is highly likely that these species, amongst others, will colonise disturbed areas, such as the road reserve.

Without mitigation, this impact is rated as **moderate**. However, with active control of alien plant populations, the significance can be reduced to a **low** rating.

6.3.8 Increased dust generation

Vegetation clearing coupled with increased vehicle traffic will result in increased dust entrainment, which can negatively affect flora and fauna communities occurring adjacent to the proposed road. Dust generation can persist through all phases of the proposed project, and will be most acute during the dry season. This impact can be maintained at a **low** significance if regular mitigation (see Table 17) is implemented.

6.3.9 Loss of flora and fauna species of conservation importance

Vegetation clearing can lead to the destruction of plant species of conservation importance (Red List and protected species) growing in the road corridor. This impact occurs during the construction phase.

The senescent remains of a *Gladiolus* inflorescence were noted during the road walk down - all *Gladiolus* species are listed as protected in Mpumalanga Province (as per the Mpumalanga Nature Conservation Act, 1998). Several other protected plant species have previously been recorded in the Mafube LifeX MRA, and some of these may also occur in the road corridor.

The loss of species of conservation importance is rated as a **moderate** impact prior to mitigation and **low** after successful mitigation.

6.4 Impact Assessment Summary

All the predicted environmental impacts resulting from the proposed project activities are described in Table 16 along with their significance ratings before and after mitigation.

Table 16: Impact rating.

Description of Impact	Environmental Significance Pre-mitigation						Environmental Significance Post mitigation					
	M	D	S	P	TOTAL	Rating	M	D	S	P	TOTAL	Rating
CONSTRUCTION PHASE												
Terrestrial Ecology												
Loss and disturbance of natural habitat	4	5	1	5	50	Moderate	2	5	1	3	24	Low
Establishment of alien invasive species	8	5	2	4	60	Moderate	4	4	1	3	27	Low
Increased dust generation	6	4	2	4	48	Moderate	4	3	1	3	24	Low
Loss of species of conservation importance	8	1	1	4	40	Moderate	4	1	1	2	12	Low
Wetland Ecology												
Loss and disturbance of wetland habitat	4	5	2	5	55	Moderate	4	5	1	3	30	Low
Interruption in hydrology	6	5	2	5	65	High	4	4	1	3	27	Low
Wetland erosion	4	5	2	5	55	Moderate	2	4	1	3	21	Low
Wetland water quality deterioration	2	4	2	5	40	Moderate	2	2	1	2	10	Low
Loss of wetland biodiversity	6	4	2	4	48	Moderate	2	4	1	2	14	Low
Establishment of alien invasive species	8	5	2	4	60	Moderate	4	2	1	2	14	Low
OPERATIONAL PHASE												
Terrestrial Ecology												
Establishment of alien invasive species	8	5	2	4	60	Moderate	4	4	1	3	27	Low
Increased dust generation	6	4	2	4	48	Moderate	4	3	1	3	24	Low
Wetland Ecology												
Wetland erosion	4	5	2	5	55	Moderate	2	2	2	2	12	Low
Wetland water quality deterioration	6	3	2	3	33	Moderate	4	2	1	2	14	Low
Establishment of alien invasive species	8	5	2	4	60	Moderate	4	4	1	3	27	Low
DECOMMISSIONING PHASE												
Terrestrial Ecology												
Establishment of alien invasive species	8	5	2	4	60	Moderate	4	4	1	3	27	Low
Increased dust generation	6	4	2	4	48	Moderate	4	3	1	3	24	Low
Wetland Ecology												
Establishment of alien invasive species	4	4	1	2	18	Low	2	2	1	2	10	Low

7.0 ENVIRONMENTAL MANAGEMENT PROGRAMME

This Environmental Management Programme (EMPr) addresses the management of potential environmental impacts related to the proposed road realignment project. The EMPr is used for managing, mitigating, and monitoring of the environmental impacts associated with construction, operational and rehabilitation phases of the realigned route.

7.1 Objectives

The primary objectives of ecological recommendations contained in the EMPr are to:

- Limit the direct loss of natural habitat; and
- Prevent a reduction in ecological integrity and functioning of remaining natural habitat.

7.2 Environmental Management and Mitigation Measures Identified

Management measures recommended for inclusion into the EMP to mitigated identified ecological impacts are presented in Table 17.

Table 17: Recommended management measures.

Impact	Relevant Project Phases	Proposed Mitigation Measures
Loss and disturbance of terrestrial and wetland habitat	Construction	■ Vegetation clearing should be restricted to the immediate road construction footprint/corridor (8 m wide) only. ■ This area should be clearly marked and no vegetation clearing or earth works should be permitted beyond this demarcated area. ■ Minimise any watercourses loss by limiting construction activities to as small an area as possible. ■ All wetlands located within the study area, but not directly crossed by the road should be carefully demarcated and no construction machinery or any other vehicles should be allowed access to these areas other than along existing roads. ■ Construction activities should be undertaken in dry season. ■ Locate all stockpiles, laydown areas and temporary construction infrastructure at least 50m from the edge of delineated wetlands. ■ After construction, active revegetation using locally occurring indigenous plant species should be undertaken to stabilise any wetland crossings. ■ An Environmental Control Officer (ECO) should manage the vegetation clearing process.
Interruption of wetland hydrology	■ Construction	■ Vegetation clearing should be restricted to the immediate road construction footprint/corridor. ■ Wetland crossings should be constructed using engineered designs that ensure that the hydrological

Impact	Relevant Project Phases	Proposed Mitigation Measures
		integrity of the affected wetlands is preserved upstream and downstream of the road crossings. ■ No materials should be stockpiled within the wetland areas along the route and driving within the wetland areas should be kept to an absolute minimum. Clearly defined access routes should be used. ■ Construction should be done in the dry season and completed by the wet season, so that appropriate water management systems are in place for stormwater management.
Wetland erosion	■ Construction ■ Operation	■ Wetland crossings should be constructed using engineered designs that limit flow concentration downstream and minimise the likelihood of erosion channels being generated within the wetlands by surface water discharge. ■ Minimise vegetation clearing to the road footprint only. ■ Construct low level water deflection berms. ■ Install erosion prevention measures prior to the onset of construction activities. Measures should include low berms on approach and departure slopes to crossings to prevent flow concentration, sediment barriers along the lower edge of bare soil areas and re-vegetation of disturbed areas as soon as possible. ■ Implement a stormwater management plan. ■ Re-establish indigenous vegetation to reduce run-off and increase infiltration. ■ Re-vegetate bare soil areas after construction.
Downstream wetland water quality deterioration	■ Construction ■ Operation	■ Store and handle potentially polluting substances and waste in designated, bunded facilities. ■ Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities. ■ Keep sufficient quantities of spill clean-up materials on site. ■ Maintenance of construction vehicles. ■ Implement a stormwater management plan for rainwater runoff from the road surface

Impact	Relevant Project Phases	Proposed Mitigation Measures
Establishment of alien invasive species	▪ Construction ▪ Operation ▪ Decommissioning and Closure	▪ Active control of NEMBA and CARA listed alien invasive plants should be undertaken along the length of the road, in line with the provisions of the Mafube AIS Control and Eradication Plan (see Golder Report No. 1776031-314542-1). ▪ Control actions should include initial treatment, follow-up treatments and regular monitoring. ▪ Re-vegetation of bare soil areas with suitable species as soon as practicable, following construction.
Increased dust generation	▪ Construction ▪ Operational ▪ Decommissioning and Closure	▪ A vehicle speed limit of 60 km/h should be enforced to limit dust entrainment. ▪ Dust suppression using water bowsers should be implemented at a regular frequency on a daily basis.
Loss of species of conservation importance	Construction	▪ A protected plant survey along the road corridor should be conducted during the wet/growing season (November to March) prior to vegetation clearing. ▪ Based on the results of the survey, search and rescue of species of conservation concern should be conducted. Where necessary, relocation permits should be obtained from the Mpumalanga Parks and Tourism Agency (MPTA). Affected plants should be relocated to adjacent undisturbed grassland patches.

7.3 Potential Cumulative Impacts Identified

Historic agricultural activities, such as cultivation and the planting of woodlots and plantations, have resulted in large-scale habitat modification throughout the Mpumalanga Highveld. More recently, mining has become a significant transformation agent in the region. These activities have all severely affected the coverage and integrity of grassland and wetlands. Conserving grassland and wetland habitats is therefore a land management priority, and is addressed at length in the Mafube Biodiversity Action Plan for the mining rights area (Golder Associates Africa, 2016).

The aggregated loss and fragmentation of the small patches of grassland and wetland that occur along the road corridor, as well the loss of such habitats caused by the Mafube LifeX mining activities and other mining operations in the region, need to be considered as a cumulative impact of concern.

It is important to note that Mafube has committed to the actioning of a wetland management and mitigation strategy for the entire Mafube mining rights area, as part of its commitments under the WUL for the project (see Appendix D). The implementation of this strategy will offset the direct loss of some wetlands and indirect effects on other wetlands as a result of the proposed mining operations, resulting in no-net-loss of wetlands overall within the mining rights area and larger catchment.

7.4 Recommended Monitoring Components

Recommendations for future monitoring are outlined in Table 17.

Table 18: Recommended monitoring

Source Activity	Impacts requiring monitoring	Monitoring Objective	Responsible Entity	Monitoring Frequency
Vegetation clearing and earth works during construction.	Dust generation	Measure dust fallout adjacent to the proposed road to inform dust suppression frequency.	Mafube Environmental Team	As per recommendations in air quality monitoring programme
Vegetation clearing and earth works during construction.	Establishment of alien invasive plant species	Measure the success of the alien species control actions and monitor further encroachment.	Mafube Environmental Team	As per recommendations in AIS control and eradication plan
Vegetation clearance during construction Presence of the road in the landscape during operation.	Loss and disturbance of wetland habitat Interruption of wetland hydrology Soil erosion	Conduct wetland site audit during construction to ensure that recommended wetland crossing designs are in place Annual monitoring of PES and EIS at wetland crossings to be conducted following construction	Wetland specialist	Audit during construction Annual monitoring post-construction for at least 3 years

8.0 DATA GAPS AND ASSESSMENT SHORTCOMINGS

The walk down of the proposed road realignment route was undertaken during the dry season (10 August 2017), when most plants are senescent and not readily visible/identifiable. A full survey of plant species of conservation importance growing within the road corridor was therefore not possible.

9.0 CONCLUSION

The proposed road route traverses across three main habitat units, comprising two modified units; cultivated fields and alien tree woodlots, and one natural unit; grassland/wetland. The modified habitat units have a low ecological integrity and are of limited conservation importance; therefore, loss and disturbance of these areas as a result of the proposed road construction and operation are of no concern. Remnant patches of natural grasslands, and wetland units within the study area are of moderate ecological importance. In the Study Area, these habitats exist within a mining and agricultural setting and are influenced by factors including intensive crop production in the catchments of wetlands and on the boundaries of the grasslands. Mining activity and linear infrastructure in the wetland catchments cause flow impoundment upstream of existing road crossings, and flow concentration downstream. Dense stands of black wattle (*Acacia mearnsii*) occur in several patches throughout the Study Area. These factors have influenced the vegetation composition, geomorphology and hydrology of the wetlands in the Study Area to varying degrees. This has resulted in most of the affected wetlands having PES scores of C, or Moderately Modified; similarly, the remnant grassland patches are of moderate ecological value due to their support of protected *Gladiolus* plant species and maintenance of biodiversity linkages in the landscape.

Most of the wetlands within the Study Area have an overall EIS category of Moderate, meaning that they are ecologically important or sensitive on a local scale, with a small role in moderating the quantity and quality of the water of major rivers. The wetlands and remnant grasslands in the Study Area also have a role in biodiversity support, particularly those connected to riparian systems downstream.

Key issues identified during the impact assessment centre on the direct loss of habitat caused by vegetation clearing, coupled with a broader reduction in ecological integrity resulting from associated secondary disturbances (e.g. alien plant species colonisation). Vegetation clearing is inevitable, but the negative effects can be partly mitigated by rescuing and relocating any protected plants, restricting the clearance footprint to the absolute minimum required for construction, and revegetating areas susceptible to erosion (i.e. drainage crossing points). Other potential impacts, such as dust generation and alien species colonisation, that are likely to persist throughout all phases of the project, can be successfully mitigated by implementing regular and consistent on-site management interventions, as listed in Table 17.

Proposed wetland mitigation measures include the use of engineered interventions at wetland crossings to ensure that the crossings are constructed in such a way that they least affect the hydrological integrity of the wetlands being traversed, as well as additional construction and operational mitigation measures to minimise the extent, duration and magnitude of predicted impacts.

Although the use of engineered interventions at wetland crossings are intended to protect and / or restore wetland health and enhance ecosystem service delivery, their construction still constitutes a Section 21 (c) & (i) water use under the National Water Act, 1998; and a water use licence must be applied for to proceed with their implementation – therefore it is recommended that these be designed and formalised as mitigation measures at ESIA stage in order to include the measures in the WUL application that will accompany the overall ESIA.

10.0 REFERENCES

Bates, M., Branch, W., Bauer, A., Burger, M., Marais, J., Alexander, G. and De Villiers, M. (eds.) (2014) *Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland*. Pretoria: Suricata 1, South African Biodiversity Institute.

CARA Conservation of Agricultural Resources Act - Declared weeds and invader plants, (1983). South Africa.

Golder (2012) *Proposed Nooitgedacht Open Cast Mine - Terrestrial Ecology Study*. Midrand.

Golder (2016) *Survey for Plant of Conservation Importance in infrastructure footprint areas at Mafube Colliery – Stage 1*. Midrand.

Golder (2017) *Alien Invasive Species Management Plan for the Mafube mining Rights Area*. Midrand.

Manning, J. (2009) *Field Guide to Wild Flowers of South Africa*. Cape Town: Struik Nature.

MBSP (2013) Mpumalanga Biodiversity Sector Plan. Mpumalanga Tourism and Parks Agency.

Minter, L., Burger, M., Harrison, J., Braack, H., Bishop, P. and Kloepfer, D. (eds.) (2004) *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland*. Washington DC: SI/MAB Series #9. Smithsonian Institution.

Mpumalanga Nature Conservation Act (1998) Schedule 1, 2, 11 & 12: Specially Protected and Protected Fauna and Flora - Mpumalanga Nature Conservation Act (Act No. 10 of 1998).

Mucina, L. and Rutherford, M. (2006) *The Vegetation of South Africa, Lesotho and Swaziland*. Pretoria: Reprint 2011, Strelitzia 19, South African National Biodiversity Institute (SANBI).

NEMBA Alien and Invasive Species Lists National Environmental Management: Biodiversity Act (Act No. 10 of 2004) - Alien and invasive species lists. (2016). South Africa.

NEMBA Threatened Ecosystems National Environmental Management: Biodiversity Act (Act No. 10 of 2004)

- National list of threatened terrestrial ecosystems for South Africa (2011). South Africa.

NEMBA ToPS List National Environmental Management: Biodiversity Act (Act No. 10 of 2004) - Lists of critically endangered, endangered, vulnerable and protected species. (2013). South Africa.

SANBI (2013) *Grassland Ecosystem Guidelines*, Cadman, M., de Villiers, C., Lechmere-Oertel, R., and McCulloch, D. (eds.) . Pretoria: South African National Biodiversity Institute.

SANBI (2015) Red List of South African Plants, *South African National Biodiversity Institute*. Available from: http://redlist.sanbi.org/ [Accessed 1 August 2016].

SIBIS:SABIF (2009) SIBIS:SABIF, *South African National Biodiversity Institute (SANBI)*. Available from: http://sibis.sanbi.org [Accessed 1 November 2015].

Tainton, N. (1999) *Veld Management in South Africa*. Pietermaritzburg: University of Natal Press.

WCS (2015). Wetland Rehabilitation and Management Strategy for Mafube Lifex Project, Mpumalanga Province. Prepared for Golder Associates Africa by Wetland Consulting Services, Pretoria.

WCS (2013). Mafube Pans Offsetting Study: Draft Strategy for Offsetting the Loss of Pans/Depressions. Prepared for Golder Associates Africa by Wetland Consulting Services, Pretoria.

Report Signature Page

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APPENDIX A

Flora species recorded during the 2017 dry-season walk down of the proposed road corridor.

Family	Scientific Name
Amaranthaceae	*Amaranthus hybridus**
Asteraceae	*Bidens pilosa**
Asteraceae	*Tagetes minuta**
Asteraceae	*Cosmos bipinnatus**
Asteraceae	*Xanthium strumarium**
Asteraceae	*Datura strumarium* *
Asteraceae	*Helichrysum aureonitens*
Asteraceae	*Senecio* sp.
Asteraceae	*Helichrysum nudifolium*
Asteraceae	*Seriphium plumosum*
Asteraceae	*Conyza* sp.*
Asteraceae	*Gazania krebsiana*
Cyperaceae	*Cyperus* sp.
Fabaceae	*Acacia dealbata**
Hypoxidaceae	*Hypoxis* spp.
Iridaceae	*Gladiolus* sp.
Myrtaceae	*Eucalyptus* sp.*
Poaceae	*Agrostis eriantha*
Poaceae	*Agrostis lachnantha*
Poaceae	*Andropogon huilensis*
Poaceae	*Aristida* sp.
Poaceae	*Arundinella nepalensis*
Poaceae	*Calamagrostis epigejos* var. *capensis*
Poaceae	*Cynodon dactylon*
Poaceae	*Eragrostis chloromelas*
Poaceae	*Eragrostis curvula*
Poaceae	*Eragrostis gummiflua*
Poaceae	*Eragrostis plana*
Poaceae	*Eragrostis racemosa*
Poaceae	*Hyparrhenia hirta*
Poaceae	*Hyparrhenia* sp.
Poaceae	*Imperata cylindrica*
Poaceae	*Setaria* sp.
Poaceae	*Sporobolus africanus*
Poaceae	*Themeda triandra*
Rubiaceae	*Riccardia brasiliensis**
Verbenaceae	*Verbena bonariensis**

Note: Data were collected during a dry season field visit.
*denotes alien /exotic species

APPENDIX B

Site Photographs

Wetlands within the Study Area

Figure 9: Typical hillslope seepage being crossed, with cropland either side

Figure 10: Depression linked to hillslope seepage

Figure 11: Pan Ma_Pan_15

APPENDIX C

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GOLDER ASSOCIATES AFRICA (PTY) LTD

APPENDIX D

Wetland Rehabilitation and Management Strategy for Mafube LifeX Project

Wetland Rehabilitation and Management Strategy for Mafube Lifex Project, Mpumalanga Province

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DATE: June 2015	DATE: June 2015	DATE: June 2015

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DATE	No.	DESCRIPTION OF REVISION OR AMENDMENT	INITIAL

DOCUMENT SUMMARY DATA

PROJECT:	**Wetland Rehabilitation and Management Strategy for the Mafube Lifex Project, Mpumalanga Province. Draft Report.**
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DECLARATION OF INDEPENDENCE

Declaration

Independent Specialist Consultant

I, Shavaughn Davis, representing Wetland Consulting Services (Pty) Ltd, in my capacity as a wetland ecologist declare that we:

- Act as independent specialist consultants, in this application, in the field of wetland and riparian ecology;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- Have, and will have, no vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006; and
- Will provide the competent authority with access to all the information at our disposal regarding the application, whether such information is favourable to the applicant or not.

Wetland Consulting Services (Pty) Ltd
Name of Company

Shavaughn Davis
Name of Specialist Consultant

Signature of Specialist Consultant

10 June 2015
Date

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

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

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EXECUTIVE SUMMARY

Wetland Consulting Services (Pty.) Ltd. (WCS) is assisting Mafube Coal ("Mafube") with developing a wetland rehabilitation and management strategy for the Mafube Lifex Project in Mpumalanga Province. The aim of the study is to evaluate potential sites for wetland rehabilitation to compensate for the loss in functionality associated with wetland losses within and adjacent to the proposed Mafube Lifex Project footprint. The goal was to assess and evaluate the adequacy of the identified candidate rehabilitation sites identified to compensate for the impact associated with the proposed mining activities associated with Mafube Lifex Project. It is hoped that in addition to the protection and conservation of wetlands, rehabilitation of suitable candidate wetlands in the identified area will ecologically counterbalance the wetlands removed through the mining activities associated with the Mafube Lifex project operations.

The primary landuse in the study area is agriculture and this is reflected in the nature of the common problems identified within the wetland systems, namely erosion and drying out of the wetlands associated with extensive alien vegetation stands, draining and impoundment of flows. Of significant value in rehabilitating the wetlands will be improvement of flows through the wetlands and control of channel erosion and head-cutting. In addition, without effective livestock management, other interventions are less likely to be effective in achieving their rehabilitation goals.

The proposed Mafube Lifex mining operations are expected to result in direct losses of wetlands within the footprint of the proposed mines' opencast pits as these systems will be completely lost and cannot be mitigated. However, in addition to calculating these losses, there are potentially also residual losses to the remaining systems surrounding and downstream of the opencast pits, which may need to be addressed in cases where the impacts cannot be mitigated These indirect losses were therefore calculated. The results of the onsite study indicated that the functional area of wetlands to be removed from the landscape, due to direct losses is approximately 208.69 hectare-equivalents (ha-eq). Should additional indirect losses occur which cannot be mitigated, the functional area of wetlands that will be removed from the landscape will increase to approximately 220.4 ha-eq. Wetland rehabilitation interventions are expected to yield approximately 54.44 ha-eq. of functional area. Therefore, rehabilitation of the candidate wetland systems will not be adequate in compensating the anticipated losses. However, the controlled release of treated water is being planned within the candidate rehabilitation wetland systems, with preliminary designs and release points detailed in Appendix I. As the design and planning of this component of the wetland management and offset strategy is still in an early stage of development, it is not yet possible to provide a quantitative estimate of its contribution to compensating for the loss of wetlands expected. Once the anticipated release flow volumes and distribution of flows

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across the release points has been determined, the potential functional gains will need to be reassessed as the systems are likely to adjust to reach equilibrium with a continuous inflow of water from the treatment plant. However, it is anticipated that the release of sufficient volumes of clean water to the downstream wetlands will further mitigate the direct and indirect loses by ensuring that there is no reduction in flows feeding the downstream watercourses or in the water quality of flows. The responsible release of good quality water into the environment in such a way that it does not cause deterioration of downstream systems is expected to be very valuable in compensating for any shortfalls in reaching the quantitative hectare equivalent target identified.

It should be noted that SANBI has recently finalised the third draft of the offset calculators. For the purpose of this study the threat status multiplier to establish the biodiversity offset target, was calculated using this tool. In order to achieve the protection based offset hectare equivalents (ha-eq) required as advocated by the SANBI offset calculator, an approximate 110 ha-eq. within the candidate sites will be required to compensate for the direct losses. Protection of the candidate wetland ecosystems is expected to yield 659.7 ha-eq. towards meeting the ecosystem protection target. Therefore, protection of the candidate wetland systems will be more than adequate in offsetting the direct losses.

The rehabilitation strategy for the candidate wetland systems provides an indication of the major problems within each of the wetland clusters, and the proposed rehabilitation objectives and strategies for achieving the set objectives. Basic designs for the various proposed interventions are included in the specialist engineers report attached to this report as well as a high level costing for implementation of the interventions.

It can be argued that the upper section of the Olifants River catchment can potentially form a meaningful offset area from both a biodiversity and water resources management perspective due of the following:

- As a result of past and current mining activities in this catchment, maintenance and rehabilitation of the remaining wetlands can only be beneficial in terms of improving water quality to downstream water users and improving the biodiversity support capacity of this catchment; and
- There are still some areas where landuse consists primarily of livestock grazing of open veld and agricultural activities which, if incorporated into protection-based offset areas, can potentially also provide biodiversity support if underlain by suitable management plans.

There is therefore a valuable opportunity within this area to create functionally healthy patches within the landscape that can support a good representation of Highveld biodiversity. Although the required functional requirements are not fully met, the catchments identified for rehabilitation provide a meaningful opportunity which will realise meaningful functional gains,

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and ecosystem targets which are far exceeded through rehabilitation and management of the targeted wetlands and buffering of these wetlands.

In addition, it is proposed that outputs from the water treatment plant located below the mining area will provide opportunities to:

- Compensate for catchment flows lost as a result of the mine footprint, through diffuse and continuous discharge into the receiving rehabilitated wetlands at specific discharge points;
- Improve the hydrology of wetlands downstream and potentially create additional wetland habitat onsite; and
- The above improvements will add value to the current functional gains anticipated.

The majority of the identified rehabilitation wetlands lie within Anglo American owned properties, thereby reducing potential land tenure issues and risks. Therefore, the potential exists to produce a holistic, practical wetland management plan that can be confidently applied as Anglo has full control of rehabilitation, implementation and management.

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1. ABREVIATIONS AND ACRONYMS

DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EIS	Ecological Importance and Sensitivity
FEPA	Freshwater Ecosystem Priority Area
GAA	Golder Associate Africa
HGM	Hydrogeomorphic
NFEPA	National Freshwater Ecosystem Priority Area
PES	Present Ecological Status
SANBI	South African National Biodiversity Institute
WCS	Wetland Consulting Services
WTP	Water Treatment Plant
WUL	Water Use Licence
WULA	Water Use Licence Application

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2. INTRODUCTION

Wetland Consulting Services (Pty.) Ltd. is assisting Mafube Coal with developing a wetland rehabilitation and management strategy for Mafube Lifex Project in the Mpumalanga Province. The aim of the study is to evaluate potential sites to compensate for lost functionality resulting from wetland losses associated with the proposed Mafube Lifex Project which consists of an opencast coal mine. The goal was to assess and evaluate the adequacy of the identified candidate sites to compensate for the impacts of the proposed mining activities associated with the Mafube Lifex Project. The objectives of this project are guided by a condition in the issued Water Use Licence for the project.

It is hoped that in addition to the protection and conservation of wetlands, rehabilitation of suitable candidate wetlands in the identified catchment areas will ecologically counterbalance the wetlands that will be removed or indirectly impacted through the proposed mining activities associated with the Mafube Lifex Project.

The wetland types that are to be affected are pans, depressions, hillslope seepage wetlands, channelled valley bottom wetlands and riparian habitat. Each HGM type is characterised by particular dominant hydrological drivers, and these translate into the provision of varying sets of ecological goods and services, at a range of different levels. The broad objectives of the study are:

1. To determine and quantify the required functionality targets using the recently developed SANBI and DWS offset calculator (SANBI and DWS, 2014) as a guide;
2. To evaluate and quantify the adequacy of the candidate sites identified for offsetting the impacts associated with the opencast coal mining and associated activities;
3. To evaluate and quantify the potential gains in wetland functional area and ecological integrity associated with rehabilitating the wetland habitat within the candidate sites;
4. To develop a suitable rehabilitation strategy for candidate wetlands within the identified candidate sites, highlighting the ecological problems underpinning wetland functioning and the types of interventions required to address them; and
5. Lastly, to compile appropriate management and monitoring measures to be associated with the rehabilitated candidate wetland areas aimed at maintaining functionality within the landscape and ensuring the maintenance or improvement of the functionality of the rehabilitated wetlands.

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The candidate wetlands will form part of the functional and ecosystem conservation requirements for the proposed for the Mafube Lifex Project mining operations.

3. OBJECTIVES

The water use licence issued, as mentioned in Section 2, includes the following condition, the fulfilment of which is the driving force behind the compilation of this Wetland Rehabilitation and Management Strategy:

"*A Wetland Management and Rehabilitation Plan (report) for all mining related activities must be compiled by a professional, independent, qualified and registered wetland specialist when wetland are affected and submitted to the Provincial Head for a written approval within six (6) month after the issuance of the licence. This plan must address baseline conditions (including PES and EIS), the wetland cluster's FEPA status and restoring the wetlands functionality and ecosystem services beyond mine closure, taking cognisance of seep/decant impacts of the mine after closure. An appropriate off-site wetland rehabilitation commitment and plan, depending on the outcome of the former, with the input from SANBI and DWA: Environment & Recreation (including land and management agreements and financial commitments) shall accompany this plan."*

As we understand it, the above WUL condition can be broken down into the following components, each of which is addressed in this document:

Compilation of a Wetland Rehabilitation and Management Plan which will include:

- Indicate the current extent, classification, PES, EIS, and NFEPA status of all wetlands that will be affected by the proposed mining-related activities;
- Determine the anticipated loss of wetland functionality/ecosystem services resulting from the proposed mining-related activities;
- Develop a strategy to rehabilitate and manage wetlands, either those directly affected by the mining activities or appropriate wetlands offsite if the former is not feasible, to maintain the wetland functionality of the affected/lost wetlands; and
- Engage with and gain input from SANBI and DWA during the development of the wetland rehabilitation and management strategy to ensure that the principles of the strategy align with their vision (Appendix II).

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The post mining landscape of the opencast pit as currently proposed will be rehabilitated to create a free draining landscape and post mining flow line patterns indicate that all or most of the overland flow generated from the rehabilitated pit will be draining to the natural lowest point i.e. the natural drainage line draining the immediate downstream catchments of the pit area. It is therefore unlikely that any wetland habitat can be created in the rehabilitated pit. Therefore, rather than trying to restore the lost wetlands beyond mine closure, which is not considered feasible on the rehabilitated lands, the objective of the wetland rehabilitation and management strategy will be to restore or maintain the wetland *functionality* of the wetlands that will be directly and indirectly lost as a result of the mining activities, through improvement (rehabilitation) in the functionality of wetlands offsite (outside of the opencast footprint). Some of the most important functions attributed to wetlands are maintenance of the quantity (through regulating of flow) and quality of water within the environment and biodiversity support ((Kotze, *et.al*, 2007). In addition, an ecosystem services supply and demand analysis was undertaken for the Mafube Mineral Rights Area in 2012, which provides details regarding the potential ecosystem services provided by wetland habitat currently and as a result of future management scenarios (Appendix III). Maintaining these functions will be the primary objective of the wetland rehabilitation and management strategy and will be addressed in several ways, including:

1. Rehabilitation of offsite wetlands downstream of the affected area to improve their capacity to manage flows, improve water quality and support a broad, wetland-specific biodiversity;
2. Buffering of the rehabilitated wetlands to further increase their contribution to biodiversity support;
3. Treatment and diffuse release of water from the area of the catchment affected by the mining activities to ensure that the quantity and quality of flows from the affected catchment (and therefore also the affected wetlands) are not diminished as a result of the loss of these wetlands.

It is envisaged that the implementation of the above strategy elements will work in concert to maintain the pre-mining wetland functionality of the affected systems and improve the ecological status of the larger systems post mining.

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4. APPROACH

4.1 Target Wetland Site/Catchment Selection

The first phase of the project identified areas within and surrounding the Mafube Lifex mineral rights area and occurring in the Upper Olifants River catchment that had sufficient wetland habitat remaining to potentially offer suitable rehabilitation opportunities. These were identified as candidate sites for further investigation. An important criterion for site selection is that the candidate wetlands are:

1. Wetland areas and associated catchments within Mafube Coal surface and mining right areas,
2. Areas earmarked by Mafube Coal for purchasing and with no future planned mining activities either prospecting or allocated mining rights;
3. Areas situated in the same catchment and ideally in the same quaternary catchment as the wetlands to be removed. The rationale being that the ecological benefits added to the landscape by rehabilitation efforts will manifest on the same water resource that has been affected by the loss of wetlands. The identification of these specific catchments followed the following process to identify:

    - The positions of existing mines, urban development, cultivation and other areas of disturbance; and
    - The distribution of wetlands in relation to the proposed mining areas within the Upper Olifants River catchment.

Factors contributing to the selection of the candidate rehabilitation wetlands/catchments were as follows:

1. Identify least impacted watersheds within the Upper Olifants River sub-catchment that could possibly be used for rehabilitation site investigations, based on landuse as highlighted above;
2. Identify areas with similar characteristics to those being removed by mining according to the following hierarchical categories:
    a. The same sub-catchment areas as the wetlands to be lost or impacted. This is aimed at ensuring that the restoration of wetland functioning is kept as close to the development as possible, so that the people and ecosystems directly affected may also gain the benefits of the rehabilitation measures;
    b. The same geological formations as those underlying the wetland areas to be lost or impacted. The rationale behind this is that wetland types which share similar landscape settings and geological formations tend to respond in the same way to

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changes in the catchment characteristics. They also perform similar ecological functions in the landscape;

c. The same vegetation types i.e. have similar species compositions as those of the wetlands to be lost. This is likely to ensure a no-net-loss of wetland biodiversity from the local landscape;

d. The extent of similar wetland types, according to their HGM classification, as those to be lost within the proposed Mafube Lifex Coal Mine, i.e. to maintain the principle of a like for like as far as is reasonably possible. Approximately fifteen ecological services have been attributed to wetlands. There is evidence that wetland function can be linked to wetland type (Kotze *et. al*., 2008), with the biophysical characteristics of the different wetland types, together with conditions in the surrounding catchments, determining the magnitude and importance of the various wetland functions they are able to perform. With different wetland types being more effective at performing certain ecological functions than others, the removal of one wetland type from the landscape, and its replacement with another, may result in a change in the types of important eco-services provided to the landscape. It was assumed that the rehabilitation and protection of required areas of similar wetland types within selected catchments would be most likely to appropriately compensate for the loss of functionality of the wetlands in the new mining areas.

The above hierarchical criteria were proposed as the first order of selection for candidate rehabilitation wetlands. Once completed the selected wetlands were further investigated by conducting more detailed ecological assessments of the candidate sites. The objective being to ensure that their rehabilitation would potentially produce gains in wetland hectare equivalents that would satisfy the various multiplier requirements. Additionally, that candidate sites would appropriately replace the hectare equivalents of functional wetland area within the affected/threatened, or lost, systems.

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4.2 Wetland Delineation and Ecological Integrity Assessment

The wetlands within the Mafube Lifex Project area and those highlighted as candidate rehabilitation wetlands have been delineated and assessed (PES and EIS) as part of previous studies undertaken by GAA and recently updated by WCS as part of this study. As part of these studies, the wetlands were classified according to their hydro-geomorphic determinants based on a modification of the system proposed by Brinson (1993), and modified for use in South Africa by Marneweck and Batchelor (2002) and subsequently revised by Kotze, Marneweck, Batchelor, Lindley and Collins (2009) and SANBI (2009). The delineated wetland boundaries and PES and EIS scores derived as part of the above studies were used in the offset calculations as part of this study.

The PES assessment assisted in identifying the current impacts that are undermining the integrity of each wetland HGM unit, and in so doing directing the objectives of the subsequent rehabilitation plan. The PES categories for each of the wetlands were used to assign the wetlands a score out of 10 as per the scoring used in the WET-Health tool (Macfarlane *et. al.* 2008). These scores were then used to calculate the current functional area, or number of hectare equivalents, of the wetlands in the target area. Rapid assessments were also undertaken of the wetlands under the hypothetical post-rehabilitation scenario, and the gain in hectare equivalents calculated to estimate whether the rehabilitation measures will satisfy the no-net-loss of wetland habitat principle stipulated as the primary goal of offsetting.

4.3 Development of an Offsite Wetland Rehabilitation and Management Strategy

4.3.1 Rationale behind Compensatory Hectare Equivalents

Environmental authorisation is likely to require some sort of initiative aimed at compensating for the wetlands removed from the landscape by the development/proposed mining operation. This may take the form of:

- Onsite mitigation: the rehabilitation of wetlands that lie within the boundary of the development, but have been excluded from the development footprint;
- Offsite mitigation: the identification of suitable wetland habitat outside the boundaries of the development, and the implementation of rehabilitation measures that result in an appropriate gain in hectare equivalents. This will compensate for the functional wetland area lost to the development;

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- The creation of new wetlands on previously terrestrial habitat; and
- The reintroduction of wetland habitat to the post-development landscape. These wetlands may be within previously existing wetland habitat, but the catchment drivers and topography have been completely transformed. The wetlands are therefore constructed to be compatible with the new landscape.

The underlying principle is that the hectare equivalents/functionality gained by these measures should appropriately offset those removed by the development. However, there is a considerable risk of failure of rehabilitation or wetland creation measures.

The risk may be associated with shortcomings in the implementation of rehabilitation interventions or future changes in the catchment landuse. To account for the risk of failure, the authorities usually attach a mitigation ratio to the target hectare equivalent figure. This usually increases the area of wetland to be rehabilitated, the rationale being that this will counterweigh any possible failure of individual rehabilitation measures.
According to our current understanding, the offset target is separated into three subparts, namely:

- The *wetland functioning target*, which represents the gain in wetland functional area that is required to ensure a no net loss of wetland functioning from the landscape. This employs the risk of failure multiplier and the temporal risk multiplier; and
- The *ecosystem conservation target*, which incorporates the conservation, threat status or protection multiplier, which ensures that there is a no net loss or ensures a gain in biodiversity value for the local landscape following the development.
- The *species of conservation concern target*, which assess residual impacts to species of conservation concern. This assessment requires an appropriate species impact measure to be selected and applied to score the potential impact of the planned development. This ensures that there is a no net loss or ensures proper relocation plans for species of concerns are put in place to maintain value and ensuring existence of such species within the local landscape following the development.

To calculate hectare equivalents and the required wetland offset targets, the revised DWS and SANBI wetland offset calculator was used, as detailed in the document entitled "*Towards a best-practice guideline for wetland offsets in South Africa: DWS and SANBI, 2014".* The DWS and SANBI offset guideline document is available from the DWA website (www.dwa.gov.za). This guideline document as it currently stands recommends a range of mitigation ratios, or multipliers, that are closely tied to the following:

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- Ecological integrity of the wetland itself (wetland conditions);
- Threat status of vegetation types;
- Habitat and vegetation conditions;
- National and regional conservation plans and targets; and
- Wetland biodiversity.

The multipliers are then determined based on area weightings of all the above

4.3.2 Wetland Functionality Calculations

The broad wetland offset policy goals proposed by the SANBI and DWS offset guidelines (SANBI and DWS, 2014) are as follows:

1. Formally protecting wetland systems in a good condition so as to contribute to meeting national conservation targets for the representation and persistence of different wetland and wetland vegetation types;
2. No net loss in the overall wetland functional area by providing gains in wetland area and / or condition equal to or greater than the losses due residual impacts;
3. Providing appropriate and adequate compensation for residual impacts on key ecosystem services; and
4. Adequately compensating for residual impacts on threatened or otherwise important (e.g. wetland-dependent) species through appropriate offset activities that support and improve the survival and persistence of these species. It must be noted that species offset projects require detailed knowledge and understanding of the species biological requirements, entailing the use of appropriate species specific and biodiversity specialists, as well as detailed studies and analysis of habitats to evaluate suitability.

Using SANBI and DWS offset calculator, both functional and ecosystem conservation offset targets were calculated for the proposed Mafube Lifex project, for the purposes of the WULA processes. The offset calculator allows for assessing different development scenarios thereby providing an overall target taking into consideration all the activities planned within the project area.

Species offsets where not examined in detail in this current work. Firstly, the SANBI and DWS offset calculator, while referring to species offsets, is not yet an effective tool. The data

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that would be required in order to determine the required adequate offset requirements and options required to ensure the persistence and viability of the species. It is likely that expert knowledge and insight from species specific experts would be required – both identifying current status in affected wetlands, as well as viability of any offset candidate sites. In addition it is however anticipated that proposed conversion of agricultural field to natural grassland and rehabilitation of wetlands on site will improve habitat of species utilising the wetlands on site and create more diverse habitat around these areas to compensate loss of species habitat on areas earmarked to be mined.

4.4 Calculation of Hectare Equivalents

A hectare equivalent (ha-eq) is a quantitative expression of the ecological integrity of a wetland hydro-geomorphic (HGM) unit under a given landuse. It represents the common currency that enables the wetland functional area restored to the landscape by restoration, rehabilitation and artificial creation to be compared to that removed from the landscape by a development (see SANBI and DWS, 2014). Most authorities advocate a no-net-loss of resources approach, be it to biodiversity or wetland functioning, and the hectare equivalent provides the conceptual means of judging whether these rehabilitation objectives have been satisfied. This document seeks to calculate the potential wetland hectare equivalents that will be lost as a result of the proposed mining operations, as well as those that that can potentially be restored to the landscape through rehabilitating the wetlands that will remain post mining, and/or which occur in the candidate rehabilitation areas.

4.5 Rehabilitation Strategy

The rehabilitation strategy, which serves as a precursor to a rehabilitation plan, comprises a description of the types of measures to be investigated once the authorities are satisfied that the approach has the potential to appropriately compensate for the wetland losses associated with the development. A subsequent rehabilitation plan entails detailed and complimentary input from a suitably qualified environmental engineer and a wetland ecologist. The wetland ecologist is responsible for identifying problems undermining the hydrological, geomorphological and vegetative integrity of the habitat on the site and deciding on appropriate measures to address these. The engineer is responsible for designing appropriate earthen, gabion and/or concrete interventions to achieve the objectives outlined by the wetland ecologist. A conceptual rehabilitation plan for the suitable candidate wetlands is provided in this report, which goes as far as identifying the problems

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undermining the wetland integrity and providing conceptual design interventions and associated high level costing for the proposed interventions.

5. ASSUMPTIONS AND LIMITATIONS

The following assumptions are relevant to this study.

- In this study the interventions are aimed at rehabilitation to try to improve wetland function in the targeted wetlands and not restoration. It is hence necessary to draw the distinction between rehabilitation and restoration, the definitions being:
    - Rehabilitation: the planned intervention in a system that aims at improving selected aspects within the system, recognising that some key ecological drivers cannot be altered.
    - Restoration: the manipulation of the physical, chemical or biological characteristics of a site with the goal of returning it to its historical or so called 'pristine' state.
- In this study, and in accordance with the recently released (*albeit* for comment and testing) SANBI wetland biodiversity offset guideline document (SANBI and DWS, 2014), the focus has been on trying to achieve the two main components in terms of the offset targets, namely:
    - The wetland functioning offset. This is aimed at satisfying the no-net-loss of wetland functioning requirement and carries a 1:1 multiplier. The target objective should hence be a gain in wetland hectare equivalents equal to those lost to the development; and
    - The protection-based, or conservation target, offset. This is aimed at a no-net-loss or, preferably, a net-gain in wetland biodiversity for the landscape and adds a threat-status multiplier to the hectare equivalents lost to the development.
- Mafube Coal will continuously rehabilitate the mining area to be free draining and in the post mining rehabilitated landscape drainage lines will be designed to connect with the existing wetlands and river channels downstream of the mining footprint. It is unlikely that wetlands will form within the free draining post mining rehabilitated landscape within the foreseeable future as wetlands require the retention of flows and the purpose of ensuring a free draining landscape is to limit the risks associated with ingress and/or retention of water within the rehabilitated areas. Therefore, the re-establishment of wetland conditions within the post

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mining rehabilitated landscape is not specifically addressed within this wetland management and rehabilitation strategy. However, should wetlands opportunistically form within the rehabilitated landscape post mining there will then be the opportunity to assess such systems and possibly update the strategy to take into account their status and contributions at that time.

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6. SITE DESCRIPTION

The locality of the Mafube Lifex Project mining rights boundary is indicated in **Figure 1**. The project area lies approximately 30 km east of Middelburg. The R104 road and the existing Mafube Mine lies to the south of the reserve. The dominant landuses in the area and within the MRA are:

- Agricultural activities i.e. cultivation (Intense row crops and Dryland pastures);
- Road infrastructure;
- Alien plant infestation;
- Secondary grassland; and
- Livestock grazing within the wetlands and secondary grassland.

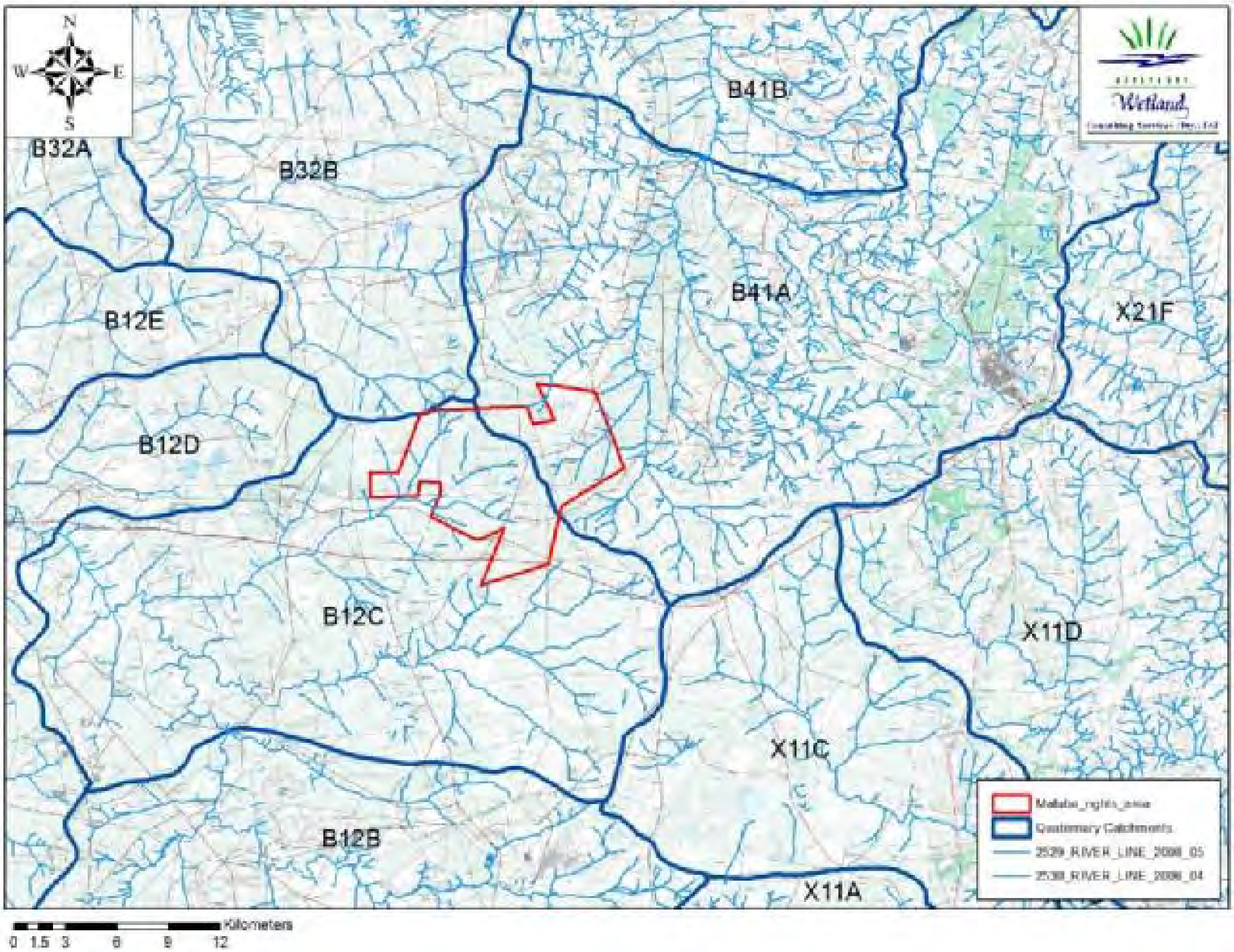

Figure 1: Map indicating Mafube Lifex mineral right boundary in relation to drainage quaternary catchment areas.

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7. WETLANDS TO BE IMPACTED BY THE PROPOSED MINING ACTIVITY

7.1 Wetland Delineation and Classification

The wetlands within and immediately surrounding the proposed mine footprint were delineated as part of previous studies undertaken by GAA and recently updated by WCS. As part of this study, the existing wetland delineations and HGM classifications were used. Wetland types present included the following:

- Valley bottom with a channel;
- Riparian habitat;
- Hillslope seepage; and
- Pans and Depressions, the distinction being that a pan has a discernible basin.

The distribution of wetlands in the study area used for the strategy development is shown in **Figure 2**.

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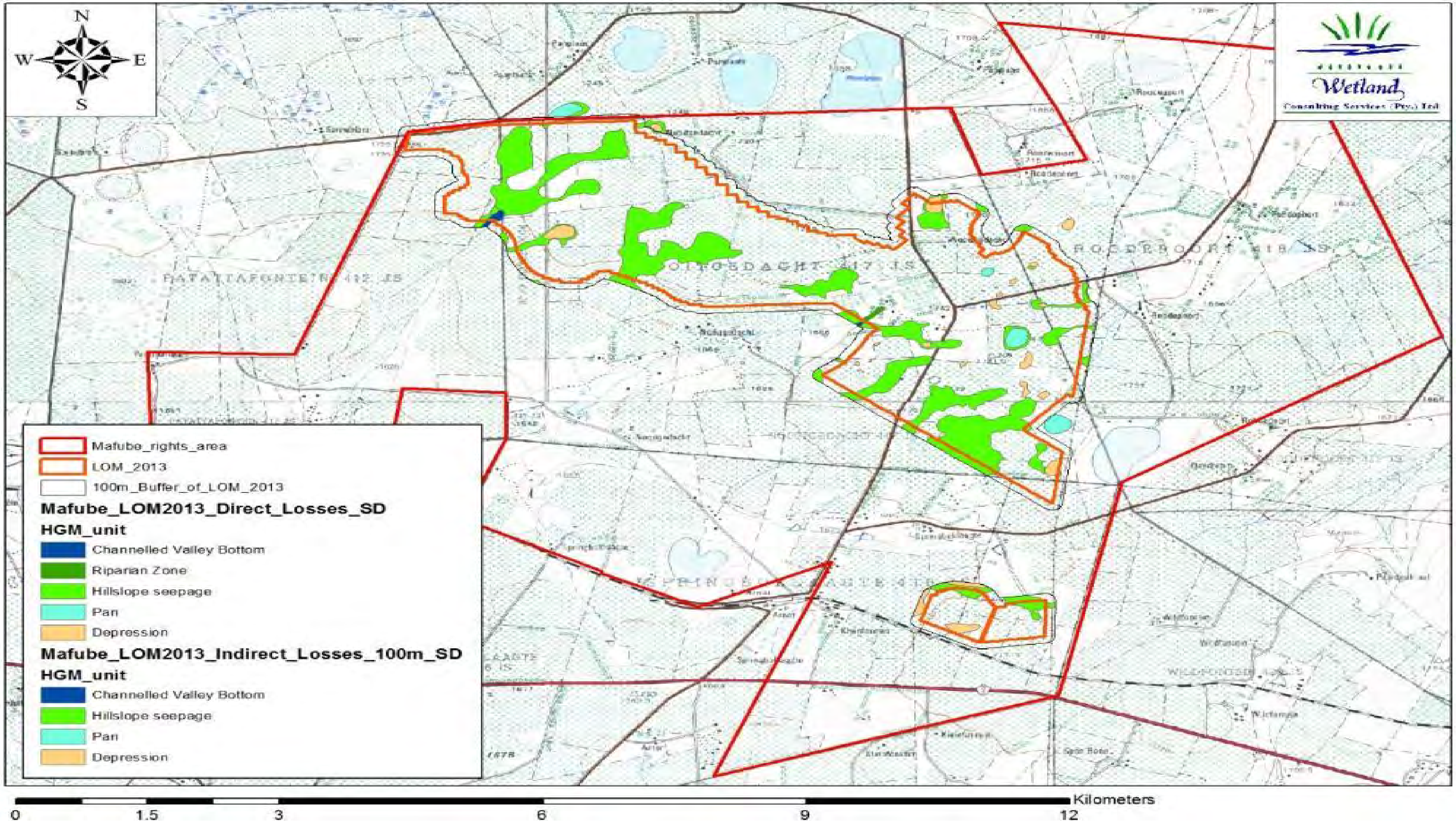

Figure 2: The Distribution and HGM classification of wetlands within the proposed mining footprint – "LOM_2013" (Direct losses) and wetlands within a 100 metre buffer of the mine footprint (Indirect losses).

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7.2 Present Ecological Status Assessment (PES)

Wetlands are an expression of water moving through the landscape, and occur in the landscape where water is slowed down and appears close enough to, or on the surface of, the land for a sufficiently long time to enable wetland conditions to develop. Activities that alter the movement or quality of water moving through the landscape will thus undoubtedly have a significant influence on the wetlands. The main impacts identified within the wetlands within the proposed mining area and surrounding sub-catchments are:

- Cultivation;
- Alien vegetation encroachment;
- Existing mining activities and associated infrastructure and sand burrowing/mining;
- Impoundments such as earthen dam walls and roads;
- Confined flow through spillways and culverts;
- Soil erosion and eroding surfaces such as headcuts and knick-points; and
- Livestock grazing and trampling.

The general pattern of disturbance is that of relatively small, localised disturbances which in some cases spread to impact on entire HGM units, primarily along the channels. An example would be a dam wall that introduces confined surface flow through the spillway to the downstream wetland, which subsequently erodes from its base. Dams also result in a drop in base level with the excavation of the basin, which also tends to introduce head-cut erosion to the wetland upstream.

The PES of the majority of wetlands within the area reflect these types of identified impacts, and are considered to be generally ***Moderately Modified* (C) to *Largely Modified (D)*** (refer to **Figure 3**).

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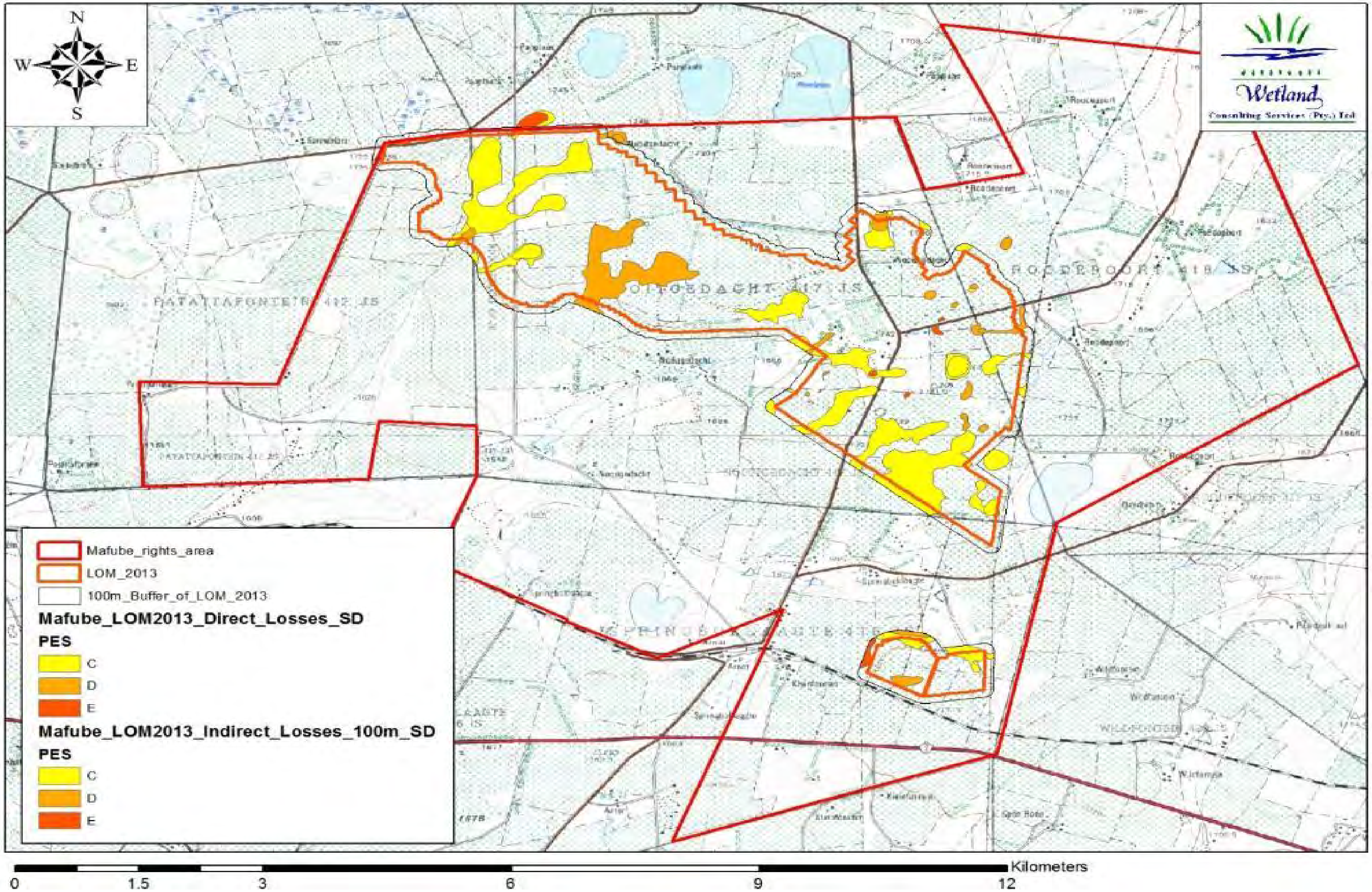

Figure 3: The current Present Ecological Status of the wetlands within the Mafube Lifex project footprint and immediate surrounds.

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7.3 Wetland Ecological Importance and Sensitivity (EIS) and Wetland NFEPA Status

Based on an assessment of the EIS of the wetlands to be affected (Figure 4) it is apparent that the majority of these systems are of Moderate ecological importance and sensitivity. The assessment took into account factors such as wetland type, size, current condition, species composition, status and importance in terms of the Mpumalanga Biodiversity Sector Plan and NFEPA wetland and river catchment status. It is important to highlight, given the requirement of the WUL condition to do so, the NFEPA status of the wetlands to be affected. None of the wetlands within either the mine footprint or the entire Mafube mineral rights boundary are considered to be FEPA wetlands. However, the north eastern section of the Mafube mineral rights area, and a small proportion of the wetlands that will be affected by the mine footprint, falls within the catchment of the Grootspruit which is listed as a “Fish Support Area” (See Figure 4).

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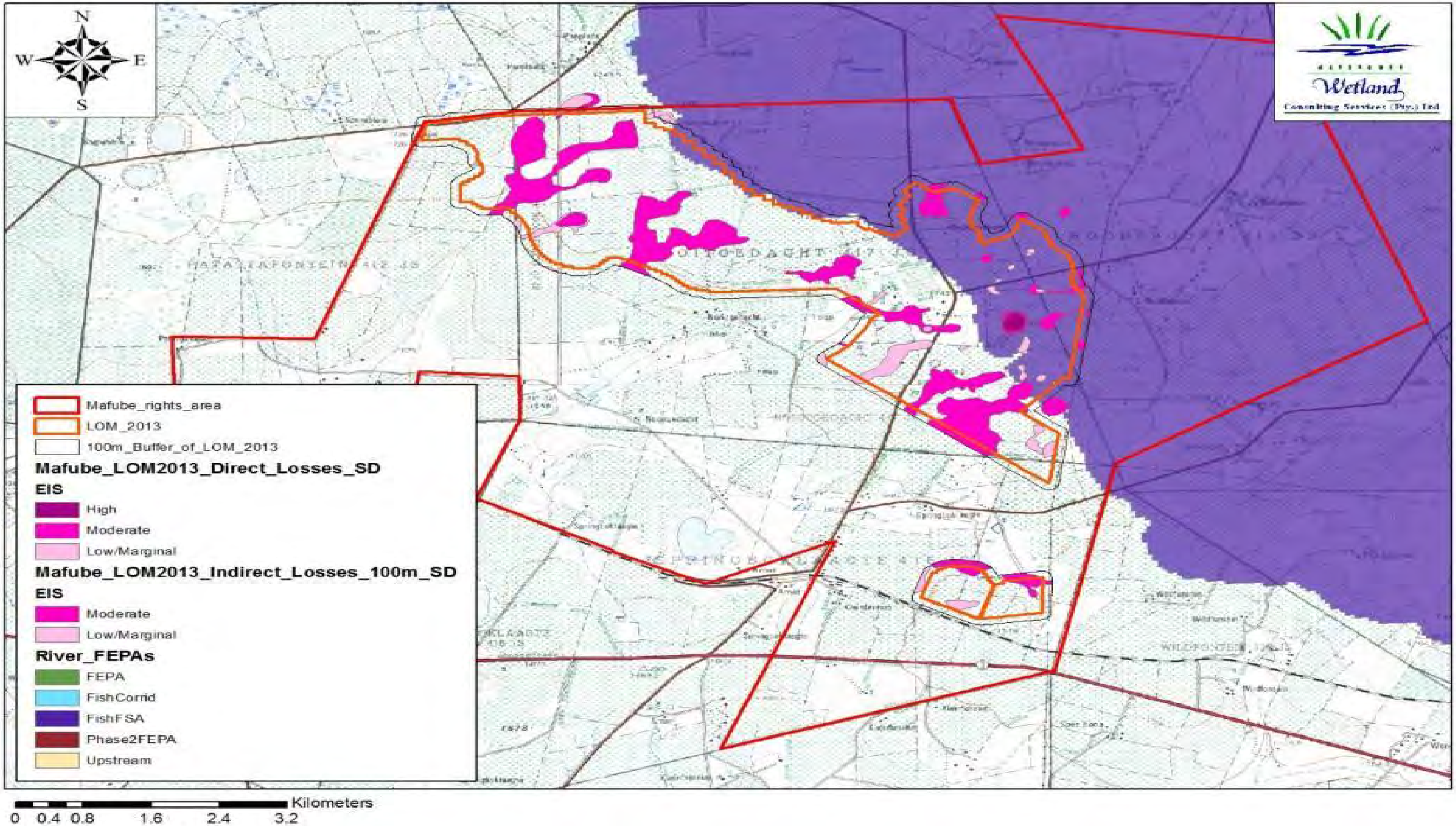

Figure 4: The ecological importance and sensitivity of wetlands within and immediately adjacent to the proposed mining footprint and the extent of NFEPA river catchments in the area.

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7.4 Wetland Functional Losses and Ecosystem Conservation Targets

The extents of wetlands that will be completely lost within the mine footprint (within the "LOM_2013" boundary shown) as well as wetlands within 100 metres of the edge of the mine footprint are shown in **Figure 2** above. Although surrounding wetlands are not directly impacted by the mining activities – i.e. through complete or partial destruction of the wetland, there are often impacts on these wetlands, through indirect effects. The most common indirect effects include changes in water balances and flow regimes, siltation and changes in water quality with the resulting impact on biota and functional attributes. The impact on these wetlands is often not immediately apparent as the effects may be gradual, or take place during the life cycle of the mine or even post-mining. This, however, does not mean that these impacts and losses are not real, nor that they can be assumed to be negligible. To account for the potential indirect impacts on the wetlands, and any potential residual losses around the pit, a buffer of 100m was used. It is assumed that all indirect losses in respect of the wetlands will be accounted for in the 100m buffer around the actual footprint of the pit. No additional indirect losses were accounted for.

The results of the wetland functional hectare equivalent calculations using the revised SANBI and DWS offset calculator are represented in summarised form in **Table 1** (Direct Losses) and **Figure 2** (Indirect Losses) below.

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Table 1: Results of the wetland functional and ecosystem hectare equivalent calculations for direct losses as a result of the Mafube Lifex project using the revised SANBI and DWS offset calculator for the currently proposed mine plan.

Wetland ID	Current/Pre-mining				Functional Hectare Equivalents	Ecosystem Conservation Target
	Type	Area (ha)	PES	EIS		
MA_HS_04	Hillslope seepage	1.64	C	Moderate	1.12	0.62
MA_HS_09	Hillslope seepage	72.52	C	Moderate	52.14	32.16
MA_HS_10	Hillslope seepage	0.31	C	Moderate	0.21	0.10
MA_HS_12	Hillslope seepage	5.27	C	Low/Marginal	3.26	0.79
MA_HS_18	Hillslope seepage	61.81	D	Moderate	31.77	16.76
MA_HS_19	Hillslope seepage	0.83	C	Moderate	0.54	0.30
MA_HS_21	Hillslope seepage	14.37	C	Moderate	9.29	2.11
MA_HS_22	Hillslope seepage	0.07	C	Moderate	0.05	0.04
MA_HS_23	Hillslope seepage	15.31	C	Low/Marginal	10.85	5.42
MA_HS_29	Hillslope seepage	15.25	C	Moderate	11.83	6.98
MA_HS_37	Hillslope seepage	21.62	C	Moderate	15.42	7.34
MA_HS_38	Hillslope seepage	47.62	C	Moderate	33.67	9.27
MA_HS_46	Hillslope seepage	7.50	C	Moderate	4.85	4.03
MA_HS_50	Hillslope seepage	4.14	C	Low/Marginal	2.61	0.71
MA_HS_53	Hillslope seepage	7.44	C	Moderate	4.69	2.43
MA_HS_61	Hillslope seepage	3.02	D	Moderate	1.79	1.44
MA_HS_62	Hillslope seepage	4.73	C	Moderate	3.27	2.10
MA_HS_70	Hillslope seepage	3.05	C	Moderate	2.03	1.14
MA_HS_71	Hillslope seepage	0.28	C	Low/Marginal	0.22	0.08
MA_RIP_01	Riparian Zone	1.55	D	Low/Marginal	0.72	0.30
MA_VB_02	Channelled Valley Bottom	1.81	D	Moderate	0.89	0.68
MA_PAN_04	Pan	5.65	C	High	3.44	3.54
MA_PAN_09	Pan	1.32	D	Moderate	0.64	0.40
MA_PAN_14	Pan	0.14	E	Low/Marginal	0.06	0.03
MA_DEP_02	Depression	0.42	E	Low/Marginal	0.16	0.05
MA_DEP_03	Depression	0.67	E	Low/Marginal	0.26	0.17
MA_DEP_05	Depression	0.43	D	Low/Marginal	0.21	0.13
MA_DEP_06	Depression	1.06	E	Low/Marginal	0.42	0.11
MA_DEP_07	Depression	0.28	E	Low/Marginal	0.11	0.05
MA_DEP_08	Depression	0.46	D	Low/Marginal	0.23	0.11
MA_DEP_10	Depression	0.53	D	Low/Marginal	0.22	0.09
MA_DEP_11	Depression	2.57	D	Moderate	1.35	1.11
MA_DEP_40	Depression	3.83	D	Low/Marginal	2.15	4.21
MA_DEP_41	Depression	0.02	E	Low/Marginal	0.01	0.00
MA_DEP_44	Depression	1.90	D	Low/Marginal	1.12	0.61
MA_DEP_46	Depression	0.20	D	Low/Marginal	0.11	0.04
MA_DEP_47	Depression	0.06	D	Low/Marginal	0.03	0.01
MA_DEP_48	Depression	0.02	D	Low/Marginal	0.01	0.00
MA_DEP_49	Depression	0.18	D	Low/Marginal	0.11	0.05
MA_DEP_50	Depression	1.50	D	Low/Marginal	0.89	0.46
MA_DEP_51	Depression	0.87	D	Low/Marginal	0.47	0.24
MA_DEP_54	Depression	0.13	D	Low/Marginal	0.08	0.03
MA_DEP_56	Depression	0.06	D	Low/Marginal	0.03	0.01
MA_DEP_59	Depression	2.73	C	Low/Marginal	1.79	0.85
MA_DEP_63	Depression	5.05	C	Moderate	3.56	2.87
		320.18			208.69	110.00

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Table 2: Results of the wetland functional hectare equivalent calculations for indirect losses as a result of the Mafube Lifex project using the revised SANBI and DWS offset calculator for the currently proposed mine plan.

Wet_ID	HGM Classification	PES Category	PES Impact Score	PES Integrity Score	Expected PES Impact Score Following Mining	EIS	Area	Functional Hectare Equivalents
MA_PAN_14	Pan	E	6.06	3.94	8.06	Low/Marginal	6.05	1.21
MA_PAN_01	Pan	C	3.50	6.50	5.50	Moderate	6.36	1.27
MA_DEP_41	Depression	E	6.08	3.92	6.08	Low/Marginal	2.82	0.00
MA_DEP_11	Depression	D	4.74	5.26	5.29	Moderate	1.16	0.06
MA_DEP_58	Depression	D	4.22	5.78	6.22	Moderate	2.27	0.45
MA_DEP_59	Depression	C	3.46	6.54	5.29	Low/Marginal	0.08	0.01
MA_DEP_13	Depression	D	5.51	4.49	7.51	Low/Marginal	1.13	0.23
MA_DEP_28	Depression	D	5.25	4.75	7.25	Moderate	1.64	0.33
MA_HS_38	Hillslope seepage	C	2.93	7.07	5.29	Moderate	8.97	2.12
MA_HS_46	Hillslope seepage	C	3.54	6.46	5.29	Moderate	7.78	1.36
MA_HS_37	Hillslope seepage	C	2.87	7.13	5.29	Moderate	1.48	0.36
MA_HS_62	Hillslope seepage	C	3.08	6.93	5.29	Moderate	1.58	0.35
MA_HS_61	Hillslope seepage	D	4.06	5.94	5.29	Moderate	1.94	0.24
MA_HS_18	Hillslope seepage	D	4.86	5.14	5.29	Moderate	3.36	0.14
MA_HS_12	Hillslope seepage	C	3.81	6.19	5.29	Low/Marginal	1.56	0.23
MA_HS_40	Hillslope seepage	C	3.27	6.73	5.29	Moderate	0.02	0.00
MA_HS_53	Hillslope seepage	C	3.70	6.30	5.29	Moderate	1.85	0.29
MA_HS_56	Hillslope seepage	C	3.72	6.28	5.29	Moderate	1.34	0.21
MA_HS_04	Hillslope seepage	C	3.20	6.80	5.29	Moderate	0.87	0.18
MA_HS_13	Hillslope seepage	D	4.40	5.60	5.29	Low/Marginal	0.36	0.03
MA_HS_19	Hillslope seepage	C	3.49	6.52	5.29	Moderate	2.55	0.46
MA_HS_21	Hillslope seepage	C	3.53	6.47	5.29	Moderate	0.93	0.16
MA_HS_22	Hillslope seepage	C	2.47	7.53	5.29	Moderate	0.40	0.11
MA_HS_23	Hillslope seepage	C	2.91	7.09	5.29	Low/Marginal	3.30	0.78
MA_HS_10	Hillslope seepage	C	3.18	6.82	5.18	Moderate	2.66	0.53
MA_HS_11	Hillslope seepage	D	5.51	4.49	7.51	Low/Marginal	2.60	0.52
MA_VB_02	Channelled Valley Bottom	D	5.07	4.93	5.29	Moderate	0.78	0.02
MA_VB_03	Channelled Valley Bottom	D	4.4	5.6	5.29	Moderate	0.31	0.03
							66.16	11.71

<u>Based on the above tables, it is evident that the wetland functional losses (direct and indirect) as well as the ecosystem conservation targets as a result of the proposed mining activities will be as follows:</u>

- Wetland Functional Target (direct and indirect losses) = **<u>220.4 ha-eq.</u>**
- Ecosystem Conservation Target = **<u>110 ha-eq.</u>**

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8. TARGET WETLANDS FOR REHABILITATION AND MANAGEMENT

Candidate wetland systems targeted for rehabilitation and management to compensate for the loss of wetland functionality associated with the proposed mine activities were identified and these areas fall downstream of the proposed mining area, within two sub-catchments within quaternary catchment B12C. In order to avoid certain risks associated with rehabilitation with regard to land tenure, an important factor in locating suitable target wetlands was the requirement that they occur on land controlled by Anglo, or where agreements are in place, in order to allow for effective rehabilitation and management of the target wetlands (**Figure 5**).

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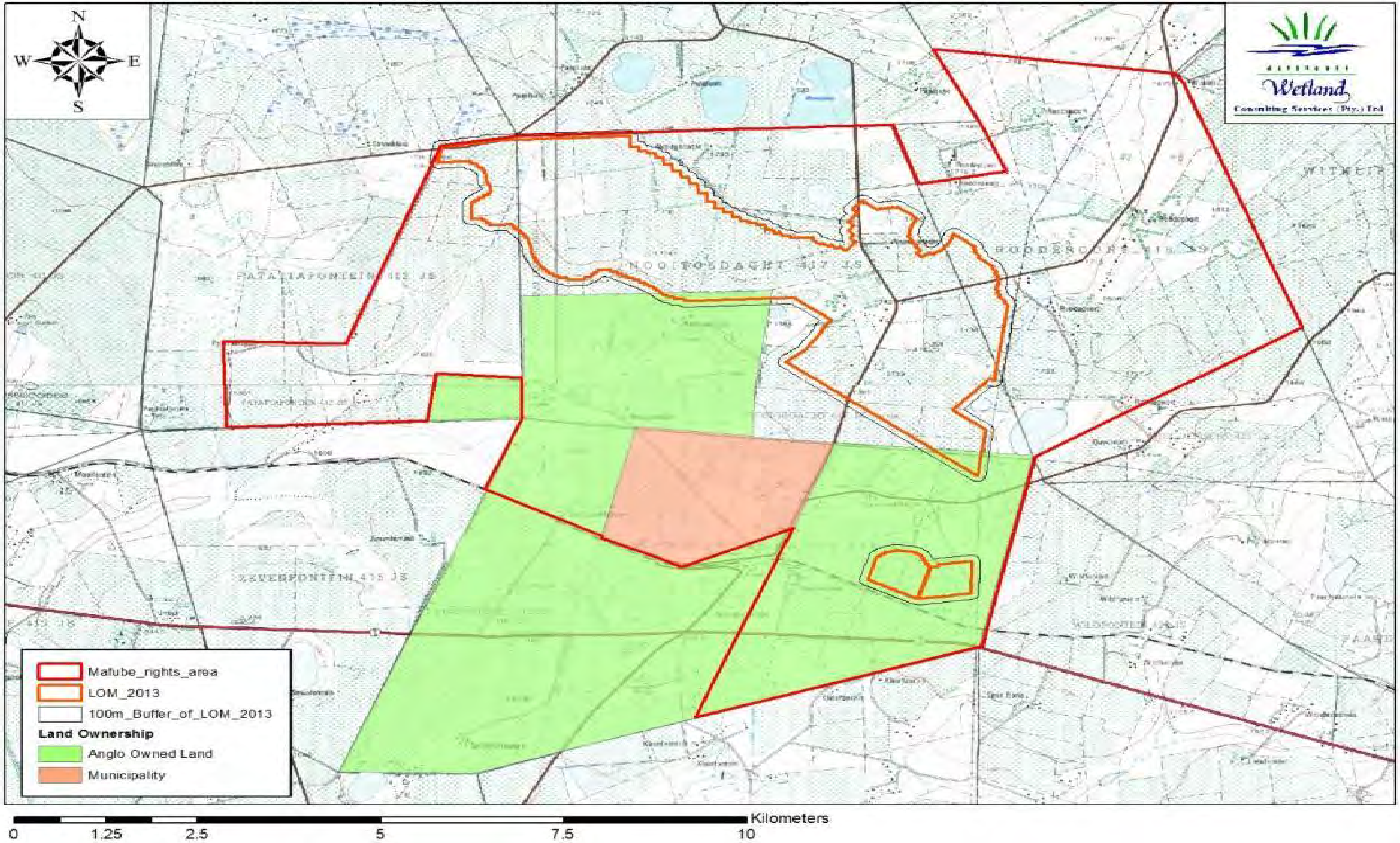

Figure 5: Area identified for wetland rehabilitation ("Land Ownership").

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8.1 Wetland Delineation and Classification

The wetlands within the targeted sub-catchments were delineated as part of previous studies undertaken by GAA and recently updated by WCS. As part of this study, the existing wetland delineations and HGM classifications were used. Wetland types present included the following:

- Valley bottom with a channel;
- Valley bottom without a channel;
- Hillslope seepage; and
- Pans and Depressions, the distinction being that a pan has a discernible basin.

The distribution of wetlands in the study area used for the strategy development is shown in **Figure 6**.

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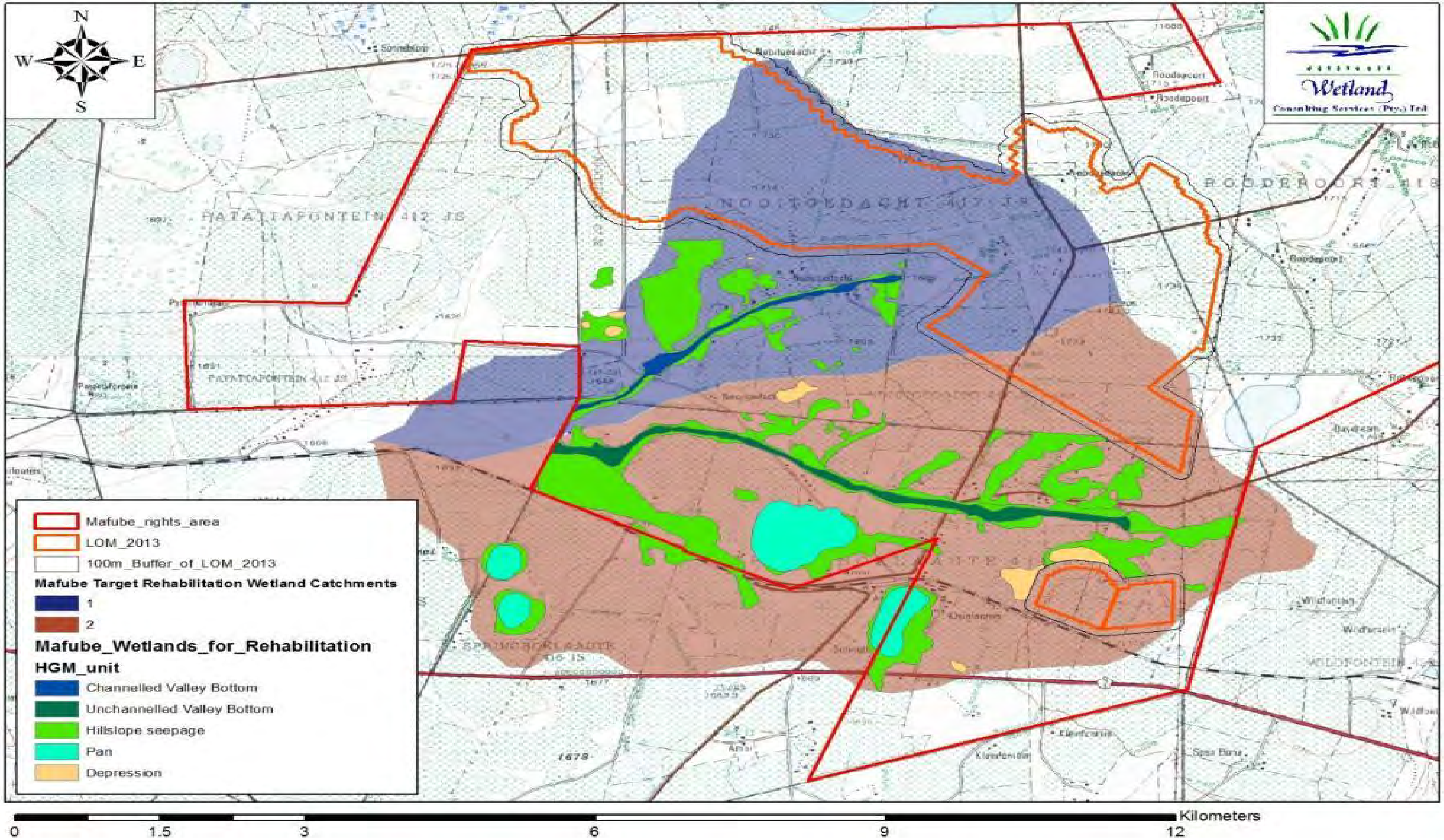

Figure 6: Identified candidate rehabilitation wetland systems within the same sub-catchments as per the current mine plan.

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8.2 Present Ecological Status Assessment (PES)

The PES of the majority of wetlands within the area targeted for rehabilitation are considered to be generally ***Moderately Modified* (C) to *Largely Modified (D)*** (refer to **Figure 7**). For further details regarding the types of impacts currently affecting the target wetland catchments, refer to Section 8.3.1 below.

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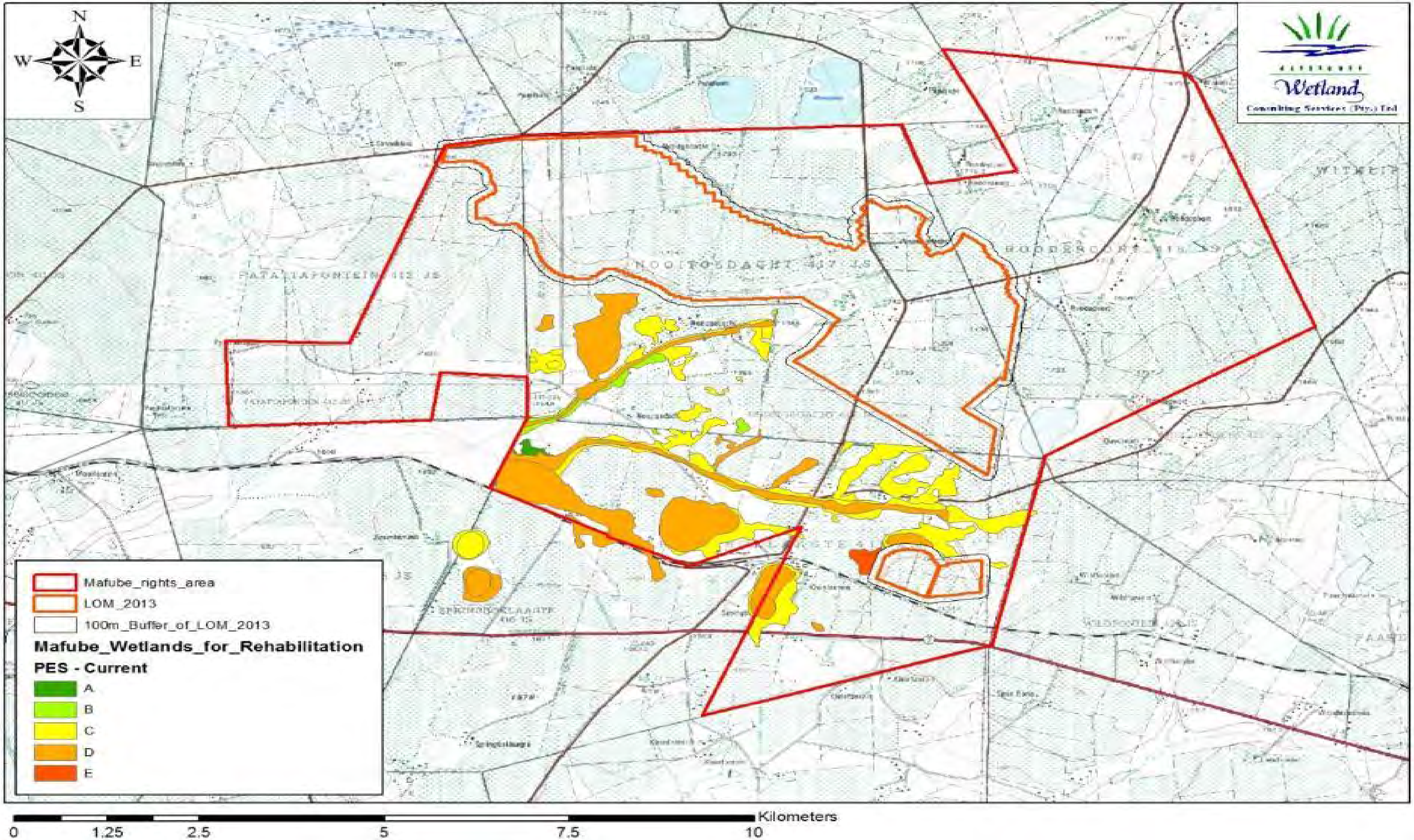

Figure 7: The current Present Ecological Status of the target rehabilitation wetlands downstream of the Mafube Lifex project mine footprint.

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8.3 Rehabilitation Strategy

Planning a wetland rehabilitation strategy is a three-phase process involving:

1. The identification of the problems compromising wetland ecological integrity;
2. Setting rehabilitation objectives based on an analysis of the problems and the feasible extent of addressing them in order to make ecological gains; and
3. Formulating solutions aimed at achieving the set objectives.

Each of these phases is addressed in the following sections.

8.3.1 Broad Ecological Problems Identified Within the Targeted Rehabilitation Sites

A range of problems undermining wetland ecological integrity and affecting the surface and shallow sub-surface hydrological processes in the catchments were identified. Implementing intervention and management measures to address these forms the underlying aim of the proposed wetland rehabilitation and management strategy. The problems identified within the wetland systems are grouped according to the wetland health component upon which they have the greatest influence, namely geomorphology, hydrology or vegetation. It should be noted that while the types of problems arise from similar impacts, the scale and threat of each problem will vary according to the environmental setting (topography, soils, hydrology, state) of the wetland. Rehabilitation therefore is highly site-specific, and involves either addressing the problem directly, or addressing the impact that is causing the problem, or a combination of both.

The primary land use in the study area is agriculture and this is reflected in the nature of the most widespread issues within the wetland systems, namely erosion and drying out of the wetlands associated with alien vegetation, trenching and impoundment and concentration of flows. Of significant value in rehabilitating the wetlands will be removal of alien vegetation, improvement of flows through the wetlands and control of channel erosion and head-cutting. In addition, without effective livestock management, other interventions are less likely to be effective in achieving their rehabilitation goals.

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8.3.1.1 Hydrological Impacts

Flow Impoundment

Structures such as dams, berms and raised roads act as impounding features to wetlands and channel flows. Within the study area this has led to back flooding upstream of the impounding features and reduced saturation of wetland soils downstream. The impoundment of longitudinal flow by dams has had a significant impact on the downstream wetland habitat in most cases, simply by reducing water supply. In systems where longitudinal flow is an important driver, this impact extends along the entire length of the wetland below the dams.

Flow confinement occurs most often at dam spillways as the concentrated release of peak surface flow may result in an increase in flow velocity and volume at outlet points. This increased erosive potential often results in channel formation and further erosion of existing channels. Alteration of the wetness regime and the lowering of the water table induced by channel formation within many of the wetlands have resulted in the drying out of the wetland soils and subsequent encroachment by terrestrial vegetation. Pipe culverts beneath road crossings often have the same impact if they are too narrow. The formation of channels within the wetlands can lead to reduced residence times of flows within the wetlands and an associated loss of functionality in terms of water quality improvement, drying out of areas of the wetlands, encroachment of terrestrial vegetation, and transport of eroded soils out of the catchment. Some examples of impacts seen in the wetlands of the area are shown in **Figure 8**.

Rehabilitation often involves the following options:

- Removal of the obstacle;
- Redesign of the impoundment to maintain longitudinal flows; and
- Management of the discharge point to prevent channel erosion and spread the water across the width of the wetland.

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Figure 8: Photographs indicating impoundment of flow upstream of dams.

Flow Concentration or Confinement

Flow concentration occurs most often at wetland road crossings and other linear infrastructure crossings, and downstream of dam spillways (**Figure 9**). The concentration of flows often leads to channel formation and further erosion of existing channels due to increases in flow velocity and volume at outlet points. The formation of channels within the wetlands can lead to reduced residence times of flows within the wetlands and an associated loss of functionality in terms of water quality improvement, drying out of areas of the wetlands and encroachment of terrestrial vegetation.

Land transformation and linear developments in the catchment may alter the pattern of water delivery to wetlands. Roads intercept surface flow that would enter the wetland diffusely, and direct them to certain areas before discharging them as a point-source. This creates confined surface flow outside the wetland which usually manifests itself within the wetland, culminating in channel erosion.

Figure 9: Photographs indicating confinement of longitudinal flow resulting in scouring and channel incision.

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Formation of Preferential Flow Paths

Within the study area, agriculture is the primary landuse, and grazing by cattle occurs through much of the study area (**Figure 10**). Wetlands are utilised by livestock as grazing because they provide a source of drinking water, usually support higher primary production, support an extended grazing season and are excluded from cultivation. Livestock movement across the wetlands and to and from watering points (typically in dams within the wetlands) has created trampled pathways through the wetlands which, particularly in the valley bottom wetlands which lie on expansive clays, has led to the formation of preferential flow pathways and resulted in head-cuts eroding. The formation of channels within the wetlands can lead to reduced residence times of flows within the wetlands, drying out of areas of the wetlands and encroachment of terrestrial vegetation.

Figure 10: Photograph indicating cattle utilisation within the wetlands.

Drain (Trench) Excavation and Contouring

Drains have been excavated in certain areas to facilitate crop cultivation and livestock grazing (**Figure 11**). They are serving to increase the rate of passage of water through the wetlands, decreasing retention time, and lower the water table. This leads to wetland desiccation and transformation of wetland vegetation to terrestrial habitat.

Contour berms and roads outside wetlands intercept diffuse surface flow and convert it into confined point-source discharge. This may change the patterns of saturation in the wetland, as well as result in longitudinal erosion inside the wetland, and lateral erosion extending outside the

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wetland. Contour berms within hillslope seepage wetlands may also lead to a degree of flow impoundment upslope and reduced saturation in the wetlands downslope.

Figure 11: Photographs indicating drains and trenches within the wetlands.

Alien Invasive Vegetation

Areas of the study area have been colonised by stands of alien trees, such as *Acacia mearnsii*, *Populus* sp., *Eucalyptus* sp. and *Salix babylonica*. The water requirements of these species tends to exceed that of indigenous grassland vegetation, and as such, can lead to a decrease in the supply of water to the wetlands and a resultant drying out of areas of the wetlands and encroachment of terrestrial vegetation.

8.3.1.2 Geomorphological Impacts

Infilling and Sedimentation

Infilling is associated with activities or structures which lead to burial of the natural wetland sediments, such as dams, berms and raised roads (**Figure 12**). The geomorphological impact entailed in these features relates to the confinement of flow through culverts, or generated by partial constriction of the wetland. This confinement of surface flow increases the erosive force of water moving past the feature, resulting in increased soil erosion, head-cut initiation and sediment mobilisation. Dams are also points of sediment deposition and accumulation.

A noticeable impact of the excavation of dams in this environment is the drop in base level in the wetland. The impact is minimal if the dam is full. However, if the dam is empty, water entering it from upstream flows over a drop, which initiates head-cut erosion that erodes upstream forming a channel. This affects the hydrology in this region of the wetland.

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Head-cut Erosion

Erosion was found to be a widespread impact affecting the wetlands within the study area. The primary cause of erosion within the wetlands appears to be associated with man-made structures such as dams and roads leading to flow concentration, and the impact of cattle trampling. Erosion has typically occurred on site at flow concentration points downstream of dams and roads and in areas with high livestock traffic, particularly surrounding watering points. Erosion and channel formation leads to a lowering of the water table and drying out of the surrounding wetland soils. The vegetation responds to the drop in water table. Eroded sediments are transported downstream where they affect water quality and, when deposited, can lead to a change in the geomorphology of wetlands and rivers downstream.

Overgrazing and Trampling

Cattle grazing is evident in the wetland systems on site. Although the stocking density does not appear to be causing severe overgrazing, trampling within the wetlands has led to the formation of preferential flow pathways, and in turn head-cut erosion points and channel formation.

Soil Borrowing

Within several of the wetlands and their catchments, soil/sand and rock borrowing is occurring. This has led to a change in the geomorphology of the wetlands, changes in the patterns of flow across the systems and changes to the vegetation composition. Recently borrowed areas also provide a sediment source and may lead to sedimentation downstream.

8.3.1.3 Vegetation Impacts

Cultivation

Agriculture is the dominant land use within the study area, and in many areas of the study site cultivated fields and pastures encroach into the wetlands, leading to a complete loss of the natural wetland vegetation. As a result, the biodiversity of these areas has been reduced, and the value of remaining wetland areas in terms of biodiversity support is also negatively affected.

Encroachment of Exotic and Terrestrial Plant Species

The replacement of indigenous wetland species with weed and/or exotic species can have a negative effect on the biodiversity support function of the wetlands. Exotic vegetation was most obvious within the study site along road margins, surrounding homesteads and dams, as well as in dense stands in the catchments of some of the wetlands (**Figure 14**). The presence of exotic species affects not only the biodiversity of the wetlands, but also the hydrology of the wetlands

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where the alien vegetation has high water uptake demands. Encroachment of terrestrial species has occurred in areas where impoundments and erosion have led to drying out of the wetland soils, leading to a change in the wetland extent and providing favourable conditions for the establishment of these species.

Figure 12: Photographs indicating encroachment of *Salix babylonica*, *Populas* sp., and *Acacia mearnsii*.

Overgrazing and Trampling

Moderate overgrazing and trampling of wetland vegetation was observed in several of the wetlands, particularly surrounding dams. This may be a consequence of overstocking or other management practices which are not compatible with the prevailing climate, vegetation or soil conditions. Overgrazing has a direct impact on the wetland vegetation biomass, and can lead to reduced diversity of wetland plant species. Other important biodiversity-related impacts are:

- The homogenisation of the habitat available for wetland flora and fauna; and
- The reduction in cover, depriving wetland fauna of the refugia on which they depend to avoid predation.

8.3.2 Rehabilitation Objectives

Rehabilitation of targeted wetland habitats is the overarching goal of this project. Rehabilitation implies that there is a concession that it will not be possible to reinstate all of the driving ecological processes within the wetlands because:

- The hydrology of the catchment has been fundamentally altered; or
- The physical impact within the wetland will be too costly to reverse.

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Those processes that are realistically achievable within the confines of these constraints are therefore selected and form the basis of rehabilitation objectives. Under the current scenario, the goal of rehabilitating the wetlands to a more natural state is considered to be realistic. The aim will be to improve the PES scores of the wetlands considered suitable by at least a category. For example, the goal of rehabilitation would be to improve a wetland HGM unit currently considered Largely Modified (D) to Moderately Modified (C) or better.

The recommended rehabilitation objectives are as follows:

- Deactivate eroding head-cuts and knick-points, preventing their migration into intact wetland habitat;
- Deactivate channels through historically un-channelled systems, reinstating diffuse longitudinal flow and raising the water table;
- Stabilise dam spillways, preventing incision. Redesign to spread water across the width of the wetland below the wall, reinstating diffuse longitudinal flow;
- Redesign dam walls to release more water to downstream wetland habitat. This will be coupled with providing safe, stable access for cattle to the water;
- Redesign road crossings to remove confined flow;
- Remove berms and redesign roads that intercept sheet flow in the catchment;
- Apply appropriate grazing and burning management to both the wetlands and the catchments;
- Removal of alien trees and other alien vegetation to improve the integrity of the wetland vegetation and to increase flows to the wetlands from the catchments; and
- Treating of polluted water associated with the mining activities and discharging clean water into the environment and ensuring quality and quantity of the resource is not compromised in anyway due to the proposed activities onsite.

8.3.3 Conceptual Rehabilitation Solutions

A summary of the generic rehabilitation objectives, together with the rationale behind their implementation for each of the targeted wetland sub-catchments is presented in **Table 3**. It is important to keep in mind that all the impacts identified in Table 3 occur in both catchments, however, the most significant impacts for each sub-catchment are presented here per catchment. The scope of the study did not allow the designation of detailed interventions to be included. However, basic design of proposed interventions (including the release of treated water from the WTP) and the associated high level costing to implement the interventions was undertaken in order to provide insight into the nature of the rehabilitation envisioned for these wetlands. Further

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details are presented in Appendix I which provides an indication of the high level costing and basic design concepts for the rehabilitation interventions. A detailed investigation of the proposed interventions would form the point of departure for a subsequent rehabilitation plan should this strategy meet with approval from Mafube and the authorities. Due to the extent and severity of impacts, which are considered to be greater in sub-catchment 1, the location of the water treatment plant (within sub-catchment 1) and the proposed implementation order of mining, it is recommended that rehabilitation begin within the wetlands of sub-catchment 1 and progress to sub-catchment 2.

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Table 3: Summary of rehabilitation activities, their rationale and the proposed interventions for the respective wetlands

Candidate Catchments	Description of the problem/Issue	Rehabilitation Objectives	Expected Outcomes	Type of Interventions likely to be required
Catchment 1	Alien invasive vegetation such as *Populus* ssp, *Euclyptus* sp. and *Aacia mearnsii*	• Removal of alien invasive vegetation.	• Improve species richness and vegetation composition within the wetlands and catchment area and increased flows from the catchment	• Physical removal of alien vegetation using Working for Water guidelines. Developing monitoring and evaluation plans
	Headcut erosion and channel incision along the valley bottom wetland	• Deactivate headcuts and raise water table	• Improved distribution of water entering the wetland system, possibly resulting in the establishment of a continuum of saturation, which will enhance wetland biodiversity.	• Rock masonry structures, grass-lined chute, earthworks, reshaping.
	Dams/ Impeding structures	• Removal of the impeding structures where excessive dams present along the valley bottom or improvement of remaining dams to improve structural integrity, promote diffuse flow and connectivity along the wetland	• Promote water distribution, increase wetness signature and promote vegetation establishment and re-colonisation and improve species richness. Increase diffuse flow across the wetland and decreased rate of passage of water through the wetland.	• Earthworks removal of dams and roads, disc ploughing and re-vegetation of all disturbed areas. Earthworks lowering of dam walls and improved spillway design
	Multiple trenches surrounding agricultural fields and draining wetland areas	• Deactivate trenches	• Removes confined flow, improving geomorphology component. • Spreads water across the entire catchment area of the wetland, improving hydrology component. • Water redistribution will result in increased wetness, promoting wetland vegetation establishment. • Promotes diffuse flow, improving wetland capacity to trap sediment, phosphates and toxicants. • Improves flood attenuation by spreading water out and slowing the flow down as it comes into contact with surface roughness of the vegetation. • Diffuse flow increases the level of saturation across the wetland, and decreases the rate of passage of water through the wetland, improving streamflow augmentation.	• Placement of rock masonry plugs at regular intervals to prevent preferential flow • Backfilling between the plugs to replace the soil and fill in the trenches. • Re-vegetation of filled areas along the trenches.
	Cultivation within wetland habitat	• Removal of cultivated crops from the wetlands and recommended 100m buffer surrounding wetland habitat	• Improve species richness and vegetation composition within the wetlands and catchment area, Reduce sediment transport into wetland habitat from bare soils.	• Physical removal of cultivated crops,, and rip, shape and revegetation all disturbed areas. Developing monitoring and evaluation plans

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Candidate Catchments	Description of the problem/Issue	Rehabilitation Objectives	Expected Outcomes	Type of Interventions likely to be required
Catchment 2	Sand borrowing and diggings surrounding several of the pans and along the edge of the valley bottom wetland	• Infilling of excavated areas within catchment area	• Improve aesthetic appeal of the catchment area as well as the integrity of the area. • Improve species richness and vegetation composition within the catchment area	• Earthworks, shaping and re-vegetation
	Pipe culverts at road crossing causing channel incision and ponding of flows	• Improve the connectivity up and downstream of the culverts and promote diffuse flow	• Promote water distribution, increase wetness signature and promote vegetation establishment and re-colonisation and improve species richness. • Increase diffuse flow across the wetland and decreased rate of passage of water through the wetland.	• Earthworks improvement of the road and replacing of the single culvert with multiple culverts and re-vegetation of all disturbed areas
	Dams/ Impeding structures	• Removal of the impeding structures where excessive dams present along the valley bottom or improvement of remaining dams to promote diffuse flow and connectivity along the wetland	• Promote water distribution, increase wetness signature and promote vegetation establishment and re-colonisation and improve species richness. Increase diffuse flow across the wetland and decreased rate of passage of water through the wetland.	• Earthworks removal of dams and roads, disc ploughing and re-vegetation of all disturbed areas. Earthworks lowering of dam walls and improved spillway design
	Multiple trenches surrounding the pans, diverting flows from the valley bottom wetland and within the catchment	• Deactivate trenches	• Removes confined flow, improving geomorphology component. • Spreads water across the entire catchment area of the wetland, improving hydrology component. • Water redistribution will result in increased wetness, promoting wetland vegetation establishment. • Promotes diffuse flow, improving wetland capacity to trap sediment, phosphates and toxicants. • Improves flood attenuation by spreading water out and slowing the flow down as it comes into contact with surface roughness of the vegetation. • Diffuse flow increases the level of saturation across the wetland, and decreases the rate of passage of water through the wetland, improving streamflow augmentation.	• Placement of rock masonry plugs at regular intervals to prevent preferential flow • Backfilling between the plugs to replace the soil and fill in the trenches. • Re-vegetation of filled areas along the trenches.
	Cultivation within wetland habitat	• Removal of cultivated crops from the wetlands and recommended 100m buffer surrounding wetland habitat	• Improve species richness and vegetation composition within the wetlands and catchment area, Reduce sediment transport into wetland habitat from bare soils.	• Physical removal of cultivated crops,, and rip, shape and revegetation all disturbed areas. Developing monitoring and evaluation plans

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8.4 Anticipated Wetland Functional Gains

Using the SANBI offset calculator and applying appropriate rehabilitation interventions and management measures (See Figure 15 below for anticipated improvements in the wetlands' PES due to rehabilitation and management), the following gains are anticipated within the candidate wetland clusters (see **Tables 4** for summarised functional and conservation gains and **Table 5** for the functional gains per HGM unit in the two sub-catchments).

Table 4: Summary of the results of the hectare-equivalent calculations for the candidate sub-catchments based on the recent offset calculator (SANBI, 2013).

	CATCHMENT 1 (Ha/Eq)	CATCHMENT 2 (Ha/Eq)	ALL (Ha/Eq)
POTENTIAL FUNCTIONAL GAINS	14	40.44	54.44
POTENTIAL ECOSYSTEM GAINS	155.3	504.4	659.7

Note that a divisor of 0.66 has already been applied to the candidate wetlands to address the risk of failure of structural interventions and recreation of wetland habitats: both physical failure and failure to achieve their objectives. In summary, the following hectare equivalent gain as a result of the proposed rehabilitation of candidate wetlands, and anticipated contribution towards the ecosystem conservation target, have been calculated:

- Wetland Functional Gain = **54.44 ha-eq.**
- Ecosystem Conservation Gain = **659.7 ha-eq.**

The candidates' site with rehabilitation measures in place will not be able to meet the required functional targets with the proposed mining plan implemented. ***However, although not taken into account in the current functional gains calculations, the potential positive impact of the water treatment plant in sub-catchment 1 is expected to be significant and will be instrumental in restoring the wetland functionality lost within the mine footprint in terms of flow quantities, flow characteristics and water quality.***

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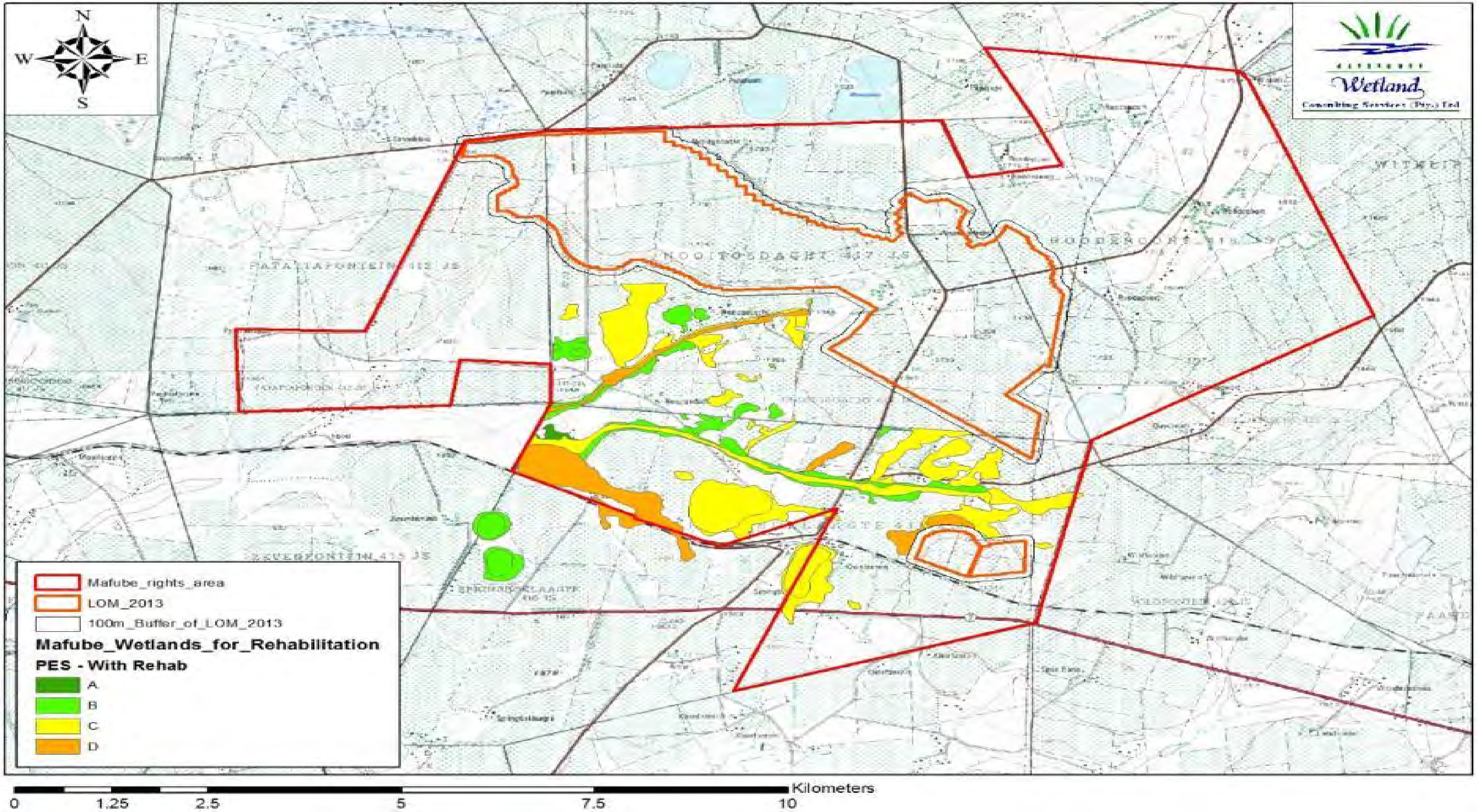

Figure 13: Anticipated future PES of wetlands following implementation of the rehabilitation and management strategy (See Figure 6 for comparison to current PES of these wetland systems).

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Table 5: Functional hectare equivalent gains for each of the wetland HGM units within the two sub-catchments proposed for rehabilitation.

Catchment	HGM unit	Area	Pre Rehabilitation PES Category	Pre Rehabilitation Integrity (%)	Post Rehabilitation PES Category	Post Rehabilitation Integrity (%)	Functional Hectare Equivalents
1	Hillslope seepage	11.22	C	71.00	B	83.70	0.94
1	Hillslope seepage	12.95	C	75.10	B	84.10	0.77
1	Hillslope seepage	4.09	D	56.00	C	80.00	0.65
1	Hillslope seepage	63.63	D	51.40	C	74.10	9.53
1	Depression	0.20	D	56.80	C	64.80	0.01
1	Depression	0.08	D	56.80	C	64.80	0.00
1	Depression	0.75	C	71.00	B	83.70	0.06
1	Depression	1.98	C	71.00	B	83.70	0.17
1	Depression	1.36	C	71.00	B	83.70	0.11
1	Channelled Valley Bottom	25.86	D	56.00	D	57.50	0.26
1	Hillslope seepage	2.70	B	88.00	B	89.60	0.03
1	Hillslope seepage	14.38	B	88.00	B	89.60	0.15
1	Hillslope seepage	10.75	C	65.15	C	78.60	0.95
1	Hillslope seepage	2.74	C	75.29	C	78.00	0.05
1	Hillslope seepage	7.48	C	70.89	C	73.30	0.12
1	Hillslope seepage	11.34	C	71.35	C	73.90	0.19
2	Pan	66.03	D	44.80	C	72.30	11.98
2	Hillslope seepage	24.59	C	61.30	C	72.90	1.88
2	Hillslope seepage	28.22	C	61.00	C	65.70	0.88
2	Pan	29.43	D	54.80	C	71.10	3.17
2	Hillslope seepage	12.01	D	54.40	B	81.60	2.16
2	Pan	11.41	D	59.90	B	80.60	1.56
2	Hillslope seepage	2.80	D	56.00	C	76.00	0.37
2	Hillslope seepage	23.94	C	64.60	C	76.90	1.94
2	Depression	10.59	E	39.20	D	56.80	1.23
2	Depression	5.98	C	72.30	C	75.80	0.14
2	Hillslope seepage	0.60	B	82.10	B	82.10	0.00
2	Hillslope seepage	3.06	B	81.36	B	83.90	0.05
2	Depression	1.59	D	58.40	C	65.20	0.07
2	Hillslope seepage	0.39	C	74.79	B	81.40	0.02

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Catchment	HGM unit	Area	Pre Rehabilitation PES Category	Pre Rehabilitation Integrity (%)	Post Rehabilitation PES Category	Post Rehabilitation Integrity (%)	Functional Hectare Equivalents
2	Hillslope seepage	0.32	C	70.36	C	73.20	0.01
2	Hillslope seepage	1.42	C	73.50	C	76.90	0.03
2	Depression	8.72	D	57.80	D	57.80	0.00
2	Hillslope seepage	5.20	B	94.80	A	94.90	0.00
2	Unchannelled Valley Bottom	57.44	D	54.67	C	72.60	6.80
2	Hillslope seepage	108.75	D	60.00	D	60.00	0.00
2	Hillslope seepage	13.29	C	71.29	B	81.00	0.85
2	Hillslope seepage	7.96	D	53.72	C	68.10	0.76
2	Hillslope seepage	8.51	D	48.72	D	48.70	0.00
2	Hillslope seepage	23.74	C	67.30	C	70.40	0.49
2	Hillslope seepage	17.45	C	67.30	C	70.40	0.36
2	Hillslope seepage	29.86	C	80.00	B	81.00	0.20
2	Hillslope seepage	22.07	C	78.00	B	81.00	0.44
2	Hillslope seepage	28.06	C	70.72	C	80.30	1.77
2	Hillslope seepage	1.62	C	71.29	B	80.60	0.10
2	Hillslope seepage	1.66	C	64.60	C	76.90	0.13
2	Pan	12.35	C	72.20	B	81.60	0.77
2	Hillslope seepage	5.58	C	62.70	B	87.40	0.91
2	Hillslope seepage	22.75	C	67.43	C	76.70	1.39

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8.5 Opportunities Associated with the Targeted Rehabilitation Wetlands

The suitability of the candidate wetlands, while feasible from a rehabilitation and management perspective, will also depend largely on securing the areas from a land tenure and/or management perspective (such as a conservation servitude for example) . The challenges, risks and opportunities related to using these areas for rehabilitation are addressed in the section below.

It can be argued that the upper section of the Olifants River catchment can potentially form a meaningful offset area from both a biodiversity and water resources management perspective due of the following:

- As a result of past and current mining activities in this catchment, maintenance and rehabilitation of the remaining wetlands can only be beneficial in terms of improving water quality to downstream water users and improving the biodiversity support capacity of this catchment; and
- There are still some areas where landuse consists primarily of livestock grazing of open veld and agricultural activities which, if incorporated into protection-based offset areas, can potentially also provide biodiversity support if underlain by suitable management plans.

There is therefore a valuable opportunity within this area to create functionally healthy patches within the landscape that can support a good representation of Highveld biodiversity.

Although the required functional targets are not fully met, the catchments identified for rehabilitation provide a meaningful opportunity which will realise meaningful functional gains, and ecosystem targets which are far exceeded through rehabilitation and management of the targeted wetlands and buffering of these wetlands.

In addition, it is proposed that outputs from the water treatment plant located below the mining area will provide opportunities to:

- Compensate for catchment flows lost as a result of the mine footprint, through diffuse and continuous discharge into the receiving rehabilitated wetlands at specific discharge points;
- Improve the hydrology of wetlands downstream and potentially create additional wetland habitat onsite; and
- The above improvements will add value to the current functional gains anticipated.

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The majority of the identified target wetlands lie within Anglo American owned properties, thereby reducing potential land tenure issues and risks. Therefore, the potential exists to produce a holistic, practical wetland management plan that can be confidently applied as Anglo has full control of rehabilitation, implementation and management.

In the target wetland area owned by Municipality (refer to Figure 5 for extent and nature of landownership), there are further opportunities of initiating a community based project. The close proximity of the Agri-village community in relation to the offset catchment areas makes this possible. Potential opportunities include:

- Training and skills transfer related to wetland functionality and benefits;
- Training and skills transfer related to wetland rehabilitation methods and implementation;
- Supporting emerging contractors with regards to the wetland rehabilitation project, which in turn Anglo could roll out to other project areas where they require rehabilitation services; and
- Job creation for the local community for the period of at least 10 years as per the implementation plan.

The end result would be a cleaner environment and greater connection of the local community to their environment and its maintenance.

8.5.1 Wetland Management

The project team should access and manage the rehabilitation sites in accordance with the best management practices and any specific requirements from the relevant authorities. The implementation of the proposed rehabilitation interventions must take into account all relevant provisions of Best Management Practices and Construction Environmental Management Plan. The appointed EAP (Environmental Assessment Practitioner) of the project must compile in conjunction with the design engineer the general construction notes and for the Construction Phase EMP (CEMP) for the project.

It should be noted that while construction-related impacts will be addressed through best management practices and the environmental management plan, there are a range of longer-term aspects that need to be addressed to ensure that anticipated improvements in wetland functionality are achieved and maintained over the long-term. A range of

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management recommendations are therefore detailed here, which will need to be taken into account by the Mafube Lifex Project team when managing the wetland system.

8.5.1.1 Wetland Buffering and Management of Agricultural Lands

The areas where cultivation extends into the wetland boundaries or lies in close proximity to wetland habitat as identified within the rehabilitation strategy, it is recommended that a buffer of 100 metres be incorporated around the wetlands, and cultivation be withdrawn from the buffer area to allow natural vegetation to become reinstated. A buffer area will provide a measure of protection to the wetland habitat by reducing sediment input directly to the wetlands, improving wetland habitat integrity along the wetland fringes and allowing space for surface flows to infiltrate without causing erosion of the wetland soils.

8.5.1.2 Burning and Grazing Management

The following burning and grazing management guidelines are recommended for the rehabilitated sub-catchments:

- In areas where erosion is severe or proposed structures such as gabions are installed, the wetland and its buffer should be fenced off to control access by cattle and a grazing management plan must be put in place;
- Ideally the wetlands should only be grazed in autumn, although some parts of each system should be left un-grazed to provide refugia for wetland fauna;
- Water points may be established at certain points in the wetland systems that are specifically modified to be able to withstand the disturbance from cattle;
- In wetlands where natural fires are controlled or prevented, the wetlands should be burned periodically (every 4 to 5 years) and such action will require the compilation and implementation of a fire management plan. Care should be taken to burn at times outside the nesting periods for important wetland bird species; and
- A full post-rehabilitation management plan should be established to ensure that the management of the area is compatible with achieving the restoration objectives of the project.

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8.5.1.3 Alien Vegetation Management

Stands of alien vegetation, which comprise of species fitting Category 1 and Category 2, must be removed (GNR 280). Stands of species fitting Category 3, if within 30 metres of a 1:50 year flood line of river, stream etc. must also be removed (GNR 280). Other, non-categorised species should ideally be removed. These have already been identified within the Mafube Lifex Project wetland strategy.

- An organization such as Working for Wetlands should be consulted regarding removal to ensure that it is done efficiently and sensitively without causing unnecessary soil disturbance;
- Alien vegetation removal should begin in the upper ends of the catchments to ensure that reseeding of cleared areas does not take place from the upstream seed bank;
- Cleared areas may need to be re-vegetated to stabilise the soil if natural re-vegetation with indigenous species does not take place; and
- An alien vegetation management plan will be required to guide the removal of alien species in terms of the objectives and methodology followed. At present, alien species management and eradication forms part of the existing Mafube Biodiversity Action Plan (see Appendix IV) in which the objective is to maintain the Mafube Mining Rights Area free of alien species. Broad guidelines are set out in this document with regard to alien species removal and the monitoring schedule to be applied.

8.5.1.4 Management and Monitoring of Important Biota

It must be noted that all the important species that were identified during EIA phase of the projects must be listed, including their locations and these should be protected and in cases where this is not possible a feasibility assessment of relocating these species must be undertaken with the guidance of the local conservation authority. It must however be noted that:

- No threatened flora should be collected or harvested.
- No threatened fauna should be hunted.
- Where endangered animal species occur in the wetland, records should ideally be kept of sightings in order to help establish whether or not wetland management practices and rehabilitation efforts are having a positive impact on these species.
- The local district conservation officer should be contacted to obtain further information on monitoring of important species.

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8.6 Wetland Monitoring Measures

Wet Rehab Evaluate indicates three levels of monitoring that are considered to be appropriate for the purposes of wetland rehabilitation in South Africa (Cowden and Kotze, 2008). Those are as follows:

- Level 1: Assessment of execution and social outputs
- Level 2: Rapid assessment of rehabilitation outcomes
- Level 3: Comprehensive assessment of rehabilitation outcomes

For the purpose of monitoring of the Mafube Lifex Project rehabilitation outcomes, the level 2 assessment is proposed. The following outcomes and outputs are included in the Level 2 assessment:

1. Ecological outcomes – wetland assessments (Present Ecological State (PES) pre and post rehabilitation)
2. Survival outputs - Structural Integrity assessment and erosion. Erosion measured pre and post implementation of rehabilitation interventions.
3. Aesthetic outcomes - Visual and morphological change assessment of the system, photographic record taken and kept pre and post implementation of rehabilitation interventions
4. Hydro-geochemical outcomes - Water levels, water distribution and water retention

The other aspects of monitoring are included in the Water Use Licence for the project and these include Water quality and Bio-monitoring. In terms of wetland rehabilitation monitoring these fall within the Level 3 assessment and for the purpose of this monitoring these are not included in the list of activities below, as the list below is planned to be additional activities to those already in the licence monitoring conditions. The summary of monitoring is provided below with the details in the following table.

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Table 6: Summary of monitoring timing and sequence for Mafube Lifex Rehabilitation Strategy

LEVEL 2 – MONITORING			
MONITORING ACTIVITES	**TIMING**	**FREQUENCY**	**RESPONSIBLE PERSON**
WET-Health data (PES scores)	Not Applicable	Before and 3 years after completion	Wetland Specialist
Structural Integrity	-	Immediate after construction and seasonal inspections and specifically after flood events	Environmental Engineer
Erosion stabilisation	Winter	Annually	Environmental Engineer
Water level	Winter	Annually	Environmental Engineer
Vegetation inventory	Late spring/Summer	Annually	Wetland Specialist
Aesthetic outcomes	Late Spring/ Summer	Annually	Wetland Specialist

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Table 7: Mafube Lifex Project - timing and frequency of Level 2 monitoring (with details on activities)

LEVEL 2 – MONITORING			
MONITORING ACTIVITIES	**TIMING**	**FREQUENCY**	**RESPONSIBLE PERSON**
WET-Health data (PES scores) collected during the wetland assessment prior to rehabilitation on site will be used as baseline monitoring data. The integrity scores will be used and the goal for monitoring to meet the projected integrity scores post rehabilitation onsite. Currently the wetlands earmarked for rehabilitation with the Mafube Lifex Project area are ranging from the below categories: • PES C • PES D • PES E The objective of rehabilitation is to retain and/or improve these categories where possible and the projected improvements are already included in the projections undertaken for the project and therefore monitoring will be to ensure that rehabilitation activities are planned accordingly to meet these predefine projected health categories.	Not Applicable	Before and 3 years after completion	Wetland Specialist
Structural Integrity - this will focus on the presence of the following forms of structural vulnerability: 1. Sign off to see if interventions is constructed according to specifications 2. Post rehabilitation, the following inspection and reporting will be required: a. Undermining b. Sliding, tilting or overturning c. Side bank collapse d. Scouring/erosion upstream and downstream e. Side cutting around the structure f. Exposed soils, and g. Premature decay of the structural material (e.g. gabion wire, earthwork settlements and etc. Detail design phase of the project will provide specific details of the interventions (construction notes and actual dimensions) that will be required for monitoring. An inventory of the issues to be monitored will be compiled by the engineer upon completion of the detailed designs and these will be incorporated in the monitoring programme of the rehabilitation project.	-	Immediate after construction and subsequently seasonal inspections and specifically after flood events	Environmental Engineer
Erosion stabilisation - dimensions of problems (headcuts and gully erosion) collected during detail design phase of the project will be used for monitoring any improvements post rehabilitation onsite. Any changes in dimensions (improvements and/or otherwise) will be recorded post rehabilitation for further attention that may be recommended by the assessor of the system. These areas include the areas that are proposed to be backfilled in the Mafube Lifex project area. The dimensions of those areas will be recorded by the engineer for the purpose of designing appropriate rehabilitation interventions during detail design phase of the project. The recorded figures will be used as baseline and post rehab dimensions will be measured in relation to these. An inventory of the issues to be monitored will be compiled by the engineer upon completion of the concept designs and these will be incorporated in the monitoring programme of the rehabilitation project.	Winter	Annually	Environmental Engineer
Water level - the depth of water level used for detailed engineering intervention design, particular for the specific problem areas where the objective is to raised water level, rewet and redistribute water across the wetland areas, will be used as baseline prior to rehabilitation. Post rehabilitation in the same area, water levels will be measures to determine adequacy of intervention designs in meeting the objectives. An inventory of the interventions aimed at raising the water table and rewet the wetland will be compiled by the engineer during detail design phase of the project. The levels of water which include degradations pre rehabilitation and used for designs will be used as baselines data and upon completion monitoring of an area of influence as per objective of the intervention will be undertaken and adequacy and improvements achieved will be recorded timeously as per recommended monitoring frequency. This plan will be incorporated in the monitoring programme of the rehabilitation project.	Winter	Annually	Environmental Engineer
Vegetation inventory - the inventory will be limited to the identified areas infested by alien vegetation. The extent of these as they stand pre rehabilitation will be used as current baseline information and compared with the post rehabilitation scenario i.e. removal and eradication of these. Regrowth monitoring will be undertaken and this will include recording any improvement including replacement of these species by either secondary grasslands and/or wetland species post rehabilitation. A monitoring plan to further monitor this aspect in the future will be put in place. The Mafube action plan includes a program for alien species management and eradication (Appendix IV) which should be applied to the management of alien vegetation as part of the wetland rehabilitation and management strategy.	Late Spring/ Summer	Annually	Wetland Specialist
Aesthetic outcomes – this includes visual and morphological changes in the system. Fixed point photographs as per specified conditions in the WetRehab Evaluate document at specific points will be taken prior to implementation of rehabilitation plan and these will be used as baseline information and on completion of the rehabilitation activities photographic records will be kept and be taken at the same point as baseline information to visually assess any changes in the system (see Table 6 below for an example). The specifications as outlined in the WetRehab Evaluate document will be applied for the monitoring of the Mafube Lifex project rehabilitation project.	Late Spring/ Summer	Annually	Wetland Specialist

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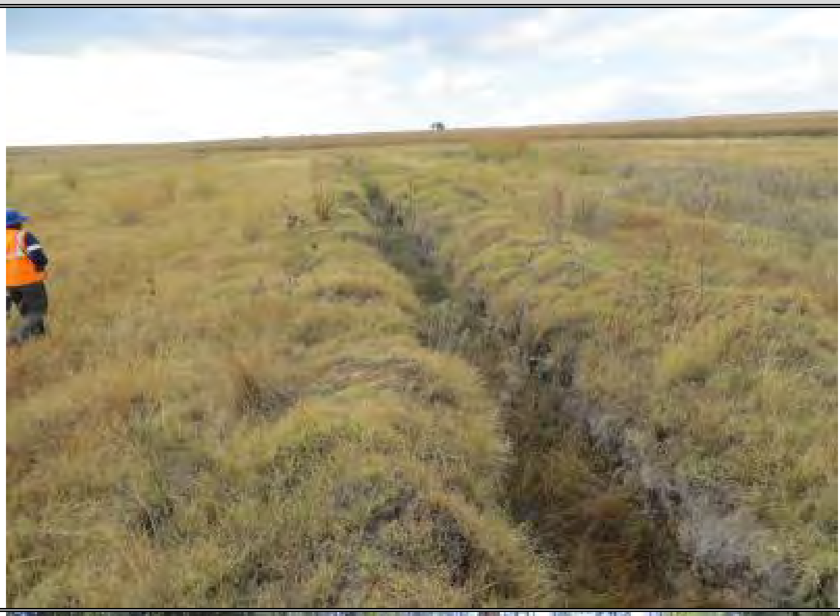
8.6.1 Fixed point photography

Fixed point photos were used to document the appearance of wetland habitat and vegetation prior to wetland rehabilitation activities being implemented. Photos were taken at points where significant changes are anticipated (linked to the Wet-Health assessment) and should be taken at the same time of the year for consecutive monitoring periods. Photographs taken are included below while the location of fixed photo points are indicated in **Figure 14.**

Table 8: Description and location of the fixed point photography to form part of the monitoring program for the Mafube Lifex Project.

Wetland Problem	Location (GPS Coordinate)	Date	Description	Photographic Record
Trench/drain	25°44'10.56"S 29°45'32.18"E	March 2015	Trench dug to divert water around the water areas and to dry the entire wetland area and channel water on the side of the wetland. At this point of the photographs the dimensions of the trench/drain pre rehabilitation are as follows: Width = 3m Depth - 2.5m Extent of the trench/drain = 600m	
Alien invasive vegetation	25°45'9.25"S 29°45'8.70"E	March 2015	Cluster of alien invasive vegetation covering an aerial extent of 15ha and consisting of the following species pre rehabilitation: 1. Black wattle 2. Eucalyptus	

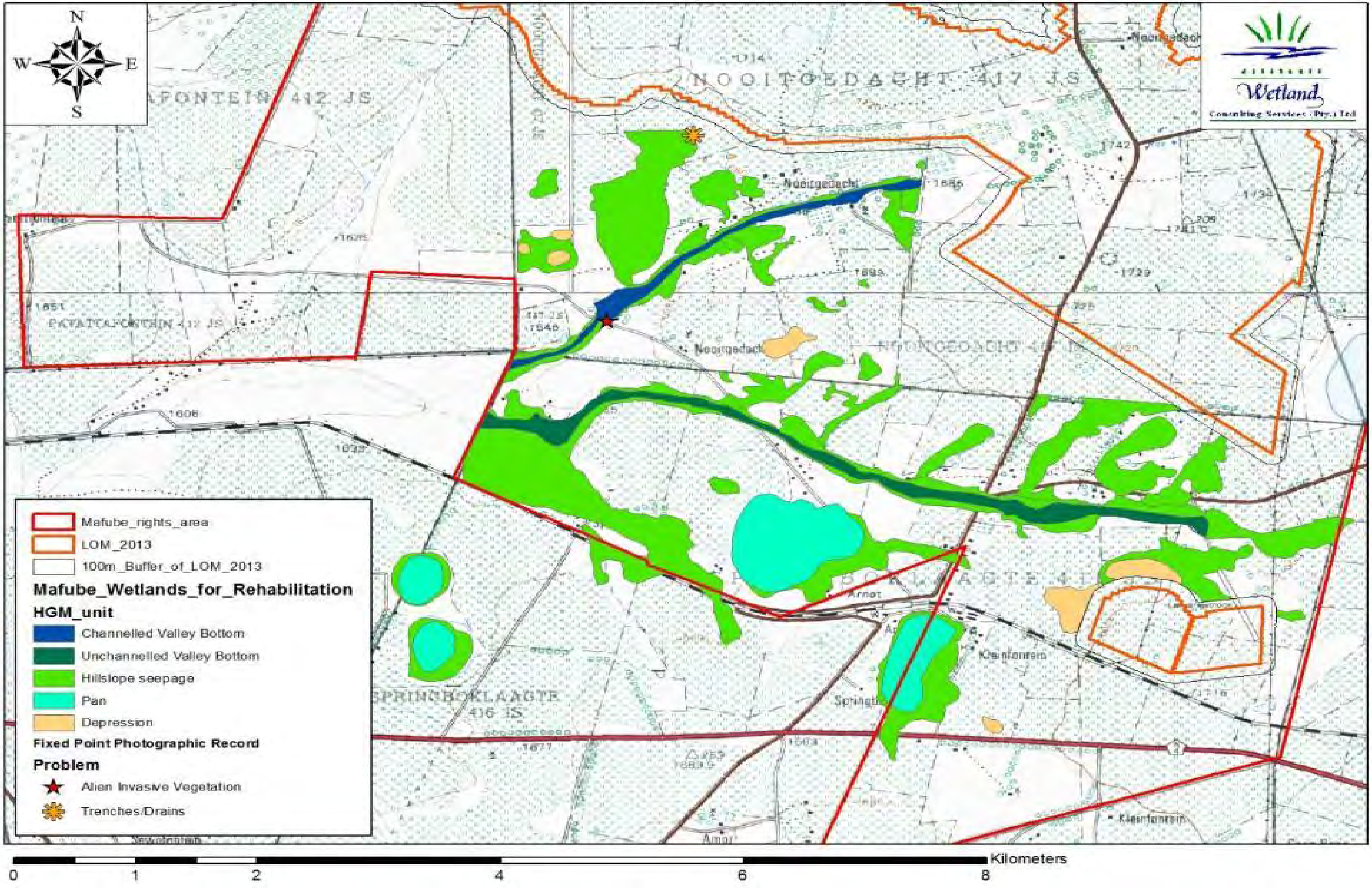


Figure 14: Locality of the fixed point photographs.

8.6.2 Water Quality monitoring

Water quality monitoring as indicated in the WUL for the Mafube Lifex project must form part of the overall monitoring programme of the rehabilitation and management strategy for the receiving watercourses onsite. This monitoring is designed to provide useful baseline water quality monitoring data which can be compared against the post-rehabilitation scenario.

9. REFERENCES

Brinson, M. M. 1993. *A hydrogeomorphic classification for wetlands*. Wetlands Research Program Technical Report WRP-DE-4. U. S. Army Corps of Engineers, Waterway Experiment Station. Vicksburg, MS: Bridgham and Richardson.

Department of Water Affairs and Forestry. 1999a. *Resource Directed Measures for Protection of Water Resources.* Volume 4. Wetland Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry. 1999b. *Resource Directed Measures for Protection of Water Resources.* Volume 1. River Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry, 2005. *A practical field procedure for identification and delineation of wetland and riparian areas*. DWAF, Pretoria.

Ferrar, A.A. & Lötter, M.C. 2007. *Mpumalanga Biodiversity Conservation Plan Handbook.* Mpumalanga Tourism & Parks Agency, Nelspruit.

Kotze, D., Marneweck, G., Batchelor, A., Lindley, D. and Collins, N. (2009) WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands. Wetland Management Series. Water Research Commission Report TT339/08, Water Research Commission, Pretoria.

Kotze, D.C, Marneweck, G.C., Batchelor, A.L., Lindley, D. and Collins, N. 2004. *Wetland Assess: A rapid assessment procedure for describing wetland benefits*. Mondi Wetland Project, Unpublished report.

MacFarlane DM, Kotze D, Walters D, Ellery W, Koopman V, Goodman P, and Goge C, 2009. WET-Health: A technique for rapidly assessing wetland health. Unpublished draft report submitted to the Water Research Commission, Pretoria.

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Macfarlane, D. M., Kotze, D. C., Ellery, W. N., Walters, D., Koopman, V., Goodman, P., (2008). WET-Health: a technique for rapidly assessing wetland health. WRC report TT340/08. South Africa: WRC.

Marneweck, G.C. and Batchelor, A. 2002. Wetland inventory and classification. In*: Ecological and economic evaluation of wetlands in the upper Olifants River catchment*. (Palmer, R.W., Turpie, J., Marneweck, G.C and Batchelor (eds.). Water Research Commission Report No. 1162/1/02.

Mucina, L. & Rutherford, M. C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia 19*. South African National Biodiversity Institute, Pretoria. 807pp.

SANBI (2009). Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report. Prepared by the Freshwater Consulting Group (FCG) for the South African National Biodiversity Institute (SANBI).

SANBI and DWS, 2014. *Wetland Offsets: A best practice guideline for South Africa*. South African National Biodiversity Institute and the Department of Water and Sanitation. First Edition. Pretoria. 53 pages.

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Golder Associates

October 2017

MAFUBE COAL MINING (PTY) LTD

Environmental Impact Assessment (EIA) for the Proposed Mafube Road Realignment Project - Surface Water Study

Submitted to:
Mafube Coal Mining (Pty) Ltd

REPORT

Report Number. 1776031-316577-6

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ABBREVIATIONS AND ACRONYMS

****Note to writer: provide any new terms (definitions of technical words you use) and acronyms*

Abbreviation / Acronym	Explanation
WMA	Water Management Area
MU	Management Units
IWQMP	Integrated Water Quality Management Plan
PES	Present Ecological State
EIS	Ecological Importance and Sensitivity
IUA	Integrated Units of Analysis

Notes:

- Project name – Proposed Mafube LifeX Road Realignment Project
- Client – Mafube Coal Mining (Pty) Ltd (Mafube)

1.0 PROJECT INTRODUCTION AND BACKGROUND

In 2011 Golder Associates Africa (Pty) Ltd (Golder) was appointed by Mafube Coal Mining (Pty) Ltd (Mafube) to conduct the Environmental Impact Assessment (EIA) process for the proposed Mafube Life Expansion project (Mafube LifeX), which included the mining operations at Nooitgedacht and Wildfontein in the Mpumalanga province of South Africa. An Environmental Management Programme (EMP) was also submitted to the Department of Mineral Resources (DMR) for approval as part of their mining rights application, as required under the Mineral and Petroleum Resources Act (Act No. 28 of 2002) (MPRDA).

Mafube Coal Mining (Pty) Ltd (Mafube) is a 50/50 Joint Venture involving Anglo American Thermal Coal (AATC) and Exxaro Coal Mpumalanga (Pty) Ltd. Environmental Authorisation for the Mafube LifeX EIA/EMP was granted by the Mpumalanga Department of Environmental Affairs and Tourism (MDEDET) in April 2013. The approval for the mining rights application was received on September 2013.

The Mafube LifeX operations are currently in the construction phase and full operational phase are planned to commence in May 2018.

In terms of the National Water Act (Act No. 36 of 1998) (NWA), an Integrated Water Use Licence application & Waste Water Management Plan was also required, and this application was submitted in December 2013 and currently a waste licence application is being compiled by Golder

During the feasibility phase investigations, it was assessed that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or re-alignment are required before this operation can commence. These roads fall under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

Mafube has appointed Golder Associates Africa (Pty) Ltd to conduct the EIA/EMP and public participation process.

An EIA application has been submitted to the Department of Mineral Resources (DMR) in terms of Regulations 326 published under NEMA (07 April 2017). This proposed project triggers a full scoping and environmental assessment EIA process for certain listed activities under NEMA, an Environmental Management Programme (EMP) based on the findings of the EIA and a Water Use Licence Application (IWULA). The public participation process will provide stakeholders with information about the proposed project, and several opportunities to comment throughout the EIA/EMP/WULA process.

2.0 SPECIALIST STUDY INTRODUCTION

This document reports on the baseline surface water assessment and impact assessment that forms part of the EIA and EMP. Six alternatives (Figure 1) were considered:

- Alternative B;
- Alternative C;
- Alternative D
- Alternative E (Option A)
- Alternative E (Option B)
- Alternative F

Alternative F was identified as the route to be taken forward.

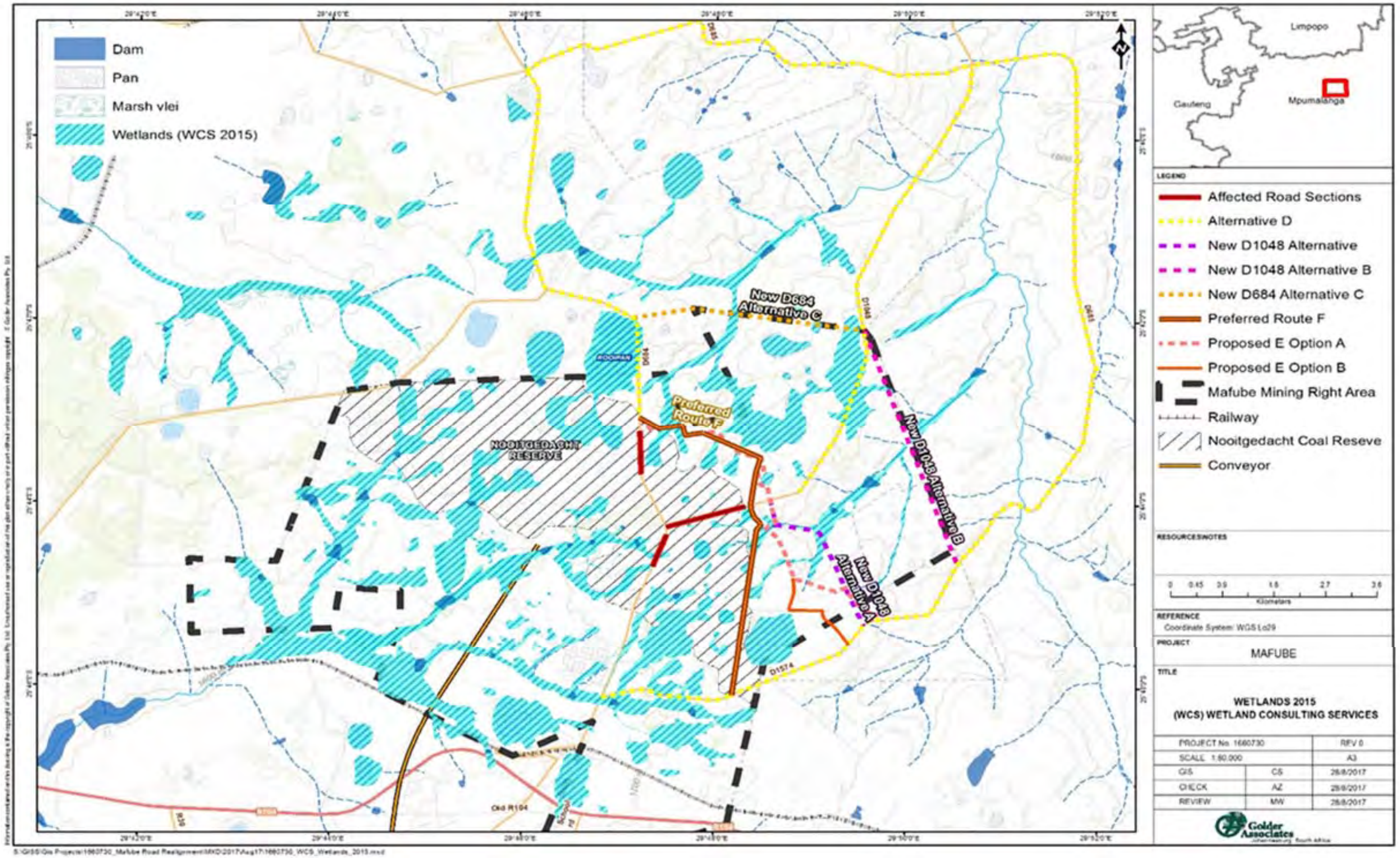

Figure 1: Road realignment alternative

2.1 Methodology

The following steps were undertaken to describe the surface water baseline conditions:

- A monitoring programme has been set up in the study area. A total of 11 river sites were selected for the surface water monitoring. Of these 11 sites, 6 drain into the Klein Olifants system, while 5 either drain into or are within the Steelpoort River. The points were chosen to assess the water quality of the Klein Olifants River system and the Steelpoort River system
- The Golder Impact Assessment (IA) Rating System was used to quantify the surface water impact; and
- A Surface Water Baseline and Impact Assessment Report which identifies potential impacts on surface water and provides significance ratings for the impacts, as well as proposed mitigation actions was compiled.

3.0 PROJECT DESCRIPTION

- No project description needed - full description will be captured in the DSR.

4.0 POLICY LEGAL AND ADMINISTRATIVE FRAMEWORK

The following national legislation, plans, policies and regulations are relevant to this project in terms of surface water management:

4.1.1 Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)

The Constitution of the Republic of South Africa, 1996 (hereafter referred to as "the Constitution") is the Supreme Law in South Africa. The Bill of Rights is included in Chapter 2 of the Constitution. The Environmental Right as set out in Section 24 of the Constitution and 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 –

i) Prevent pollution and ecological degradation;

ii) Promote conservation; and

iii) Secure ecologically sustainable development and use of natural resources, while

iv) Promoting justifiable economic and social development.

The National Environmental Management Act, 1998 (Act No. 107 of 1998) is the primary statute which gives effect to Section 24 of the Constitution. The Environmental Right contained in Section 24 of the Constitution also places responsibility on the Environmental Assessment Practitioner (EAP), the Applicant and the Competent Authority to ensure that this right is not infringed upon. The Sector Guidelines for Environmental Impact Assessment (2010) (Government Notice 654) describes a number of responsibilities which are placed on the EAP, Applicant and Competent Authority to ensure conformance with the statutory Environmental Right.

4.1.2 National Water Act, 1998 (Act No. 36 of 1996)

The specialist surface water assessment complies with South African legislation for environmental authorisations, most specifically the National Water Act (NWA), 1998 (Act No. 36 of 1998). The activities associated with the proposed Mafube LifeX Road Realignment Project will trigger some of the Water Uses that are defined in Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).

- (c) impeding or diverting the flow of water in a watercourse; and
- (i) altering the bed, banks, or characteristics of a watercourse.

Accordingly, these Water Uses may not be undertaken without being granted a Water Use License from the DWS. In accordance with Sections 40 and 41 of the NWA (1998), a Water Use License Application Process will be carried out. The resultant documents from the WULA process will include completed WULA Forms as well as a Technical Report. These documents will be submitted to DWS for review and decision making.

Although a joint PPP is followed for the WULA within the EIA Phase, these two EA processes constitute separate applications and submissions are made to the respective Competent Authorities.

4.1.3 National Environmental Management Act, 1998 (Act No. 107 of 1998)

The Environmental Management can be defined as the management of human interaction with the environment. Fuggle and Rabie (Strydom & King; 2009) defines Environmental Management as the regulation of the effects of peoples' activities, products and services on the environment. Although South Africa has a comprehensive array of environmental legislation and policies in place, these must be aligned with the provisions of the NEMA (1998), in particular the National Environmental Management Principles stipulated in Chapter 1 of the NEMA (1998). The Environmental Management Principles are centred around providing explicit guidance for co-operative and environmental governance on all matters relating to decision-making which will affect the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state, and to provide for matters connected therewith.

4.2 Water Use Licence

National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest. A person may only use water if the use is permissible under the National Water Act, no 36 of 1998. In general, a water use must be licensed unless it is listed in Schedule 1, is an existing lawful use, is permissible under a general authorisation or if a responsible authority dispenses with the requirement for a licence. An integrated process has been designed to address issues relating to environmental laws in mining areas, which needs to be applied in a well-co-ordinated, structured and synchronised manner, which will give effect to the "one environmental system".

4.3 Water Resources Classification

The classification of significant water resources in the Olifants Catchment in accordance with the Water Resource Classification System (WRCS) was undertaken in 2011/ 2012 and finalised in 2013 (Department of Water Affairs, 2013). Classification of water resources aims to ensure that a balance is reached between the need to protect and sustain water resources on the one hand and the need to develop and use them on the other. The WRCS places the following principles at the forefront of implementation:

- Maximising economic returns from the use of water resources;
- Allocating and benefits of utilising the water resources fairly; and
- Promoting the sustainable use of water resources to meet social and economic goals without detrimentally impacting on the ecological integrity of the water resource.

Each quaternary catchment is classified as a Class I, II or III, defined as:

- Class I - Minimally used: Water resource is one which is minimally used and the overall condition of that water resource is minimally altered from its pre-development condition;
- Class II - Moderately used: Water resource is one which is moderately used and the overall condition of that water resource is moderately altered from its pre-development condition; and
- Class III - Heavily used: Water resource is one which is heavily used and the overall condition of that water resource is significantly altered from its pre-development condition.

5.0 BASELINE DATA

Ninety percent of the mining area falls into catchment B12C which covers an area of 530 km^2. Streams drain from the study area (quaternary catchment B12C) into the Klein-Olifants River, which in turn drain into the Middelburg Dam. Thereafter the Klein-Olifants flows into the Olifants River, which drains into the Loskop Dam, which is also fed by the Wilge River. The Middelburg Dam catchment area is about 30% of the Loskop Dam catchment area. From the Loskop Dam the Olifants River flows through Mpumalanga and the central part of the Kruger National Park to Mozambique. Within quaternary catchment B41A the Grootspruit and Laersdrift tributaries drain into the Steelpoort River.

The Nooitgedacht and Wildfontein open cast mining coal expansion area as well as the associated road realignment alternatives are made up of predominantly flat to gently sloping catchments within quaternary catchments B12C and B41A. The study area is approximately 25 km south-west of Belfast and approximately 30 km north-east of the Middelburg. The catchment is still largely undeveloped with limited water resources and water uses.

The greater Mafube catchment is a relatively wet catchment with various perennial and non-perennial flow and therefore produces a sustainable yield of surface water.

5.1 Classification of the resources

The Department of Water and Sanitation (DWS) has completed the classification process for the significant water resources of the Olifants WMA (DWA, 2013). The process included stakeholder engagement for input in recommending the classes for the Integrated Units of Analysis (IUA) defined for the WMA.

The Springbokspruit and Grootspruit rivers are in a moderately modified state (Category C) with less developed areas present in the catchment. Impacts within the catchments are related to urban areas, agriculture, dams and some mining. The importance of the resources is moderate especially in terms of good water quality in that the Springbokspruit drains into Klein-Olifants River above Middleburg Dam and in that the Grootspruit drains into Steelpoort River.

The management class for both the Springbokspruit and the Steelpoort catchments has been set as a Class II with an overall ecological category of a B/C for the Integrated Units of Analysis (IUA). This class implies moderate usage of the water resource in future and the status quo in the river system has to at least be maintained.

5.1.1 Water Quality Planning Limits

During 2016 a study was undertaken to develop an integrated water quality management plan (IWQMP) for the Olifants River System. As part of the study, the catchment was divided into Management Units MUs. Proposed Water Quality Planning Limits (WQPLs) were set for each of the MUs. Mafube falls within MU 14 and 59. The WQPLs for MU 14 and 59 as set out in Table 1 were used in the surface water quality assessments.

Table 1: Proposed WQPL for the Olifants Catchment, Management Unit 14 and 59

Water Quality Variables	Units	14	59
Calcium (dissolved)	mg/L	80	15
Chloride (dissolved)	mg/L	100	25
Total Dissolved Solids	mg/L	500	260
Electrical Conductivity	mS/m	90	30
Fluoride (dissolved)	mg/L	0.8	0.7
Potassium (dissolved)	mg/L	20	50
Magnesium (dissolved)	mg/L	70	30
Sodium (dissolved)	mg/L	60	70
Ammonium (NH_4-N)	mg/L	0.05	0.05
Nitrate	mg/L	0.5	0.5
Total Phosphorus	mg/L	0.25	0.25
pH		6.5-8.4	6.5 - 8.4
Ortho-phosphate	mg/L	0.025	0.01
Sulphate (dissolved)	mg/L	400	20
Total Alkalinity	mg/L	130	70

Water Quality Variables	Units	14	59
Dissolved Organic Carbon	mg/L	10	5
Dissolved Oxygen	mg/L	9	9
SAR		2	2
Suspended Solids	mg/L	25	25
Chlorophyll a	µg/L	1.5	1
Escherichia coli	CFU/ 100mL	130	130
Faecal coliforms	CFU/ 100mL	130	130
Aluminium	mg/L	0.02	0.01
Boron	mg/L	0.5	0.5
Chromium (VI)	µg/L	14	7
Iron	mg/L	0.1	0.1
Manganese	mg/L	0.02	0.02

5.1.2 Present Ecological State and Ecological Importance and Sensitivity

The Present Ecological State (PES) is defined as the current state or condition of a water resource in terms of its biophysical components (drivers) such as hydrology, geomorphology and water quality and biological responses viz. fish, invertebrates and riparian vegetation. The degree to which ecological conditions of an area have been modified from the natural (reference) condition and the Ecological Importance and Sensitivity (EIS) relate to the presence, representativeness and diversity of species of biota and habitat. Ecological Sensitivity relates to the vulnerability of the habitat and biota to modifications that may occur in flows, water levels and physico-chemical conditions.

PES and EIS were determined for the Springbokspruit and Steelpoort and were found to be in a moderately modified state (category B/C) within less developed areas present in the catchment. The importance of the resource is moderate especially in terms of good water quality contributed to the main stem Olifants River above Loskop Dam. Therefore, it was proposed to maintain the current PES category within the catchments. A management class II was recommended for both quaternary catchment B12C and B41A (DWA, 2013). In this respect mitigation implemented must be such that it will protect the water resources so that an ecological category of B/C is maintained.

5.2 Description of the proposed Road Realignment Option

The Road Realignment Alternative for the proposed Nooitgedacht and Wildfontein opencast coal mine expansion project cuts through a few water courses. The alternatives form part of both existing roads as well as an extension of the proposed road. The water courses that would be impacted include two non-perennial streams and wetlands. As per the requirements of the Section 21 (c) and (i) of the NWA, a surface water impact assessment for all road-river crossings needs to be carried out.

5.2.1 Klein Olifants River area

The chemical water quality within the study area is generally good. However, most sample points (Table 3) indicate high levels of iron (Fe), aluminium (Al), manganese (Mn), Ammonium (NH_4-N), Nitrate ($N0_3$-N) and Orthophosphate ($P0_4$). Fluctuations in concentrations were recorded for sodium, chloride, sulphate and manganese, with a general increase in Aug 2017. Dissolved oxygen levels were below the stipulated WQPLs values in throughout the monitoring period with the exception of August 2017 for most samples.

5.2.2 Steelpoort River area

SP1, SP2, SP4, SP5 and Pan11 are located in the Steelpoort River area that drains towards the north of the study area. These samples indicated high levels of conductivity (EC), total alkalinity, iron (Fe), aluminium (Al), manganese (Mn). These parameters are indicators of mining activities within the area

Table 2: Water quality results for the Steelpoort River area and tributaries during December 2016, April 2017, and June 2017-July 2017

Water Quality Variables	Units	MU59	SP1					SP2		SP4					SP5					Pan 11				
pH		6.5 - 8.4	8.29	8.22	8.35	8.02	8.26	7.89	8	7.78	7.43	7.63	7.34	7.46	8.03	7.84	8.21	7.97	8.13	8.7	7.36	8.65	8.14	8.49
Electrical Conductivity	mS/m	30	34.7	36.7	39.1	41.2	40.8	26.4	25.7	8.9	7.67	8.18	7.8	7.79	29.9	26.7	29.4	32.2	33.1	375	71.9	283	477	581
Suspended Solids	mg/L	25	<10	10	10	<10	<10	20	16	<10	14	10	<10	<10	11	12	24	51	<10	14	28.6	42	57	1376
Dissolved Oxygen	mg/L	9	7	8	8	10	10	10	9	7	8	9	10	10	5	7	7	9	9	5	1	8	4	6
Sulphate (dissolved)	mg/L	20	9.3	12.1	18.9	18.8	16.6	6.7	3.9	2.1	3.1	3.2	4	3.4	11.6	10.3	14	15.2	14.9	110.1	39.7	105.6	160.3	267.5
Sodium (dissolved)	mg/L	70	17.2	15.5	17.3	18.8	18	18.1	17.1	9.2	8.6	9.6	9.3	9.3	15.4	13.9	16	16.3	17.5	931.8	126.5	561.2	1061	1339.2
Chloride (dissolved)	mg/L	25	17.8	17.8	21.5	21.9	22.1	9.9	8.2	5.1	6.7	7	7.2	6.8	11.7	11.9	13.8	14.2	14.5	796.8	96.4	598.4	1134.8	1367.3
Turbidity	NTU	-	2	4.4	3.9	3.5	4.2	17.2	8.8	9	12.8	9.7	5.5	5.5	2.9	5.8	18.8	15.1	5.3	592	28.6	317	530	1454
Total Alkalinity	mg/L	70	148	140	148	160	164	113	116	34	18	17	20	22	126	96	108	120	132	592	159	356	636	773
Iron	mg/L	0.1	0.078	0.098	0.1	0.156	0.139	0.106	0.112	1.142	0.627	0.414	0.346	0.336	0.069	0.245	0.102	0.115	0.116	0.079	0.807	0.666	0.48	0.147
Aluminium	mg/L	0.01	<0.02	<0.02	<0.020	<0.020	<0.020	<0.02	<0.020	0.069	0.029	0.172	0.054	0.051	<0.02	0.023	<0.02	<0.02	<0.020	0.047	0.543	0.899	0.486	0.203
Manganese	mg/L	0.02	0.77	0.047	0.039	0.061	0.072	0.042	0.054	0.128	0.022	0.021	0.055	0.017	0.076	0.018	0.019	0.028	0.039	0.003	0.031	0.004	0.11	0.034
Ammonium (NH_3-N)	mg/L	-	1.57	0.14	0.14	0.08	0.13	0.08	0.06	1.28	0.28	0.12	0.07	<0.03	0.19	0.17	0.12	0.28	0.35	-	0.66	-	-	-
Ammonium (NH_4-N)	mg/L	0.05	1.66	0.015	0.15	0.08	0.14	0.08	0.06	1.36	0.3	0.13	0.07	0.03	0.2	0.18	0.13	0.3	0.37	-	0.7	-	-	-
Nitrite		-	<0.006	2	<0.006	0.043	<0.006	0.043	<0.006	<0.006	3.3	<0.006		0.043	<0.006	3.5	<0.006	0.04	0.043	<0.006	<0.2	<0.006	<0.006	<0.006
Nitrate	mg/L	0.5	0.25	<0.02	0.66	0.84	0.47	0.38	<0.05	0.36	<0.02	1.13	1.11	1.04	0.29	<0.02	1.13	1.27	0.75	0.36	<0.02	0.54	<0.05	0.38
Ortho-phosphate	mg/L	0.01	0.08	<0.06	<0.06	<0.03	<0.09	0.08	<0.09	0.11	<0.06	<0.06	0.08	<0.09	0.16	0.15	<0.06	0.09	<0.09	1.79	0.25	2.97	1.09	4.567

Table 3: Water quality results for the Klein Olifants River area and tributaries during December 2016, April 2017, and June 2017-July 2017

Water Quality Variables	Units	MU59	SP1					SP2		SP4					SP5					Pan 11				
pH		6.5 - 8.4	8.29	8.22	8.35	8.02	8.26	7.89	8	7.78	7.43	7.63	7.34	7.46	8.03	7.84	8.21	7.97	8.13	8.7	7.36	8.65	8.14	8.49
Electrical Conductivity	mS/m	30	34.7	36.7	39.1	41.2	40.8	26.4	25.7	8.9	7.67	8.18	7.8	7.79	29.9	26.7	29.4	32.2	33.1	375	71.9	283	477	581
Suspended Solids	mg/L	25	<10	10	10	<10	<10	20	16	<10	14	10	<10	<10	11	12	24	51	<10	14	28.6	42	57	1376
Dissolved Oxygen	mg/L	9	7	8	8	10	10	10	9	7	8	9	10	10	5	7	7	9	9	5	1	8	4	6
Sulphate (dissolved)	mg/L	20	9.3	12.1	18.9	18.8	16.6	6.7	3.9	2.1	3.1	3.2	4	3.4	11.6	10.3	14	15.2	14.9	110.1	39.7	105.6	160.3	267.5
Sodium (dissolved)	mg/L	70	17.2	15.5	17.3	18.8	18	18.1	17.1	9.2	8.6	9.6	9.3	9.3	15.4	13.9	16	16.3	17.5	931.8	126.5	561.2	1061	1339.2
Chloride (dissolved)	mg/L	25	17.8	17.8	21.5	21.9	22.1	9.9	8.2	5.1	6.7	7	7.2	6.8	11.7	11.9	13.8	14.2	14.5	796.8	96.4	598.4	1134.8	1367.3
Turbidity	NTU	-	2	4.4	3.9	3.5	4.2	17.2	8.8	9	12.8	9.7	5.5	5.5	2.9	5.8	18.8	15.1	5.3	592	28.6	317	530	1454
Total Alkalinity	mg/L	70	148	140	148	160	164	113	116	34	18	17	20	22	126	96	108	120	132	592	159	356	636	773
Iron	mg/L	0.1	0.078	0.098	0.1	0.156	0.139	0.106	0.112	1.142	0.627	0.414	0.346	0.336	0.069	0.245	0.102	0.115	0.116	0.079	0.807	0.666	0.48	0.147
Aluminium	mg/L	0.01	<0.02	<0.02	<0.020	<0.020	<0.020	<0.02	<0.020	0.069	0.029	0.172	0.054	0.051	<0.02	0.023	<0.02	<0.02	<0.020	0.047	0.543	0.899	0.486	0.203
Manganese	mg/L	0.02	0.77	0.047	0.039	0.061	0.072	0.042	0.054	0.128	0.022	0.021	0.055	0.017	0.076	0.018	0.019	0.028	0.039	0.003	0.031	0.004	0.11	0.034
Ammonium (NH_3-N)	mg/L	-	1.57	0.14	0.14	0.08	0.13	0.08	0.06	1.28	0.28	0.12	0.07	<0.03	0.19	0.17	0.12	0.28	0.35	-	0.66	-	-	-
Ammonium (NH_4-N)	mg/L	0.05	1.66	0.015	0.15	0.08	0.14	0.08	0.06	1.36	0.3	0.13	0.07	0.03	0.2	0.18	0.13	0.3	0.37	-	0.7	-	-	-
Nitrite		-	<0.006	2	<0.006	0.043	<0.006	0.043	<0.006	<0.006	3.3	<0.006		0.043	<0.006	3.5	<0.006	0.04	0.043	<0.006	<0.2	<0.006	<0.006	<0.006
Nitrate	mg/L	0.5	0.25	<0.02	0.66	0.84	0.47	0.38	<0.05	0.36	<0.02	1.13	1.11	1.04	0.29	<0.02	1.13	1.27	0.75	0.36	<0.02	0.54	<0.05	0.38
Ortho-phosphate	mg/L	0.01	0.08	<0.06	<0.06	<0.03	<0.09	0.08	<0.09	0.11	<0.06	<0.06	0.08	<0.09	0.16	0.15	<0.06	0.09	<0.09	1.79	0.25	2.97	1.09	4.567

6.0 ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Methodology for Assessing Impact Significance

The significance of identified impacts was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Table 4: Impact assessment factors

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude of impact

To assess these factors for each impact, the following four ranking scales are used:

Table 5: Impact assessment scoring methodology

Magnitude	Duration
10- Very high/unknown	5- Permanent (>10 years)
8- High	4- Long term (7 - 10 years, impact ceases after site closure has been obtained)
6- Moderate	3- Medium-term (3 months- 7 years, impact ceases after the operational life of the activity)
4- Low	2- Short-term (0 - 3 months, impact ceases after the construction phase)
2- Minor	1- Immediate
Scale	**Probability**
5- International	5- Definite/Unknown
4- National	4- Highly Probable
3- Regional	3- Medium Probability
2- Local	2- Low Probability
1- Site Only	1- Improbable
0- None	0- None

Significance Points= (Magnitude + Duration + Scale) x Probability.

Table 6: Significance of impact based on point allocation

Points	Significance	Description
SP>60	High environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 - 60	Moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP<30	Low environmental significance	Impacts with little real effect and which will not have an influence on or require modification of the project design.
+	Positive impact	An impact that is likely to result in positive consequences/effects.

For the methodology outlined above, the following definitions were used:

- Magnitude is a measure of the degree of change in a measurement or analysis (e.g., the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorization of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely-recognised standards are to be used as a measure of the level of impact;
- Scale/Geographic extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- Duration refers to the length of time over which an environmental impact may occur: i.e. immediate/transient, short-term (0 to 7 years), medium term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent; and
- Probability of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

6.2 Project Phases

The environmental impacts of the project were assessed for the:

- Construction phase and
- Operational phase;

The closure phase is not relevant as the road realignment will stay

6.3 Potential Impacts during all phases of the proposed Road Realignment project

The potential surface water impacts from the project, both direct and indirect, are summarised in Table 7. In summary, these potential impacts contribute to overall surface water impacts and include:

- Change in surface water catchment areas;
- Changes in surface water quality;
- Change in surface water runoff; and
- Erosion.

The surface water quality impacts due to the construction and operation of the proposed road/s will ultimately impact on the downstream water users. This potentially impacted water is flows to downstream users via the river system.

Table 7: Summary of potential surface water impacts with respect to road realignment project

Major Aspect	Key Environmental Issues/Potential Impacts
Changes in surface water catchment areas	■ Disruption and reduction in land due to construction of roads and associated infrastructure
Changes in surface water quality	■ Poor quality runoff from road activities; ■ Possible fuel and lubricants spillage from equipment and other chemical spills; and ■ Pollution of wetlands

Major Aspect	Key Environmental Issues/Potential Impacts
Change in surface water runoff	■ Increased runoff due to vegetation and veld removal therefore decreasing infiltration into soil which may impact on downstream communities; and ■ Increased runoff due to hard road surfaces.
Erosion	Erosion along road may be increased due to site clearance of vegetation and veld.

6.4 Impact Assessment Summary

All the predicted environmental impacts resulting from the proposed project activities are described in Table 8 along with their significance ratings before and after mitigation.

Table 8: Impact assessment for construction and operation phase

ACTIVITY	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Interpretation
Pollution of surface water	Pollution of receiving water resource during the construction of the road. Pollution of receiving water from vehicles used during construction.	Sub-standard water quality due to spillage of chemicals such as oils from machinery used to construct the road. During the operational phase there will be oils and greases from vehicles using the road	Construction/Operational	6	3	2	3	60	Moderate	2	1	1	2	20	Low	Maintain the water quality monitoring programme; - Store and handle potentially polluting substances such as oil and grease for the heavy machinery in designated bunded facilities during the construction period; -Soils removed should be placed in areas where runoff causing sedimentation will be minimised. The areas should be rehabilitated as soon as possible as the road progresses.	- Construction phase will have some negative impact on site; - The impact can be mitigated to very low risk by applying mitigation described - Operation of the road should not have a great deal of additional impacts related to oils from normal vehicle travel as this is just a realignment and not a completely new road.
Sedimentation and siltation	Increased sediment transport into water resources	Erosion with increased sediment transport into water resources when the area is cleared. During the operational phase there may be sedimentation if inadequate rehabilitation of cleared areas takes place.	Construction/Operational	8	3	2	3	60	Moderate	2	1	1	2	25	Low	- Design the stormwater management culverts adequately; -Maintenance of the stormwater management system; -Rehabilitation of sloped areas to minimise erosion.	- Construction phase may have some negative impacts if areas are not adequately rehabilitated - Impacts from the operational phase are expected to be low; - The impact can be a low risk rating by applying mitigation described.

ACTIVITY	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Interpretation
Pollution of wetlands	Pollution of receiving wetlands during the construction of the road. Pollution of receiving wetlands from vehicles used during construction as well as from vehicles using the road once operational.	Water quality deterioration in adjacent wetlands because of spills and mechanical equipment and normal vehicle use	Construction/Operational	6	2	2	3	50	Moderate	2	1	1	2	23	Low	- Maintain the water quality monitoring programme; - Store and handle potentially polluting substances such as oil and grease for the heavy machinery in designated bunded facilities during the construction period; -Soils removed should be placed in areas where runoff causing sedimentation will be minimised. The areas should be rehabilitated as soon as possible as the road progresses.	Construction phase will have some negative impact on site; Operation of the road will have additional impacts; The impact can be mitigated to very low risk by applying mitigation described.
Change in hydrological regime	Changes in the hydrological regime resulting from construction of across the non-perennial streams Changes in the hydrological regime due to flow reduction.	Stream flow reduction if inadequately designed which could lead to flooding of the road and adjacent areas.	Construction/Operational	6	3	2	3	30	Moderate	2	1	1	2	12	Low	- Vegetation clearing only where necessary; - Stabilisation/rehabilitation of exposed areas as soon as possible; - Stormwater management will be incorporated to limit sediment transport; - Stormwater culverts must be adequately designed to allow unimpeded flow during rain events.	- Construction phase will have some negative impact on site; - The designs must be designed to prevent flooding at the culverts and allow adequate runoff - Stormwater management will be incorporated to limit sediment transport;

7.0 ENVIRONMENTAL MANAGEMENT PROGRAMME

This Environmental Management Programme (EMPr) addresses the management of potential environmental impacts related to the proposed road realignment project. The EMPr is used for managing, mitigating, and monitoring of the environmental impacts associated with construction, operational and rehabilitation phases of the realigned route.

7.1 Environmental Management and Mitigation Measures Identified

Mitigation measures include:

- Construction mitigation
  - When clearing the site keep the footprint of site clearance as small as possible and rehabilitate badly eroded areas as soon as they are noticed;
  - Stockpile soil in areas where it is not likely to be washed away during a rainfall event;
  - The river crossings must be rehabilitated as soon as the construction is complete to avoid unnecessary erosion and sedimentation;
  - Keep on site spillage of pollutants such as oils to an absolute minimum and clean spillages as they happen to prevent environmental damage; and
  - Have an appropriate spillage and environmental protocol and procedures to deal with onsite spillage and environmental damage.

- Operational mitigation
  - Flooding from excessive run-off will be mitigated by adequately sized stormwater culverts designed to convey the 50-year flood peak away from the road to avoid flooding;
  - The road itself needs to be designed with adequate stormwater drainage along the sides to convey the 50-year flood peak away from the road to avoid flooding.

7.2 Potential Cumulative Impacts Identified

The construction phase, if inadequately mitigated will have some impact, specifically sedimentation, on the water quality of the local water resources and ultimately the Springbokspruit/Klein Olifants River system and the Steelpoort River system.

Additional project impact (if no mitigation measures are implemented) will increase the significance of the existing baseline impacts. The cumulative unmitigated impact will probably be of a LOW to MODERATE negative significance, affecting the study/local area extent. The impact is very likely and will be short term to permanent (where water resources such as streams and pans may be removed).

8.0 REFERENCES

- Department of Water Affairs, South Africa, January 2013. Classification of Significant Water Resources in the Olifants Water Management Area (WMA 4): Management Classes of the Olifants WMA. Report No: RDM/WMA04/00/CON/CLA/0213.

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APPENDIX A

Document Limitations

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A PHASE I HERITAGE IMPACT ASSESSMENT (HIA) STUDY FOR THE PROPOSED MAFUBE LIFE X ROAD REALIGNMENT PROJECT NEAR BELFAST IN THE MPUMALANGA PROVINCE

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ACRONYMS AND ABBREVIATIONS

AIA Archaeological Impact Assessment

ASAPA Association of South African Professional Archaeologists

CRM Cultural Resource Management

EAP Environmental Assessment Practitioner

ECO Environmental Control Officer

EIA Environmental Impact Assessment

EMP Environmental Management Plan

EPS Environmental Performance Standards

EIA Early Iron Age

ESA Early Stone Age

GPS Global Positioning System

HIA Heritage Impact Assessment

IEM Integrated Environmental Management

IFC PS International Finance Corporation Performance Standards on Environmental and Social Sustainability, 2012

I & Aps Interested and Affected Parties

LIA Late Iron Age

LSA Late Stone Age

MIA Middle Iron Age

MPRDA Mineral and Petroleum Resources Development Act, 28 of 2002

MSA Middle Stone Age

NEMA National Environmental Management Act, 107 of 1998

NEMBA National Environmental Management: Biodiversity Act, 10 of 2004

NEMAQA National Environmental Management: Air Quality Act, 39 of 2004

NEMWA National Environmental Management: Waste Act, 59 of 2008

NHRA National Heritage Resources Act, 25 of 1999

NWA National Water Act, 36 of 1998

OSHA Occupational Health and Safety Act, 85 of 1993

PHRA Provincial Heritage Resource Agency

RSA Republic of South Africa

SAHRA South African Heritage Resources Agency

SAHRIS South African Heritage Resources Information System

ToR Terms of Reference

TERMINOLOGY

Terms that may be used in this report are briefly outlined below:

- Cultural resource management: A process that consists of a range of interventions and provides a framework for informed and value-based decision-making. It integrates professional, technical and administrative functions and interventions that impact on cultural resources. Activities include planning, policy development, monitoring and assessment, auditing, implementation, maintenance, communication, and many others. All these activities are (or will be) based on sound research.

- Cultural resources: A broad, generic term covering any physical, natural and spiritual properties and features adapted, used and created by humans in the past and present. Cultural resources are the result of continuing human cultural activity and embody a range of community values and meanings. These resources are non-renewable and finite. Cultural resources include traditional systems of cultural practice, belief or social interaction. They can be, but are not necessarily identified with defined locations.

- Heritage resources: The various natural and cultural assets that collectively form the heritage. These assets are also known as cultural and natural resources. Heritage resources (cultural resources) include all human-made phenomena and intangible products that are the result of the human mind. Natural, technological or industrial features may also be part of heritage resources, as places that have made an outstanding contribution to the cultures, traditions and lifestyles of the people or groups of people of South Africa.

- In-Situ Conservation: The conservation and maintenance of ecosystems, natural habitats and cultural resources in their natural and original surroundings.

- Iron Age: Refers to the last two millennia and 'Early Iron Age' to the first thousand years AD. 'Late Iron Age' refers to the period between the 16th century and the 19th century and can therefore include the Historical Period.

- Maintenance: Keeping something in good health or repair.

- Pre-historical: Refers to the time before any historical documents were written or any written language developed in a particular area or region of the world. The historical period and historical remains refer, for the Project Area, to the first appearance or use of 'modern' Western writing brought to the Eastern Highveld by the first Colonists who settled here from the 1840's onwards.

- Preservation: Conservation activities that consolidate and maintain the existing form, material and integrity of a cultural resource.

- Recent past: Refers to the 20th century. Remains from this period are not necessarily older than sixty years and therefore may not qualify as archaeological or historical remains. Some of these remains, however, may be close to sixty years of age and may, in the near future, qualify as heritage resources.

- Protected area: A geographically defined area designated and managed to achieve specific conservation objectives. Protected areas are dedicated primarily to the protection and enjoyment of natural or cultural heritage, to the maintenance of biodiversity, and to the maintenance of life-support systems. Various types of protected areas occur in South Africa.

- Reconstruction: Re-erecting a structure on its original site using original components.

- Replication: The act or process of reproducing by new construction the exact form and detail of a vanished building, structure, object, or a part thereof, as it appeared at a specific period.

- Restoration: Returning the existing fabric of a place to a known earlier state by removing additions or by reassembling existing components.

- Stone Age: Refers to the prehistoric past, although Late Stone Age people lived in South Africa well into the Historical Period. The Stone Age is divided into an

Earlier Stone Age (3 million years to 150 000 thousand years ago) the Middle Stone Age (150 000 years to 40 000 years ago) and the Late Stone Age (40 000 years to 200 years ago).

- Sustainability: The ability of activities or phenomena to continue indefinitely, at current and projected levels, without depleting social, financial, physical and other resources required to produce the expected benefits. Heritage resources are non-renewable and whenever damaged or destroyed cannot be replaced. Conservation and restoration aim to employ heritage resources in a sustainable way so that it can be enjoyed, studied or utilized into the undefined future.

- Translocation: Dismantling a structure and re-erecting it on a new site using original components.

- Project Area: refers to the area (footprint) where the developer wants to focus its development activities (refer to Figure 7).

- Phase I studies refer to surveys using various sources of data in order to establish the presence of all possible types and ranges of heritage resources in any given Project Area (excluding paleontological remains as these studies are done by registered and accredited palaeontologists).

- Phase II studies include in-depth cultural heritage studies such as archaeological mapping, excavating and sometimes laboratory work. Phase II work may include the documenting of rock art, engraving or historical sites and dwellings; the sampling of archaeological sites or shipwrecks; extended excavations of archaeological sites; the exhumation of human remains and the relocation of graveyards, etc. Phase II work involves permitting processes, requires the input of different specialists and the co-operation and approval of the SAHRA.

EXECUTIVE SUMMARY

This document contains the report on a Phase I Heritage Impact Assessment (HIA) study which was done according to Section 38 of the National Heritage Resources Act (No 25 of 1999) for the proposed Mafube Life X Road Realignment Project (Mafube Project) near Belfast on the eastern Highveld in the Mpumalanga Province of South Africa**.**

The aims with the Phase I HIA study were the following:

- 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) (see Box 1) do occur in the project area and, if so, to determine the nature, the extent and the significance of these remains.
- To establish if any of these heritage resources will be affected by the proposed Mafube Project and, if so, to evaluate what appropriate mitigation measures must be taken if any of the types and ranges of heritage resources will be affected by the project.

The Phase I HIA for the proposed 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) in and near the project area, namely:

- A graveyard (previously identified as GY07).

The graveyard was geo-referenced and mapped (Figure 8, Tables 1 & 2). Its significance is indicated as well as any possible impact on the graveyard.

Mitigation measures are outlined to take precautionary measures that the graveyard is not impacted during the construction of the road.

The significance of the graveyard

The significance of the graveyard is indicated in order to determine the significance of any possible impact on the graveyard and to establish if any mitigation measures are required for the graveyard.

All graveyards and graves can be considered to be of high significance and are protected by various laws (Table 2). Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (NHRA) (Act No 25 of 1999) in instances where graves are older than sixty years. It is highly likely that most of the graves are older than sixty years. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

Possible impact on the graveyard

GY07 is located approximately 100m from the proposed Alternative F and therefore needs not to be impacted by the new road.

The significance of any impact on the graveyard therefore is very low and will remain low if the mitigation measures outlined in this report is implemented (Table 2).

Mitigating the graveyard

GY07 needs not to be affected by the Mafube Project. However, to ensure that no accidental damage may befall GY07 during the construction of the road it is recommended that the graveyard be demarcated with red cautionary tape and that a signpost with the following be erected at the graveyard: 'Beware and avoid graveyard. Any damage caused may lead to prosecution'. Demarcation measures to be done in accordance with community requirements.

Summary

There is no reason from a heritage point of view why the proposed Alternative F for the Mafube Life X Road Realignment Project cannot be implemented if the mitigation measures outlined in this report are followed.

Disclaimer

It is possible that this Phase I HIA study may have missed heritage resources in the project area as heritage sites may occur in maize fields or in tall grass or thick clumps of vegetation while others may be located below the surface of the earth and may only be exposed once development commences.

If any heritage resources of significance are exposed during the Mafube Project the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities must be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notified in order to determine appropriate mitigation measures for impacts to the discovered finds. This may include obtaining the necessary authorisation (permits) from SAHRA to conduct the mitigation measures.

CONTENTS

1 INTRODUCTION

1.1 Background and context to the project

Mafube Coal, an existing operation outside of Middelburg in Mpumalanga, is a 50/50 joint venture involving Anglo Operations Limited and Exxaro Coal Mpumalanga (Pty) Ltd. The expansion of the existing Mafube opencast operations onto the Nooitgedacht reserve (Mafube LifeX Nooitgedacht and Wildfontein operations) extends the life of the existing Mafube operations. Mafube LifeX Nooitgedacht and Wildfontein operations will supply power station and A-grade thermal export coal.

Golder Associates Africa (Pty) Ltd (Golder) has been conducting environmental authorisation process, studies and monitoring for the Mafube LifeX Nooitgedacht and Wildfontein operations since 2008. The project plan has evolved during this time and a number of updates and amendments have taken place.

The Mafube LifeX Nooitgedacht and Wildfontein operations are in the construction phase and operations are scheduled to commence in May 2018. Coal extracted from the life expansion pits on Nooitgedacht will be transported by conveyor approximately 6 km to the existing plant, at Springboklaagte, for processing. Construction is due to commence on 10 December 2016 and is scheduled to take18 months. First coal is planned for 1 April 2018 and over the life of mine, of 13 years, approximately 63 million tonnes of coal will be extracted.

In 2011 Golder was appointed by Mafube to conduct the Environmental Impact Assessment (EIA) process for the proposed Mafube LifeX Nooitgedacht and Wildfontein operations, which included the mining operations at Nooitgedacht and Wildfontein. An Environmental Management Programme (EMP) was also submitted to the Department of Mineral Resources (DMR) for approval as part of their mining rights application, as required under the Mineral and Petroleum Resources Act (Act No. 28 of 2002) (MPRDA).

Environmental authorisation (EA) conducted under the National Environmental Management Act (NEMA) for the Mafube Nooitgedacht and Wildfontein opencast coal expansion project (Mafube LifeX) was received from the Mpumalanga Department of Environmental Affairs and Tourism (MDEDET) in April 2013 (17/2/6/3 (101) N-1). An approval for the mining right's application was granted by the Mpumalanga Department of Minerals Resources (DMR) on 30 August 2013 (MR 30/5/1/2/2/10026 MR) and the EMP approved by them on 14 November 2013.

In terms of the National Water Act (Act No. 36 of 1998) (NWA), an Integrated Water Use Licence application & Waste Water Management Plan was also required for the LifeX Nooitgedacht and Wildfontein operations. These applications were submitted in December 2013 and approved on 1 December 2014. Subsequent amendments to these licences were issued on 1 February 2016. A WUL authorising a number of section 21 (c) & (i) water uses associated with wetland interventions as part of an extensive wetland rehabilitation programme were issued on 13 April 2017.

During the feasibility phase investigations it was assessed that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or re-alignment are required before this operation can commence (Figure 1). These roads fall under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

Mafube has appointed Golder to conduct the EIA/EMP and public participation process (under NEMA) for the proposed realignment of sections of the D684 and D1048 district roads. Part of this process is to identify potential route realignment alternatives and follow an alternative analysis process to identify the most preferred alternative route. Alternative F was identified as the preferred alternative and this study consequently focusses on this road alternative.

An EIA application has been submitted to the Department of Mineral Resources (DMR) in terms of Regulations 326, 327, 325, and 324 published under NEMA on 7 April 2017. This proposed road realignment project triggers a full scoping and environmental assessment EIA process for certain listed activities under NEMA, an Environmental Management Programme (EMP) based on the findings of the EIA and a Water Use Licence Application (IWULA). The public participation process will provide stakeholders with information about the proposed project, and several opportunities to comment throughout the EIA/EMP/WULA process.

1.2 Aims with this report

In order to comply with heritage legislation the Mafube Coal Mining (Pty) Ltd (Mafube Colliery) requires knowledge of the presence, relevance and the significance of any heritage resources that may be affected by the proposed new road Alternative F. Mafube Coal needs this knowledge in order to take pro-active measures with regard to any heritage resources that may be affected, damaged or destroyed when the road is constructed, in operation or when the road is decommissioned. Golder Associates Africa (Pty) Ltd, the environmental company responsible for compiling the Environmental Impact Assessment report (EIAr) for the road therefore commissioned the author to undertake a Phase I HIA study in accordance with Section 38 of the NHRA (25 of 1999) for the proposed road alternatives.

The aims with the Phase I HIA study were the following:

- 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) (see Box 1) do occur in the project area and, if so, to determine the nature, the extent and the significance of these remains.
- To establish if any of these heritage resources will be affected by the proposed Mafube Project and, if so, to evaluate what appropriate mitigation measures must be taken if any of the types and ranges of heritage resources will be affected by the project.

Focused archaeological research has been conducted in the Mpumalanga Provinces for several decades. This research consists of surveys and of excavations of Stone Age and Iron Age sites as well as of the recording of rock art and historical sites in this area. The Mpumalanga Provinces have a rich heritage comprised of remains dating from the pre-historical and from the historical (or colonial) periods of South Africa. Pre-historical and historical remains in the Mpumalanga Province form a record of the heritage of most groups living in South Africa today. Heritage resources in the Mpumalanga Province therefore constitute a rich and wide diversified range (comprising the 'national estate') as outlined in Section 3 of the National Heritage Resources Act (Act 25 of 1999) (see Box 1).

1.3 Assumptions and limitations

It is possible that this Phase I HIA study may have missed heritage resources in the project area as heritage sites may occur in maize fields or in tall grass or thickets of wattle bush while others may be located below the surface of the earth and may only be exposed once development commences.

If any heritage resources of significance are exposed during the construction, operation or decommissioning of the Mafube Project the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities must be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notified in order to determine appropriate mitigation measures for impacts to the discovered finds. This may include obtaining the necessary authorisation (permits) from SAHRA to conduct the mitigation measures.

2 DETAILS OF THE SPECIALIST

Profession: Archaeologist, Museologist (Museum Scientists), Lecturer, Heritage Guide Trainer and Heritage Consultant

Qualifications:

BA (Archaeology, Anthropology and Psychology) (UP, 1976)

BA (Hons) Archaeology (distinction) (UP, 1979)

MA Archaeology (distinction) (UP, 1985)

D Phil Archaeology (UP, 1989)

Post Graduate Diploma in Museology (Museum Sciences) (UP, 1981)

Work experience:

Museum curator and archaeologist for the Rustenburg and Phalaborwa Town Councils (1980-1984)

Head of the Department of Archaeology, National Cultural History Museum in Pretoria (1988-1989)

Lecturer and Senior lecturer Department of Anthropology and Archaeology, University of Pretoria (1990-2003)

Independent Archaeologist and Heritage Consultant (2003-)

Accreditation: Member of the Association for Southern African Professional Archaeologists. (ASAPA)

Summary: Julius Pistorius is a qualified archaeologist and heritage specialist with extensive experience as a university lecturer, museum scientist, researcher and heritage consultant. His research focussed on the Late Iron Age Tswana and Lowveld-Sotho (particularly the Bamalatji of Phalaborwa). He has published a book on early Tswana settlement in the North-West Province and has completed an unpublished manuscript on the rise of Bamalatji metal workings spheres in Phalaborwa during the last 1 200 years. He has written a guide for Eskom's field personnel on heritage management. He has published twenty scientific papers in academic journals and several popular articles on archaeology and heritage matters. He collaborated with environmental companies in compiling State of the Environmental Reports for Ekhurhuleni, Hartebeespoort and heritage management plans for the Magaliesberg and Waterberg. Since acting as an independent consultant he has done approximately 800 large to small heritage impact assessment reports. He has a longstanding working relationship with Eskom, Rio Tinto (PMC), Rio Tinto (EXP), Impala Platinum, Angloplats (Rustenburg), Lonmin, Sasol, PMC, Foskor, Kudu and Kelgran Granite, Bafokeng Royal Resources, Pilanesberg Platinum Mine etc. as well as with several environmental companies.

3 DECLARATION OF INDEPENDENCE

I, Julius CC Pistorius, declare that:

•I act as the independent environmental practitioner in this application
•I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
•I declare that there are no circumstances that may compromise my objectivity in performing such work;
•I have expertise in conducting environmental impact assessments, including knowledge of the National Heritage Resources Act (No 25 of 1999) and any guidelines that have relevance to the proposed activity;
•I will comply with the Act, regulations and all other applicable legislation;
•I will take into account, to the extent possible, the matters listed in regulation **8** of the regulations when preparing the application and any report relating to the application;
•I have no, and will not engage in, conflicting interests in the undertaking of the activity;
•I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
•I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
•I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
•I will keep a register of all interested and affected parties that participated in a public participation process; and
•I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
•all the particulars furnished by me in this form are true and correct;
•will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
•I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010.

Signature of the heritage practitioner:
Private Consultant

1 August 2017

4 LEGAL FRAMEWORK

South Africa's heritage resources ('national estate') are protected by international, national, provincial and local legislation which provides regulations, policies and guidelines for the protection, management, promotion and utilization of heritage resources. South Africa's 'national estate' includes a wide range of various types of heritage resources as outlined in Section 3 of the National Heritage Resources Act (NHRA, Act No 25 of 1999) (see Box 1).

At a national level heritage resources are dealt with by the National Heritage Council Act (Act No 11 of 1999) and the National Heritage Resources Act (NHRA, Act No 25 of 1999). According to the NHRA (Act No 25 of 1999) heritage resources are categorized using a three-tier system, namely Grade I (national), Grade II (provincial) and Grade III (local) heritage resources.

At the provincial level, heritage legislation is implemented by Provincial Heritage Resources Agencies (PHRA's) which apply the National Heritage Resources Act (Act 25 of 1999) together with provincial government guidelines and strategic frameworks. Metropolitan or Municipal (local) policy regarding the protection of cultural heritage resources is also linked to national and provincial acts and is implemented by the South African Heritage Resources Agency (SAHRA) and the Provincial Heritage Resources Agencies (PHRA's).

4.1 Legislation relevant to heritage resources

Legislation relevant to South Africa's national estate includes the following:

- National Environmental Management Act (NEMA) Act 107 of 1998
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Development Facilitation Act (DFA) Act 67 of 1995

Box 1: Types and ranges of heritage resources (the national estate) as outlined in Section 3 of the National Heritage Resources Act, 1999 (No 25 of 1999).

The National Heritage Resources Act (Act No 25 of 1999, Art 3) outlines the following types and ranges of heritage resources that qualify as part of the National Estate, namely:

(a) places, buildings structures and equipment of cultural significance;
(b) places to which oral traditions are attached or which are associated with living heritage;
(c) historical settlements and townscapes;
(d) landscapes and natural features of cultural significance;
(e) geological sites of scientific or cultural importance;
(f) archaeological and palaeontological sites;
(g) graves and burial grounds including-
  (i) ancestral graves;
  (ii) royal graves and graves of traditional leaders;
  (iii) graves of victims of conflict;(iv) graves of individuals designated by the Minister by notice in the Gazette;
  (v) historical graves and cemeteries; and
  (vi) other human remains which are not covered by in terms of the Human Tissues Act, 1983 (Act No 65 of 1983);
(h) sites of significance relating to the history of slavery in South Africa;
(i) movable objects, including -
(i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
  (ii) objects to which oral traditions are attached or which are associated with living heritage;
  (iii) ethnographic art and objects;
  (iv) military objects;
  (v) objects of decorative or fine art;
  (vi) objects of scientific or technological interest; and
  (vii) books, records, documents, photographs, positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No 43 of 1996).

The National Heritage Resources Act (Act No 25 of 1999, Art 3) also distinguishes nine criteria for places and objects to qualify as 'part of the national estate if they have cultural significance or other special value …'. These criteria are the following:

(a) its importance in the community, or pattern of South Africa's history;
(a) its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
(b) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
(c) its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
(e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
(f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;
(g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons; (h)
(h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa;
(i) sites of significance relating to the history of slavery in South Africa

4.1.1 NEMA

The NEMA stipulates under Section 2(4)(a) that sustainable development requires the consideration of all relevant factors including (iii) the disturbance of landscapes and sites that constitute the nation's cultural heritage must be avoided, or where it cannot be altogether avoided, is minimised and remedied. Heritage assessments are implemented in terms of the NEMA Section 24 in order to give effect to the general objectives. Procedures considering heritage resource management in terms of the NEMA are summarised under Section 24(4) as amended in 2008. In addition to the NEMA, the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEMPA) may also be applicable. This act applies to protected areas and world heritage sites, declared as such in terms of the World Heritage Convention Act, 1999 (Act No. 49 of 1999) (WHCA).

4.1.2 MPRDA

The MPRDA stipulates under Section 5(4) no person may prospect for or remove, mine, conduct technical co-operation operations, reconnaissance operations, explore for and produce any mineral or petroleum or commence with any work incidental thereto on any area without (a) an approved environmental management programme or approved environmental management plan, as the case may be.

4.1.3 NHRA

According to Section 3 of the NHRA (Act No 25 of 1999) the 'national estate' comprises a wide range and various types of heritage resources (see Box 1).

4.1.3.1 Heritage Impact Assessment studies

According to Section 38 of the National Heritage Resources Act (Act No 25 of 1999) a Heritage Impact Assessment (HIA) process must be followed under the following circumstances:

- The construction of a linear development (road, wall, power line, canal etc.) exceeding 300m in length

- The construction of a bridge or similar structure exceeding 50m in length
- Any development or activity that will change the character of a site and which exceeds 5 000m^2 or which involve three or more existing erven or subdivisions thereof
- Re-zoning of a site exceeding 10 000 m^2
- Any other category provided for in the regulations of SAHRA, a provincial or local heritage authority or any other legislation such as NEMA, MPRDA, etc.

4.1.3.2 Section 34 (Buildings and structures)

Section 34 of the NHRA provides for general protection of structures older than 60 years. According to Section 34(1) no person may alter (demolish) any structure or part thereof which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.

A structure means any building, works, device or any other facility made by people and which is fixed to land and which includes fixtures, fittings and equipment associated with such structures.

Alter means any action which affects the structure, appearance or physical properties of a place or object, whether by way of structural or any other works such as painting, plastering, decorating, etc..

Most importantly, Section 34(1) clearly states that no structure or part thereof may be altered or demolished without a permit issued by the relevant Provincial Heritage Resources Authority (PHRA). These permits will not be granted without a HIA being completed. A destruction permit will thus be required before any removal and/or demolition may take place, unless exempted by the PHRA according to Section 34(2) of the NHRA.

4.1.3.3 Section 35 (Archaeological and palaeontological resources and meteorites)

Section 35 of the NHRA provides for the general protection of archaeological and palaeontological resources, and meteorites. In the event that archaeological resources are discovered during the course of development, Section 38(3) specifically requires that the discovery must immediately be reported to the PHRA, or local authority or museum who must notify the PHRA. Furthermore, no person may without permits issued by the responsible heritage resources authority may:

- destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or paleontological site or any meteorite
- destroy, damage, excavate, remove from its original position, collect or own any archaeological or paleontological material or object or any meteorite
- trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or paleontological material or object, or any meteorite; or bring onto or use at an archaeological or paleontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and paleontological material or objects, or use such equipment for the recovery of meteorites
- alter or demolish any structure or part of a structure which is older than 60 years.

Heritage resources may only be disturbed or moved by an archaeologist after being issued with a permit received from the South African Heritage Resources Agency (SAHRA). In order to demolish heritage resources the developer has to acquire a destruction permit by from SAHRA.

4.1.3.4 Section 36 (Burial grounds and graves)

Section 36 of the NHRA allows for the general protection of burial grounds and graves. Should burial grounds or graves be found during the course of development, Section 36(6) stipulates that such activities must immediately cease and the discovery reported to the responsible heritage resources authority and the South

African Police Service (SAPS). Section 36 also stipulates that no person without a permit issued by the relevant heritage resources authority may:

a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves
b) destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation, or any equipment which assists in the detection or recovery of metals.

Section 36 of the NHRA divides graves and burial grounds into the following categories:

a. ancestral graves
b. royal graves and graves of traditional leaders
c. graves of victims of conflict
d. graves designated by the Minister
e. historical graves and cemeteries
f. human remains

Human remains less than 60 years old are subject to provisions of the National Health Act, 2003 (Act No 61 of 2003), Ordinance 12 of 1980 (Exhumation Ordinance) and Ordinance No 7 of 1925 (Graves and dead bodies Ordinance, repealed by Mpumalanga). Municipal bylaws with regard to graves and graveyards may differ. Professionals involved with the exhumation and relocation of graves and graveyards must establish whether such bylaws exist and must adhere to these laws.

Unidentified graves are handled as if they are older than 60 years until proven otherwise.

Permission for the exhumation and relocation of graves older than sixty years must also be gained from descendants of the deceased (where known), the National

Department of Health, Provincial Department of Health, Premier of the Province and local police. Furthermore, permission must also be gained from the various landowners (i.e. where the graves are located and where they are to be relocated) before exhumation can take place.

Human remains can only be handled by a registered undertaker or an institution declared under the Human Tissues Act (Act 65 of 1983 as amended).

4.1.3.5 Section 37 (Public monuments and memorials)

Section 37 makes provision for the protection of all public monuments and memorials in the same manner as places which are entered in a heritage register referred to in Section 30 of the NHRA.

4.1.3.6 Section 38 (HRM)

Section 38 (8): The provisions of this section do not apply to a development as described in Section 38 (1) if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act No. 50 of 1991), or any other legislation. Section 38(8) ensures cooperative governance between all responsible authorities through ensuring that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of Subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent.

The Listed Activities in terms of the Government Notice Regulations (GNRs) stipulated under NEMA for which Environmental Authorisation (EA) will be applied for will trigger a HIA as contemplated in Section 38(1) above as follows:

4.2 NEMA: EIA Regulations, dated 2014 - Appendix 6 requirements

NEMA Regulations (2014) - Appendix 6	Relevant section in report
Details of the specialist who prepared the report	Dr Julius CC Pistorius
The expertise of that person to compile a specialist report including a curriculum vitae	See Part 2, Details of the specialist
A declaration that the person is independent in a form as may be specified by the competent authority	See Part 3, Declaration of independence
An indication of the scope of, and the purpose for which, the report was prepared	See Part 2.1,Aims with the report
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	See Part 6, Approach and Methodology. (6.1 Fieldwork)
A description of the methodology adopted in preparing the report or carrying out the specialised process	See Part 6, Approach and Methodology
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	See Part 7 Contextualising the project area and Part 8.1 Types and ranges of heritage resources
An identification of any areas to be avoided, including buffers	See Part 9.2 Possible impact on the graveyard
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	See Figure 8, p45
A description of any assumptions made and any uncertainties or gaps in knowledge;	See Part 1.3. Assumptions and limitations
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	See Part 8.1 Types and ranges of heritage resources and Part 8.5 Possible impact on the graveyard
Any mitigation measures for inclusion in the EMPr	See 8.6 Mitigating the graveyard impacts

Any conditions for inclusion in the environmental authorisation	See Part 1.3 Assumptions and limitations
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	None, but see Part 8.6 Mitigating the graveyard impacts
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	See Part 9 Conclusion and recommendation. There is no reason from a heritage point of view why the proposed Alternative F for the Mafube LifeX Realignment Project cannot proceed if the mitigation measures outlined in this report be implemented.
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	See Part 8.6 Mitigating the graveyard impacts.
A description of any consultation process that was undertaken during the course of carrying out the study	None
A summary and copies if any comments that were received during any consultation process	None
Any other information requested by the competent authority.	None

5 THE MAFUBE LIFEX ROAD REALIGNMENT PROJECT

5.1 Location

Mafube Coal's prospecting area is spread out across several farms located between Middelburg and Belfast in the Mpumalanga Province of South Africa. The proposed Mafube LifeX Road Realignment Project which involves several road deviations are located across the farms Roodepoort 418JS, Hartbeeshoek 393JS, Genadebult 121JS, Panplaats 395JS, Bayview 430JP, Jubilatum 401JS and Witklip 391JS in the central part of the mining rights area. The project area therefore is located in the Steve Tshwete Local Municipality in the Nkangala District Municipality in the Mpumalanga Province (2529DA Selonsrivier, 2529DB Languitsig, 2529DD; 1:50 000 topographical maps and Pretoria 2528; 1: 250 000 map) (Figure 1).

5.2 The nature of the project area

The project area covers an undulating piece of land that is marked by vast outstretched agricultural fields, pieces of grass veld and a number of pans. Several dirt roads criss-cross the area. Few trees occur, the majority of which are exotics such as Blue Gums, wattles and a few Oak trees which are sometimes associated with historical farmsteads. These trees are anthropogenic in origin as they were planted by the first colonists who settled on the Eastern Highveld during the first part of the 19th century.

The Mafube Coal prospecting area was subjected to several surveys in the summer and winter seasons during the last decade (see Part 11, 'Bibliography relating to earlier heritage studies'). The nature and character of the project area was first hand observed and illuminated in detail when field survey was conducted (Part 9.1, 'Types and ranges of heritage resources'). The project area is part of a bigger cultural landscape that is marked by heritage remains dating from the pre-historical into the historical (colonial) period. Stone Age sites, Iron Age remains and colonial remains therefore do occur on the Eastern Highveld (see Part 8, 'Contextualising the project area'). The field survey and photographs revealed the following main characteristics of the project area.

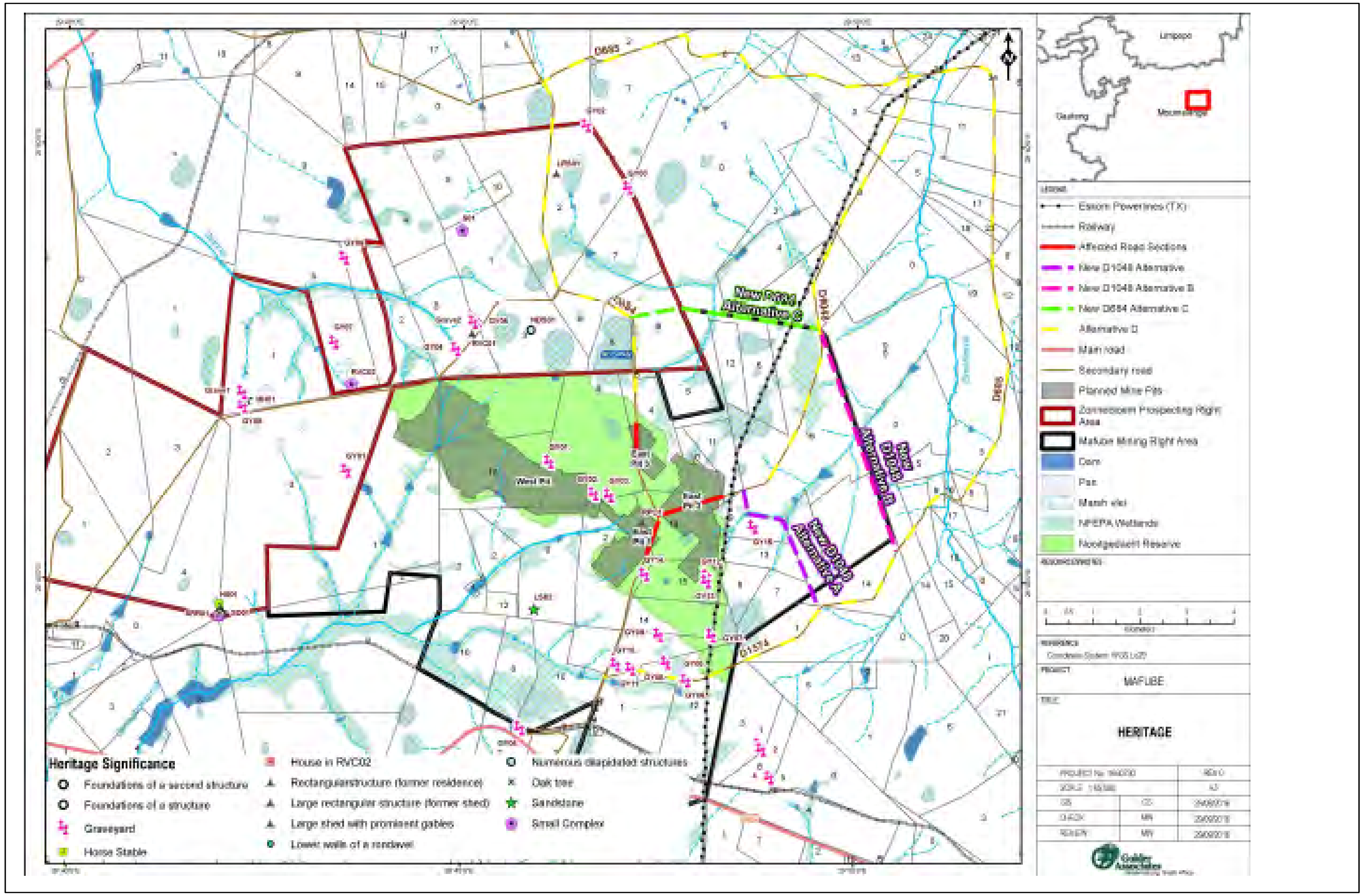

Figure 1- The Mafube Coal prospecting area has been surveyed in the past. Heritage resources such as graveyards and farm homestead complexes have been identified. The current survey only dealt with the proposed Mafube Life X Road Realignment Project involving a survey and assessment for Alternative F which is the preferred road alternative (above).

Figure 2- The undulating project area is occupied by large stretches of grass veld which are mostly used for grazing (above).

Figure 3- The larger part of the project area is covered with agricultural fields (above).

Figure 4- Dirt roads here and there criss-cross the project area and assisted with the survey of the road alternatives. Alternative F runs along Eskom's existing 400kV power lines (above).

Figure 5- Short stretches of existing roads such as D1574, D685, D1048 and D684 criss cross the project area and assisted with the heritage survey (above).

5.3 The nature of the Mafube LifeX Road Realignment Project

Several road alternatives were planned for the Mafube Life X Road Realignment Project, namely:

- Alternative A runs across Portions 7, 9, 11 and 13 as well as Portions 14 and 16 of Roodepoort 418JS. This alternative is approximately 3,51km long of which 1,54km traverses agricultural fields. The entire length of this alternative runs along existing property boundaries.
- Alternative B runs across Portions 14 and 16 of Roodepoort 418JS, RE of Bayview 430JS, RE of Jubilatum 401JS and Portions 5 and 14 of Witklip 391JS. Alternative B is approximately 5,9km long and the entire length runs along existing property boundaries and in-between existing agricultural fields.
- Alternative C runs across Portions 4, 6, 12, and 16 of Roodepoort 418JS and the RE and Portion 4 of Hartbeeshoek 392JS as well as Portion 1 of Genadebult 121JS and Portion 6 of Panplaats 395JS. Alternative C is approximately 4,06km long: 2,47km runs through natural vegetation and approximately 1,59km traverses agricultural fields.
- Alternative D involves the construction of a new alternative route. It includes the upgrades of the existing river/water course crossings and the D1574, D685 and D1048.
- Alternative E entails the proposed closure of the affected road and the construction of a new gravel road. This alternative route has an approximate length of 7.52 km and will run along exiting property fences (which currently do not exist). The entire length of Alternative E runs along existing agricultural field boundaries or has agricultural fields on one side and grazing veld/natural vegetation on the other side.

<u>Alternative F:</u>

Alternative F is the preferred alternative and was surveyed, accessed and is reported on this report.

Alternative F entails to serve as a link between the new Road D683/D1048 link Road and will affect the following farms Springboklaagte 416JS (portions 1, 12), Nooitgedacht 417JS (portions 04, 14 & 15), Roodepoort 418JS (Portion 8, 9, 10, 11 & 13). Alternative F entails the proposed closure of the affected road and the construction of a new gravel road. This alternative route has an approximate length of 5.0 km and will run along exiting property boundaries although currently there is no boundary fences. The entire length of the proposed Alternative F run along existing agricultural field boundaries or have agricultural fields on one side and grazing veld on the other side.

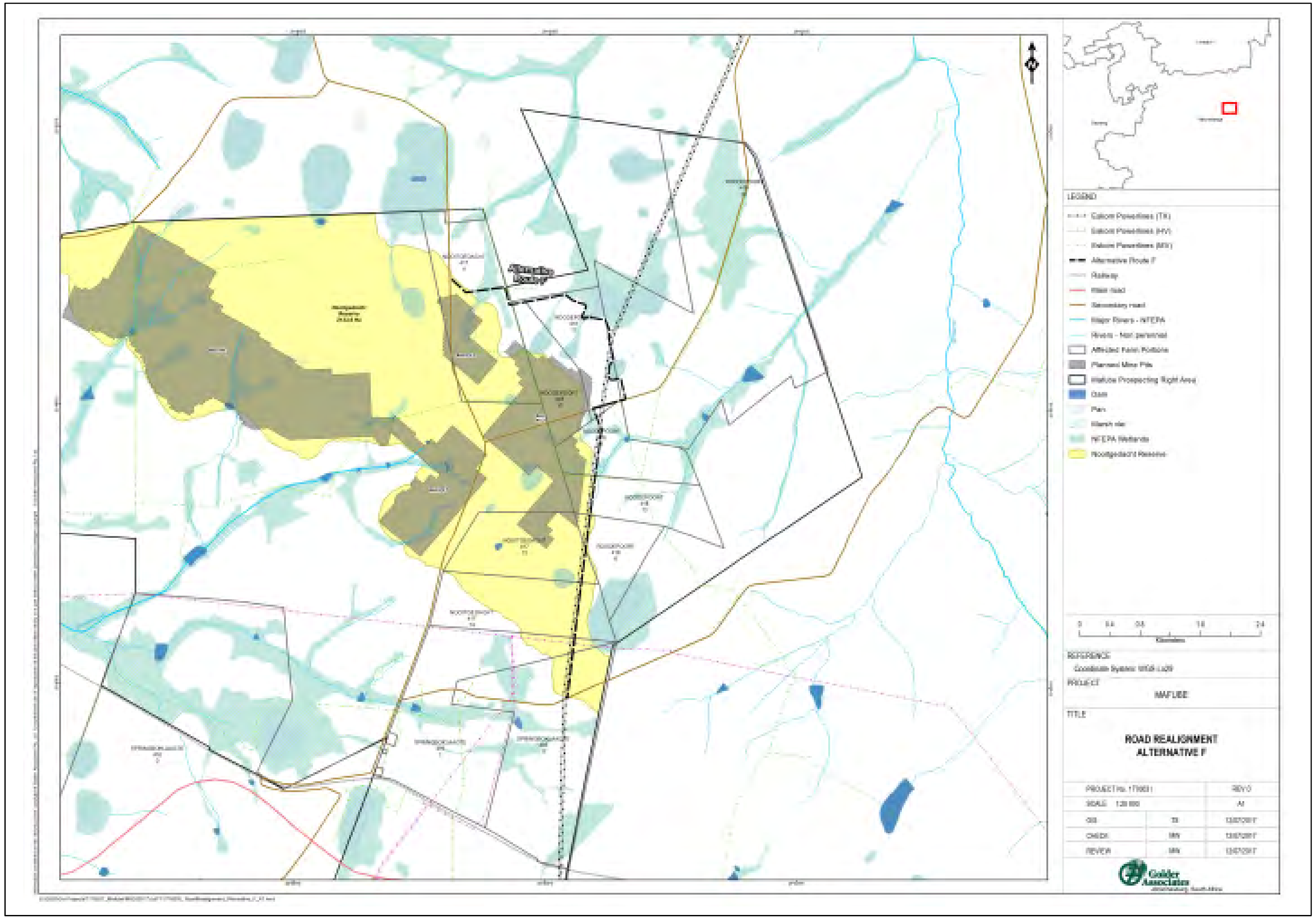

Figure 6- Preferred Alternative F for the Mafube LifeX Road Realignment Project (above).

6 APPROACH AND METHODOLOGY

This Phase I HIA study was conducted by means of the following:

6.1 Field survey

Field surveys were conducted during 3 to 4 April 2017. The field survey for the proposed road deviations was conducted by means of following district and two track roads as well as any other accessible pathways in the project area in order to gain access to the footprint of the proposed new road alternatives. The routes that were followed with a vehicle during the survey were recorded with a mounted GPS instrument. Pedestrian surveys were undertaken from these primary access routes and not all of these tracks were necessarily recorded on a GPS.

All coordinates for heritage resources were recorded with a Garmin Etrex hand set Global Positioning System (instrument) with an accuracy of < 15m.

Figure 7- GPS track log which was registered for the project area. Pedestrian surveys were conducted from the main pathway which was recorded with a GPS instrument which was mounted in a vehicle (above).

Large parts of the project area are covered with maize fields. These fields could not be surveyed as a result of the dense stands of maize.

Google imagery was used as a supplementary source next to the fieldwork to establish the possible presence of heritage resources such as historical farm homesteads with outbuildings.

Ecological indicators such as alternations in vegetation patterns; open or bald spots in the veld covered only with grass or extremely dense patches of vegetation were searched as possible indicators for settlements such as stone walls or as former abodes where farm workers may have settled in the past.

6.2 Databases, literature survey and maps

Databases kept and maintained at institutions such as the Provincial Heritage Resources Agency (PHRA), the Archaeological Data Recording Centre at the National Flagship Institute (Museum Africa) in Pretoria and SAHRA's national archive (SAHRIS) were consulted to determine whether any heritage resources of significance had been identified during earlier heritage surveys in or near the project area.

The author is acquainted with the project area at large as he has done several heritage impact assessment studies near the proposed project area. Several earlier heritage impact assessment studies have been done in close proximity to the current project area. These studies provided information regarding the nature and heritage character of the area, namely (see 'Part 9, Bibliography relating to earlier heritage studies'):

Literature relating to the pre-historical and the historical unfolding of the region where the Project Area is located was reviewed (see Part 8, 'Contextualising the Project Area' and Part 10, 'Select Bibliography). The pre-historical and historical context of the larger area assisted with assumptions about the possible types and ranges of heritage resources to be expected in the project area as well as to comprehend the identity and meaning of heritage sites which may be found in and near the project area.

In addition, the project area was studied by means of maps outlining Mafube Coal's prospecting area and the farms Nooitgedacht 417JS and Roodepoort 418JS where the road deviations occur (2529DA Selonsrivier, 2529DB Languitsig, 2529DD Pan; 1:50 000 topographical maps; Pretoria 2528 1: 250 000 map and Google Earth imagery).

6.3 Significance rating

The significance of possible impacts on the heritage resources was determined using a ranking scale based on the following:

- Occurrence
  - Probability of occurrence (how likely is it that the impact may/will occur?), and
  - Duration of occurrence (how long may/will it last?)
- Severity
  - Magnitude (severity) of impact (will the impact be of high, moderate or low severity?), and
  - Scale/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?).

Each of these factors has been assessed for each potential impact using the following ranking scales:

Probability: 5 – Definite/don't know 4 – Highly probable 3 – Medium probability 2 – Low probability 1 – Improbable 0 – None	Duration: 5 – Permanent 4 – Long-term (ceases with the operational life) 3 - Medium-term (5-15 years) 2 - Short-term (0-5 years) 1 – Immediate
Scale: 5 – International 4 – National 3 – Regional	Magnitude: 10 - Very high/don't know 8 – High 6 – Moderate

2 – Local 1 – Site only 0 – None	4 – Low 2 – Minor

The significance of each potential impact was assessed using the following formula:

Significance Points (SP) = (Magnitude + Duration + Scale) x Probability

The maximum value is 100 Significance Points (SP). Potential environmental impacts are rated as very high, high, moderate, low or very low significance on the following basis:

- More than 80 significance points indicates VERY HIGH significance.
- Between 60 and 80 significance points indicates HIGH significance.
- Between 40 and 60 significance points indicates MODERATE significance.
- Between 20 and 40 significance points indicates LOW significance.
- Less than 20 significance points indicates VERY LOW significance.

7 CONTEXTUALISING THE PROJECT AREA

The following overview of pre-historical, historical and cultural evidence indicates the wide range of heritage resources which do occur across the Eastern Highveld in which the project area is located, namely:

7.1 Stone Age and rock art sites

Stone Age sites are marked by stone artefacts that are found scattered on the surface of the earth or as parts of deposits in caves and rock shelters. The Stone Age is divided into the Early Stone Age (ESA) (covers the period from 2.5 million years ago to 250 000 years ago), the Middle Stone Age (MSA) (refers to the period from 250 000 years ago to 22 000 years ago) and the Late Stone Age (LSA) (the period from 22 000 years ago to 200 years ago).

Dongas and eroded areas at Maleoskop near Groblersdal is one of only a few places in Mpumalanga where ESA Olduwan and Acheulian artefacts have been recorded. Evidence for the MSA has been excavated at the Bushman Rock Shelter near Ohrigstad. This cave was repeatedly visited over a prolonged period. The oldest layers date back to 40 000 years BP (Before Present) and the youngest to 27 000BP (Esterhuysen & Smith 2007).

LSA occupation of the Mpumalanga Province also has been researched at Bushman Rock Shelter where it dates back 12 000BP to 9 000BP and at Höningnestkrans near Badfontein where a LSA site dates back to 4 870BP to 200BP (Esterhuysen & Smith 2007).

The LSA is also associated with rock paintings and engravings which were done by San hunter-gatherers, Khoi Khoi herders and EIA (Early Iron Age) farmers (Maggs 1983, 2008). Approximately 400 rock art sites are distributed throughout Mpumalanga, notably in the northern and eastern regions at places such as Emalahleni (Witbank) (4), Lydenburg (2), White River and the southern Kruger National Park (76), Nelspruit and the Nsikazi District (250). The Ermelo area holds eight rock paintings (Smith & Zubieta 2007).

The rock art of the Mpumalanga Province can be divided into San rock art which is the most wide spread, herder or Khoe Khoe (Khoi Khoi) paintings (thin scattering from the Limpopo Valley) through the Lydenburg district into the Nelspruit area) and localised late white farmer paintings. Farmer paintings can be divided into Sotho-Tswana finger paintings and Nguni engravings (Only 20 engravings occur at Boomplaats, north-west of Lydenburg). Farmer paintings are more localised than San or herder paintings and were mainly used by the painters for instructional purposes (Smith & Zubieta 2007).

During the LSA and Historical Period, San people called the Batwa lived in sandstones caves and rock shelters near Lake Chrissie in the Ermelo area. The Batwa are descendants of the San, the majority of which intermarried with Bantu-Negroid people such as the Nhlapo from Swazi-descend and Sotho-Tswana clans such as the Pai and Pulana. Significant intermarriages and cultural exchanges occurred between these groups. The Batwa were hunter-gatherers who lived from food which they collected from the veldt as well as from the pans and swamps in the area. During times of unrest, such as the *difaqane* in the early nineteenth century, the San would converge on Lake Chrissie for food and sanctuary. The caves, lakes, water pans and swamps provided relative security and camouflage. Here, some of the San lived on the surfaces of the water bodies by establishing platforms with reeds. With the arrival of the first colonists in the nineteenth century many of the local Batwa family groups were employed as farm labourers. Descendants of the Batwa people still live in the larger Project Area (Schapera 1927; Potgieter 1955; Schoonraad & Schoonraad 1975).

No sites dating from the Stone Age or any lithic scatters with tools, flakes or waste material have been recorded close to where the proposed road alignments are planned.

7.2 Iron Age remains

The Iron Age is associated with the first agro-pastoralists or farming communities who lived in semi-permanent villages and who practised metal working during the last two millennia. The Iron Age is usually divided into the Early Iron Age (EIA) (covers the 1st millennium AD) and the Later Iron Age (LIA) (covers the first 880 years of the 2nd millennium AD).

Evidence of the first farming communities in the Mpumalanga Province is derived from a few EIA potsherds which occur in association with the LSA occupation of the Höningnest Shelter near Badfontein. The co-existence of EIA potsherds and LSA stone tools suggest some form of 'symbiotic relationship' between the Stone Age hunter-gatherers who lived in the cave and EIA farmers in the area (also note Batwa and Swazi/Sotho Tswana relationship) (Esterhuysen & Smith 2007).

The Welgelegen Shelter on the banks of the Vaal River near Ermelo also reflects some relationship between EIA farmers who lived in this shelter and hunter-gatherers who manufactured stone tools and who occupied a less favourable overhang nearby during AD1200 (Schoonraad & Beaumont 1971).

EIA sites were also investigated at Sterkspruit near Lydenburg (AD720) and in Nelspruit where the provincial governmental offices were constructed. The most infamous EIA site in South Africa is the Lydenburg head site which provided two occupation dates, namely during AD600 and from AD900 to AD1100. At this site the Lydenburg terracotta heads were brought to light. Doornkop, located south of Lydenburg, dates from AD740 and AD810 (Evers 1981; Whitelaw 1996).

The LIA is well represented in Mpumalanga and stretches from AD1500 well into the nineteenth century and the Historical Period. Several spheres of influence, mostly associated with stone walled sites, can be distinguished in the region. Some of the historically well-known spheres of influence include the following:

- Early arrivals in the Mpumalanga Province such as Bakone clans who lived between Lydenburg, Badfontein and Machadodorp and Eastern Sotho clans such as the Pai, Pulana and Kutswe who established themselves in the eastern parts of the province (Collett 1979, 1983; Delius 2007; Makhura 2007; Delius & Schoeman 2008).

- Swazi expansion into the Highveld and Lowveld of the Mpumalanga Province occurred during the reign of Sobhuza (AD1815 to 1836/39) and Mswati (AD1845 to 1868) while Shangaan clans entered the province across the Lembombo Mountains in the east during the second half of the nineteenth century (Delius 2007; Makhura 2007.).
- The Bakgatla (Pedi) chiefdom in the Steelpoort Valley rose to prominence under Thulare during the early 1800's and was later ruled by Sekwati and Sekhukune from the village of Tsjate in the Leolo Mountains. The Pedi maintained an extended sphere of influence across the Limpopo and Mpumalanga Provinces during the nineteenth century (Mönnig 1978; Delius 1984).
- The Ndzundza-Ndebele established settlements at Kwasimkulu (between Middelburg and Belfast) and at the foot of the Bothasberge (Kwa Maza and Esikhunjini) in the 1700's and lived at Erholweni from AD1839 to AD1883 where the Ndzundza-Ndebele's sphere of influence known as KoNomthjarhelo stretched across the Steenkampsberge.
- The Bakopa lived at Maleoskop (1840 to 1864) where they were massacred by the Swazi while the Bantwane live in the greater Groblersdal and Marble Hall areas.
- Corbelled stone huts which are associated with ancestors of the Sotho on Tafelkop near Davel which date from the AD1700's into the nineteenth century (Hoernle 1930).
- Stone walled settlements spread out along the eastern edge of the Groot Dwarsriver Valley served as the early abode for smaller clans such as the Choma and Phetla communities which date from the nineteenth century.

Stone walled sites which occur closest to the project area are those approximately twenty kilometers to the north-west of the project area. Here the Ndzundza-Ndebele established a capital Kwasimkulu and other villages in a hilly area from AD1600 onwards.

7.3 The Historical Period

Historical towns closest to the project area include Delmas, Leandra, Kinross and Devon.

Delmas was laid out in 1907 on the farm Witklip (‘white stone’) which was divided into 192 residential stands, 48 smallholdings of 4 ha each and a commonage of 138ha. The farm belonged to Frank Dumat who originated from France where his grandfather had a small farm. He named the town Delmas which is derived from ‘mas’ which means a small farm in a southern dialect of French. In 1909 the government added another 5 500 ha to Frank Dumat’s original rural settlement.

The town of Leandra’s name is derived from two townships, Leslie and Eendrag, which are incorporated in this mining village.

Kinross, about 20 km east of Leandra, is the railhead for the township of Leandra and four gold mines in the region, namely Winkelhaak, Leslie, Bracken and Kinross which all opened in the 1950's.

The village was proclaimed in the 1915 and named after Kinross in Scotland by the engineers who constructed the railway line between Springs and Breyton. Kinross is near the watershed that separates the rivers flowing towards the Indian Ocean in the east and the rivers flowing towards the Atlantic Ocean in the west.

Devon is one of a number of small towns on the Eastern Highveld located approximately 40km to the south-east of Springs. The town gives the impression of a scarce number of scattered buildings held together by a giant grain silo. The town's name is derived from the hometown of the surveyor, namely Devon in England. Nearby, but inaccessible to everybody but the military, is the underground nerve centre of the country's northern radar defence system.

7.4 A coal mining heritage

Coal mining on the eastern Highveld is now older than one century and has become the most important coal mining region in South Africa**.** Whilst millions of tons of high-grade coal are annually exported overseas more than 80% of the country's electricity is generated on low-grade coal in Eskom's power stations such as Duvha, Matla and Arnot situated near coal mines on the eastern Highveld.

The earliest use of coal (charcoal) in South Africa was during the Iron Age (300-1880AD) when metal workers used charcoal, iron and copper ores and fluxes (quartzite stone and bone) to smelt iron and copper in clay furnaces.

Colonists are said to have discovered coal in the French Hoek Valley near Stellenbosch in the Cape Province in 1699. The first reported discovery of coal in the interior of South Africa was in the mid-1830s when coal was mined in Kwa-Zulu/Natal.

The first exploitation for coal was probably in Kwa-Zulu/Natal as documentary evidence refers to a wagon load of coal brought to Pietermaritzburg to be sold in 1842. In 1860 the coal trade started in Dundee when a certain Pieter Smith charged ten shillings for a load of coal dug by the buyer from a coal outcrop in a stream. In 1864 a coal mine was opened in Molteno. The explorer, Thomas Baines mentioned that farmers worked coal deposits in the neighbourhood of Bethal (Transvaal) in 1868. Until the discovery of diamonds in 1867 and gold on the Witwatersrand in 1886, coal mining only satisfied a very small domestic demand.

With the discovery of gold in the Southern Transvaal and the development of the gold mining industry around Johannesburg came the exploitation of the Boksburg-Spring coal fields, which is now largely worked out. By 1899, at least four collieries were operating in the Middelburg-Witbank district, also supplying the gold mining industry. At this time coal mining also had started in Vereeniging. The Natal Collieries importance was boosted by the need to find an alternative for imported Welsh anthracite used by the Natal Government Railways.

By 1920 the output of all operating collieries in South Africa attained an annual figure of 9,5million tonnes. Total in-situ reserves were estimated to be 23 billion tonnes in Witbank-Springs, Natal and Vereeniging. The total in situ reserves today are calculated to be 121 billion tonnes. The largest consumers of coal are Sasol, Mittal and Eskom.

No evidence for early coal mining activities was observed in or near the project area.

7.5 A vernacular stone architectural heritage

A unique stone architectural heritage was established in the eastern Highveld from the second half of the 19th century well into the early 20th century. During this time period stone was used to build farmsteads and dwellings, both in urban and in rural areas. Although a contemporary stone architecture also existed in the Karoo and in the Eastern Free State Province of South Africa a wider variety of stone types were used in the eastern Highveld. These included sandstone, ferricrete ('ouklip'), dolerite ('blouklip'), granite, shale and slate (Naude 1993).

The origins of a vernacular stone architecture in the eastern Highveld may be ascribed to various reasons of which the ecological characteristics of the region may be the most important. Whilst this region is generally devoid of any natural trees which could be used as timber in the construction of farmsteads, outbuildings, cattle enclosures and other structures, the scarcity of fire wood also prevented the manufacture of baked clay bricks. Consequently stone served as the most important building material in the eastern Highveld (Naude 1993, 2000). One of these historical structures was excavated and described after a heritage mitigation project was conducted for a coal mine (Pistorius 2005).

LIA Sotho, Pedi, Ndebele and Swazi communities contributed to the Eastern Highveld's stone walled architecture. The tradition set by these groups influenced settlers from Natal and the Cape Colony to utilise the same resources to construct dwellings and shelters. Farmers from Scottish, Irish, Dutch, German and Scandinavian descend settled and farmed in the eastern Highveld. They brought the knowledge of stone masonry from Europe. This compensated for the lack of fire wood on the Eastern Highveld which was necessary to bake clay bricks.

No sandstone structures was recorded in the project area although farmsteads with wagon sheds and outbuildings that were constructed with this building material occur in the wider Mafube prospecting area (Figure 1).

7.5 Most common types and ranges of heritage resources

Heritage resources which are common on the Eastern Highveld near the project area are the following (see Part 10 ‘Bibliography relating to earlier heritage studies’):

- Historical remains associated with farmstead complexes consisting of houses, associated outbuildings, cattle enclosures and graveyards.
- Abandoned graveyards left by farm workers who moved from farms to urban areas.

8 THE PHASE I HERITAGE IMPACT ASSESSMENT

8.1 Types and ranges of heritage resources

The Phase I HIA for the proposed 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) in and near the project area, namely:

- A graveyard (previously identified as GY07).

The graveyard was geo-referenced and mapped (Figure 8, Tables 1 & 2). Its significance is indicated as well as any possible impact on the graveyard.

Mitigation measures are outlined to take precautionary measures that the graveyard is not impacted during the construction of the road.

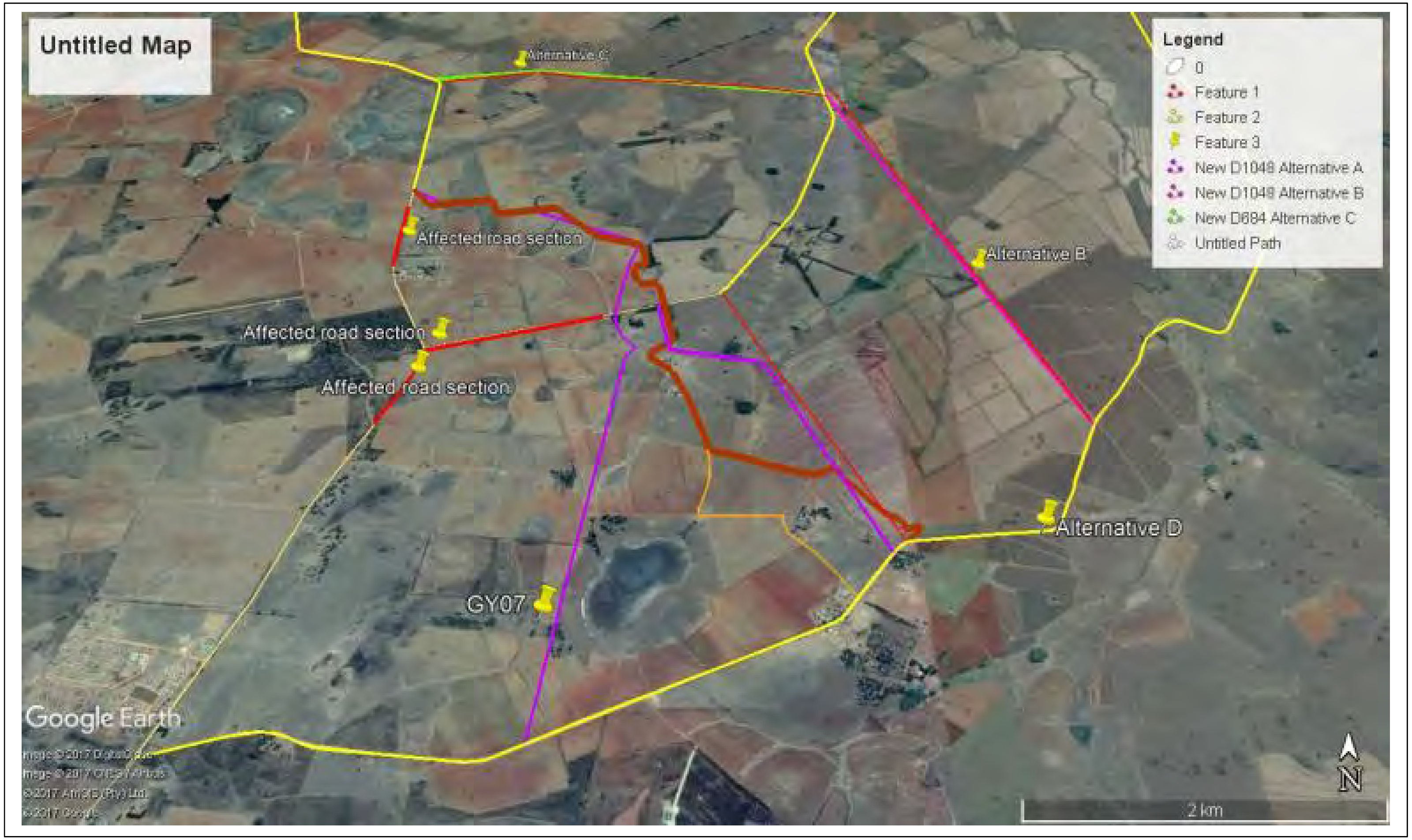

Figure 8- Graveyard 07 is located approximately one hundred meters from Alternative F (purple) for the proposed Mafube LifeX Road Realighnment Project and will not be directly affecetd by the construction of the road (above).

8.2 The graveyard

Graveyard 07 (GY07) is located near Eskom's power lines. During the survey conducted in 2012 it contained approximately eleven graves but now has grown to approximately twenty eight graves. Many of the graves are older than sixty years and many of these are demarcated with ferricrete stones.

Figure 9- Graveyard 07 is located near Eskom's power lines and approximately one hundred meters from Road Alternative F (above).

8.3 Table

Table 1- Coordinates and significance rating for graveyard (below).

GY07. Graveyard 07	25˚ 45.629' 29˚ 48.185'	**HIGH**

8.4 The significance of the graveyard

The significance of the graveyard is indicated in order to determine the significance of any possible impact on the graveyard and to establish if any mitigation measures are required for the graveyard.

All graveyards and graves can be considered to be of high significance and are protected by various laws (Table 2). Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (NHRA) (Act No 25 of 1999) in instances where graves are older than sixty years. It is highly likely that most of the graves are older than sixty years. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

8.5 Possible impact on the graveyard

GY07 is located approximately 100m from the proposed Alternative F and therefore needs not to be impacted by the new road.

The significance of any impact on the graveyard therefore is very low and will remain low if the mitigation measures outlined in this report is implemented (Table 2).

Table 2- The significance of the potential impacts on the graveyard (below).

	Probability of impact	**Magnitude of impact**	**Duration of impact**	**Scale**	**Significance points**	**Significance rating**	**Significance after mitigation**
GY07	**1**	**6**	**5**	**1**	**12**	**Very Low**	**Na**

8.6 Mitigating the graveyard

GY07 needs not to be affected by the Mafube Project. However, to ensure that no accidental damage may befall GY07 during the construction of the road it is recommended that the graveyard be demarcated with red cautionary tape and that a signpost with the following be erected at the graveyard: ‘Beware and avoid graveyard. Any damage caused may lead to prosecution’. Demarcation measures to be done in accordance with community requirements.

Summary

There is no reason from a heritage point of view why the proposed Alternative F for the Mafube Life X Road Realignment Project cannot be implemented if the mitigation measures outlined in this report are followed.

9 CONCLUSION AND RECOMMENDATIONS

The Phase I HIA for the proposed 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) in and near the project area, namely:

- A graveyard (previously identified as GY07).

The graveyard was geo-referenced and mapped (Figure 8, Tables 1 & 2). Its significance is indicated as well as any possible impact on the graveyard.

Mitigation measures are outlined to take precautionary measures that the graveyard is not impacted during the construction of the road.

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Possible impact on the graveyard

GY07 is located approximately 100m from the proposed Alternative F and therefore needs not to be impacted by the new road.

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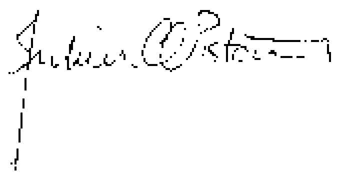

Archaeologist & Heritage Consultant

10 SELECT BIBLIOGRAPHY

Bergh, J.S. (red.) 1998. *Geskiedenisatlas van Suid Afrika. Die vier noordelike provinsies*. J.L. van Schaik: Pretoria.

Delius, P. 1984. The land belongs to us. Raven Press: Johannesburg.

Delius, P. 2007. Mpumalanga. History and Heritage. CTP Book Printers: Cape Town.

Delius, P. & Hay, M. 2009. *Mpumalanga: an illustrated history*. Johannesburg: The Highveld Press.

Erasmus, B.P.J. 1995. *Oppad in Suid Afrika. 'n Gids tot Suid Afrika, Streek vir Streek*. Jonathan Ball Uitgewers Bpk.

Esterhuysen, A. & Smith, J. 2007. Stories in stone. In Delius, P. (ed.) *Mpumalanga. History and Heritage*. University of Kwa Zulu Natal Press: Scottsville.

Evers, T.M. 1981. The Iron Age in the Eastern Transvaal, South Africa. In Voight, E.A. (ed). *Guide to archaeological sites in Northern and Eastern Transvaal.* Pretoria: South African Association of Archaeologists, 64-109.

Hoernle, R,F. 1930. The stone hut settlements on Tafelkop near Bethal. *Bantu Studies*. 4, pp217-233.

Makhura, T. 2007. Early inhabitants. In Delius, P. (ed). Mpumalanga. History and Heritage. University of Kwa Zulu Natal Press: Scottsville.

Mason, R.J. 1968. Transvaal and Natal Iron Age settlement revealed by aerial photography and excavation. *African Studies*. 27:167-180.

Naude, M. 1993. The use of stone on farmsteads on the eastern Transvaal. *Africana Society of Pretoria* (11): 49-55.

Naude, M. 2000. Vernacular stone buildings and structures on farmsteads in the southern districts of the Mpumalanga Province. *South African Journal of Cultural History*. 14(2): 31-64

Potgieter, E.F. 1955. *The disappearing Bushmen of Lake Chrissie: A preliminary survey*. J. L. Van Schaik: Pretoria.

Prins, F.E. 2001. Rock art and motivation: the evidence from Magageng. *Pictogram*. 12: 14-18.

Pretorius, Fransjohan. 1999. *Life on commando during the Anglo Boer War 1899-1902*. Human & Rousseau: Cape Town.

Smith, B.W. & Zubieta, L. 2007. The power of ancient art. In Delius, P. (ed.) *Mpumalanga. History and Heritage*. University of Kwa Zulu Natal Press: Scottsville.

Schoonraad, M. & Beaumont, P. 1971. The Welgelegen Shelter, Eastern Transvaal. In Schoonraad M. (ed.). Rock paintings of Southern Africa (*Supplement to the South African Journal of Science*. Special Publication No. 2).

Schoonraad, M. & Schoonraad, E. 1975. Rotsskilderinge in die Oos Transvaalse Laeveld. In Barnard, C. (ed.) *Die Transvaalse Laeveld*. Cape Town: Tafelberg.

Schapera, I. 1927. The Tribal Divisions of the Bushmen. *Man*. Published by the Royal Anthropological Institute of Great Britain and Ireland. 27, 68-73.

Whitelaw, G. 1996. Lydenburg revisited. Another look at the Mpumalanga Early Iron Age sequence. *South African Archaeological Bulletin*. 51.

11 BIBLIOGRAPHY RELATING TO EARLIER HERITAGE STUDIES

Pistorius, J.C.C. 2008. *A Phase I Heritage Impact Assessment (HIA) study for Keaton Mining's (Pty) Ltd proposed new opencast and underground mining activities on the farm Vanggatfontein 251 east of Delmas on the Eastern Highveld in the Mpumalanga Province of South Africa*. Unpublished report prepared for Metago Environmental Engineers.

Pistorius, J.C.C. 2008. *A Phase I Heritage Impact Assessment (HIA) study for Keaton Mining's (Pty) Ltd proposed new coal loading and storage facility at the existing hawerklip railway station on portion 21 of the farm Matjiesgoedkuil 266IR near Delmas on the Eastern Highveld in the Mpumalanga Province of South Africa*. Unpublished report prepared for Metago Environmental Engineers.

De Jongh, R. 2010. Specialist study: Heritage scoping (basic assessment) report: Input into EIA, IWWMP and IWULA for the proposed Kuyasa IPP power generation on portions of the farms Haverglen 269IR and Haverklip 265IR near Delmas, Mpumalanga Province. Unpublished report prepared by Cultmatrix.

Pistorius, J.C.C. 2012. A Phase I Heritage Impact Assessment study for a proposed 600MM power plant and associated infrastructure for Kipower (Pty) Ltd near Delmas on the Eastern Highveld in the Mpumalanga Province. Unpublished report prepared for Jones and Wagner.

Pistorius, J.C.C. 2012. A Phase I Heritage Impact Assessment study for a proposed raw water supply pipeline for Kipower (Pty) Ltd near Delmas on the Eastern Highveld in the Mpumalanga Province. Unpublished report prepared for Jones and Wagner.

Pistorius, J.C.C. 2013. An updated Phase I Heritage Impact Assessment study for a proposed raw water supply pipeline for Kipower (Pty) Ltd near Delmas on the Eastern Highveld in the Mpumalanga Province. Unpublished report prepared for Jones and Wagner.

Pistorius, J.C.C. 2002. *A Heritage Impact Assessment (HIA) study for a new power line on the farm Rietvallei 397JS between Middelburg and Arnot in the Mpumalanga Province of South Africa*. Unpublished report done for Eskom, Menlyn.

Pistorius, J.C.C. 2003. *A Heritage Impact Assessment study for the proposed 22kV Duvha Colliery power line deviation near Middelburg in the Mpumalanga Province of South Africa.* Unpublished report done for Eskom, Menlyn.

Pistorius, J.C.C. 2004. *A Heritage Impact Assessment (HIA) study for the EMP Amendment for Douglas Colliery in the Mpumalanga Province of South Africa.* Unpublished report for Pulles, Howard and De Lange.

Pistorius, J.C.C. 2004. *A Heritage Impact Assessment (HIA) study for the proposed new Optimum Colliery on the farm Schoonoord 164IS in the Mpumalanga Province of South Africa*. Unpublished report done for African EPA.

Pistorius, J.C.C. 2005. *Results of a Phase II Heritage Impact Assessment Study: An investigation of a historical sandstone farmstead and outbuildings on the banks of the Olifants River on the farm Kleynkopje 15IS within the boundaries of Douglas Colliery in the Mpumalanga Province of South Africa*. Unpublished report for the South African Heritage Resources Authority (SAHRA), Pulles Howard and De Lange (PHD) and Douglas Colliery.

Pistorius, J.C.C. 2007. *A Phase I Heritage Impact Assessment (HIA) study for the proposed new Mafube Coal Mine between Middelburg and Belfast in the Mpumalanga Province of South Africa*. Unpublished report for Golder Associates (Pty) Ltd.

Pistorius, J.C.C. 2007. *A Phase I Heritage Impact Assessment (HIA) study for the proposed new Zonnebloem Coal Mine between Middelburg and Belfast in the Mpumalanga Province of South Africa*. Unpublished report for Clean Stream Environmental Services.

Pistorius, J.C.C. 2012a. *A Phase I Heritage Impact Assessment (HIA) study for the proposed open cast mining of the Mafube Coal Mine Mining (Pty) Ltd: Nooitgedacht and Wildefontein Reserves between Middelburg and Belfast in the Mpumalanga Province of South Africa*. Unpublished report done for Golder Associates (Pty) Ltd.

Pistorius, J.C.C. 2012b. *A Phase I Heritage Impact Assessment (HIA) study for a new railway line and plant for the Mafube Project between Middelburg and Belfast in the Mpumalanga Province of South Africa*. Unpublished report done for Golder Associates (Pty) Ltd.

Report for proposed Mafube LifeX Road Realignment Project

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Palaeontological Impact Assessment: Phase 1 Field Study

Commissioned by: Golder Associates Africa (Pty)

P.O. Box 6001, Halfway House, 1685

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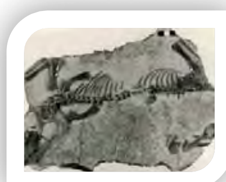
2017/10/30

Project Ref: 1776031



B. Executive summary

Outline of the development project: Golder Associates Africa (Pty) facilitated the appointed of Dr H. Fourie, a palaeontologist, to undertake a Paleontological Impact Assessment (PIA): Phase 1 Field Study of the suitability for the proposed Mafube Road Realignment project.

The applicant, Mafube Coal Mining (Pty) Ltd is currently undertaking the Mafube Life Expansion project (Mafube LifeX), which included the mining operations at Nooitgedacht and Wildfontein in the Mpumalanga Province. This authorisation was granted, but it was found that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or realignment will be required.

The new proposed road realignment will be situated on Nooitgedacht 417 JS and Panplaats 395 JS, 40 km east of the town of Middelburg via the R104 regional road, and 30 km west of Belfast, in the Mpumalanga Province.

This development includes one approved Alternative (see Locality Map) (Figure 1).
Alternative F – Approved route will transect Panplaats 395-JS in a northerly direction and then the route will turn west through Nooitgedacht 395-JS.

Legal requirements:-

The **National Heritage Resources Act (Act No. 25 of 1999) (NHRA)** requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. The Republic of South Africa (RSA) has a remarkably rich fossil record that stretches back in time for some 3.5 billion years and must be protected for its scientific value. Fossil heritage of national and international significance is found within all provinces of the RSA. South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act. According to this act, palaeontological resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

The main aim of the assessment process is to document resources in the development area and identify both the negative and positive impacts that the development brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.

For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) for further specialist palaeontological input where this is considered necessary.

A Palaeontological Impact Assessment is generally warranted where rock units of **LOW to VERY HIGH** palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No. 25 of 1999):
(i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.

This report adheres to the guidelines of Section 38 (1) of the National Heritage Resources Act (Act No. 25 of 1999) (NHRA).
Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50m in length; (c) any development or other activity which will change the character of a site (see Section 38); (d) the re-zoning of a site exceeding 10 000 m² in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report aims to provide comment and recommendations on the potential impacts that the proposed development could have on the fossil heritage of the area and to state if any mitigations or conservation measures are necessary.

Outline of the geology and the palaeontology:
The geology was obtained from the Geological Map of the Republic of South Africa, 1:100 000 (Visser, 1984) and 2528 Pretoria, 1:250 000 (Walraven 1978).
Legend to Map and short explanation (Figure 1).
Pe – Shale, shaly sandstone, grit, sandstone, conglomerate, coal in places near base and top (brown). Vryheid Formation, Ecca Group, Karoo Supergroup.
Mr – Granophyre, pseudogranophyre (orange). Rashoop Granophyre Suite, Bushveld Complex.
Vu – Ferrogabbro, ferrodiorite, diorite [=] (green). Upper Zone, Rustenburg Layered Suite, Bushveld Complex.
Vdr – Glassy amygdaloidal pseudospherulitic and porphyritic black rhyolite; black rhyolite, leptite [=] (pink). Damwal Formation, Rooiberg Group, Transvaal Supergroup.
Alt F– Proposed Route Alternative.

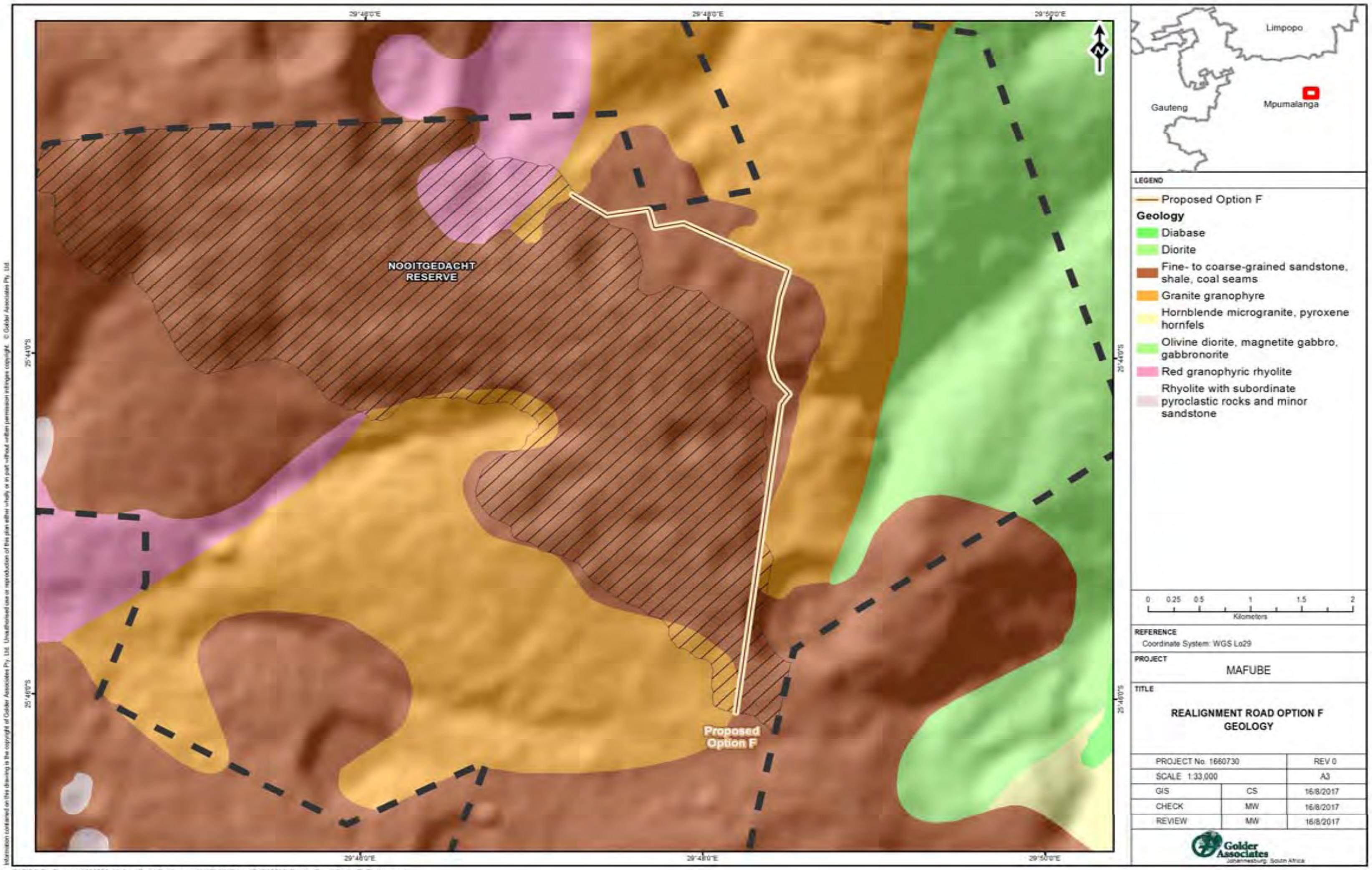
Mining activities:
Presently coal.
Summary of findings (1d): The Desktop PIA was undertaken during February 2017, it was summer, the Phase 1 Field Study was undertaken in October 2017 in the summer in hot and dry conditions and the following is reported:

The formations present are mainly the Rustenburg Layered Suite (Mr, Vu) of the Bushveld Complex, Transvaal Supergroup (Vdr) and the Vryheid Formation, Karoo Supergroup (Pe).

The proposed development and associated structures will be developed on the Vryheid Formation. It is Permian in age. The area is covered with corn fields, vegetation and grassland.

The Vryheid Formation (Pe,Pv), Ecca Group is rich in plant fossils such as the Glossopteris flora represented by stumps, leaves, pollen and fructifications. This formation is early to mid-Permian (Palaeozoic) in age and consists of sandstone, shaly sandstone, grit, conglomerate, coal and shale. Coal seams are present in the Vryheid Formation within the sandstone and shale layers. Fossils are mainly present in the grey shale which is interlayered between the coal seams (Kent 1980, Visser 1989). Borehole logs in the coalfields show the following layers; soil, shale and sandstone, shale and sandstone interbedded, sandstone, coal, conglomerate reworked diamictite, Dwyka Tillite, and the Pre-Karoo Basement.

Figure 1: The geology of the development area (Golder Associates).



Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally LOW to VERY HIGH, but here locally **VERY HIGH** for the Vryheid Formation (SG 2.2 SAHRA APMHOB, 2012).

Recommendation: The impact of the development on fossil heritage is **VERY HIGH** and therefore mitigation or conservation measures were necessary for this development. A Phase 1 Palaeontological Assessment was recommended. The topsoil, subsoil, overburden, inter-burden and bedrock may have to be surveyed for fossiliferous outcrops. Protocol and Management Plan is attached (Appendix 3). No fossils were found during the walk through.

There is no objection to the development.

Concerns/threats to be added to the EMPr (1g,1ni,1nii,1o,1p):

1) Threats are earth moving equipment / machinery (for example haul trucks, front end loaders, excavators, graders, dozers) during construction, the sealing-in or destruction of the fossils by development, vehicle traffic, mining activities, and human disturbance.
2) Special care must be taken during construction of the road as a site visit may have missed a fossiliferous outcrop. An appropriate Protocol and Management plan is attached for the Environmental Control Officer (Appendix 2).

The Recommendations are:

1) No consultation with parties was necessary. The Environmental Control Officer (ECO) must familiarise him- or herself with the Vryheid Formation fossils.
2) Mitigation may be needed if fossils are found.
3) The development may go ahead with caution, but the ECO must survey for fossils before or after excavation in line with the legally binding Environmental Management Programme (EMPr). This must be updated to include the involvement of a palaeontologist if any fossils are uncovered.

Stakeholders:
Developer – Mafube Coal Mining (Pty) Ltd, Mafube Colliery, Springboklaagte, Anglo Operations Limited and Exxaro, B. van Stelten, Tel. 013 246 9410.
Environmental – Golder Associates Africa (Pty), P.O. Box 6001, Halfway House, 1685. Tel. 011 254 4800.
Mineral Rights Holder – Mafube Coal Mining (Pty) Ltd.

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D. Background information on the project

Report This report is part of the environmental impact assessment process under the National Environmental Management Act, as amended (Act No. 107 of 1998) (NEMA) and includes Appendix 6 (GN R38282 of 4 December 2014) of the Environmental Impact Assessment Regulations contained in GN R982 of 04 December 2010.

Outline of development

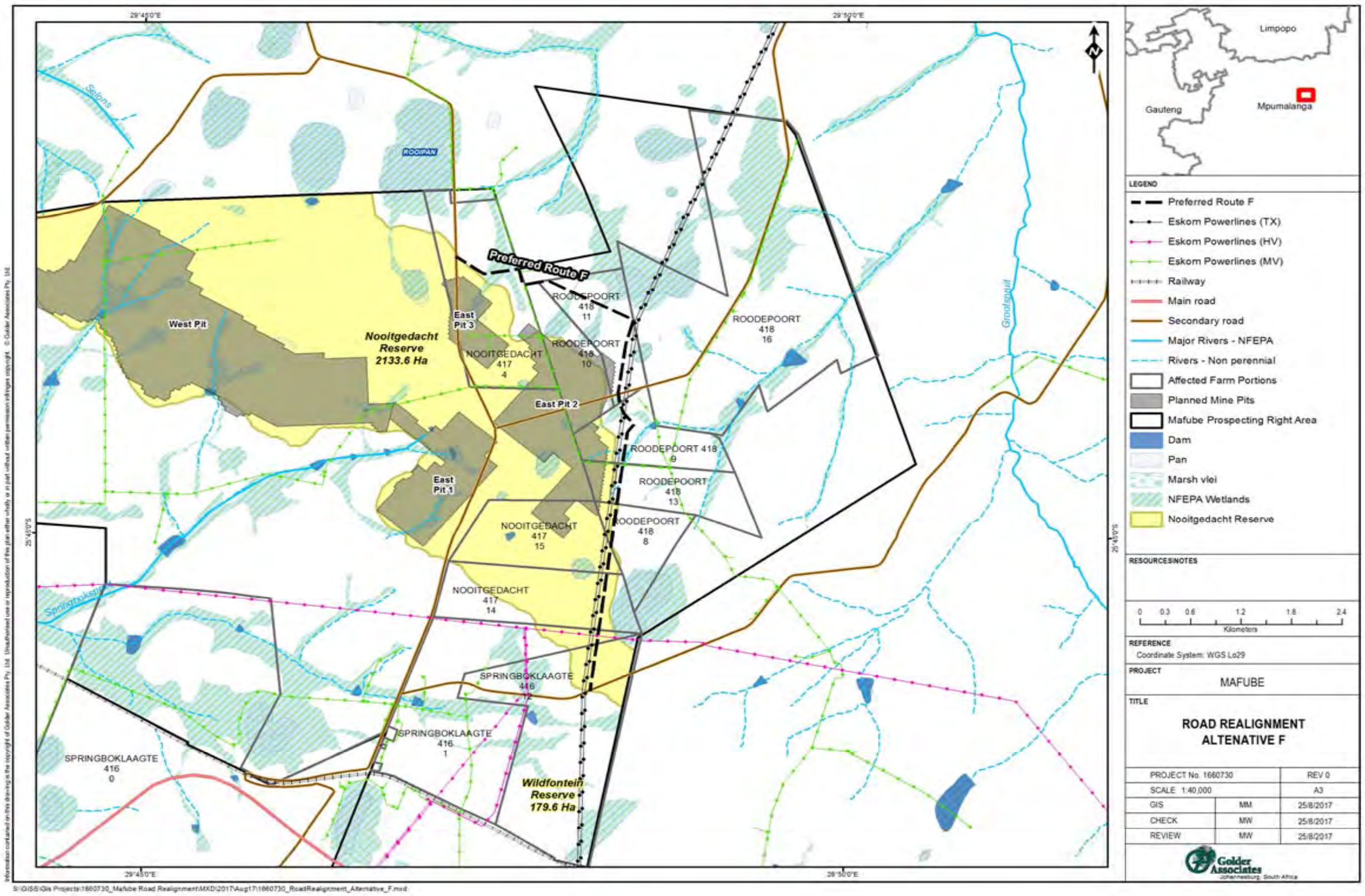
This report discusses and aims to provide the developer with information regarding the location of palaeontological material that will be impacted by the development. In the pre-construction phase, if the palaeontological sensitivity is VERY HIGH or LOW, it may be necessary for the developer to apply for the relevant permit from the South African Heritage Resources Agency (SAHRA) and follow protocol.

The applicant, Mafube Coal Mining (Pty) Ltd is currently undertaking the Mafube Life Expansion project (Mafube LifeX), which included the mining operations at Nooitgedacht and Wildfontein in the Mpumalanga Province. This authorisation was granted, but it was found that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or realignment will be required.

Road D684 is an unpaved road, approximately 8 m in width. It is located in a rural area that consists predominantly of farming and some coal mining. It provides access to the Sikhululiwe Village that is located adjacent to the road reserve. It is proposed to close this road over a distance of approximately 8.0 km from the T-junction with road D1574 in the south to the change in a western direction in the north. The closure of road D1048 is also proposed over a distance of 2.5 km.

This development includes one approved Alternative (see Locality Map) (Figure 2).
Alternative F – Approved route will transect Panplaats 395-JS in a northerly direction and then the route will turn west through Nooitgedacht 395-JS.

Figure 2: Map indicating surface infrastructure (Golder Associates)



Rezoning/ and or subdivision of land: No.
Name of developer and consultant: Mafube Coal Mining (Pty) Ltd and Golder Associates Africa (Pty).
Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a Desktop PIA to ascertain if any palaeontological sensitive material is present in the development area. This study will advise on the impact on fossil heritage mitigation or conservation necessary, if any.

Dr Fourie obtained a Ph.D from the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand. Her undergraduate degree is in Geology and Zoology. She specialises in vertebrate morphology and function concentrating on the Therapsid Therocephalia. For the past nine years she carried out field work in the Eastern Cape Province, Gauteng Province, Free State Province and Mpumalanga Province. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 23 years.
Legislative requirements: SAHRA / Provincial Heritage Resources Agency (PHRA) for issue of permits if necessary. The National Heritage Resources Act (NHRA). An electronic copy of this report must be supplied to SAHRA/PHRA.

E. Description of property or affected environment
Location and depth:
The new proposed road realignment will be situated on Nooitgedacht 419-JS and Panplaats 395-JS, 40 km east of the town of Middelburg via the R104 regional road, and 30 km west of Belfast, in the Mpumalanga Province.

Depth is determined by the road construction. The thickness of the grey shale can vary and this is interlayered with the also variable yellow sandstone and coal seams.

F. Description of the Geological Setting
Description of the rock units:
The development is taking place in an area covered by the Vryheid Formation (Figure 1).

The Bushveld Complex (surrounding area) is a massive body of igneous origin and it is intrusive in the Transvaal Supergroup (Kent, 1980). It covers an area of 65 000 km^2 and is chrome and platinum rich (Visser, 1989). The age is Vaalian (2,100 – 1,920 Ma). The Rustenburg Layered Suite is so termed as it is intrusive in origin and the term is to be equivalent to a 'group'. It consists of mafic and ultramafic rocks and is rich in platinum, chrome and vanadium. The layered rocks of the Bushveld Complex are generally believed to be the result of crystals settling out of magma during slow cooling. The magmatic events petrogenetically related to and generally considered part of the whole magmatic evolution of the Complex are, the diabase sills and the Rooiberg Group. The Complex consists of three main units or suites of which the Rustenburg Layered Suite is one (Kent, 1980), the other two are the Rashoop and Lebowa Granite Suites (Visser, 1989). This region is covered by the 'Bushveld' vegetation.

The Bushveld Complex rocks are classified mafic and ultramafic because of the iron and magnesium (and/or calcium) rich content, such as norite, gabbro and pyroxenite. The heaviest minerals, such as olivine and pyroxene, and any sulphide minerals (like magnetite and chromite) concentrate towards the base of each layer. Lighter minerals, such as feldspar and quartz, tend to form at the top (Norman and Whitfield, 2006).

It is believed that the Bushveld Complex looked like the Yellowstone National Park in the States of Wyoming, Idaho and Montana, United States of America, when it formed. The Rustenburg Layered Suite formed first. Erosion caused the Bushveld Complex to shrink in size. The Complex crops out at surface in three very long arcs, from Thabazimbi to Pretoria in the west, from Mokopane to Middelburg in the east, and north of Mokopane (McCarthy and Rubidge, 2005).

The Bushveld Complex is economically very important. By far the most important metal mined from the Rustenburg Layered Suite is platinum. Gold is also present, other minerals are nickel, copper, chrome, vanadium, tin, fluorspar and cobalt. Quarries provide dimension stone and granite (Visser, 1989).

The Transvaal Supergroup fills an east-west elongated basin in the south-central part of the old Transvaal (now North – West, Gauteng and Mpumalanga Provinces) as far south as Potchefstroom. It is Vaalian in age, approximately 2600 Ma to 2100 Ma. A maximum thickness of the Transvaal Supergroup reaches 2000 m in the north-eastern section. An east-west elongated basin is filled with clastic, volcanic and chemical sedimentary rocks. Three groups based on lithological differences have been established: they are the Rooiberg, Chuniespoort, and Pretoria Groups as well as other smaller groups (Kent 1980). It is the Bushveld Complex that is responsible for the tilting of the Transvaal sediments and the heat of its intrusion having created andalusite crystals (Norman and Whitfield 2006). This Supergroup is underlain by the Ventersdorp, Witwatersrand and Pongola Supergroups, and the Dominion Group. The Rooiberg Group is divided into the Formations Damwal and Selonsrivier in the Loskop dam area (Visser 1989).

The Vryheid Formation present is part of the Karoo Supergroup. The Karoo Supergroup is renowned for its fossil wealth. The Vryheid Formation (Pe,Pv), Ecca Group is rich in plant fossils such as the *Glossopteris* flora represented by stumps, leaves, pollen and fructifications. This formation is early to mid-Permian (Palaeozoic) in age and consists of sandstone, shaly sandstone, grit, conglomerate, coal and shale. Coal seams are present in the Vryheid Formation within the sandstone and shale layers. Fossils are mainly present in the grey shale which is interlayered between the coal seams (Kent 1980, Visser 1989). Borehole logs in the coalfields show the following layers; soil, shale and sandstone, shale and sandstone interbedded, sandstone, coal, conglomerate reworked diamictite, Dwyka Tillite, and the Pre-Karoo Basement (Figure 3).

The Vryheid Formation is named after the type area of Vryheid-Volksrust. In the north-eastern part of the basin the Vryheid Formation thins and eventually wedges out towards the south, southwest and west with increasing distance from its source area to the east and northeast (Johnson 2009). The Vryheid Formation consists essentially of sandstone, shale, and subordinate coal beds, and has a maximum total thickness of 500 m. It forms part of the Middle Ecca (Kent 1980). This formation has the largest coal reserves in South Africa. The pro-delta sediments are characterised by trace and plants fossils (Snyman 1996).

This development includes one approved Alternative (see Location Map) (Figure 2).
Alternative F – Approved route will transect Panplaats 395-JS in a northerly direction and then the route will turn west through Nooitgedacht 395-JS.

Ecca rocks are stable and lend themselves well to developments. It is only unstable in or directly above mining activities (Snyman 1996). The site itself is situated on the flat-lying Vryheid Formation, Ecca Group, Karoo Supergroup. Dolerite dykes do occur throughout the Karoo Supergroup. Structural geological features such as dykes and faults can have a measurable influence on ground water flow and mass transport.

The typical colours for the Vryheid Formation are grey and yellow for the sediments and black for the coal seam. The thickness of the grey shale can vary and this is interlayered with the also variable yellow sandstone and coal seams.

Field Observations

Figure 3: Overview of site.

The road will follow the route of the power lines

Area mostly covered in corn fields

G. Background to Palaeontology of the area

Summary: When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a desktop and or field scoping (survey) study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required (SG 2.2 SAHRA AMPHOB, 2012).

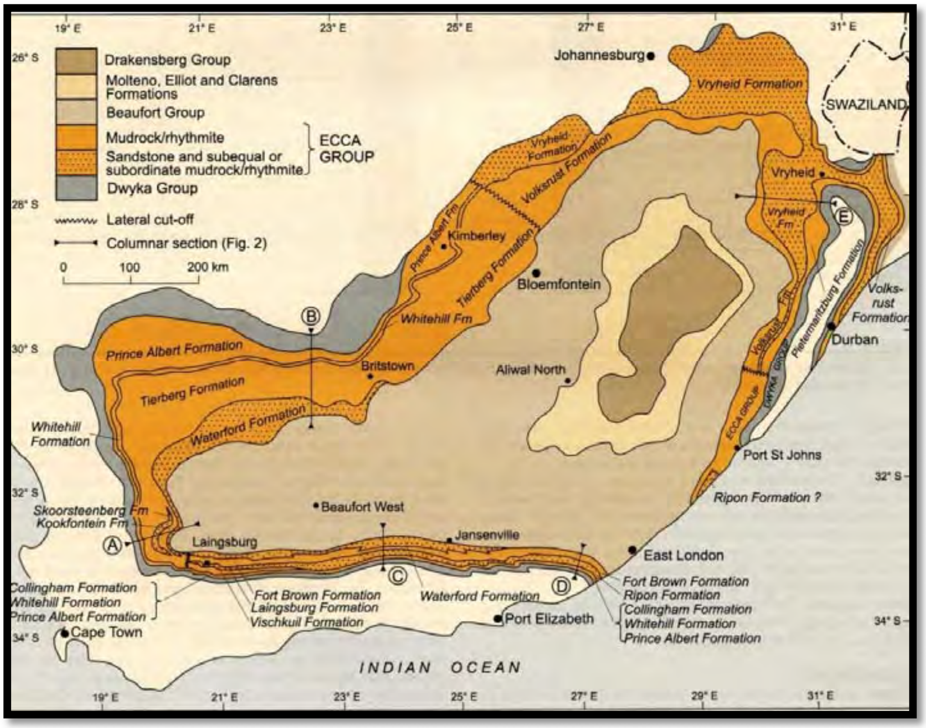


Figure 4: Map to show extent of the Ecca Group (Johnson 2009).

The Ecca Group may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005).

The *Glossopteris* flora is thought to have been the major contributor to the coal beds of the Ecca. These are found in Karoo-age rocks across Africa, South America, Antarctica, Australia and India. This was one of the early clues to the theory of a former unified Gondwana landmass (Norman and Whitfield 2006).

Table 1: Criteria used (Fossil Heritage Layer Browser/SAHRA).

Rock unit	Significance/vulnerability	Recommended action
Vryheid Formation	Very High	Field assessment and protocol for finds is required
Bushveld Complex	Insignificant or zero	No palaeontological studies are required.
Rooiberg Group	Low	No palaeontological studies are required however a protocol for finds is required

Table 2: Taken form palaeotechnical report (Groenewald and Groenewald 2014).

Subgroup / Supergroup	Group	Formation	Fossil Heritage	Comment
Karoo Supergroup	Ecca	Vryheid	Rich fossil plant assemblages of the Permian Glossopteris flora, rare fossil wood, diverse palynomorphs. Abundant low diversity trace fossils, rare insects, possible conchostracans, non-marine bivalves, fish scales	Globally important and under collected

Databases and collections: Ditsong: National Museum of Natural History.
Impact: **VERY HIGH.** There are some fossil resources that may be impacted by the development.

H. Description of the Methodology (1e)

The Desktop PIA was undertaken during February 2017. This Phase 1 Field Study was undertaken in October 2017. The walk through of the affected portion was done and photographs (in 20 mega pixels) were taken of the site with a digital Canon camera (PowerShot SX620HS). It was not necessary to use a Global Positioning System (GPS) (Garmin eTrex 10) to record outcrops if not covered with topsoil, subsoil, overburden, and vegetation. The walk through and drive through did identify the Vryheid Formation. A literature survey is included.

Assumptions and Limitations (1i):-

The accuracy and reliability of the report may be limited by the following constraints:

1. Most development areas have never been surveyed by a palaeontologist or geophysicist.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of rocky outcrops.
6. A site visit was not conducted.
7. Insufficient data from developer and exact lay-out plan for all structures.

A Phase 1 Palaeontological Impact Assessment: Field Study will include:

1. Recommendations for the future of the site.
2. Background information on the project.
3. Description of the property of affected environment with details of the study area.
4. Description of the geological setting and field observations.
5. Background to palaeontology of the area.
6. Heritage rating.
7. Stating of significance (Heritage Value).

A Phase 2 Palaeontological Impact Assessment: Mitigation will include:

1. Recommendations for the future of the site.
2. Description of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan.
6. Possible declaration as a heritage site or Site Management Plan.

The National Heritage Resources Act No. 25 of 1999 further prescribes -

Act No. 25 of 1999. National Heritage Resources Act, 1999.
The National Estate as: 3 (2) (f) archaeological and palaeontological sites, (i)(1) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens,
Heritage assessment criteria and grading used: (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance;
(b) Grade 11: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and (c) Grade 111: Other heritage resources worthy of conservation.

SAHRA is responsible for the identification and management of Grade 1 heritage resources.
Provincial Heritage Resources Authority (PHRA) identifies and manages Grade 11 heritage resources.
Local authorities identify and manage Grade 111 heritage resources.

No person may damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of a provincially protected place or object without a permit issued by a heritage resources authority or local authority responsible for the provincial protection.

Archaeology, palaeontology and meteorites: Section 35.
(2) Subject to the provisions of subsection (8) (a), all archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered paleontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

I. Description of significant fossil occurrences (Heritage value) (1f)
All Karoo Supergroup geological formations are ranked LOW to VERY HIGH, but here the impact is potentially **VERY HIGH,** for the Vryheid Formation, Ecca Group. Rocks of Permian age in South Africa are particularly rich in fossil plants (Rayner and Coventry 1985). The fossils are present in the grey shale interlayered with the coal seams. The fossils are not very rare and also occur in other parts of the

Karoo stratigraphy. The pollen of the Greenside Colliery also on the Vryheid formation was the focus of a Ph.D study. It is often difficult to spot the greyish fossils as they are the same colour as the grey shale in which they are present as these coalified compressions have been weathered to leave surface replicas on the enclosing shale matrix. A locality close to Ermelo, also Vryheid Formation, has yielded *Scutum, Glossopteris* leaves, *Neoggerathiopsis* leaves, the lycopod *Cyclodendron leslii,* and various seeds and scale leaves (Prevec 2011).

Fossils likely to be found are mostly plants (Appendix 1) such as '*Glossopteris* flora' of the Vryheid Formation. The aquatic reptile *Mesosaurus* and fossil fish may also occur with marine invertebrates, arthropods and insects. Trace fossils can also be present. The marine bivalve *Megadesmus* is found in the upper part of the Volksrust Formation near Newcastle (Johnson 2009).

During storms a great variety of leaves, fructifications and twigs accumulated and because they were sandwiched between thin films of mud, they were preserved to bear record of the wealth and the density of the vegetation around the pools. They make it possible to reconstruct the plant life in these areas and wherever they are found, they constitute most valuable palaeobotanical records (Plumstead 1963) and can be used in palaeoenvironmental reconstructions.

Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to be determined due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot. The vast coal mining industry provides palaeontologists with fantastic access to coal-associated plant fossils, while simultaneously resulting in the destruction of important National palaeontological heritage.

Fossils likely to be found are mostly plants (Appendix 1) such as '*Glossopteris* flora' of the Vryheid Formation. The aquatic reptile *Mesosaurus* and fossil fish may also occur with marine invertebrates, arthropods and insects. Trace fossils can also be present. The marine bivalve *Megadesmus* is found in the upper part of the Volksrust Formation near Newcastle (Johnson 2009).

The threats are:- earth moving equipment/machinery (for example haul trucks, front end loaders, excavators, graders, dozers) during construction, the sealing-in or destruction of fossils by development, vehicle traffic, mining activities, and human disturbance. See Description of the Geological Setting (F) above.

J. Recommendation (1j,1l)

a. There is no objection to the development, but it was necessary to complete this Phase 1 PIA to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity is **VERY HIGH** for the Vryheid Formation. A Phase 2 Palaeontological Mitigation would only have been required if the Phase 1 Palaeontological Assessment found fossiliferous outcrops, which was not the case.
b. This project will benefit the economy, the growth of the community and social development in general.
c. Preferred choice: By developer Alternative F.
d. The following should be conserved: if any palaeontological material is exposed during excavating SAHRA/PRHA must be notified. All construction activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures.

Sampling and collecting (1m,1k):
Wherefore a permit may be needed from the SAHRA/PHRA.

a) Objections: None.
b) Conditions of development: See Recommendation.
c) Areas that may need a permit: Yes if fossils are found.
d) Permits for mitigation - needed from SAHRA / PHRA: **Yes**.

K. Conclusions

a) All the land involved in the development was assessed and none of the property is unsuitable for development.
b) All information needed for the Phase 1: Field Scope was provided by Golder Associates Africa (Pty).
c) Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed.
d) The following should be conserved: if any palaeontological material is exposed during digging, SAHRA/PHRA must be notified. All development activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures.
e) Condition in which development may proceed: It is further suggested that Occupational, Health and Safety Act is adhered to for safety and security reasons.

L. Bibliography

ALMOND, J., PETHER, J., and GROENEWALD, G. (2013), South African National Fossil Sensitivity Map. Fossil Heritage Layer Browser, SAHRA and Council for Geoscience.

GRODNER, M. and CAIRNCROSS, B. 2003. A regional scale 3-D model of the Witbank Coalfield, Northern Karoo Basin, South Africa. *South African Journal of Geology,* **106(4):** 249-264.

GROENEWALD, G and GROENEWALD, D. 2014. SAHRA Palaeotechnical Report. Palaeontological Heritage of Mpumalanga, Pp 23.

JOHNSON, M.R. 2009. Ecca Group. Karoo Supergroup. Catalogue of South African Lithostratigraphic Units. SACS, **10:** 5-7.

KENT, L. E. (1980), Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei and Venda. SACS, Council for Geosciences, Pp 535-574.

MCARTHY, T. and RUBIDGE, B. (2005), *The Story of Earth Life: A southern African perspective on a 4.6-billion-year journey.* Struik, Pp 333.

NORMAN, N. and WHITFIELD, G. (2006), *Geological Journeys.* De Beers, Struik, Pp 1-320.

PLUMSTEAD, E.P. 1963. The influence of plants and environment on the developing animal life of Karoo times. *South African Journal of Science,* **59(5):** 147-152.

PREVEC, R. 2011. A structural re-interpretation and revision of the type material of the glossopterid ovuliferous fructification *Scutum* from South Africa. *Palaeontologia africana,* **46:** 1-19.

RAYNER, R.J. and COVENTRY, M.K. 1985. A *Glossopteris* flora from the Permian of South Africa. *South African Journal of Science,* **81:** 21-32.

RUBIDGE, B. S. (Ed.) (1995), Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Biostratigraphy, Biostratigraphic Series No. 1, 46pp. Council for Geoscience, Pretoria.

SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Report, Pp 1-15.

SNYMAN, C.P. (1996), *Geologie vir Suid Afrika,* Departement Geologie, Universiteit van Pretoria, Pretoria, Volume 1, Pp 513.

VAN der WALT, M.; DAY, M.; RUBIDGE, B. S.; COOPER, A. K. and NETTERBERG, I. (2010), Utilising GIS technology to create a biozone map for the Beaufort Group (Karoo Supergroup) of South Africa. *Palaeontologia Africana,* **45:** 1-5.

VISSER, D.J.L. (1984), Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy. Council for Geoscience.

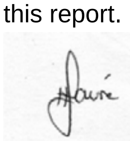
VISSER, D.J.L. (1989), Information to the Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy. Council for Geoscience.
WALRAVEN, F (1978). Geological Map of Pretoria 1:250 000, 2528. South African Committee for Stratigraphy. Council for Geoscience.

Declaration / disclaimer (1b)
I, Heidi Fourie, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project for which I was appointed to do a palaeontological scope. There are no circumstances that compromise the objectivity of me performing such work.

I accept no liability, and the client, by receiving this document, indemnifies me against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the use of the information contained in this document.

It may be possible that the Phase 1 PIA Field Study may have missed palaeontological resources in the project area as outcrops are not always present or visible due to vegetation while others may lie below the overburden of earth and may only be present once development commences.

This report may not be altered in any way and any parts drawn from this report must make reference to this report.



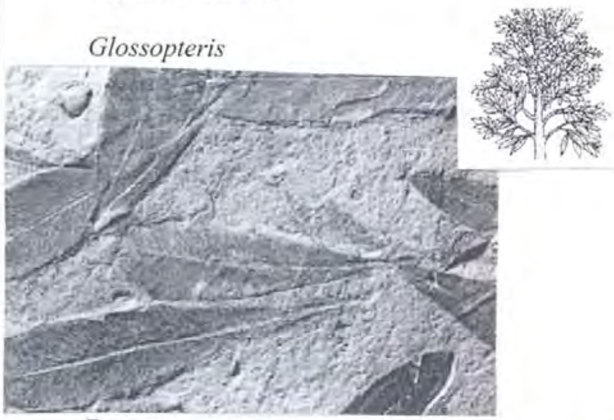
Heidi Fourie
2017/10/30

Appendix 1: Examples of Vryheid Formation Fossils.

Ecca Group

Vryheid Formation

Glossopteris



Ferns

Horsetails

Clubmosses

Appendix 2:

Table 1: Listing points in Appendix 6 of the Act and position in Report.

Section in report	**Point in Act**	**Heading**
B	1(c)	Outline of development project
	1(d)	Summary of findings
	1(g)	Concerns/threats:
	1(n)i	“
	1(n)ii	“
	1(o)	“
	1(p)	“
D	1(h)	Figures
	1(a)i	Terms of reference
H	1(e)	Description of Methodology
	1(i)	Assumptions and Limitations
I	1(f)	Heritage value
J	1(j)	Recommendation
	1(l)	“
	1(m)	Sampling and collecting
	1(k)	“
Declaration	1(b)	Declaration
Appendix 2	1(k)	Protocol for finds
	1(m)	“
	1(q)	“

Appendix 3: Examples of Vryheid Formation Fossils (Horsetail fern stem, *Glossopteris* leave).

Appendix 4:

Protocol for Finds and Management Plan

This protocol is to be used for all Phase 2 Mitigation processes as well as for reports where the Palaeontological Sensitivity is **LOW**; this process guides the palaeontologist on site and should not be attempted by the layman. As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to oversee the construction / mining activities in line with the legally binding Environmental Management Programme (EMPr) so that when a fossil is unearthed they can notify the relevant department and specialist to further investigate. When a fossil is found the area must be fenced-off and the construction workers must be informed that this is a no-go area. Therefore the EMPr must be updated to include the involvement of a palaeontologist (site visit once a month or training for the ECO) during the digging and excavation (ground breaking) phase of the development.

The EMPr already covers the conservation of heritage and palaeontological artefacts that may be exposed during construction activities. The ECO should familiarise him- or herself with the Ecca Group formations and its fossils. The Evolutionary Studies Institute, University of the Witwatersrand has good examples of Ecca Group Fossils.

The developer must survey the areas affected by the development and then indicate on plan where the construction / development / mining will take place. Trenches have to be dug to ascertain how deep the sediments are above the bedrock (can be a few hundred metres). This will give the depth of the topsoil, subsoil, and overburden, if need be trenches should be dug deeper to expose the interburden.

Mitigation will involve recording, rescue and judicious sampling of the fossil material present in the layers sandwiched between the geological / coal layers. It must include information on number of taxa, fossil abundance, preservational style, and taphonomy. This can only be done during excavations. In order for this to happen, in case of mining operations, the process will have to be closely scrutinised by a professional palaeontologist / palaeobotanist to ensure that only the coal layers are mined and the interlayers (siltstone and mudstone) are surveyed for fossils or representative sampling of fossils are taking place.

A Phase 2 study is very often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include (SAHRA) -

7. Recommendations for the future of the site.
8. Description and purpose of work done (including number of people and their responsibilities).
9. A written assessment of the work done, fossils excavated, not removed or collected and observed.
10. Conclusion reached regarding the fossil material.
11. A detailed site plan and map.
12. Possible declaration as a heritage site or Site Management Plan.
13. Stakeholders.
14. Detailed report including the Desktop and Phase 1 study information.
15. Annual interim or progress Phase 2 permit reports as well as the final report.
16. Methodology used.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

The Palaeontological Society of South Africa (PSSA) does not have guidelines on excavating or collecting, but the following is suggested:

1. The developer needs to clearly stake or peg-out (survey) the areas affected by the mining / construction / development operations and dig representative trenches and if possible supply geological borehole data.
2. Fossils likely to occur are for example the fossil plants from the Vryheid Formation, these are present in the grey shale.
3. When clearing topsoil, subsoil or overburden and hard rock (outcrop) is found, the contractor needs to stop all work.
4. A Palaeontologist / Palaeobotanist (contact SAHRIS for list) must then inspect the affected areas and trenches for fossiliferous outcrops / layers. The contractor / developer may be asked to move structures, and put the development on hold.
5. If the Palaeontologist / Palaeobotanist is satisfied that no fossils will be destroyed or have removed fossils, development and removing of the topsoil can continue.
6. After this process the same Palaeontologist / Palaeobotanist will have to inspect and offer advice through the Phase 2 Mitigation Process. Bedrock excavations for footings may expose, damage or destroy previously buried fossil material and must be inspected.
7. When permission for the development is granted, the next layer can be removed, if this is part of the Vryheid Formation, then with the removal of each layer of sediment, the Palaeontologist / Palaeobotanist must do an investigation (a minimum of once every two weeks).
8. At this stage the Palaeontologist / Palaeobotanist in consultation with the developer / mining company must ensure that a further working protocol and schedule is in place. Onsite training should take place, followed by an annual visit by the Palaeontologist / Palaeobotanist.

Fossil excavation if necessary during Phase 2:

1. Photography of fossil / fossil layer and surrounding strata.
2. Once a fossil has been identified as such, the task of extraction begins.

3. It usually entails the taking of a GPS reading and recording lithostratigraphic, biostratigraphic, date, collector and locality information.
4. Using Paraloid (B-72) as an adhesive and protective glue, parts of the fossil can be kept together (not necessarily applicable to plant fossils).
5. Slowly chipping away of matrix surrounding the fossil using a geological pick, brushes and chisels.
6. Once the full extent of the fossil / fossils is visible, it can be covered with a plaster jacket (not necessarily applicable to plant fossils).
7. Chipping away sides to loosen underside.
8. Splitting of the rock containing palaeobotanical material will reveal any fossils sandwiched between the layers.

SAHRA Documents:

Guidelines to Palaeontological Permiting policy.
Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.
Guidelines for Field Reports.
Palaeotechnical Reports for the nine Provinces.

October 2017

MAFUBE COAL MINING (PTY) LTD

Environmental Impact Assessment (EIA) for the Proposed Mafube Road Realignment Project- Soil, Land Use and Land Capability Assessment

Submitted to:
Mafube Coal Mining (Pty) Ltd

REPORT

Report Number. 1776031-316470-5

Distribution:

1 Copy - Mafube
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Executive Summary

Introduction

The Mafube LifeX operations are currently in the construction phase and full operational phase are planned to commence in May 2018. During the feasibility phase investigations, it was assessed that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or realignment are required before this operation can commence. These roads falls under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

Golder Associates Africa (Pty) Ltd, an independent environmental and engineering company, is conducting the EIA and licensing process for the proposed road realignment project. As part of the EIA, a soil, land use and land capability study was conducted with the following objectives:

- Conduct a detailed soils assessment along the proposed route alternative F;
- Classify and map the observed soils according to the South Africa Taxonomic Soil Classification System, 1991;
- Conduct a land capability assessment of the area along the route and compile a map of the land capability classes;
- Map the current land-use along the route;
- Determine impacts associated with the proposed route realignment.
- Propose environmental management actions required for the preservation of local soils (mitigation measures).

Methodology

The soil survey was undertaken on 10 August 2017 of the preferred route. Observations were conducted by hand auger along transects of the main terrain and geological units. At each sampling point augering was conducted to a depth of 1.20 m or refusal. Morphological descriptions were made according to the South Africa Taxonomic Soil Classification System methodology. A total of seven (7) soil profiles were evaluated and described in detail and representative profile samples were collected for laboratory analysis.

The land use was assessed by field observations, conducted together with the soil survey. Land capability was compiled by matching field data and analytical data with the requirements for rain-fed crops. The overall fertility status of the soils were evaluated according to the methodology outlined in the Fertilizaer Society of South Africa's Fertilizer Handbook.

Baseline description

The soil forms identified within the assessment area of Route F include the following soil forms Pinedene (16.95ha), Hutton (8.28ha), Mispah (4.94ha), Clovelly (4.26ha) and Katspruit (2.48ha). Areas that are delineated as permanent wetlands comprises 2.48ha (Katspruit form) and 16.95ha of Temporary and Seasonal wetland zone (Pinedene form). The pH (H_2O) of all the soils analysed are acid to very acidic, ranging from 4.61 to 5.23. The EC of all soil samples are below 200 mS/m, and thus the salinity of these soils will have no effect on plant growth. The cation status of the soils analysed were rated as high, medium or low. Overall the concentration of Ca and K in the soils are medium to low and the levels of Mg is generally medium. The concentration of P in the topsoil of the representative Hutton soil analysed is high (> 35 mg/kg), with the remainder of the soils having medium to low levels of P.

The land capability for most of the soils falls under class II, III, IV (arable land suitability) and V (non-arable land suitability) and the majority (80%) of the route has high soil agricultural potential.

The dominant land-use along the route comprises of agricultural maize fields, grazing land and gravel roads.

The main potential impacts are likely to occur only during the pre-construction and construction phases. These are (i) disturbance of soil, resulting in increased decomposition of soil organic matter from topsoil; (ii) contamination of soils by hydrocarbon pollutants; (iii) loss/ change of land use; (iv) loss of potentially arable land; and (v) soil loss due to erosion. Of these impacts, the disturbance of soil, resulting in increased decomposition of soil organic matter from topsoil; loss/ change of land use and loss of potentially arable land are significantly high, and remain high even if some degree mitigation measures are implemented. This is the case since the land (and soil) where the road will be constructed will change land uses from agricultural to transport. It is understood that the road will not be decommissioned at closure of the mine, but rather be handed over to the Municipal District on completion of construction. The loss of arable land, land use (as agriculture) and the soil disturbance is permanent, and thus remains a significantly high impact for the parcel of land evaluated for this assessment. It must however be indicated that the minimum portion of land required for feasible (economically) maize production is 800 – 1000 ha in the Eastern Highveld (GrainSA, 2017). The full extent of the impact (land take) for the construction of the road is approximately 36.ha, of which, 80% (28 ha) has a high agricultural potential. Given the above economical aspect, in the context of maize production in the Eastern Highveld, the overall significance of loss of arable land and loss of high agricultural land the impact is thus low (2.8 - 3.5% of minimum requirement for economically feasiable production).

Potential Impacts and Mitigation Measures

The potential impacts of the construction activities on soil can be minimized through the following mitigation measures:

- Ensure that all laydown areas are monitored for spillages and that vehicles and equipment are serviced and well maintained. Emergency spill kits should be provided at the project site. Workers should be trained to be able to respond in case of spills.
- Ensure that workers or persons accessing the site during these phases are informed on the waste disposal protocol for the site.
- Contractors (in particular heavy machinery) needs to be restricted to designated areas as defined by the Mine Environmental Department.;
- The procedures on land clearance and soils handling needs to be followed;
- Implement, monitor and control soil erosion minimisation procedures along route;
- Implement measures to protect soil stockpiles from erosion. Minimise stockpile height to <1.5m. (if soil is stockpiled on construction site); and
- Investigate the use of binding agents for Roads as an alternative to water dust suppression.

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APPENDICES

1.0 PROJECT INTRODUCTION AND BACKGROUND

In 2011 Golder Associates Africa (Pty) Ltd (Golder) was appointed by Mafube Coal Mining (Pty) Ltd (Mafube) to conduct the Environmental Impact Assessment (EIA) process for the proposed Mafube Life Expansion project (Mafube LifeX), which included the mining operations at Nooitgedacht and Wildfontein in the Mpumalanga province of South Africa. An Environmental Management Programme (EMP) was also submitted to the Department of Mineral Resources (DMR) for approval as part of their mining rights application, as required under the Mineral and Petroleum Resources Act (Act No. 28 of 2002) (MPRDA).

Mafube Coal Mining (Pty) Ltd (Mafube) is a 50/50 Joint Venture involving Anglo American Thermal Coal (AATC) and Exxaro Coal Mpumalanga (Pty) Ltd. Environmental authorisation (EA) conducted under the National Environmental Management Act (NEMA) for the Mafube Nooitgedacht and Wildfontein opencast coal expansion project (Mafube LifeX) was received from the Mpumalanga Department of Environmental Affairs and Tourism (MDEDET) in April 2013 (17/2/6/3 (101) N-1). An approval for the mining right's application was granted by the Mpumalanga Department of Minerals Resources (DMR) on 30 August 2013 (MR 30/5/1/2/2/10026 MR) and the EMP approved by them on 14 November 2013. In terms of the National Water Act (Act No. 36 of 1998) (NWA), an Integrated Water Use Licence application (IWULA) & Integrated Water and Waste Management Plan (IWWMP) was also required for the LifeX project, and this application was submitted in December 2013 and approved 1 December 2014.

The Mafube LifeX operations are currently in the construction phase and full operational phase are planned to commence in May 2018.

During the feasibility phase investigations, it was assessed that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or realignment are required before this operation can commence. These roads falls under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

Golder Associates Africa (Pty) Ltd, an independent environmental and engineering company, is conducting the EIA and licensing process for the proposed road realignment project.

An EIA application has been submitted to the Department of Mineral Resources (DMR) in terms of Regulations 326 published under NEMA (07 April 2017). This proposed project triggers a full scoping and environmental assessment EIA process for certain listed activities under NEMA, an Environmental Management Programme (EMP) based on the findings of the EIA and a Water Use Licence Application (IWULA). The public participation process will provide stakeholders with information about the proposed project, and several opportunities to comment throughout the EIA/EMP/WULA process.

2.0 SPECIALIT STUDY INTRODUCTION

The report provides the current land capability and land use of the area along the proposed road realignment route F (see Figure 1). As part of the land capability study, soils along the proposed route were surveyed, sampled and sent for analysis to Eco Analytical laboratory in Potchefstroom on 10 August 2017.

The study provides an input into the Environmental Impact Assessment (EIA) as required in terms of the Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002 and the National Environmental Management Act (NEMA), Act 107 of 1998. The Act requires the avoidance of pollution and/or degradation of the environment or where either cannot be avoided, it is required that the pollution or degradation thereof be minimised or remediated.

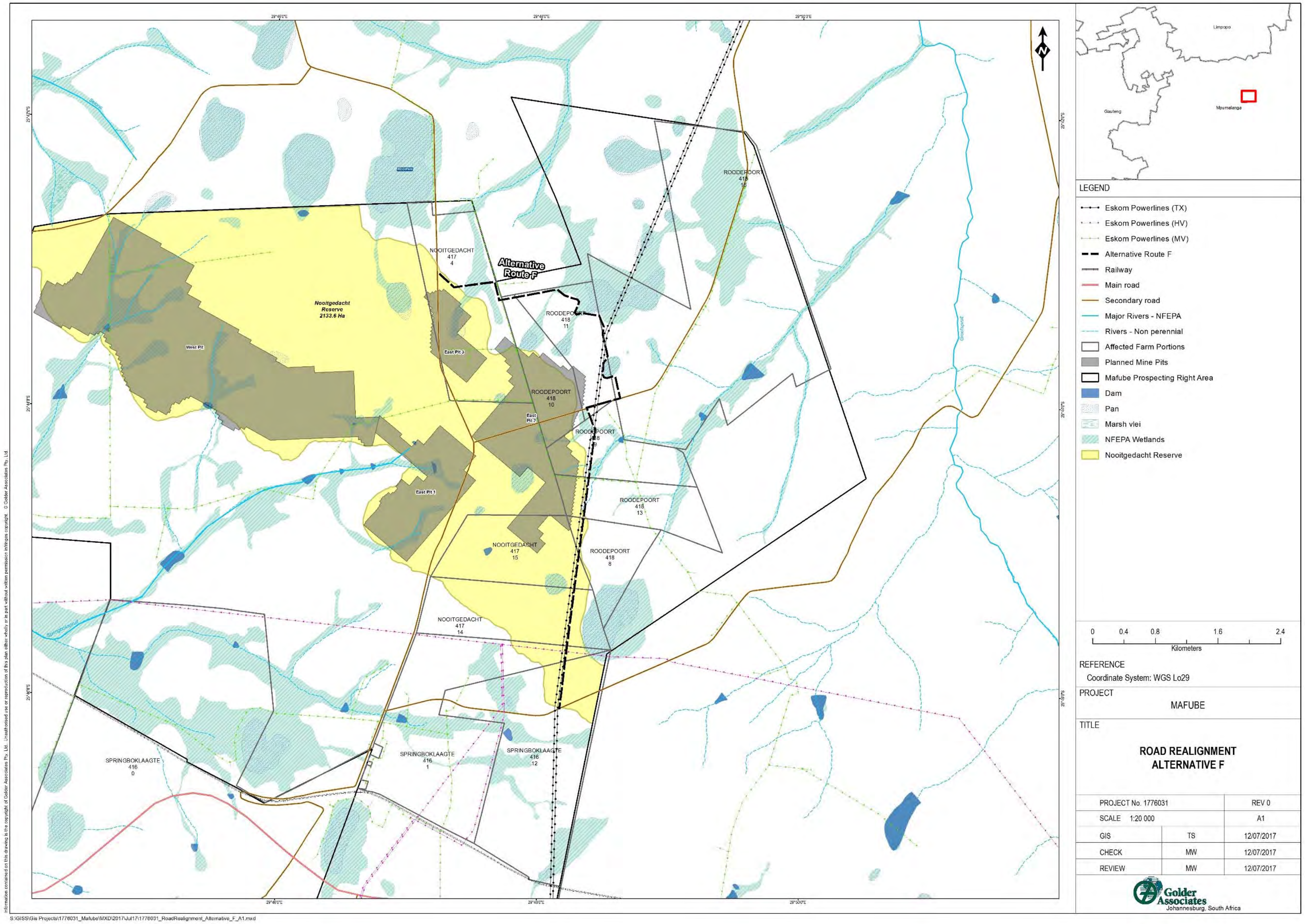

Figure 1: proposed road realignment route F

2.1 Study Objectives

The objectives of the study were therefore to do the following:

- Conduct a detailed soils assessment along the proposed route alternative F;
- Classify and map the observed soils according to the South Africa Taxonomic Soil Classification System, 1991;
- Conduct a land capability assessment of the area along the route and compile a map of the land capability classes;
- Map the current land-use along the route;
- Determine impacts associated with the proposed route realignment; and
- Propose environmental management actions required for the preservation of local soils (mitigation measures).

3.0 PROJECT DESCRIPTION

- The detailed description is provided in the Draft Scoping Report.

4.0 POLICY LEGAL AND ADMINISTRATIVE FRAMEWORK

The following section outlines a summary of South African Environmental Legislation that needs to be considered for the proposed mining project at the Mafube LifeX Project with regards to management of soil:

- *The law on Conservation of Agricultural Resources (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal;*
- *The Bill of Rights states that environmental rights exist primarily to ensure good health and well-being, and secondarily to protect the environment through reasonable legislation, ensuring the prevention of the degradation of resources;*
- *The Environmental right is furthered in the National Environmental Management Act (No. 107 of 1998), which prescribes three principals, namely the precautionary principle, the "polluter pays" principle and the preventive principle;*
- *It is stated in the above-mentioned Act that the individual/group responsible for the degradation/pollution of natural resources is required to rehabilitate the polluted source;*
- *Soils and land capability are protected under the National Environmental Management Act 107 of 1998, the Environmental Conservation Act 73 of 1989, the Minerals Act 50 of 1991 and the Conservation of Agricultural Resources Act 43 of 1983;*
- *The National Veld and Forest Fire Bill of 10 July 1998 and the Fertiliser, Farm Feeds, Agricultural Remedies and Stock Remedies Act 36 of 1947 can also be applicable in some cases;*
- *The National Environmental Management Act 107 of 1998 requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimized and remedied;*
- *The Minerals Act of 1991 requires an EMPR, in which the soils and land capability be described; and*
- *The Conservation of Agriculture Resources Act 43 of 1983 requires the protection of land against soil erosion and the prevention of water logging and salinisation of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and water courses are also addressed.*

5.0 BASELINE DATA

The desk-top assessment was conducted to collect relevant data on the soil. The following documents and information sources were used:

- Soil, land capability and land use assessment of the proposed Nooitgedacht and Wildfontein opencast areas of Mafube Coal Mining (Pty) Ltd Report compiled by Steenkamp (2012);
- Landtype map for South Africa;
- Erosion susceptibility maps for Mpumalanga; and
- National Land Capability map.

The soils and land capability assessment focused on the proposed Route Alternatives.

5.1 Landtype description

The landtype survey was conducted in the early 1970's in order to compile inventories of the natural resources of South Africa in terms of soil, climate and terrain and was conducted as a reconnaissance survey at scale of 1:250 000. The survey reflects the dominant soils in each landtype by percentage. The landtype information is not a substitute for a detailed soil map, but gives a very good indication of where certain soil patterns are located.

The landtype memoirs and associated maps of 2528 Pretoria, (Landtype Survey Staff, 1976-2006) indicates that the site lies within the Ea8, Ea5, Ba20, Ba17 and Ib24 landtypes. The estimated percentage each landtype occupies for the Route Alternatives are provided in Table 1 The main land types are shown in Figure 2.

Landtype unit Ea indicates "*land with high base status, dark coloured and/or red soils, usually clayey, associated with basic parent materials. A land type, more than half of which is covered by soil forms with vertic, melanic and red structured diagnostic horizons. Land types in which these soils cover less than half of the area may also qualify for inclusion (i) where duplex soils occur in the non-rock land but where unit Ea soils cover a larger area than the duplex soils, or (ii) where exposed rock covers more than half the land type*." (AGIS, 2016).

The Ea 8 landtype unit comprises 28.5% of the Hutton soil form, 26.5% of the Shortlands soil form, 17.0 % of the Mayo soil form, 15% Glenrosa soil form, 8% of the Arcadia soil form, 3.5 % of the Bonheim soil form and 1.5% of the Rensburg soil form. The Hutton soil form is medium sandy loam to sandy clay loam, with a clay content of 10 -20% in the topsoil, 15 – 35 % clay in the B horizon and has an effective depth of 500-1200 mm. Depth limiting material associated with the Hutton soil form in the Ea 8 landtype unit includes saprolite. The majority (75%) of soils of this landtype unit is found in midslope terrain position with 20% occurring in footslope position and 5% occurring in the valley position. The dominant geology represented by landtype Ea8 is Ferrogabbro, ferrodiorite and diorite of the Upper zone; gabbro, norite and anorthosite of the Main zone, Bushveld Complex; hornblende microgranite and piroxeenhornfels (AGIS, 2016).

The Ea 5 landtype unit comprises 52% of the Shortlands soil form, 34% of the Hutton soil form, 7 % of the Bonheim soil form, 4% of the Arcadia soil form, 2% of the Rensburg soil form and 1% are stream beds. The Shortlands soil form is fine sandy clay to clayey soils with clay content of 30 -40% in the topsoil, 35 – 60 % clay in the B horizon and has an effective depth of 500 – 800 mm. Depth limiting material associated with the Shortlands soil form in the Ea 5 landtype unit includes saprolite. The majority (50%) of soils of this landtype unit is found in midslope terrain position, 25% occurring in the crest position, 20% occurring in footslope position and 5% occurring in the valley position. The dominant geology represented by landtype Ea5 is Mainly ferrogabbro and ferrodiorite of the Upper zone, Rustenburg Layered Suite; some gabbro, norite, anorthosite and magnetite gabbro of the Main zone, Rustenburg Layered Suite, Bushveld Complex; hornblende microgranite and pyroxene hornfels of Vaalian age in places (AGIS, 2016).

Landtype unit Ba represents "*a catena that in its perfect form is represented by (in order from highest to lowest in the upland landscape) Hutton, Bainsvlei, Avalon and Longlands forms. The valley bottom is occupied by one or other gley soil (e.g. Rensburg, Willowbrook, Katspruit, Champagne forms)*."

The Ba 20 landtype unit comprises 32.3% of the Hutton soil form, 16% of the Glencoe soil form, 15 % of the Avalon soil form, 9.5% Wasbank soil form, 7% of the Longlands soil form, 5.5 % of the Clovelly soil form, 4.3% of the Katspruit soil form, 5.5% of the Mispah soil form and 5% consisting of pans. The Hutton soil form is medium sandy loam to sandy clay loam, with a clay content of 15-25% in the topsoil, 20-35 % clay in the B horizon and has an effective depth of 600-1200 mm. Depth limiting material associated with the Hutton soil form in the Ba 20 landtype unit includes saprolite and hardpan ferricrete. The majority (50%) of soils of this landtype unit is found in crest position, 30% in the midslope terrain position with 15% occurring in footslope position and 5% occurring in the valley position. The dominant geology represented by landtype Ba20 is mainly sandstone, shale, shaly sandstone and grit of the Ecca Group, Karoo Sequence; some gabbro, norite and granophyre of the Bushveld Igneous Complex, as well as rhyolite of the Damwal Formation, Rooiberg Group, Transvaal Sequence (AGIS, 2016).

The Ba 17 landtype unit comprises 44.3% of the Hutton soil form, 29.3% of the Shortlands soil form, 15 % of the Glencoe/Avalon soil forms, 5.5% Swartland soil form, 5% Mispah soil form and 1% of the Oakleaf soil form. The Hutton soil form is fine sandy clay loam with a clay content of 20 – 35% in the topsoil, 30 - 45 % in the subsoil and has an effective depth of 450-1200 mm. Depth limiting material associated with the Hutton soil form in the Ba 17 landtype unit includes saprolite and hardpan ferricrete. The majority (95%) of soils of this landtype unit is found in midslope position and 5% occurring in the valley position. The dominant geology represented by landtype Ba17 is mainly ferrogabbro and ferrodiorite of the Upper zone, Rustenburg Layered Suite, Bushveld Complex (AGIS, 2016).

Landtype unit Ib indicates "*land types with exposed rock (exposed country rock, stones or boulders) covering 60 – 80% of the area*." (AGIS, 2016)

The Ib24 landtype unit comprises 60% Rock, 16.2% of the Hutton soil form, 15 % of the Clovelly soil form, 7% of the Mispah soil form and 1.2% stream beds. The Hutton soil form is medium/coarse sand clay loam, with a clay content of 20 – 30 % in the topsoil, 20 – 40 % clay in the subsoil and has an effective depth of 600 – 1200 mm. Depth limiting material associated with the Hutton soil form in the Ib24 landtype unit includes hard rock and saprolite. The majority (50%) of soils of this landtype unit is found in midslope terrain position with 45% occurring in crest position, 3% in the footslope position and 2% occurring in the valley bottom position. The dominant geology represented by landtype Ib24 is mainly granophyre of the Rashoop Suite; leptite of the Bushveld Complex; granophyric rhyolite of the Damwal Formation, Rooiberg Group (AGIS, 2016).

Table 1: Landtypes of Route Alternatives

Routes	Landtype occupied by route
Alternative A: New D1048 link road	**Ba20 (±14%)**- Plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread **Ea8 (±86%)**- one or more of: vertic, melanic, red structured diagnostic horizons; Undifferentiated
Alternative B: New D1048 link road	**Ea8 (± 57.5%)**- one or more of: vertic, melanic, red structured diagnostic horizons; Undifferentiated **Ea5 (± 16.9%)** – one or more of: vertic, melanic, red structured diagnostic horizons; Undifferentiated **Ib24 (±13.5%)** – miscellaneous land classes; Rock areas with miscellaneous soils **Ba17 (±11.5%)** – plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread
Alternative C: Constructing only the New D684 Road	**Ba20 (±72%)** – Plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread **Ib24 (±28%)** – miscellaneous land classes; Rock areas with miscellaneous soils
Alternative D: No new link roads constructed - Existing	This option will not include construction of new roads, but only include some upgrades to be done at the existing river/watercourse crossings on the D1574, D685 and D1048 roads, as well as maintenance of these roads during the operational phase of the

Routes	Landtype occupied by route
district roads will be used by locals	Mafube LifeX project. Along this existing route, the surrounding land types are Ba20, Ba17, Ib24, Ea5 and Ea8.
Alternative E: Construction of New D684 Road	**Ba20 (100%)** – Plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread
Alternative F: Construction of new D683/D1048 link Road	**Ba20 (100%)** – Plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread

Table 2: Landtypes for Route Alternatives and dominant soil form (Landtype Survey Staff, 1976-2006)

Route Alternative	Landtype	Dominant Soil form/ feature
A	Ea8	Hutton
	Ba20	Hutton
B	Ea8	Hutton
	Ea5	Shortlands
	Ib24	Rocks
	Ba17	Hutton
C	Ba20	Hutton
	Ib24	Rocks
D	*Exisiting route*	
E	Ba20	Hutton
F	Ba20	Hutton

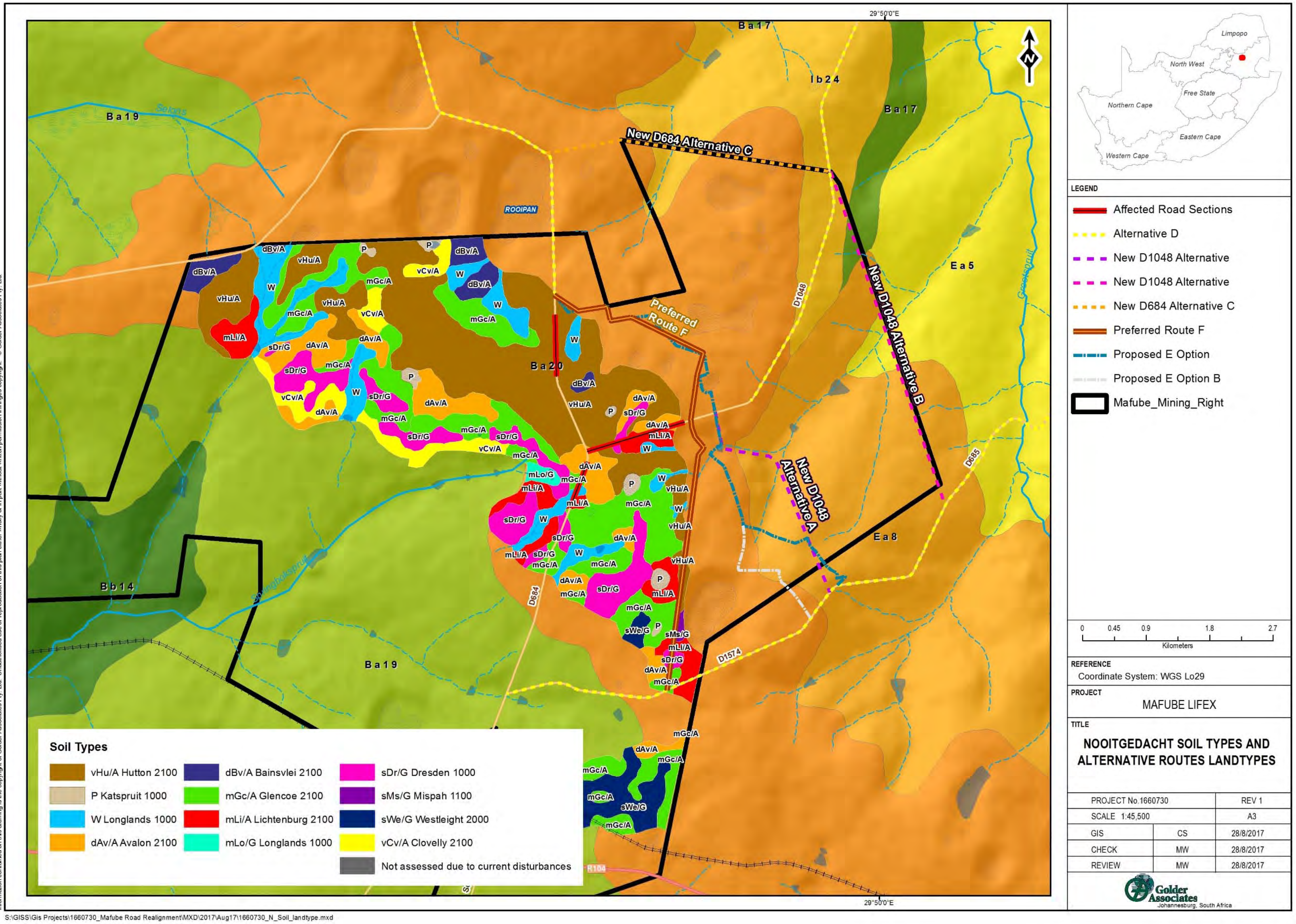

Figure 2: Nooitgedacht soil types and Landtypes intersected by alternative routes

5.2 Dominant soils characteristics

The main soil form occurring along each of the Route Alternatives is Hutton(as defined in the landtype survey). A soil survey conducted on the farms Nooitgedacht and Wildfontein (located east to south-east of the Route Alternatives) at a scale of 1:40 000, indicate that the following soil forms occur in the area: Hutton (31.11%), Bainsvlei (3.01%), Lichtenburg (5.80%), Clovelly (4.64%), Avalon (9.80%), Glencoe (21.14%), Westleigh (4.15%), Dresden (9.47%), Mispah (0.21%), Longlands (0.81%) and Katspruit (1.53%).

The soil forms identified in the soil survey conducted by Steenkamp (2012), are similar to what is recorded in the Landtype memoirs for the areas of Route Alternatives. Both the soil survey by Steenkamp (2012) and the Landtype data indicate that the Hutton soil form is the dominant soil form in the study area.

Hutton soils are characterised by relatively uniform red, apedal (structureless) subsoil. The red soil colour is attributed to hematite. Hutton soils very seldom become saturated with water, thus reducing conditions that may change the soil colour never occurs. These soils occur in better drained positions in the landscape and on better drained underlying material. Fine sand variants of this form are sensitive to wind erosion and are easily compacted by cultivation. The wind erosion hazard of the topsoil is low to moderate, based on the clay content.

5.3 Soil erodibility

The soil erodibility, the tendency of the soil to be detached and transported by wind or water, becomes increasingly important as the slope increases. Silt and fine sandy soils are usually more easily erodible than more clayey soils. The soil's susceptibility to wind and water erosion based on textural class and slope in the study area are listed below (Table 3 and Table 4) and shown in Figure 3 and Figure 4. The erosion susceptibility maps were generated using the Land type survey data (Schoeman & van der Walt, 2006).

Table 3: Wind erosion susceptibility classes per Route Alternative

Road	Wind erosion class	Description	Area (ha)*
Alternative A	4a	Sandy loams strongly dominant. Somewhat susceptible	1.2
Alternative A	5	Sandy clay loams. Non-susceptible	7.6
Alternative B	5	Sandy clay loams. Non-susceptible	15.0
Alternative C	4a	Sandy loams strongly dominant. Somewhat susceptible	8.6
Alternative C	5	Sandy clay loams. Non-susceptible	3.4
Alternative D	5	Sandy clay loams. Non-susceptible	86.7
Alternative D	3c	Loamy sands sub-dominant. Moderately susceptible	4.7
Alternative D	4a	Sandy loams strongly dominant. Somewhat susceptible	45.3
Alternative D	4a	Sandy loams strongly dominant. Somewhat susceptible	0.2
Alternative D	4b	Sandy loams dominant. Somewhat susceptible	3.7
Alternative E (A)	5	Sandy clay loams. Non-susceptible	5.6
Alternative E (A)	4a	Sandy loams strongly dominant. Somewhat susceptible	16.8
Alternative E (B)	5	Sandy clay loams. Non-susceptible	1.4
Alternative E (B)	4a	Sandy loams strongly dominant. Somewhat susceptible	21.2
Alternative F	4a	Sandy loams strongly dominant. Somewhat susceptible	22.2

Notes: * Area occupies 15m buffer along route

Table 4: Water erosion susceptibility of land for Route Alternatives

Road	Water erosion class	Description	Area (ha)*
Alternative A	1	Land with low susceptibility to water erosion. Generally level to gently sloping. Soils have favourable erodibility index.	1.2
Alternative A	3	Land with moderate susceptibility to water erosion.Generally moderately sloping land. Soils have low to moderate erodibility.	7.6

Road	Water erosion class	Description	Area (ha)*
Alternative B	2	Land with low to moderate susceptibility to water erosion. Generally gently to moderately sloping. Soils have low to moderate erodibility.	4.6
Alternative B	3	Land with moderate susceptibility to water erosion.Generally moderately sloping land. Soils have low to moderate erodibility.	10.4
Alternative C	1	Land with low susceptibility to water erosion. Generally level to gently sloping. Soils have favourable erodibility index.	8.6
Alternative C	2	Land with low to moderate susceptibility to water erosion. Generally gently to moderately sloping. Soils have low to moderate erodibility.	3.4
Alternative D	1	Land with low susceptibility to water erosion. Generally level to gently sloping. Soils have favourable erodibility index.	45.5
Alternative D	2	Land with low to moderate susceptibility to water erosion. Generally gently to moderately sloping. Soils have low to moderate erodibility.	27.5
Alternative D	3	Land with moderate susceptibility to water erosion.Generally moderately sloping land. Soils have low to moderate erodibility.	25.0
Alternative D	5	Land with low to moderate water or wind erosion hazard. Generally level to gently sloping land; soils may have low to very high erodibility.	4.7
Alternative E (A)	1	Land with low susceptibility to water erosion. Generally level to gently sloping. Soils have favourable erodibility index.	16.8
Alternative E (A)	3	Land with moderate susceptibility to water erosion.Generally moderately sloping land. Soils have low to moderate erodibility.	5.6
Alternative E (B)	1	Land with low susceptibility to water erosion. Generally level to gently sloping. Soils have favourable erodibility index.	21.2
Alternative E (B)	3	Land with moderate susceptibility to water erosion.Generally moderately sloping land. Soils have low to moderate erodibility.	1.4
Alternative F	1	Land with low susceptibility to water erosion. Generally level to gently sloping. Soils have favourable erodibility index.	22.2

Notes: * Area occupies 15m buffer along route

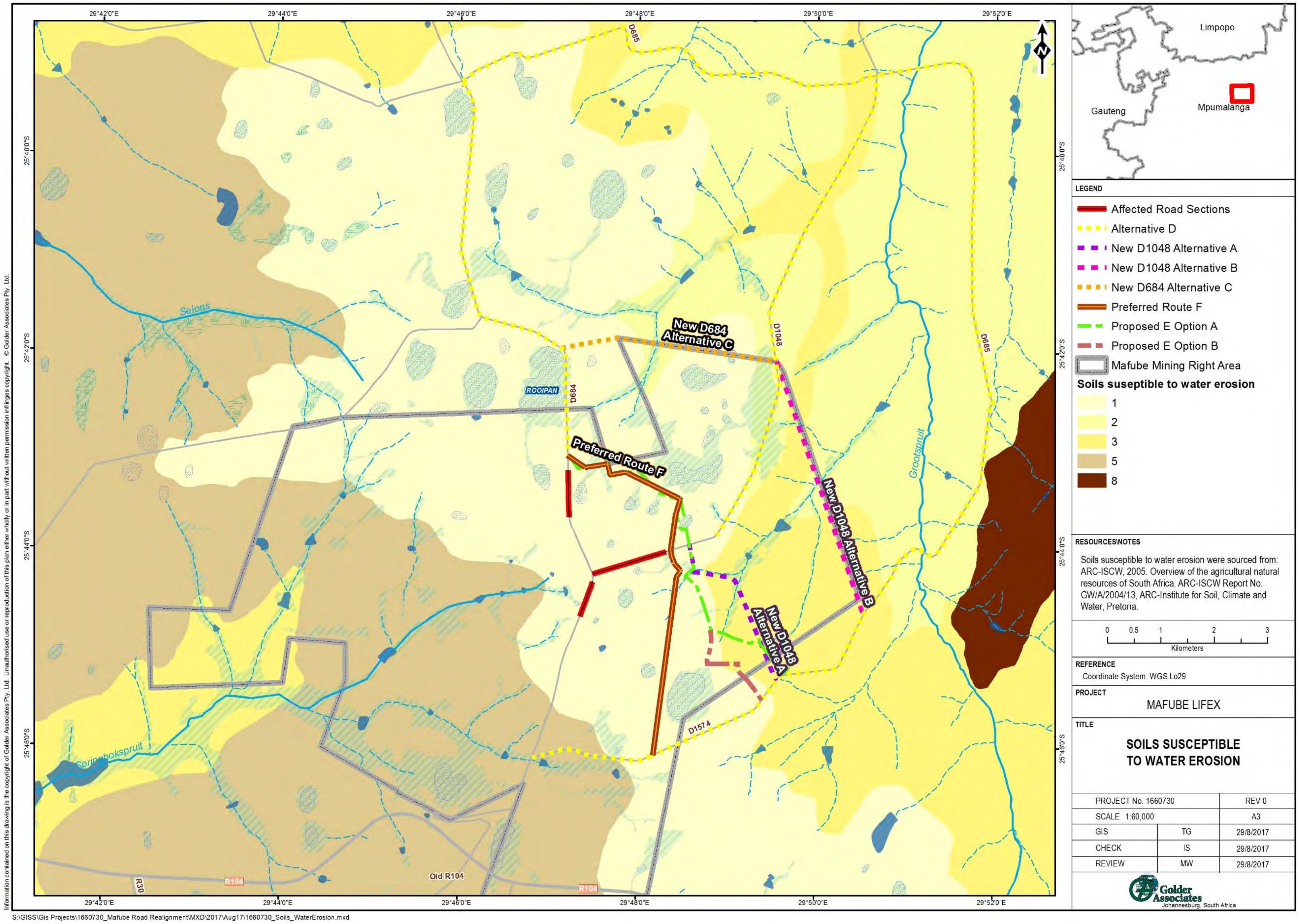

Figure 3: Soil susceptibility to water erosion

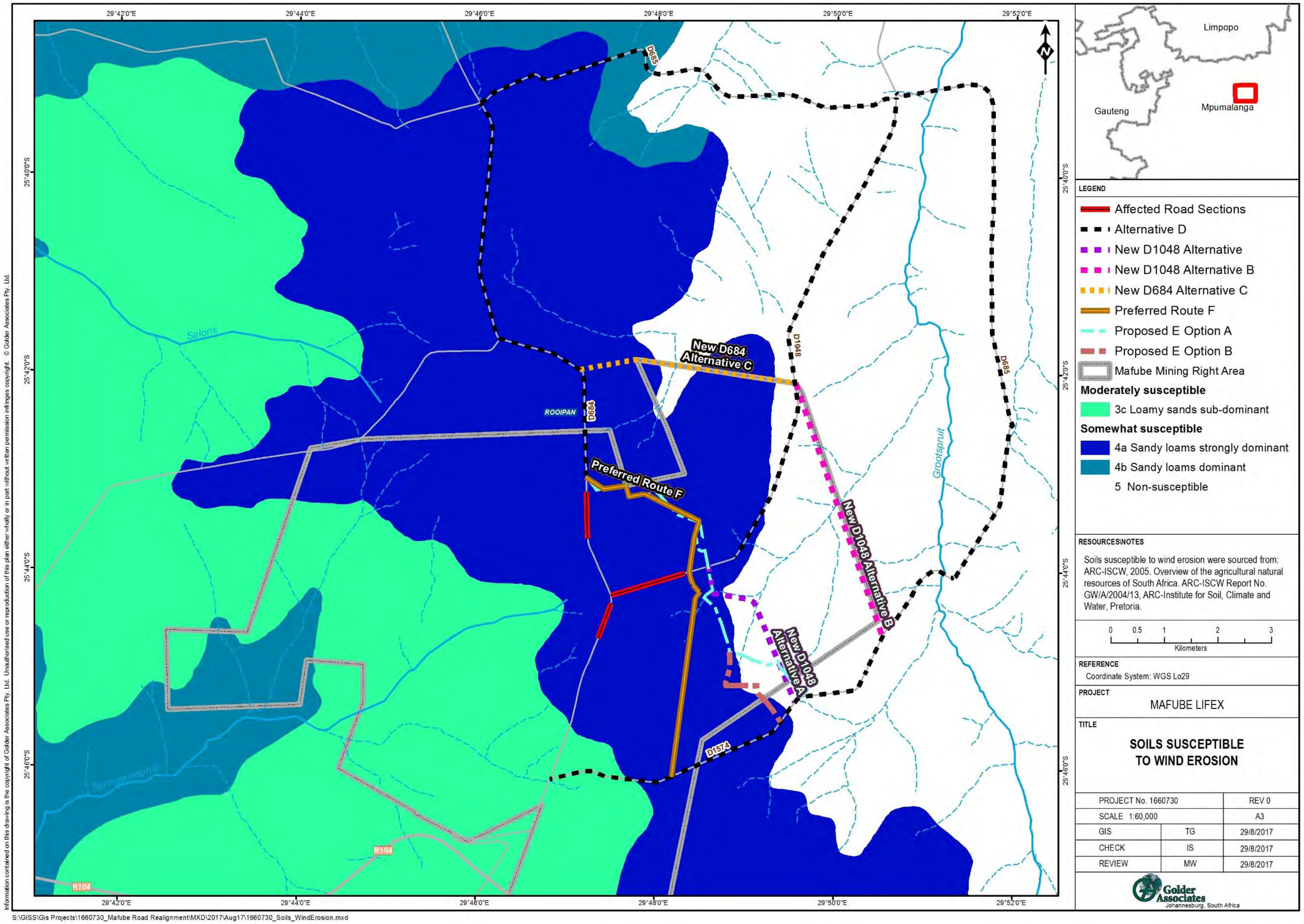

Figure 4: Soil susceptibility to wind erosion

5.4 Baseline Land Capability

Land capability classification (LCC) is a system of grouping soils into map units based on the ability of the land to sustain rain-fed arable crops (Klingebiel & Montgomery, 1961). The map units are classed as *arable* (classes I – IV) or *non- arable* (class VI- VIII) depending on the degree of physical limitations and therefore also indicates the potential of the soil for agricultural use. The LCC does not indicate soil fertility status, a chemical feature of the soil which can be ameliorated. The parameters evaluated during land capability assessment may include combinations of the following:

- Soil textural and structural properties (sand, silt and clay content), as these are known to be co-variants with a number of other more complex soil properties (hydraulic conductivity, CEC, moisture retention; plasticity; susceptibility to compaction).
- Susceptibility to erosion as determined by the type of soil and *slope* (to be considered if changes in land cover and changes in slope may result from a developmental initiative);
- Continuous or periodic waterlogging, caused by low permeability of underlying material, the presence and duration of water tables, or flooding (to be considered in infrastructure placement);
- Depth of soils relative to limiting materials/layers, specifically inhibiting root penetration
- Soil Salinity, specifically regarding plant sensitivity to saline conditions;
- Mechanical (Physical) limitations such as rocky outcrops or deep gullies, which prevent access to areas
- Climatic conditions, temperature and rainfall are the key determinant in land arability.

The national land capability classification for the project area was evaluated. The land capability classification was undertaken at a national scale, using the landtype data on a scale of 1:250 000. The classification is as follows: "*The land capability is assigned to each land type by applying the table for soil and climate classes constituting land capability classes, to each soil entry. Land types in which a particular class occupies more than 50%, are assigned to that class, starting with Class I. If the land type does not comply with this requirement, components belonging to the next class in the sequence are added to the components from higher classes. If the sum occupies more than 50%, the land type is assigned to that class*."

The land capability for the Route Alternative A is classified as Class II and Class III, for Alternative B as class III and class VIII, and for Alternative C as class II and class VIII.

The classes have the following capabilities as defined in the land capability system for South Africa (Schoeman et al., 2000):

- ***Class II***: "Land in Class II have some limitations that reduce the choice of plants or require moderate conservation practices. It may be used for cultivated crops, but with less latitude in the choice of crops or management practices than Class I. The limitations are few and the practices are easy to apply. Limitations may include singly or in combination the effects of:
  - *Gentle slopes.*
  - *Moderate susceptibility to wind and water erosion.*
  - *Less than ideal soil depth.*
  - *Somewhat unfavourable soil structure and workabability.*
  - *Slight to moderate salinity or sodicity easily corrected but likely to recur.*
  - *Occasional damaging flooding.*
  - *Wetness correctable by drainage but existing permanently as a moderate limitation.*
  - *Slight climatic limitations on soil use and management.*

Limitations may cause special soil-conserving cropping systems, soil conservation practices, water-control devices or tillage methods to be required when used for cultivated crops".

- ***Class III** – "Land in this class has severe limitations that reduce the choice of plants or require special conservation practices, or both. It may be used for cultivated crops, but has more restrictions than Class II. When used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain. The number of practical alternatives for average farmers is less than that for soils in Class II. Limitations restrict, singly or in combination, the amount of clean cultivation, time of planting, tillage, harvesting and choice of crops. Limitations may result from the effects of one or more of the following:*
  - *Moderately steep slopes.*
  - *High susceptibility to water or wind erosion or severe adverse effects of past erosion.*
  - *Frequent flooding accompanied by some crop damage.*
  - *Very slow permeability of the subsoil.*
  - *Wetness or some continuing waterlogging after drainage.*
  - *Shallow soil depth to bedrock, hardpan, fragipan or claypan that limit the rooting zone and the water storage.*
  - *Low water-holding capacity.*
  - *Low fertility not easily corrected.*
  - *Moderate salinity or sodicity.*
  - *Moderate climatic limitations."*
- ***Class VIII** – "Land in this class have limitations that preclude its use for commercial plant production and restrict its use to recreation, wildlife, water supply or aesthetic purposes. Land in Class VIII cannot be expected to return significant on-site benefits from management for crops, grasses or trees, although benefits from wildlife use, watershed protection or recreation may be possible. Badlands, rock outcrop, sandy beaches, river wash, mine tailings and other nearly barren lands are included in Class VIII. Limitations that cannot be corrected may result from the effects of one or more of:*
  - *Erosion or erosion hazard.*
  - *Severe climate.*
  - *Wet soil.*
  - *Stones.*
  - *Low water-holding capacity.*
  - *Salinity or sodicity."*

The land capability for the different Route Alternatives is shown in Table 5. The approximate area (ha) per LCC each Alternative Route occupies is listed below.

Table 5: Land capability classes (ha) each Route Alternatives occupies

Route	Area (ha)*		
	Class II	**Class III**	**Class VIII**
Alternative A	21.7	3.4	
Alternative B	2.2	7.9	
Alternative C		12.8	2.2
Alternative D	45.5	67.6	27.2
Alternative E (A)	16.8	5.7	
Alternative E (B)	21.2	1.3	
Alternative F	19.2		

Notes: * Area occupies 15m buffer along route

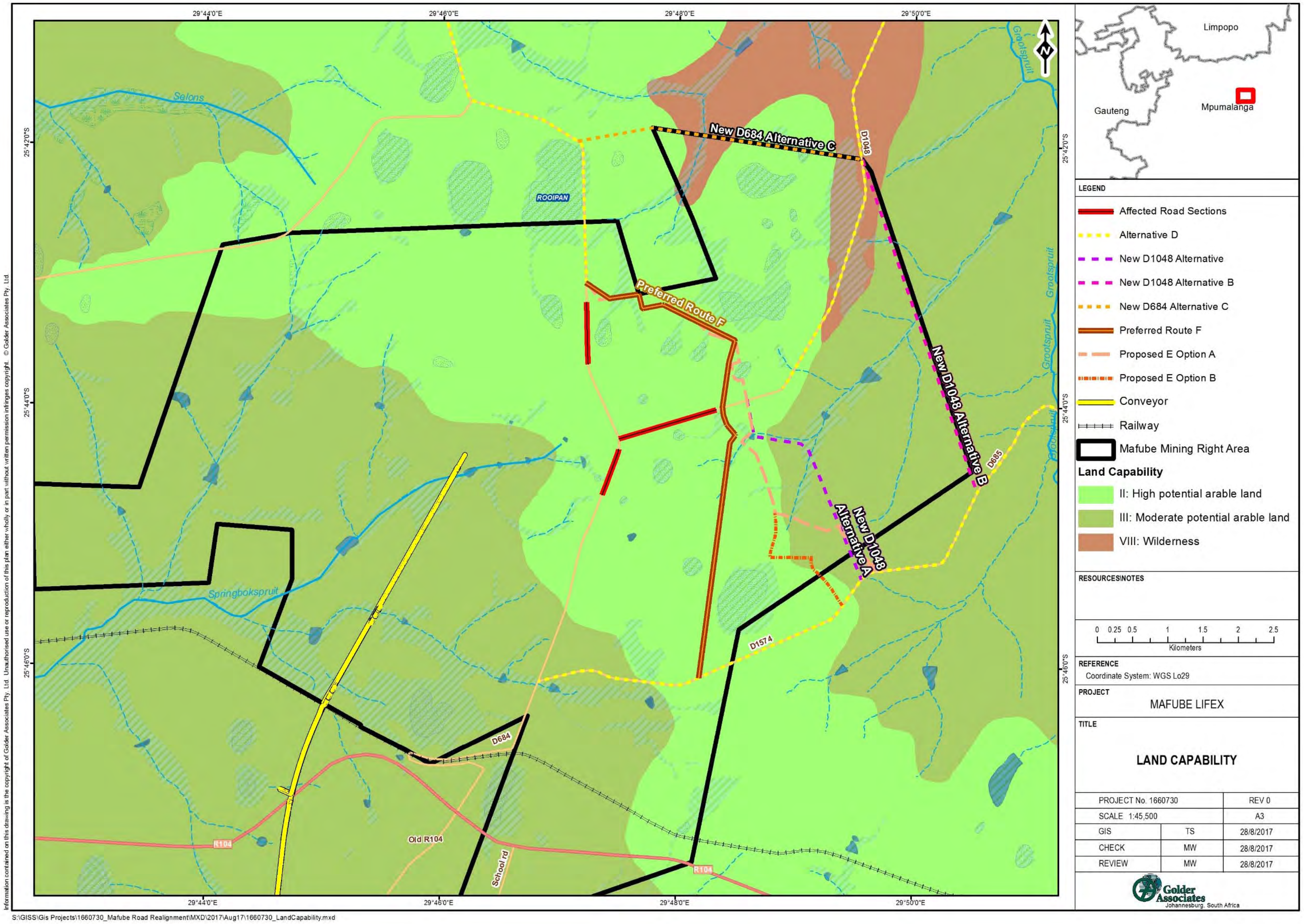

Figure 5: Land Capability of Route Alternatives

5.5 Soil agricultural potential

The agricultural potential is dependant on the characteristics of the land and management input and reflects the production capacity of a land under a specific management. The various land capability classes also have different agricultural potentials. At the desktop level of the assessment, the land capability classes were assigned soil agricultural potentials. For the different Route Alternatives these are: Soils in Land Capability (LC) Class II as high potential, soils in Class III having a moderate potential and soils in Class VIII having a low potential.

6.0 SOIL SURVEY

6.1 Methodology

In order to meet the objectives of the investigation, the following scope of work was conducted on the 10 August 2017.

6.1.1 Preparation of Field Maps

The soil survey was conducted according to standard soil survey techniques comprising of seven (7) auger holes (150 x 150 x 1,2m) on a flexible grid system GPS referenced (WGS 84, decimal degrees). Soil sampling and observation points were positioned along the road realignment route F. Shapefiles of the road realignment, project boundary, existing and proposed infrastructure, surface water features, terrain, geology and existing land-capability and use were superimposed on google earth imagery and 1:50 000 topographic map sheet. The geographical positions of observation points were loaded onto a handheld Global Positioning System (GPS) to aid for field traversing of the positions. Maps showing observation points, proposed route was printed to delineate observation on-site.

6.1.2 Soil Classification

During the field survey of the Route (including the buffer zone), the areas were delineated (into map units) and the natural resources; climate; terrain form; soil type and land use of the project area, recorded. The entire length of the Route was evaluated along transects. The soil was evaluated at the main terrain units (crest, scarp, midslope, footslope and valley bottom positions) of the main geological groups and land types of the project area. Where access to the indicated observation points was restricted, observation points were shifted to more accessible areas but on the same terrain position, geology and landtype as the original point. The locations of observation points for the transect walks are presented in APPENDIX D and shown Figure 6.

At each observation point the soil was augered to a depth of 120 cm (unless an impenetrable layer is encountered restricting sampling depth). Observable soil characteristics such as colour, texture, soil depth, stoniness, and drainage class and parent material was logged. At each observation point the relevant and distinct features was also be recorded such as signs of erosion, vegetation cover, micro-topography, aspect and fauna. A total of **7** modal profiles were described in detail and soil samples collected of the topsoil and subsoil horizons. The soil characteristics were described and classified according to the Taxonomic Soil Classification System for South Africa (Soil Classification Working Group, 1991).

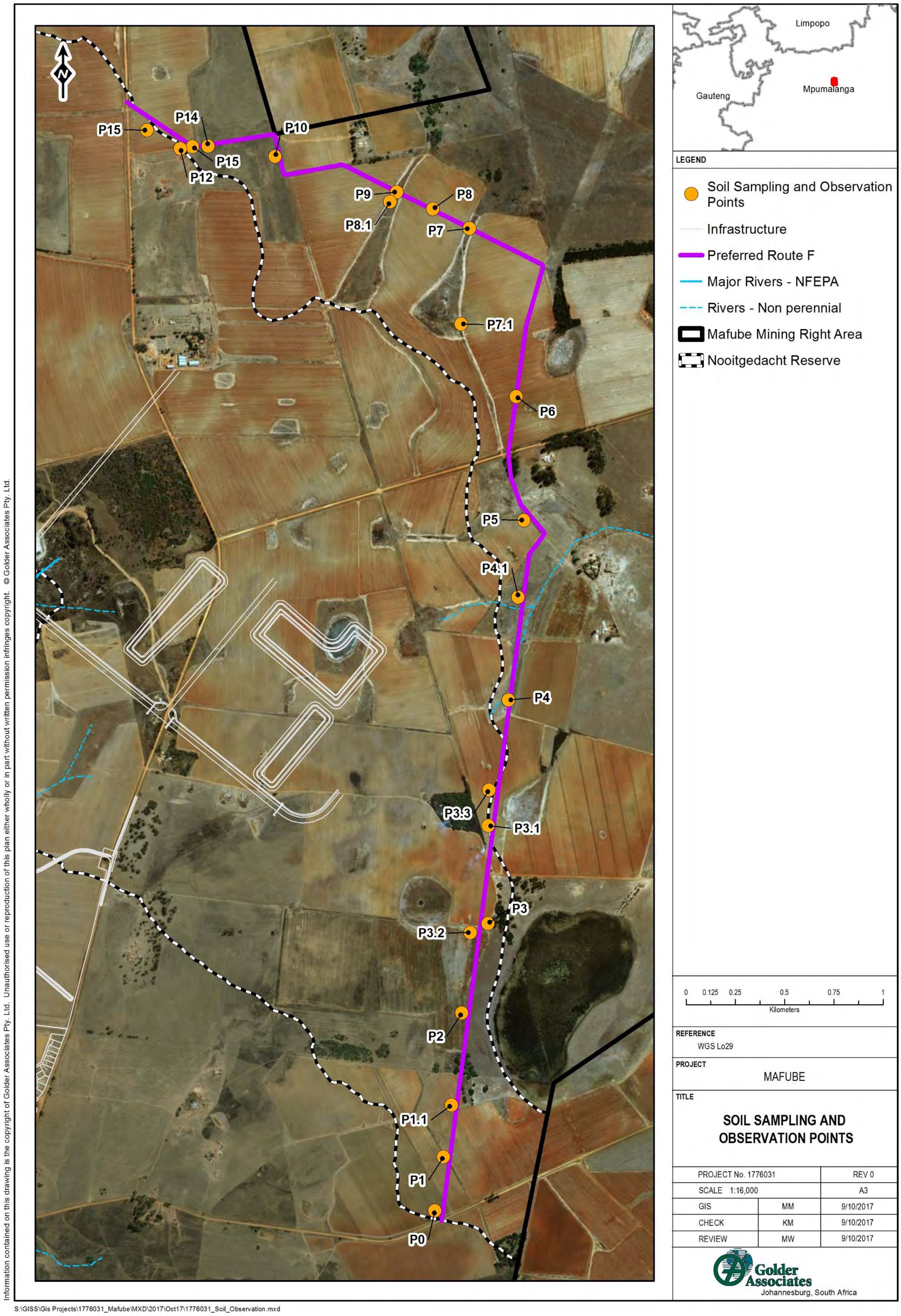

Figure 6: Soil sampling and observation points

6.1.3 Soil Sampling and analysis

The soil samples were collected from distinctively different modal profiles comprising of A and B horizons or saprolite and were submitted for laboratory analysis with Eco Analytica laboratory, at the Northwest University in Potchefstroom. The analysis were conducted according to methods set out in the Handbook of Standard Testing for Advisory purposes (Soil Science Society of South Africa, 1990). Soil samples were analysed for the following parameters:

- Three (3) fraction particle size (sand, silt and clay) analysis;
- Ammonium acetate (pH 7) extractable cations (Ca, Mg, K and Na);
- Walkley- Black Organic Carbon;
- Effervescence test with 10% HCl;
- Total Nitrogen (by LECO);
- Bray-1 P;
- pH and EC.

6.1.4 Land Capability Classification

The land capability of the proposed route was assessed in accordance to the definitions outlined by Scotney et al (1987) and updated for South African soils by the Agricultural Research Council (Schoeman, 2000). A list of criteria used as general guidelines to place soil or land into capability classes are indicated below. This system is based on the Land Capability Classification system of the United States Department of Agriculture (USDA) Soil Conservation Service by Klingelbiel and Montgomery (1961). The soils were classified into eight (8) capability classes (Table 6) based on varying limitations (restrictions for rain-fed cropping) of the following soil parameters:

- Soil reaction (pH);
- Effective Depth (D);
- Flood Hazard (F);
- Erosion Hazard (E);
- Mechanical limitations (M);
- Drainage (W); and
- Soil Texture (T).

Table 6: Definitions of land capability classes (after Scotney et al. 1987)

Class	General description
ARABLE LAND SUITABILITY CLASSES	
I	Land has little permanent limitations that restrict the use thereof and has a high potential for intensive crop production.
II	Land has some permanent limitations that lowers the degree of intensity of crop production, but is still of a high potential.
III	Land has serious permanent limitations that restricts the choice of alternative crops or the intensity of crop production and is of a moderate potential.
IV	Land has very serious permanent limitations that restricts the choice of alternative crops or the intensity of crop production to a great extent.
NON-ARABLE LAND SUITIBILITY CLASSES	
V	Land is not suitable for the production of annual crops, but has a slight erosion hazard under natural veld, permanent pastures, forestry or special crops (*this is crops which gives sufficient cover and which, with special conservation measures will keep soil losses on an acceptable level*).

Class	General description
VI	Land has permanent limitations which make it unsuitable for cultivation and restrict the use of natural veld, forestry and nature life.
VII	Land has such serious limitations that it is unsuitable for cultivation and intensification and the use of the land is therefore limited to natural veld, forestry and nature life.
VIII	Land has permanent limitations that excludes it from commercial plant production and the use thereof is limited to nature life, recreation, water provision and aesthetic qualities.

Erosion and Flood Hazards

Erosion hazard of the soil was determined from the slope percentage, soil erodibility factor, terrain unit and erosion control practices at each representative observation point as defined by Schoeman et al. (2000). The flood hazard of the surveyed area was determined to identify areas prone to flooding where soil types and terrain units were taken into consideration as defined by Schoeman et al. (2000).

6.1.5 Agricultural potential classification

Land Capability Classification (LCC) categorises soils into groups based on the ability to sustain typical cultivated rain-fed crops, which do not require intensive site conditioning or amelioration. The capability classification groups individual soil types (soil mapping units) into groups of similar soils (capability units or classes) on the basis of the criteria for the eight capability classes. Land with higher LCC typically have lower production input costs producing higher yields than land with lower LCC (Singer, 2006). The LCC system thus provides an economical estimation of the soil agricultural capability (or potential). In previous soil specialist studies conducted as part of EIA work, the soil agricultural potential was determined in terms of the land capability classification for project areas (Paterson, 2009; Kruger et al, 2009). The soil agricultural potential was determined based on the LCC, by assigning qualitative criteria ratings such as high, moderate, marginal to low (Table 7).

Table 7: Criteria for agricultural potential classification

LCC	Soil Agricultural Potential
I – III	High
V – VI	Medium
VII – VIII	Marginal to Low

6.1.6 Land Use Mapping

Land use mapping along the proposed road realignment was conducted using areal imagery and field observations. The land use was classified according to the Spatial Planning and Land Use Management Bill (SPLUMP, 2012: 33).

6.2 Survey Results

6.2.1 Soil Survey and Classification

The soils were classified according to the according to the Taxonomic Soil Classification System for South Africa (Soil Classification Working Group, 1991). A total of four (4) different soil forms were observed along the route alternative F. A detailed legend of the observed soil forms is presented in Table 8 and the geographic representation of the distribution of identified soils along the route (including the 25 m survey buffer) is shown in Figure 7.

The proposed realignment route F is dominated by the following soil forms: Pinedene representing 16.95ha, Hutton representing 8.28ha, Mispah representing 4.94ha, Clovelly representing 4.26ha and Katspruit soil form representing 2.48ha of the total area (36.91ha). Areas that are delineated as wetlands comprises of Katspruit soil form, representing 2.48ha of the total area of the route.

Table 8: A detailed soil map of the proposed Route Alterative F

Soil type Code	Dominant and Subdominant soil form and family	Summarised description of soil horizon sequences	Area (ha)	Area (%)
Cv1 Cv2	Clovelly 2200* Clovelly 2100	Yellow brown, apedal (structureless), medium sandy loam topsoil on brown, apedal, medium sandy loam underlain by yellow brown, apedal, moist, medium sandy loam.	4.26	11.54
Hu	Hutton 3100*	Red, apedal, fine sandy loam topsoil on reddish brown fine sandy loam B1 underlain by reddish brown fine to medium silty loam with Mn/Fe concretions	8.28	22.43
Ka	Katspruit 1100*	Dark brown, blotched red, moist silt loam topsoil on dark grey to light grey loamy sand with orange mottles. Weak seepage also observed at 75cm.	2.48	6.72
Ms	Mispah 1100*	Yellow brown, apedal, medium sandy loam topsoil underlain by reddish brown rocky medium loamy underlain by sandstone.	4.94	13.38
Pe	Pinedene 3100*	Greyish brown, apedal, fine-medium loamy sand topsoil on brown, apedal, medium loamy sand subsoil underlain by yellow brown, apedal, medium loamy sand with black ferric concretions becoming orange mottles with depth.	16.95	45.93

* Dominant Soil form

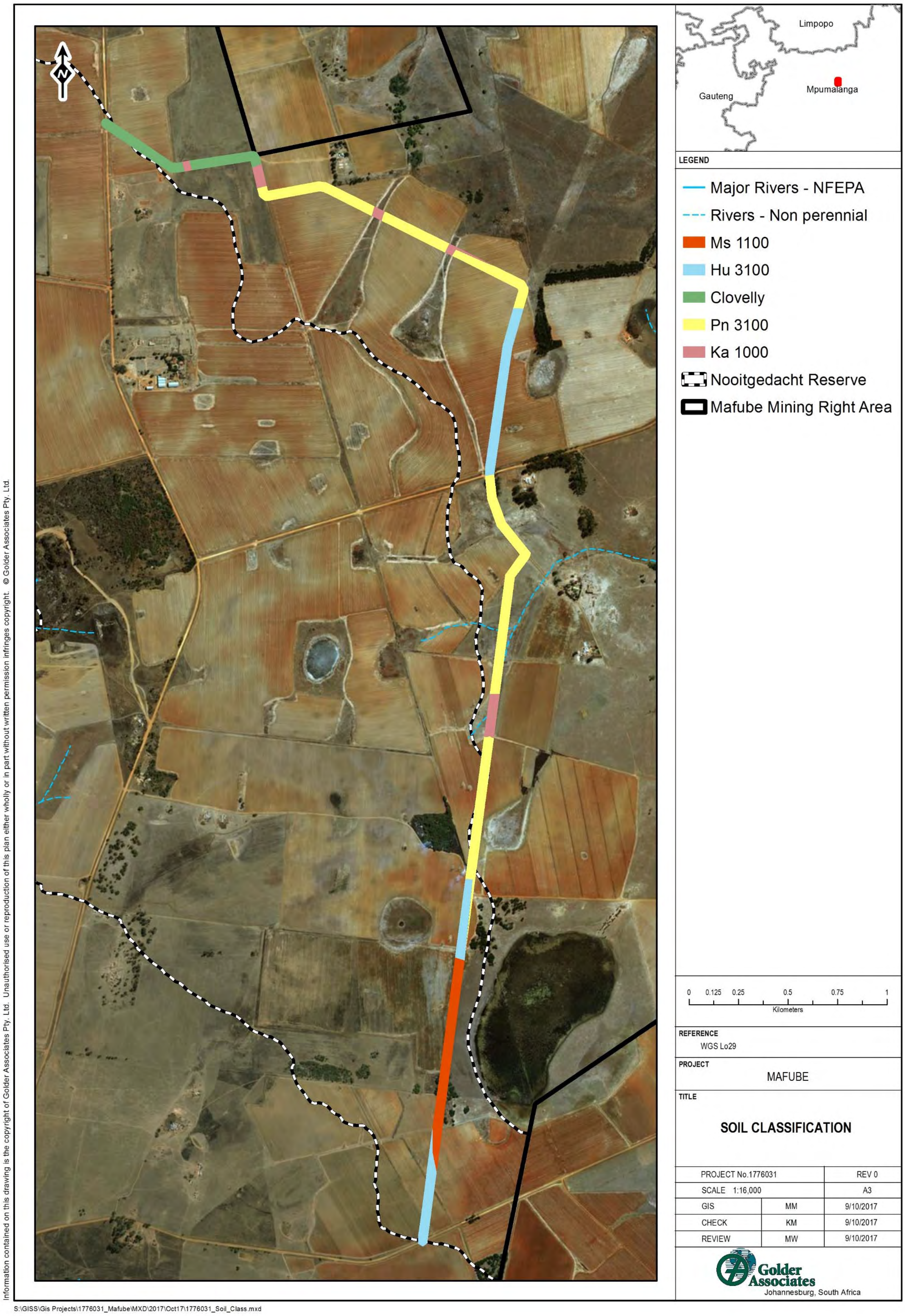

Figure 7: Soil map for surveyed route

6.2.2 Soil Chemical Analysis

The soil chemistry of sampled representative soils collected along route alternative F are presented in Table 9. The laboratory certificates are provided in APPENDIX B.

The soil chemical results were evaluated using the guideline for interpretation of soil analysis according to the methodology outlined in the Fertilizer Handbook (Fertilizer Society of South Africa, 2007). The soils along Route F have the following soil fertility related properties:

- The particle size analysis of the representative soils indicates loamy sand for the Clovelly and Hutton forms, sandy loam for the Mispah form, silt loam to loamy sand for the Katspruit and loamy sand to sandy loam for the Pinedene soil form.
- The pH (H_2O) of all the soils analysed are acid to very acidic, ranging from 4.61 to 5.23. The $EC_{sat\text{-}paste}$ of all soil samples are below 200 mS/m, and thus the salinity of these soils will have no effect on plant growth.
- The cation status of the soils analysed were rated as high, medium or low. Overall the concentration of Ca and K in the soils are medium to low and the levels of Mg is generally medium.
- The concentration of P in the topsoil of the representative Hutton soil analysed is high (> 35 mg/kg), with the remainder of the soils having medium to low levels of P.

Table 9: Analytical data of representative soil forms

Soil form	Sample no.	Depth	pH(H_2O)	EC	Exchangeable cations				P	Organic carbon
					Ca	Mg	K	Na		
	Units	cm	pH units	(mS/m)	(mg/kg)					%
Hu	P1.1-1	0 – 20	4.61	41	207.5	50.0	72.5	0.5	60.2	0.82
	P1.1-2	20 – 60	5.23	32	309.0	34.0	62.5	0.5	23.2	
	P1.1-3	60 - 120	4.74	27	142.0	52.0	1.5	0.5	4.7	
Ms	P2-1&2	0 - 35	4.65	32	125.0	92.0	105.5	0.5	8.9	1.25
Ka	P4-1	0 – 5	4.73	38	617.5	123.5	118.5	32.5	18.4	4.53
	P4-2	25 – 35	4.62	28	314.5	64.0	2.0	21.0	5.6	
	P4-3	35 – 75	4.70	13	59.5	62.0	0.5	1.0	4.0	
Pn	P12-1	0 – 5/9	5.11	28	202.0	71.5	33.5	0.5	10.7	0.74
	P12-2	5/9 – 60	5.23	23	229.5	82.0	2.0	0.5	7.6	
	P12-3	60 – 75	5.31	21	182.5	88.0	0.5	0.5	3.9	

Nutrient status	*High*	*Medium*	*Low*

6.2.3 Wetland and Riparian Delineation

The detailed wetland delineation was conducted as part of the Ecology Baseline and Impact Assessment and is based on the Department of Water Affairs and Forestry Procedure (DWAF, 2006) for identification and delineation of wetlands and riparian areas. The Procedure integrates the terrain, soil form, soil wetness and vegetation indicators to delineate wetland and riparian areas.

The soil form indicator identifies the soil forms which are associated with prolonged and frequent saturation, as defined by the Taxonomic Soil Classification System for South Africa (1991). The soil forms indicative of the various wetland zones are listed in the table below.

Table 10: Soil form indicators of wetlands (based on DWAF, 2005).

Soil form	Wetland zone (Non-wetland, Temporary and Seasonal, Permanent)	Estimated Percentage occurrence (%) along Route F
Katspruit 1100*	Permanent zone	7
Pinedene 3100*	Temporary and Seasonal zone	46
Clovelly 2200*, Clovelly 2100, Hutton 3100, Mispah 1100	Non-wetland zone	47

6.2.4 Land Capability Classification

Land capability along the proposed route alternative F was assessed according to the methodology from Schoeman et al (2000). Field observations and soil properties (Table 9 and Table 11) of representative soil forms were compared to land capability features presented in the methodology to formulate the soil capability classes presented in Table 12.

Table 11: Soil physical properties of representative profiles

Profile ID	pH	Depth (cm)	Slope Percentage	Particle Size Distribution (%<2mm)			Soil Texture
				Sand	Silt	Clay	
P1.1-1	4.61	0 – 20	2-5	84.0	6.5	9.6	Loamy sand
P1.1-2	5.23	20 – 60		83.9	6.5	9.6	Loamy sand
P1.1-3	4.74	60 – 120		83.9	7.6	8.5	Loamy sand
P2-1	4.65	0 – 25	5-12	81.1	7.6	11.3	Sandy loam
P2-2	4.65	25 – 35		81.1	7.6	11.3	Sandy loam
P4-1	4.73	0 – 5	5-12	25.5	54.7	19.8	Silt loam
P4-2	4.62	5 – 35		55.9	27.3	16.8	Sandy loam
P4-3	4.70	35 – 75		82.8	6.9	10.3	Loamy sand
P12-1	5.11	0 – 9.5	0-2	86.9	3.9	9.2	Loamy sand
P12-2	5.23	9.5 – 60		86.6	1.6	11.8	Loamy sand
P12-3	5.31	60 – 120		83.5	1.7	14.8	sandy loam

Table 12: Land capability rating and soil capability classes according to Schoeman et al. (2000)

Soil form	Profile ID	pH (s)	Effective Depth (D)	Flood Hazard (F)	Erosion Hazard (E)	Mechanical limitations (M)	Drainage (W)	Soil Texture (T)	Soil Capability Class
Hu	P1.1-1	S_3	D_1	F_1	E_1	M_0	W_1	T_{1-2}	2
	P1.1-2	S_{1-2}							
	P1.1-3	S_3							
Ms	P2-1	S_3	D_4	F_1	E_4	M_2	W_2	T_2	4
	P2-2	S_3							
Ka	P4-1	S_3	D_4	F_4	E_2	M_3	W_5	T_{1-2}	5
	P4-2	S_3						T_2	
	P4-3	S_3						T_2	
Pn	P12-1	S_{1-2}	D_1	F_1	E_1	M_0	W_3	T_2	3
	P12-2	S_{1-2}							
	P12-3	S_{1-2}							

The soil capability ratings were compared to climatic factors as outlined in the methodology of Schoeman et al. (2000) to formulate land capability classes as shown in Table 14.

Land capability classes that were identified along the proposed Route F are as follows (extracted Schoeman et al, 2000):

Class II

*"*Land in this class have some limitations that reduce the choice of plants or require moderate conservation practices. It may be used for cultivated crops, but with less latitude in the choice of crops or management practices than Class I. The limitations are few and the practices are easy to apply. Limitations may include singly or in combination the effects of:

- *Gentle slopes.*
- *Moderate susceptibility to wind and water erosion.*
- *Less than ideal soil depth.*
- *Somewhat unfavourable soil structure and workabability.*
- *Slight to moderate salinity or sodicity easily corrected but likely to recur.*
- *Occasional damaging flooding.*
- *Wetness correctable by drainage but existing permanently as a moderate limitation.*
- *Slight climatic limitations on soil use and management.*
- *Limitations may cause special soil-conserving cropping systems, soil conservation practices, water-control devices or tillage methods to be required when used for cultivated crops."*

Class III

- "Land in this class has severe limitations that reduce the choice of plants or require special conservation practices, or both. It may be used for cultivated crops, but has more restrictions than Class II. When used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain. The number of practical alternatives for average farmers is less than that for soils in Class II. Limitations restrict, singly or in combination, the amount of clean cultivation, time of planting, tillage, harvesting and choice of crops. Limitations may result from the effects of one or more of the following:
  - *Moderately steep slopes.*
  - *High susceptibility to water or wind erosion or severe adverse effects of past erosion.*
  - *Frequent flooding accompanied by some crop damage.*
  - *Very slow permeability of the subsoil.*
  - *Wetness or some continuing waterlogging after drainage.*
  - *Shallow soil depth to bedrock, hardpan, fragipan or claypan that limit the rooting zone and the water storage.*
  - *Low water-holding capacity.*
  - *Low fertility not easily corrected.*
  - *Moderate salinity or sodicity.*
  - *Moderate climatic limitations;*

Class IV

- "Land in Class IV has very severe limitations that restrict the choice of plants, require very careful management, or both. It may be used for cultivated crops, but more careful management is required than for Class III and conservation practices are more difficult to apply and maintain. Restrictions to land use are greater than those in Class III and the choice of plants is more limited. It may be well suited to only two or three of the common crops or the harvest produced may be low in relation to inputs over long period of time.In sub-humid and semiarid areas, land in Class IV may produce good yields of adapted cultivated crops during years of above average rainfall and failures during years of below average rainfall.
- Use for cultivated crops is limited as a result of the effects of one or more permanent features such as:
  - *Steep slopes.*
  - *Severe susceptibility to water or wind erosion or severe effects of past erosion.*
  - *Shallow soils.*
  - *Low water-holding capacity.*
  - *Frequent flooding accompanied by severe crop damage*
  - *Excessive wetness with continuing hazard of waterlogging after drainage.*
  - *Severe salinity or sodicity.*
  - *Moderately adverse climate"*

Class V

"Land in Class V has little or no erosion hazard but have other limitations impractical to remove that limit its use largely to pasture, range, woodland or wildlife food and cover. These limitations restrict the kind of plants that can be grown and prevent normal tillage of cultivated crops. Pastures can be improved and benefits from proper management can be expected. It is nearly level. Some occurrences are wet or frequently flooded. Other are stony, have climatic limitations, or have some combination of these limitations.Examples of Class V are:

- *Bottomlands subject to frequent flooding that prevents the normal production of cultivated crops.*
- *Nearly level land with a growing season that prevents the normal production of cultivated crops.*
- *Level or nearly level stony or rocky land.*
- *Ponded areas where drainage for cultivated crops is not feasible but which are suitable for grasses or trees."*

The approximate extent of each land capability class along route alternative F (including the 50m survey buffer) is presented in Table 13 and shown on Figure 8.

Table 13: Land Capability Classes (ha) along route alternative F

Land Capability Classes	Area (ha)
Class II	12.52Ha (33.98%)
Class III	16.92Ha (45.92%)
Class IV	4.93Ha (13.38%)
Class V	2.48Ha (6.73%)

Table 14: Land Capability Classification

Soil form	Profile ID	Soil Capability Class	Terrain Factors		Soil Factors				Climatic Factors (C)	Land Capability Class
			Erosion Hazard (E)	Flood Hazard (F)	pH	Effective depth (D)	Soil texture (T)	Wetness (W)		
Hu	P1.1-1	2	E_1	F_1	S_3	D_1	T_2	W_1	C_1	II
	P1.1-2				S_{1-2}					
	P1.1-3				S_3					
Ms	P2-1	4	E_4	F_1	S_3	D_4	T_2	W_2	C_1	IV
	P2-2				S_3					
Ka	P4-1	5	E_2	F_4	S_3	D_3	T_{1-2}	W_5	C_1	V
	P4-2				S_3		T_2			
	P4-3				S_3		T_2			
Pn	P12-1	3	E_1	F_1	S_{1-2}	D_2	T_2	W_3	C_1	III
	P12-2				S_{1-2}					
	P12-3				S_{1-2}					

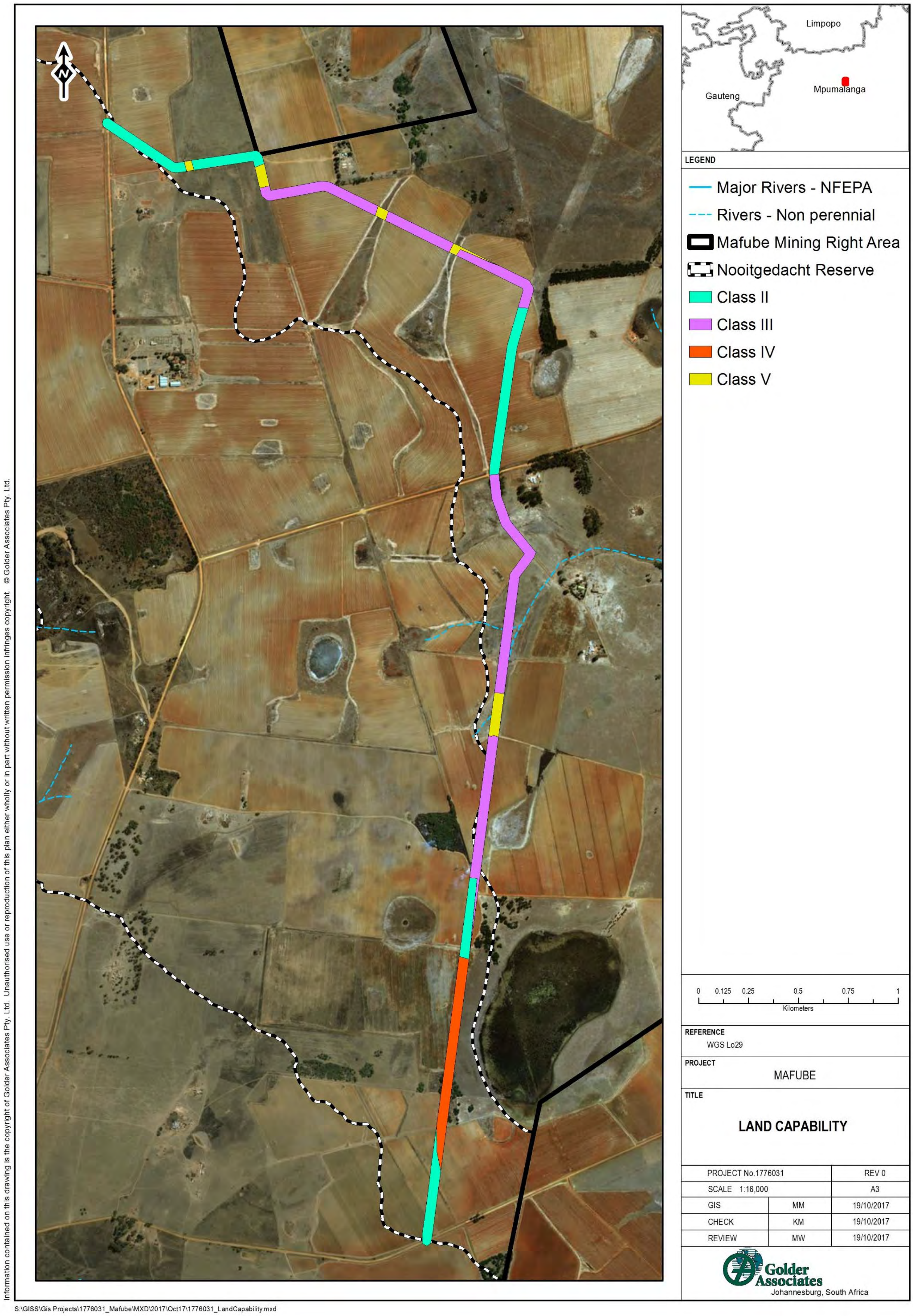

Figure 8: Land capability classification along Route F

6.2.5 Soil Agricultural Potential

The land capability classification of the soil types (soil mapping units) found four land classes (II, III, V and and VI). As mentioned earier, land with higher LCC typically have lower production input costs producing higher yields than land with lower LCC and subsequently also varying agricultural potentials. The soil agricultural potential ratings determined in terms of the land capability classification for Route F is indicated in the Table 15 below and illustrated in the Figure 9.

The majority (80%)of the route has high soil agricultural potential (Table 7).

Table 15: Soil agricultural potential classification for Route F

Soil Agricultural Potential	Area (ha)	Estimated Percentage occurrence (%) along Route F
High	29.44	80
Medium	7.4 ha	20
Total	36.85	100

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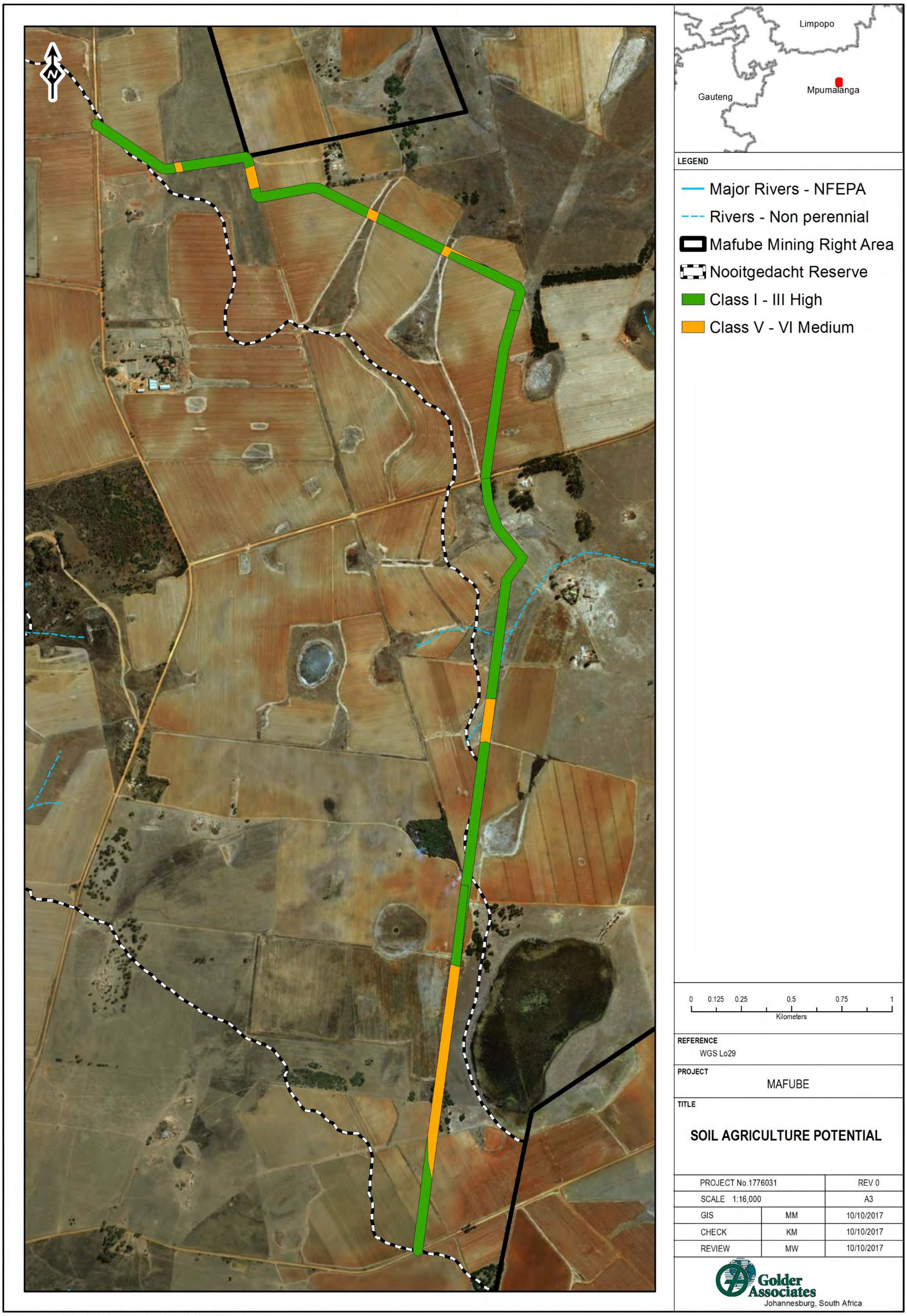

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Figure 9: Soil Agricultural Potential along Route F

6.2.6 Land use

The land use descriptions along the proposed route have are presented below.

6.2.6.1 Pre-road Construction

The land-use practices prior to the road construction were assessed as part of the soil survey and land capability study using aerial photo interpretation and data from field observations. The dominant land-use along the route comprises of agricultural maize fields (22.22ha), grazing land (14.16ha) and gravel roads (0.53ha) as show on Figure 10. The current land use, unit counts, areal extent and percentage are summarised Table 16 and presented in Figure 11.

Table 16: Areas and percentages of current land use

Zone	Primary Use	Secondary Use	Unit Count	Area (ha)	Area (%)
Ca1*	Agricultural	Maize Fields	9	22.22	60.20
Ca2	Agricultural	Grazing land	5	14.16	38.36
T	Transport	Local gravel roads	4	0.53	1.43
Total			18	36.91	100

*: Dominant agricultural land-use

Figure 10: General view of maize agricultural fields (left) and open veld grazing areas (right) along route alternative F

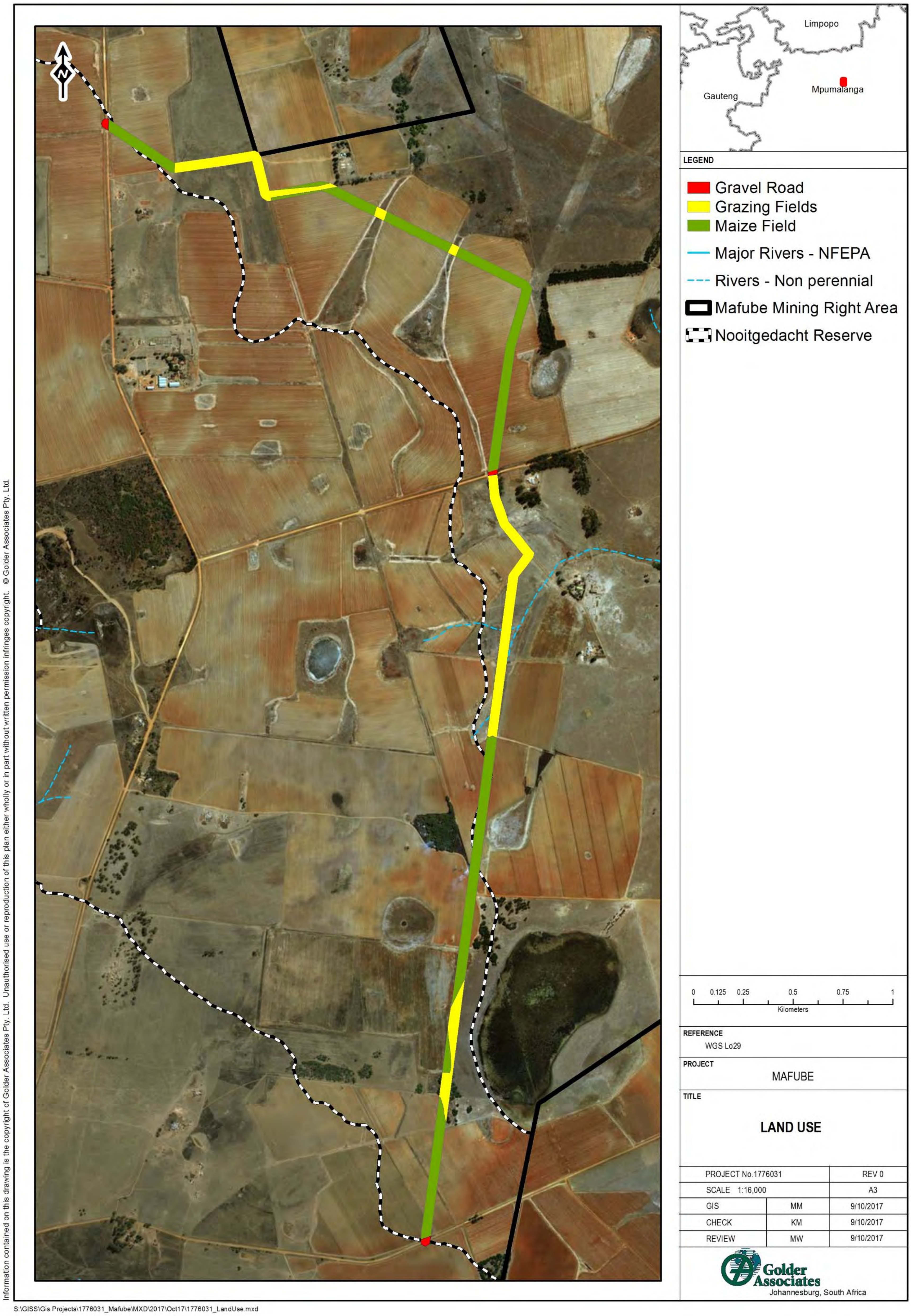

Figure 11: Land use identified along Surveyed route

7.0 ENVIRONMENTAL IMPACT ASSESSMENT

Note: The preferred route Alternative F is the only route alternative that is to be assessed in detail

7.1 Methodology for Assessing Impact Significance

The significance of identified impacts was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Table 17: Impact assessment factors

Occurrence		**Severity**	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude of impact

To assess these factors for each impact, the following four ranking scales are used:

Table 18: Impact assessment scoring methodology

Magnitude	**Duration**
10- Very high/unknown	5- Permanent (>10 years)
8- High	4- Long term (7 - 10 years, impact ceases after site closure has been obtained)
6- Moderate	3- Medium-term (3 months- 7 years, impact ceases after the operational life of the activity)
4- Low	2- Short-term (0 - 3 months, impact ceases after the construction phase)
2- Minor	1- Immediate
Scale	**Probability**
5- International	5- Definite/Unknown
4- National	4- Highly Probable
3- Regional	3- Medium Probability
2- Local	2- Low Probability
1- Site Only	1- Improbable
0- None	0- None

Significance Points= (Magnitude + Duration + Scale) x Probability.

Table 19: Significance of impact based on point allocation

Points	**Significance**	**Description**
SP>60	High environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 - 60	Moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP<30	Low environmental significance	Impacts with little real effect and which will not have an influence on or require modification of the project design.
+	Positive impact	An impact that is likely to result in positive consequences/effects.

For the methodology outlined above, the following definitions were used:

- Magnitude is a measure of the degree of change in a measurement or analysis (e.g., the area of pasture, or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorization of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely-recognised standards are to be used as a measure of the level of impact;
- Scale/Geographic extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- Duration refers to the length of time over which an environmental impact may occur: i.e. immediate/transient, short-term (0 to 7 years), medium term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent; and
- Probability of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

7.2 Project Phases

The environmental impacts of the project were assessed for the:

- Pre-construction phase;
- Construction phase;
- Operational phase; and
- Closure and rehabilitation phase.

7.3 Detailed description of Potential Impacts during all phases of the proposed Road Realignment project

7.3.1 Activities

- *Pre -Construction activities* – clearing land of surface vegetation and obstacles for the construction of the new route, including temporary contractor laydown areas;
- *Construction activities* – construction of road infrastructure as per South African standards for District roads;
- *Operational phase* – general vehicle and pedaestrian road usage;
- *Decommissioning & Closure* – It is understood that Route F will not be decommissioned during the mine closure operations, but will remain as a District Road for public use.

The key potential impacts on soils, land use and land capability that have been identified for detailed assessment mainly occur during the *Pre-Construction* and *Construction* phases are:

- Disturbance of soils resulting in degradation of soil quality:
- Loss of soil agricultural potential.
- Contamination of soils due to pollution;
- Changes to land use.

7.4 Impact Assessment Summary

All the predicted environmental impacts resulting from the proposed project activities are described in Table 20 along with their significance ratings before and after mitigation.

7.4.1 Pre-Construction and Construction phase

The following impacts have been identified for the pre-construction and contruction phases:

- The **clearance of vegetation** and grubbing, will definitely cause **disturbance of soils, resulting in removal of the organic matter** from topsoils. This soil often contains the highest fraction of organic matter in comparison to deeper portions of the soil profile. Loss of this topsoil portion has a high probability of occurring during the pre-construction phase, and is therefore considered as a significantly **high** impact on the soil.
- In the project area, there will be a definite and permanent **loss of the soils with high agricultural potential.** Since the land will not be rehabilitated back to agricultural land, the significance of the impact remains **high**.
- **Loss and change of land use** was rated as **highly** significant impact as the land uses are likely to remain for transport use as a District road. Since the land use will not be returned to Agriculture, the significance of the impact remains **high**.
- During the pre-construction and construction phases an increased presence and use of machinery and earthmoving vehicles is expected on site. Potential leakages of **oil and diesel** from the machinery could cause **contamination** of soils and shallow groundwater. This impact has a medium probability of occurring throughout the duration of the pre-construction and construction phases and is expected to occur only on site. The significance of the impact is **moderate at vehicle and equipment storage points** and **low** on the **route** on average. In order to reduce the probability of the leakages of oil and diesel from the machinery and earthmoving vehicles, it is recommended that dedicated laydown areas for equipment are established. With the appropriated mitigation measures, the significance of the impact can be **low**.
- **Soil erosion** may occur when the vegetation and arable soil layers are removed for construction of the road. Site clearance will increase the vulnerability of the soils to erosion, the consequences of which are loss of the original spatial distribution of soil types and natural soil horizon sequences; loss of some original soil fertility; loss of original topography and drainage pattern; loss of original soil depth and soil volume; and loss of the natural functioning of the soil (habitat for fauna and flora). The significance of the impact is **moderate** and with appropriate migitation the significance of the impact will be **low** on the route .

7.4.2 Operation phase

- It is understood that during the operational phase, the constructed road will be handed over to the District Municipality.

7.4.3 Decommissioning phase

- None anticipated

7.4.4 Residual Impacts

- None anticipated.

7.4.5 Cumulative Impacts

- None anticipated.

.

Table 20: Impact significance ratings

ACTIVITY whether listed or not listed. (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.).	POTENTIAL IMPACT (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc….etc…)	ASPECTS AFFECTED	PHASE In which impact is anticipated (e.g. Construction, commissioning, operational Decommissioning, closure, post-closure)	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type (Modify, remedy, control or stop) e.g. Modify through alternative method; Control through noise control; Control through management and monitoring; Remedy through rehabilitation	Time period for implementation (time period when the measures in the environmental management programme must be implemented Measures must be implemented when required)	Standards to be Achieved (Impact avoided, noise levels, dust levels, rehabilitation standards, end use objectives etc)	Compliance with Standards (A description of how each of the recommendations made, will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities)
Removal of vegetation/ Land clearing	Disturbance of soil, resulting in increased decomposition of soil organic matter from topsoil.	Soil degradation	Construction Phase	10	5	1	5	80	High	10	5	1	5	80	High	Impact remains high				
Spills of chemicals (e.g., hydrocarbon) .Soil contamination on adjacent land potentially occuring due to inappropriate waste disposal and potential oil and diesel leakages from vehicles and machinary	Contamination of soils by hydrocarbon pollutants	Soil contamination	Construction Phase	4	5	1	3	30	Moderate	6	2	1	2	18	Low	- All vehicles and machinery shall be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required; - Repairs shall be carried out in a dedicated repair area only, unless in-situ repair is necessary as a result of a breakdown; - Drip trays shall at all times be placed under vehicles that require in-situ repairs; - Drip trays shall be emptied into designated containers only and the contents disposed of at a licenced	- Identify areas where the soil was impacted. - Control through management or remediation options.- Prevent by restricting spillage from construction vehicles; - Control by implementation of storm water management measures; - Remedy by treatment of contaminated soils.	During project	Contaminant levels below SSV1	Rehabilitation standards/objectives

ACTIVITY whether listed or not listed. (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.).	POTENTIAL IMPACT (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc….etc…)	ASPECTS AFFECTED	PHASE In which impact is anticipated (e.g. Construction, commissioning, operational Decommissioning, closure, post-closure)	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type (Modify, remedy, control or stop) e.g. Modify through alternative method; Control through noise control; Control through management and monitoring; Remedy through rehabilitation	Time period for implementation (time period when the measures in the environmental management programme must be implemented Measures must be implemented when required)	Standards to be Achieved (Impact avoided, noise levels, dust levels, rehabilitation standards, end use objectives etc)	Compliance with Standards (A description of how each of the recommendations made, will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities)
																hazardous material disposal facility; - Accidental spills (concrete, chemicals, process water, hydrocarbons, waste) need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented; - Soil that is contaminated by fuel or oil spills, for example, from vehicles, will be collected to be treated at a pre-determined and dedicated location, or will be treated in situ, using sand, soil or cold cole-ash as absorption medium.				
Preparation of road surface	Loss/ Change of land use	Land use	Construction Phase	10	5	1	5	80	High	10	5	1	5	80	High	Impact remains high				
Preparation of road surface	Loss of potentially arable land	Agricultural potential	Construction Phase	10	5	1	5	80	High	10	5	1	5	80	High	Impact remains high				

ACTIVITY whether listed or not listed. (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.).	POTENTIAL IMPACT (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc….etc…)	ASPECTS AFFECTED	PHASE In which impact is anticipated (e.g. Construction, commissioning, operational Decommissioning, closure, post-closure)	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type (Modify, remedy, control or stop) e.g. Modify through alternative method; Control through noise control; Control through management and monitoring; Remedy through rehabilitation	Time period for implementation (time period when the measures in the environmental management programme must be implemented Measures must be implemented when required)	Standards to be Achieved (Impact avoided, noise levels, dust levels, rehabilitation standards, end use objectives etc)	Compliance with Standards (A description of how each of the recommendations made, will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities)
Preparation of road surface	Soil erosion	Soil quality	Construction Phase	8	2	1	4	44	Moderate	4	2	1	3	21	Low	Contractors (in particular heavy machinery) will be restricted to designated areas as defined by the Mine Environmental Department. Procedures on land clearance, soils handling and rehabilitation plan to be followed. Implement, monitor and control soil erosion minimisation procedures along route. Undertake appropriate design of road drainage to minimise erosion. Implement measures to protect soil stockpiles from erosion. Minimise stockpile height to <1.5m. (*if soil is stockpiled on construction*	- Control through management by means of a soil handling plan during the construction phase.	Construction phase	Minimal soil erosion from exposed areas. All erosion reduction measures in place.	All soil stripping should be done in strict compliance with the soil stripping guidelines (assuming these guidelines have been prepared for the overall mining operations).

ACTIVITY whether listed or not listed. (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc...etc...etc.).	POTENTIAL IMPACT (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc….etc…)	ASPECTS AFFECTED	PHASE In which impact is anticipated (e.g. Construction, commissioning, operational Decommissioning, closure, post-closure)	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type (Modify, remedy, control or stop) e.g. Modify through alternative method; Control through noise control; Control through management and monitoring; Remedy through rehabilitation	Time period for implementation (time period when the measures in the environmental management programme must be implemented Measures must be implemented when required)	Standards to be Achieved (Impact avoided, noise levels, dust levels, rehabilitation standards, end use objectives etc)	Compliance with Standards (A description of how each of the recommendations made, will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities)
																site). Investigate the use of binding agents for Roads as an alternative to water dust suppression.				

8.0 ENVIRONMENTAL MANAGEMENT PROGRAMME

This Environmental Management Programme (EMPr) addresses the management of potential environmental impacts related to the proposed road realignment project. The EMPr is used for managing, mitigating, and monitoring of the environmental impacts associated with construction, operational and rehabilitation phases of the realigned route.

8.1 Objectives

- Manage soil quality during the pre-construction and construction phases.

8.2 Environmental Management and Mitigation Measures Identified

A summary of mitigation measures should be presented:

- For negative impacts (either / or):
  - Avoid;
  - Minimize;
  - Rehabilitate/Repair; or
  - Compensate;
- For positive impacts:
  - Enhance.

8.3 Potential Cumulative Impacts Identified

- None anticipated.

8.4 Potential Impacts to be mitigated in their respective phases

8.4.1 Pre-Construction and Construction phases

- Contamination of soils due to pollution.

8.4.2 Operation phase

- None anticipated.

8.4.3 Decommissioning phase

- None anticipated.

8.5 Summary of Mitigation and Management measures for the Operational, Decommissioning and Closure phases

8.5.1 Pre-Construction and Construction phases

Soil contamination

- In order to reduce the impact of soil contamination due to leakage or spillage of oil and diesel, ensure that all laydown areas are monitored for spillages and that vehicles and equipment are serviced and well maintained. Emergency spill kits should be provided at the project site. Workers should be trained to be able to respond in case of spills;
- Ensure that workers or persons accessing the site during these phases are informed on the waste disposal protocol for the site;

Soil erosion

- Contractors (in particular heavy machinery) needs to be restricted to designated areas as defined by the Mine Environmental Department.;
- The procedures on land clearance and soils handling needs to be followed;
- Implement, monitor and control soil erosion minimisation procedures along route;
- Implement measures to protect soil stockpiles from erosion. Minimise stockpile height to <1.5m. (if soil is stockpiled on construction site); and
- Investigate the use of binding agents for Roads as an alternative to water dust suppression.

8.5.2 Operation phase

- None required.

8.5.3 Decommissioning phase

- None required

8.6 Mechanisms for monitoring compliance

The mechanisms for compliance monitoring with and performance assessment against the environmental management programme and reporting thereof, include:

- Monitoring of impact Management Actions;
- Monitoring and reporting frequency;
- Responsible persons;
- Time period for implementing impact management actions;
- Mechanisms for monitoring compliance;

The impact of the development of Route F activities on soil, land use and land capability can be monitored by the following methods (Table 21).

Table 21: Soil, Land use and Land Capability Monitoring Program

Source Activity	Impacts requiring monitoring programmes	Locations	Functional requirements for monitoring	Roles and responsibilities (for the execution of the monitoring programme)	Monitoring and reporting frequency and time periods for implementing impact management actions
Surface preparation for contruction of road.	**Soil Contamination** - Sampling of soils for analysis	All areas where oil and diesel spillages may have occurred Minimum - three samples per affected area.	Soil Analysis of Hydrocarbons, Trace and semi-metals if spillages are reported.	Environmental team to monitor – and appoint appropriate consultant for soil sampling when required.	As required – when a major incident is reported during the Construction phase
Road usage	**Soil contamination** - Visual inspection of open land along Route for signs of illegal waste	Entire length of Route	None required if no visible signs of illegal waste disposal is noted. *If* illegal dumping of waste is	Environmental team to monitor – and appoint appropriate waste	Monthly during the Construction phase

Source Activity	Impacts requiring monitoring programmes	Locations	Functional requirements for monitoring	Roles and responsibilities (for the execution of the monitoring programme)	Monitoring and reporting frequency and time periods for implementing impact management actions
	disposal and signs of hydrocarbon spillages.		reported, conduct appropriate Waste Assessment and Classification to guide waste disposal.	consultant when required.	

9.0 DATA GAPS AND ASSESSMENT SHORTCOMINGS

- Lack of detailed civil engineering procedures/standards for construction of District Roads.

10.0 CONCLUSION

The objectives of the study were as follows:

- Conduct a detailed soils assessment along the proposed route alternative F;
- Classify and map the observed soils according to the South Africa Taxonomic Soil Classification System, 1991;
- Conduct a land capability assessment of the area along the route and compile a map of the land capability classes;
- Map the current land-use along the route;
- Determine impacts associated with the proposed route realignment.
- Propose environmental management actions required for the preservation of local soils (mitigation measures).

The soil forms identified within the assessment area of Route F include the following soil forms Pinedene (16.95ha), Hutton (8.28ha), Mispah (4.94ha), Clovelly (4.26ha) and Katspruit (2.48ha). Areas that are delineated as permanent wetlands comprises 2.48ha (Katspruit form) and 16.95ha of Temporary and Seasonal wetland zone (Pinedene form).

The land capability for most of the soils falls under class II, III, IV (arable land suitability) and V (non-arable land suitability) and the majority (80%) of the route has high soil agricultural potential.

The dominant land-use along the route comprises of agricultural maize fields, grazing land and gravel roads.

The main potential impacts are likely to occur only during the pre-construction and construction phases. These are (i) disturbance of soil, resulting in increased decomposition of soil organic matter from topsoil; (ii) contamination of soils by hydrocarbon pollutants; (iii) loss/ change of land use; (iv) loss of potentially arable land; and (v) soil loss due to erosion. Of these impacts, the disturbance of soil, resulting in increased decomposition of soil organic matter from topsoil; loss/ change of land use and loss of potentially arable land are significantly high, and remain high even if some degree mitigation measures are implemented. This is the case since the land (and soil) where the road will be constructed will change land uses from agricultural to transport. It is understood that the road will not be decommissioned at closure of the mine, but rather be handed over to the Municipal District on completion of construction. The loss of arable land, land use (as agriculture) and the soil disturbance is permanent, and thus remains a significantly high impact for the parcel of land evaluated for this assessment. It must however be indicated that the minimum portion of land required for feasible (economically) maize production is 800 – 1000 ha in the Eastern Highveld (GrainSA, 2017). The full extent of the impact (land take) for the construction of the road is approximately 36.ha, of which, 80% (28 ha) has a high agricultural potential. Given the above economical aspect, in the context of maize production in the Eastern Highveld, the overall significance of loss of arable land and loss of high agricultural land the impact is thus low (2.8 - 3.5% of minimum requirement for economically feasiable production).

Potential Impacts and Mitigation Measures

The potential impacts of the construction activities on soil can be minimized through the following mitigation measures:

- Ensure that all laydown areas are monitored for spillages and that vehicles and equipment are serviced and well maintained. Emergency spill kits should be provided at the project site. Workers should be trained to be able to respond in case of spills.
- Ensure that workers or persons accessing the site during these phases are informed on the waste disposal protocol for the site.
- Contractors (in particular heavy machinery) needs to be restricted to designated areas as defined by the Mine Environmental Department.;
- The procedures on land clearance and soils handling needs to be followed;
- Implement, monitor and control soil erosion minimisation procedures along route;
- Implement measures to protect soil stockpiles from erosion. Minimise stockpile height to <1.5m. (if soil is stockpiled on construction site); and
- Investigate the use of binding agents for Roads as an alternative to water dust suppression.

11.0 REFERENCES

GrainSA. 2017. Average area required for econonmically feasible production of maize in the Eastern Highveld. GrainSA Agronomist (Mr. Corne Louw) in Eastern Highveld. Personal Communication (Telephonic, 19 October 2017).

Land Type Survey Staff, 1976-2006. Land type Survey Database. ARC-ISCW, Pretoria.

Schoeman J.L.; van der Walt M.; Monnik K.A.; Thackrah A.; Malherbe J.; Le Roux R.E. 2000. Development and Application of a Land Capability Classification system for South Africa. ARC-ISCW Report no. GW/A/2000/57

Singer, M.J. 2006. Land Capability Analysis, in Encyclopaedia of Soil Science (Vol. 2), edited by R Lal.

Scotney, D.M., F. Ellis, R.W. Nott, K.P. Taylor, B.J. van Niekerk, E. Verster & P.C. Wood, 1987. A system of soil and land capability classification for agriculture in the TBVC states. Technical Committee for Agriculture and Environmental Affairs (MTC/AGEN).

Soil Classification Working Group. 1991. Soil Classification: A Taxonomic system for South Africa. Memoirs of the Agricultural Natural Resources of South Africa No. **15**. Department of Agricultural Development, Pretoria.

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APPENDIX A

Detailed Methodology

PROJECT UNDERSTANDING

The Mafube LifeX opencast pit mines through two roads, namely the D684 and the D1048. A road relocation EIA therefore needs to be conducted in support of the relocation of these roads. Included in the EIA is a specialist soils assessment, consisting of a desktop soil assessment of each new Alternative Route, followed by a survey and impact assessment of the preferred Route option.

This memorandum details the approach which will be taken to execute the Field Survey for the soils agricultural potential assessment as part of the above mentioned EIA. The memorandum also includes the objectives and the approach for the Field Survey.

OBJECTIVES

The objective of the study is to obtain sufficient baseline information on the soil characteristics, land capability and land use in the proposed project areas in order to:

- Understand the baseline soil conditions;
- Provide a detailed description of the baseline and pre-development soil characteristics, land capability and land use;
- Evaluate the potential impacts of the proposed project; and
- Describe and evaluate any other limiting characteristics of the soils.

APPROACH

Field survey

The Route Alternative analysis indicated that Route Alternative F (along the existing powerline) is the preferred Route in the EIA/EMP and WULA processes.

During the field survey the Route (including the buffer zone) will be delineated (into map units) and the natural resources; climate; terrain form; soil type and land use of the project area, recorded. The entire length of the Route will be evaluated along transects and evaluating the soil at the crest, scarp, midslope, footslope and valley bottom positions of the main geological groups and land types of the project area. If access to the indicated observation points is restricted, observation points can be shifted to more accessible areas but to the same terrain position, geology and landtype as the original point. The proposed observation points for the transect walks are shown in Figure A and Figure B. The co-ordinates of the proposed observation points for the transect walks are listed in Table A.

At each observation point the soil will be augered to a depth of 120 cm (unless an impenetrable layer is encountered restricting sampling depth). Observable soil characteristics such as colour, texture, soil depth, stoniness, and drainage class and parent material will be logged. At each observation point the relevant and distinct features will also be recorded such as signs of erosion, vegetation cover, micro-topography, aspect and fauna. At least **8** modal profiles will be described in detail and soil samples collected of the topsoil and subsoil horizons. The soil characteristics will be described and classified according to the Taxonomic Soil Classification System for South Africa (Soil Classification Working Group, 1991).

Table A: Co-ordinates of proposed soil observation points

Profile No.	latitude	longitude
P0	-25.7677	29.80275
P1	-25.7636	29.80339
P2	-25.7587	29.80406
P3	-25.7551	29.80446
P4	-25.7433	29.80606
P5	-25.7364	29.80704

Profile No.	latitude	longitude
P6	-25.7328	29.80855
P7	-25.7285	29.80767
P8	-25.7244	29.80675
P9	-25.7237	29.80413
P10	-25.7223	29.80235
P11	-25.7211	29.80077
P12	-25.7208	29.79764
P13	-25.7196	29.79375
P14	-25.7195	29.79096
P15	-25.7188	29.78786

Sampling

In order to obtain the baseline chemical status, soil samples will also be collected and analysed for key properties. All samples collected should be labelled as follows:

Site Name: RR

Project Number: 1776031

Sample name: *Site & profile number* / *Horizon*/ *depth*/ *terrain unit*/ *Sampler Name*

e.*g* RR_AH 1 / A / 0-30 /1/ K Maake

Date sampled: 10 –Aug -2017

Laboratory analysis of the topsoil and subsoil of the modal profiles will be conducted at Eco-Analytical Laboratories at the University of the North West, South Africa. The properties which will be analysed include:

- Particle size distribution on selected samples (3-fraction testing);
- pH (water);
- Exchangeable cations Na, K, Ca, Mg (NH_4oAc Acetate extract);
- Extractable anions SO_4^{2-} ,F^-, Cl^-, NH_4^+
- Phosphorus (Bray1 method);
- Organic carbon content on selected topsoil samples (Walkley Black method);
- Electrical conductivity (indication of salt presence); and
- Total metals (for selected samples, representing typical soil types surveyed).

Figure A: Proposed soil observation points (P0-P6)

Figure B: Proposed soil observation points (P7-P15)

ASSUMPTIONS

The following assumptions are relevant:

- A dedicated person will be available to accompany Golder personnel during the fieldwork/site activities and to assist to gain access to required areas;
- The proposed scope of work is based on our current understanding of the level of information available and can be adjusted if additional information becomes available.
- The security of buried services situated anywhere on the project site(s), which are NOT identified on the drawings provided or suitably demarcated on site to us, will remain the responsibility of the client;
- The investigation procedures offered herein will involve operations and techniques using standard health and safety norms applied by Golder to all its projects, and generally followed in the geotechnical investigation industry. In the event that specific client requirements for safety issues are to be applied, of which we have not been appraised in prior documentation, these will be implemented to the extent reasonable and possible (within investigation industry standards and norms), but may attract additional time and cost which are not covered in this present proposal and will be negotiated as contract extras;
- Any water logged (or soft underfoot) areas may also present constraints insofar as accessibility of the site for investigatory equipment is concerned, and may therefore also require reconsideration of the proposed programme and test method (and where necessary costing).

CONCLUDING REMARKS

It is envisioned that the sampling will require one day's field work, to be conducted on 10 August 2017. Samples will be couriered to the North West University Analytical Laboratory in South Africa for the analysis by 14 August 2017. Laboratory analysis results may be expected after about 2-3 weeks.

REFERENCES

Soil Classification Working Group.1991. Soil Classification –a Taxonomic System for South Africa. Memoirs on the Agricultural Natural Resources of South Africa No. 15. Department of Agricultural Development, Pretoria.

APPENDIX B

Laboratory certificates

NORTH-WEST UNIVERSITY
ECO-ANALYTICA

Eco Analytica
P.O. Box 19140
NOORDBRUG 2522
Tel: (018) 293 3900

GOLDER (MIDDELBURG)

31/8/2017 **Nutrient Status**

Sample no.	Ca	Mg	K	Na	P	$pH(H_2O)$	Organi %C Walkley-Blac	EC (mS/m)
	(mg/kg)							
P1.1-1	207.5	50.0	72.5	0.5	60.2	4.61	0.82	41
P1.1-2	309.0	34.0	62.5	0.5	23.2	5.23		32
P1.1-3	142.0	52.0	1.5	0.5	4.7	4.74		27
P2-1&2	125.0	92.0	105.5	0.5	8.9	4.65	1.25	32
P4-1	617.5	123.5	118.5	32.5	18.4	4.73	4.53	38
P4-2	314.5	64.0	2.0	21.0	5.6	4.62		28
P4-3	59.5	62.0	0.5	1.0	4.0	4.70		13
P12-1	202.0	71.5	33.5	0.5	10.7	5.11	0.74	28
P12-2	229.5	82.0	2.0	0.5	7.6	5.23		23
P12-3	182.5	88.0	0.5	0.5	3.9	5.31		21

Exchangeable cations

Sample no.	Ca	Mg	K	Na	CEC	S-value	Base saturation (%)	pH(H_2O)	Effervesance 10%HCl	LECO %N
	(cmol(+)/kg)									
P1.1-1	1.04	0.41	0.19	0.00	13.63	1.64	12.00	4.61		0.03
P1.1-2	1.54	0.28	0.16	0.00	16.30	1.98	12.18	5.23		0.03
P1.1-3	0.71	0.43	0.00	0.00	12.82	1.14	8.91	4.74		0.02
P2-1&2	0.62	0.76	0.27	0.00	14.22	1.65	11.63	4.65	0	0.08
P4-1	3.08	1.02	0.30	0.14	23.03	4.54	19.72	4.73	0	0.32
P4-2	1.57	0.53	0.01	0.09	20.92	2.19	10.48	4.62	0	0.13
P4-3	0.30	0.51	0.00	0.00	14.11	0.81	5.76	4.70	0	0.01
P12-1	1.01	0.59	0.09	0.00	17.06	1.68	9.87	5.11		0.04
P12-2	1.15	0.67	0.01	0.00	12.95	1.83	14.11	5.23		0.02
P12-3	0.91	0.72	0.00	0.00	13.51	1.64	12.12	5.31		0.01

HANDBOOK OF STANDARD SOIL TESTING METHODS FOR ADVISORY PURPOSES

Exchangeable cations: 1M NH_4-Asetaat pH=7

CEC: 1 M Na-asetaat pH=7

Extractable, Exchangeable micro-elements: 0.02M $(NH_4)_2$ EDTA.H_2O

EC: Saturated Extraction

pH H_2O/KCl: 1:2.5 Extraction

Phosphorus: P-Bray 1 Extraction

Particle Size Distribution

Sample no.	> 2mm (%)	Sand (% < 2mm)	Silt	Clay
P1.1-1	4.6	84.0	6.5	9.6
P1.1-2	3.9	83.9	6.5	9.6
P1.1-3	18.0	83.9	7.6	8.5
P2-1&2	18.6	81.1	7.6	11.3
P4-1	0.4	25.5	54.7	19.8
P4-2	0.1	55.9	27.3	16.8
P4-3	3.8	82.8	6.9	10.3
P12-1	0.3	86.9	3.9	9.2
P12-2	0.6	86.6	1.6	11.8
P12-3	2.6	83.5	1.7	14.8

APPENDIX C

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APPENDIX D

Co-ordinates of soil observation points

Table D1: Co-ordinates of proposed soil observation points

Profile No.	latitude	longitude
P0	-25.767703	29.803183
P1	-25.765236	29.803510
P1.1	-25.762942	29.803844
P2	-25.758722	29.804446
P3	-25.754581	29.805024
P3.1	-25.750185	29.805633
P3.2	-25.748491	29.805892
P4	-25.744529	29.806324
P4.1	-25.739874	29.806788
P5	-25.736388	29.807043
P6	-25.731055	29.806616
P7	-25.723231	29.804271
P8	-25.722322	29.802353
P9	-25.721546	29.800604
P10	-25.720388	29.797072
P11	-25.719937	29.794529
P12	-25.719224	29.792516
P13	-25.719536	29.790961
P14	-25.719573	29.790177
P15	-25.717560	29.786860

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TRAFFIC INVESTIGATION

CLOSURE AND RE-ALIGNMENT OF SECTIONS OF DISTRICT ROADS D684 & D1048 TO ENABLE MINING OF NOOITGEDACHT COAL RESERVE

Mpumalanga Provincial Government

February 2018

1 INTRODUCTION

Two sections of provincial district roads, namely a section of Road D684 and a section of Road D1048 traverse through the Nooitgedacht Coal Reserve. Mining of this area by the owners Anglo Operations Limited / Mafube Coal Mining (Pty) Ltd requires the closure and relocation of these sections of roads.

Golder Associates is conducting an environmental impact assessment in support of these road closures. This assessment has identified route alternative F as the most viable alignment from an environmental point of view. This new route will be located directly to the east of the existing Eskom powerlines and servitude and follows the Eskom powerlines and servitude from district road D1574 in the south up to about 300m south of district road D1048 in the north, it will then cross underneath the Eskom powerlines to intersect with road D1048 at a right angle. The portion of road D1048 to the west of this new intersection is to be closed. From this new intersection with road D1048 the new route will circle back to the existing road D684 in the north-west over Portion 11 of Roodepoort 418 JS and over Portion 4 of Nooitgedacht 417 JS. The portion of the existing road D684 to the south of this new intersection up to the intersection of existing roads D684 and D1574 will be closed. *Refer to drawing - TW941/v1 (attached).*

Full technical reference: *Traffic Investigation in Support of EIA: Mafube Coal Mining (Pty) Ltd, Proposed Nooitgedacht and Wildfontein Opencast Coal Expansion, May*

2 KEY FEATURES OF PROJECT ROADS

2.1 PHYSICAL PARAMETERS OF EXISTING AND PROPOSED NEW ALIGNMENTS

With reference to TW941/v1 (attached), the section of Road D684 that will be closed (A – E – B) was determined to be approximately 6046m in length. Also, the section of Road D1048 that will be closed (E – C) was determined to be approximately 1535m in length. This totals an approximate closure length of 7581m. The proposed new road was determined to be 7067m in length, which is slightly more than 500m shorter than the sections of roads that will be closed.

The topography of the area was also investigated, and it was found that, regarding the existing and proposed new roads, the area is relatively flat. Generally, elevation differences occur over relatively large distances. This is true for the existing sections of roads that will be closed, as well as the proposed new road, with the proposed new road crossing terrain that is flatter than the existing sections of roads.

2.2 FUNCTION AND DESIGN PARAMETERS OF EXISTING AND PROPOSED NEW ROADS

The existing and proposed roads are classified as Class R4 rural collector roads and these roads primarily provide access to smaller rural settlements, mines, heritage sites, large farms, etc. It was found that Roads D684 and D1048 have 25m wide road reserves and the proposed new road will also have a 25m wide road reserve.

The existing roads have a gravel surface with a carriageway width of about 8.5m. The proposed new road will also be constructed as a gravel surface road with a carriageway width of 9m. The design speed for the existing and proposed roads is 80 km/h. However, during a site visit, it was found that the sections of roads that will be closed are in a poor condition, and speeds exceeding 40km/h were not practically possible. There are horizontal curves on the section of Road D684 that will be closed, and it was found that the radii of these curves all exceed 400m. Due to the surface type and design speed of these roads, minimum radii of 400m should be used for all new horizontal curves. The edge of the 25m road reserve of the section of the proposed new road that follows the existing Eskom powerlines should also be positioned at least 20m away from the Eskom servitude.

The GIS data that was used showed that the sections of Roads D684 and D1048 that will be closed do not cross any watercourses, but it was found that there are drainage structures at two separate locations on Road D684.

The proposed new road is expected to cross five watercourses and drainage structures (e.g. culverts) will need to be constructed at these crossings.

2.3 TRAFFIC DEMAND

12-hour traffic counts were done in April 2012 (refer to previous traffic impact study TW553). A growth rate of 1% per annum over 5 years was applied to the results of the traffic counts to obtain the theoretical 2017 traffic volumes. The total theoretical 2017 traffic volumes on all links are shown in Table 1. *Refer to drawing TW941/v1 (attached)*.

Table 1: Total theoretical 2017 traffic volumes.

LINK	TOTAL VOLUME (veh/12hr)
A – B	38
A – C	20
A – D	6
B – C	25
B – D	15
C – D	4

Inspection of Table 1 shows the following:

- The traffic demand in the area is low,
- Most of the traffic is found on the A – B link,
- Traffic travelling on the B – C link is comparable to the traffic volumes on the A – B link.

3 COMPARISON OF ALIGNMENTS FROM A ROAD USER POINT OF VIEW

The existing road alignments were subsequently compared with the new proposed road alignments from a road user point of view; i.e. based on travel distance and travel time. For comparison purposes, four origin – destination points were identified namely A, B, C and D. *Refer to drawing TW941/v1 (attached)*.

3.1 TRAVEL DISTANCE

The existing travel (route) distances are compared with the proposed new alignments – to the nearest metre – in Table 2. The relative differences (%) between the new and existing alignments are also shown.

Table 2: Comparison of existing and new alignment travel distances.

LINK	EXISTING DISTANCE (m)	NEW DISTANCE (m)	RELATIVE DIFF. (%)
A to B	6046	9576	158%
A to C	3927	3219	82%
A to D	8555	7067	83%
B to C	5189	6357	123%
B to D	2509	2509	100%
C to D	7698	3848	50%

Inspection of Table 2 shows the following:

- With reference to the traffic demand, there is an increase in distance on the main links (when travelling between points A & B and B & C),
- The largest increase in distance occurs when travelling from point A to point B,
- The largest decrease in distance occurs when travelling from point C to point D,
- There is no relative change in distance from point B to point D.

3.2 TRAVEL TIME

A uniform travelling speed of 80 km/h was assumed to determine travel times. The existing travel times are compared with the proposed new alignment travel times – to the nearest half minute – in Table 3. The relative differences (%) between the new and existing alignments are also shown.

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Tel: (012) 348-0386 Fax: (012) 348-3587 Int. Code (27) Cell: 083 447 9961 Email : admin@techworld.co.za

Table 3: Comparison of existing and new alignment travel times.

LINK	EXISTING TIME (min.)	NEW TIME (min.)	RELATIVE DIFF. (%)
A to B	4.5	7	158%
A to C	3	2.5	82%
A to D	6.5	5.5	83%
B to C	4	5	123%
B to D	2	2	100%
C to D	6	3	50%

Inspection of Table 3 shows the following:

- The relative differences are the same as in Table 2, the reason being that a uniform travelling speed was applied to all existing and new travel distances,
- There is no route, existing or new, that has a travel time exceeding 7 minutes,
- The route that has the longest expected travel time is the A – B link, with an expected travel time of 7 minutes,
- The route with the shortest expected travel time is the B – D link, with an expected travel time of 2 minutes.

3.3 TRAVEL COST

As mentioned previously, the roads that will be closed and re-aligned are Class R4 rural collector roads. Accessibility is the primary function of these roads, with mobility not being an important function. These roads are not designed to carry through traffic. Therefore, these roads only carry traffic with origins and destinations along or near the road. Because of these reasons, the expected increase in travel cost is only marginal and travel cost was not a primary consideration for this study.

4 COMPARISON OF ALIGNMENTS – ROAD AUTHORITY

The proposed alternative will favour the road authority from a long term maintenance and improvement perspective. Table 4 shows the lengths – to the nearest metre – of road sections that will be closed, as well as the length of the new proposed route.

The absolute (m) and relative (%) differences between the new and existing alignment lengths are also shown. *Refer to drawing TW941/v1 (attached).*

Table 4: Comparison of existing and new alignment road section lengths.

LINK	CLOSED SECTION LENGTHS (m)	NEW SECTION LENGTH (m)
A – E – B	6046	
E – C	1535	
Total (sum of A – E – B & E – C)	7581	
A – C – D		7067
Absolute Difference (m)	514	
Relative Difference (%)	93%	

Inspection of Table 4 shows the following:

- Although the new alignment leads to increased travel distances along the main routes (as shown in Table 2), the new alignment will be shorter than the sections of Roads D684 and D1048 that will be closed.

5 AFFECTED PROPERTIES AND OWNERS

Golder Associates identified the following affected properties, which are as shown in Table 5:

Table 5: Properties and landowners affected by proposed alternative road.

Property Details	Landowner Details
Springboklaagte 416 JS Portion 1	Anglo Operations Limited
Springboklaagte 416 JS Portion 12	Anglo Operations Limited
Nooitgedacht 417 JS Portion 4	Hooggenoeg Boerdery CC
Nooitgedacht 417 JS Portion 14	Wessels Anneke
Nooitgedacht 417 JS Portion 15	Anglo Operations Limited
Roodepoort 418 JS Portion 8	Anglo Operations Limited
Roodepoort 418 JS Portion 9	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 10	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 11	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 13	Anglo Operations Limited

All the affected properties that are currently privately owned will be acquired by Anglo Operations Limited / Mafube Coal Mining (Pty) Ltd.

The following properties will be provided with access from the proposed new alignment:

- Nooitgedacht 417 JS Portion 4,
- Nooitgedacht 417 JS Portion 14,
- Nooitgedacht 417 JS Portion 15,
- Roodepoort 418 JS Portion 4,
- Roodepoort 418 JS Portion 5
- Roodepoort 418 JS Portion 8,
- Roodepoort 418 JS Portion 9,
- Roodepoort 418 JS Portion 10,
- Roodepoort 418 JS Portion 11 and
- Roodepoort 418 JS Portion 13.

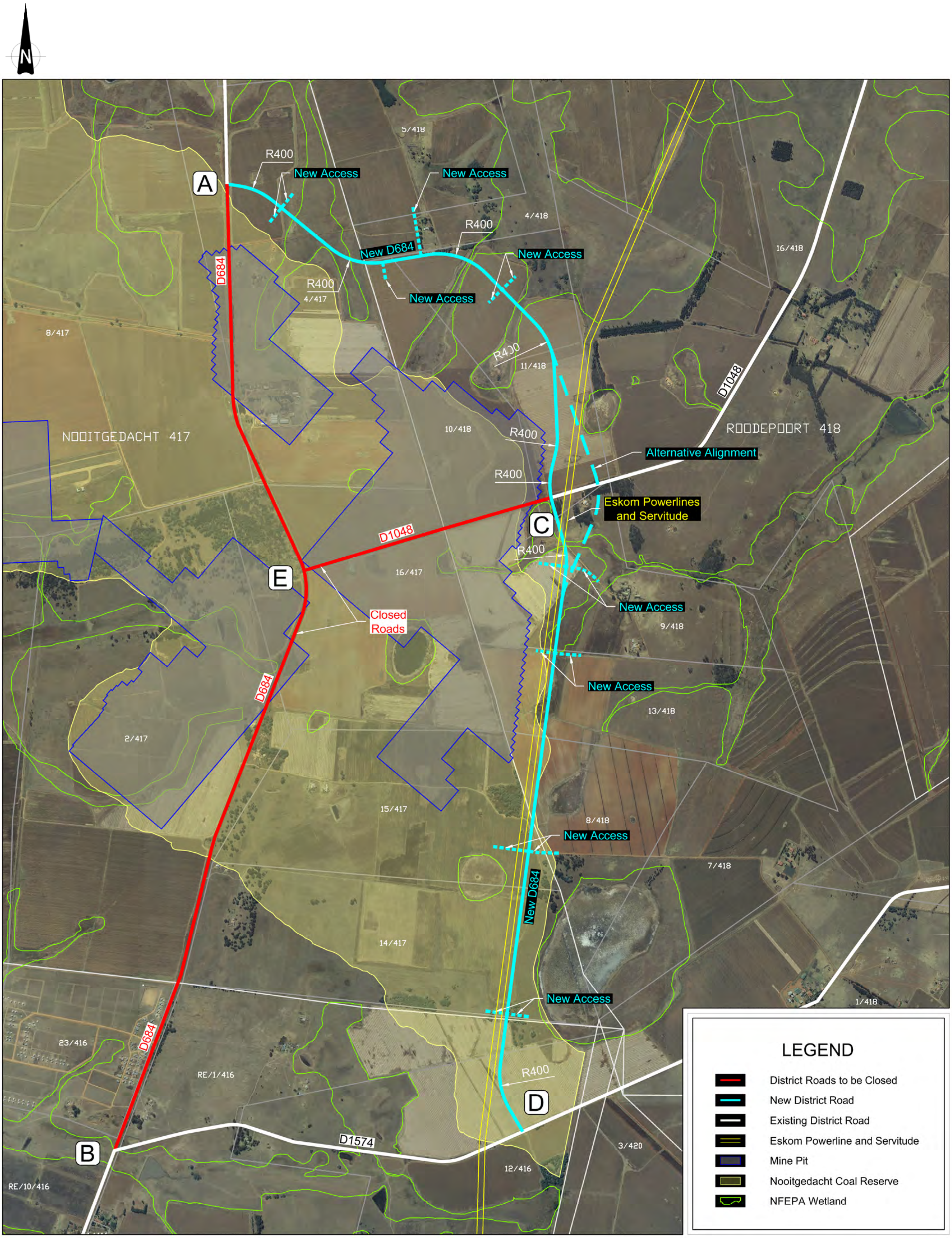
Portions 4 and 5 of the Farm Roodepoort 418 JS currently obtain access from Road D684. The access point is located at the section of Road D684 that will be closed, therefore access to these properties will have to be provided from the proposed new alignment.

All other properties (including Springboklaagte 416 JS Portions 1 and 12) will obtain access from existing roads in the area. A 25m ROW servitude will however have to be provided for access to the residential area situated on Portion 23 of Springboklaagte 416 JS. This ROW servitude will originate from the intersection of roads D684 and D1574.

6 CONCLUSION

Mafube Coal Mining (Pty) Ltd identified coal reserves on various farm portions in Mpumalanga, including portions of the farms Springboklaagte 416, Nooitgedacht 417 and Roodepoort 418. To mine these coal reserves, sections of district roads D684 and D1048 will need to be closed and re-aligned. Golder Associates identified a proposed re-aligned route, known as alternative F. A study was done to investigate the adequacy, from a traffic engineering point of view, of proposed alternative F. The study found that the new route will increase travel distance and time along the main links, but that the proposed new route will be shorter than the sections of Roads D684 and D1048 that will be closed. Finally, properties that would be affected by the road closures and re-alignment were identified and possible accesses to these properties were schematically shown.

Number 78, Glenmore Ave, Lynnwood Glen, Pretoria. PO Box 12530, Hatfield 0028, South Africa.
Tel: (012) 348-0386 Fax: (012) 348-3587 Int. Code (27) Cell: 083 447 9961 Email : admin@techworld.co.za



TECHWORLD consulting ENGINEERS

MAFUBE COAL MINE	Proposed D684 & D1048 Closure and New Re-alignment	TW941/v1

APPENDIX H

Correspondence with Authorities

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

Private Bag X7279, Emalahleni, 1035, Tel: 013 653 0500, Fax: 013 656 0932
Saveways Centre, Mandela Drive, Witbank, 1034
Enquiries: Ms. V. Moshapo : **Email**: Victoria.Moshapo@dmr.gov.za
Ref: (MP) 30/5/1/3/2/1/ (10026 MR) EM
Directorate: Mine Environmental Management: Mpumalanga Region

REGISTERED MAIL

Mafube Coal Mining (Pty) Ltd
Private Bag X 3385
Middleburg
1050

Attention: Chantelle Gerber **Email:** chantelle.gerber@ngloamerican.com

ACKNOWLEDGEMENT RECEIPT OF AN APPLICATION FOR ENVIRONMENTAL AUTHORISATION IN RESPECT OF THE FARMS SPRINGBOKLAAGTE 416 JS (PORTION 1 & 12), NOOITGEDACHT 417 JS (PORTION 4, 14 & 15) ROODEPOORT 418 JS (PORTION 8, 9, 10, 11 & 13) WITHIN THE MAGISTERIAL DISTRICT OF MIDDLEBURG, AS REQUIRED IN TERMS OF REGULATION 3(6) OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO.107 OF 1998): ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, 2014 LODGED IN TERMS OF REGULATION 19 OF THE ABOVE-MENTIONED REGULATIONS AS READ TOGETHER WITH SECTION 12 OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2008 (ACT NO.49 OF 2008) AS AMENDED.

The above-mentioned matter refers.

1. This letter serves to inform you that your application for an Environmental Authorisation lodged with this Department is hereby acknowledged.

2. Kindly be informed that the above-mentioned application has not yet been evaluated. Once the evaluation is concluded, you shall be informed in due course of the outcome thereof. Notwithstanding this, you are reminded that all documents must be submitted in accordance with the timeframes stipulated on the NEMA: EIA Regulations, 2014.

3. For any enquire regarding this application please contact the above mentioned Official.

Yours faithfully

Mtengwa

PP **REGIONAL MANAGER:**
MINERAL REGULATION
MPUMALANGA REGION
DATE: 19/04/2018

Cc: M Weideman

Fax: 086 582 1561

ALL THE CORRESPONDENCE SHOULD BE ADDRESSED TO THE ATTENTION OF THE REGIONAL MANAGER OF DEPARTMENT OF MINERAL RESOURCES: MPUMALANGA.

APPENDIX I

CV of EAP

Education

B.Sc. Biological Science Botany and Biochemistry, North West University , Potchefstroom, 2003

B.Sc. (Hons) Environmental Sciences and Development, North West University, Potchefstroom, 2008

B.Sc. (Hons) Environmental Management , University of South Africa, Nelspruit, 2010

AVCASA Crop Protection Diploma, Tshwane University of Technology, Pretoria, 2004

Certifications

Professional Natural Scientist (Pri. Sci. Nat. 400107/17) - South African Council for Natural Scientific Professions (SACNASP), 17 July 2017

Languages

English – Fluent

Afrikaans – Fluent

Golder Associates Africa (Pty.) Ltd. – Johannesburg

Environmental Consultant

Responsibilities:
Project and Finance Coordination and Management;
Integrated Authorisation Projects;
Compliance Projects;
Consultation with Interested and Affected Parties and Government Departments;
Compliance / Risk Auditing;
Stakeholder Engagement and Public Participation;
Environmental Management Programme Report Performance Assessments;
Environmental Management Programme Report Development and Amendments;
Environmental Management Programme Report Consolidations.

Employment History

Golder Associates Africa (Pty) Ltd – Johannesburg, South Africa

Environmental Consultant (September 2011 to Present)

Environmental Impact Assessments (EIA's), Environmental Management Plans (EMP's), Project Co-ordination, Integrated Regulatory Process (IRP) co-ordination and Public Participation. Shadow the Lead project manager on large scale EIAs and environmental projects. Attending meetings with clients, authorities, and other team members. Writing proposals, reports, and presentations. Undertaking site visits and fieldwork. Project research and budgeting.

Ocean Agriculture (Pty) Ltd. – Johannesburg, South Africa

Agronomist (November 2009 to August 2011)

Responsibilities:
Advisory agronomic support to emerging farmers and commercial farmers in South Africa and Kenya, on agricultural crop production aspects, agricultural production planning, and developing specific nutritional plant production (feeding) programs.

Ocean Agriculture (Pty) Ltd. – Nelspruit, South Africa

Technical and Sales Advisor (September 2007 to October 2009)

Responsibilities:
Advisory agronomic support to local farmers in the Mpumalanga area, on agricultural crop production aspects, agricultural production planning, and developing specific nutritional plant production (feeding) programs.

MGK Obaro (Pty) Ltd – Brits, South Africa

Assistant Technical Advisor (February 2007 to August 2007)

Responsibilities:
Client visits and consulting with farmers on different products and general problem solving;
Organizing and participating in farmers' day;
Assist with writing fertilizer application programs

PROJECT EXPERIENCE – ENVIRONMENTAL ASSESSMENT

Foskor (Pty) Ltd Limpopo, South Africa	Completed Basic Assessment Report and WUL Amendment process for the proposed new Silt Pond Project
Elkem Ferroveld Mpumalanga, South Africa	Completed Basic Assessment Report and AEL Amendment process for the proposed Gas Abatement Plant
Gold Fields Limited: South Deep Gold Mine Gauteng, South Africa	Compiled a Consolidated EMP Report
Optimum Coal Mine Mpumalanga, South Africa	Assisted in drafting the Basic Assessment Report for the Eikeboom Water Treatment Plant.
Anglo Operations New Denmark Mpumalanga, South Africa	Assisted in drafting the EMP Performance Assessment Report and Audit Matrix.
Glencore Zonnebloem CoalMine Mpumalanga, South Africa	Assisted in drafting the EIA and EMP Amendment Reports.
Samancor Chrome North West, South Africa	Assisted in drafting an Environmental Compliance Audit report and Audit Matrix.
Scaw South Africa Eclipse West Foundry Gauteng, South Africa	Acted as independent ECO, and completed the final decommissioning audit report.
Scaw South Africa Eclipse West Foundry Gauteng, South Africa	Assisted in drafting the Basic Assessment Report and EMP for the Decommissioning of the EclipseWest Plant. Also acted as a Public Participation Practitioner to put up posters and site notifications.
Palabora Mining Company Limited Limpopo, South Africa	Assisted in drafting the Basic Assessment Report for the Magnetite Expansion project
Rio Tinto Benga Coal Mine Mozambique	Assisted in drafting the EMP report.
Exxaro Grootegeluk Limpopo, South Africa	Assisted in drafting the Basic Assessment Report for the New Gate project
New Vaal Colliery Gauteng, South Africa	Completed an EMP Performance Assessment Report and Audit Matrix
Palabora Mining Company Limited Limpopo, South Africa	Assisted in drafting the consolidated EMP report

Exxaro Grootegeluk Limpopo, South Africa	Assisted in drafting the consolidated EMP report
ACWA Power - Bokpoort II Northern Cape, South Africa	Public Participation practitioner during the public meeting for the proposed Solar Development, and assisted in the compilation of the application forms and the Basic Assessment Report.
Exxaro Arnot Colliery Mpumalanga, South Africa	Assisted in drafting a revised EMP and IWULA. Assisted in drafting the EIA/EMP for the expansion of Mooifontein Opencast Mine.
Scaw South Africa Eclipse East Plant Gauteng, South Africa	Compiled an Environmental Assessment report and EMP as requested by GDARD.
Exxaro Arnot Coal Mine Mpumalanga, South Africa	Assisted in drafting the Consolidated EMP Report.
Mintails Mining (Pty) Ltd Gauteng, South Africa	Completed environmental performance assessment audits for 3 Mining Rights areas.
Mintails Mining (Pty) Ltd Gauteng, South Africa	3 month secondment - located on site 2 days per week to assist with any environmental legal compliance issues.
Foskor Limpopo, South Africa	Compilation of Basic Assessment/EMP and Water Use License amendment for new additional silt pond.
Kamoa Copper Project Katanga Province, DRC	Assisted with the screening and scoping phases of the project including: minute taking, compilation of Stakeholder database, presentation posters and sections of the Scoping Report.
Arnot Coal Mine Mpumalanga, South Africa	Assist in drafting the baseline section of the Consolidated Environmental Management Programme report (EMPR) for Arnot Coal Mine owned by Exxaro.
Various Gauteng, South Africa	Assisted with the rectification of environmental legislative non-compliances including waste licences and Section 24G applications for an iron and steel manufacturing company.
Scaw South Africa (Pty) Ltd Gauteng, South Africa	Project Management, Client Liaison, Section 24G Applications, Regulator Consultation, Specialist Coordination, Invoicing and debtors, Consolidation of site management actions, and Assisted in Water Use and Waste Management Licence Applications
Mafube Coal Mine Mpumalanga, South Africa	Compilation of EIA/EMP, Project Coordination, Client Liaison, Project Scheduling, Invoicing and debtors, Specialist Coordination
Tweefontein Coal Mine Mpumalanga, South Africa	(Xstrata Coal South Africa, 2012) Environmental Impact Assessment Project Co-ordinator for a proposed Water Reclamation Project (reverse osmosis treatment plant and associated pipelines and waste facilities).

TRAINING

Implementation and Facilitation of Environmental Management Systems based on ISO 14001:2015 Requirements
South African Certification and Auditing Services (SACAS), 27-29 March 2017

Planning for Effective Public Participation
International Association for Public Participation, September 2011

Project Management Fundamentals
Internal Training, 16-19 October 2013

Environmental Law for Environmental Managers
Centre for Environmental Management (CEM), Potchefstroom, July 2013

Isometrix
Internal Training, 2012

Microsoft Project 2007 Essentials
Bytes Technology Group, 29-30 November 2011

Communications for Effective Public Participation
International Association for Public Participation, September 2011

APPENDIX J

Public Meeting on 4 April 2018

The meeting was advertised in the 16 March Middleburg Observer (APPENDIX C), on six Site Notices that were placed at various locations near communities in the area (APPENDIX E) and in a background information letter that was distributed to interested and affected parties (I&APs) via email and post on 16 March (APPENDIX B). Notwithstanding these notification measures, no I&APs arrived at the meeting. The signed attendance register and a number of photographs taken at the venue on 4 April 2018 are attached.

APPLICATION FOR ENVIRONMETAL AUTHORISATION FOR THE PROPOSED ROAD REALIGNMENT AND WATER USE LICENCE APPLICATION PROCESS FOR THE MAFUBE LIFE EXTENSION PROJECT, MPUMALANGA PROVINCE

PUBLIC MEETING ATTENDANCE REGISTER

Meeting with:	**The Mafube Life Extension Project I&APs**
Date and Time:	**Wednesday 4 April 2018 (11:00 – 13:00)**
Venue:	**Arnot Vroue Landbou-unie Hall, Farm Springboklaagte, Middelburg District**
Purpose of meeting:	**Public Meeting**

TITLE	FIRST NAME	SURNAME	ORGANISATION (Please do not use acronyms)	POSTAL ADDRESS	CONTACT DETAILS	
MR	Michael	Whitfield	Golder Associates	Mwhitfield@golder.co.za	Tel No:	011 254 4800
					Fax No:	
					Cell No:	083 4 301033
					e-mail:	mwhitfield@golder.co.za
					Signature:	
Mr	GARETH	ISENEGGER	GOLDER ASSOCIATES	gisenegger@golder.co.za	Tel No:	011 254 4800
					Fax No:	
					Cell No:	072 683 5350
					e-mail:	gisenegger@golder.co.za
					Signature:	
Ms	Ursula	Papi	Golder Associates	upapi@golder.co.za	Tel No:	011 2544801
					Fax No:	
					Cell No:	083 415 4358
					[redacted]	upapi@golder.co.za
					Signature:	
Ms	Rebecca	Ledwaba	Golder Associates	Mledwaba@golder.co.za	Tel No:	011 254 4800
					Fax No:	
					Cell No:	083 459 9538
					e-mail:	Mledwaba@golder.co.za
					Signature:	
Mr.	Moses	Mahlangu	Margan Industrial Services	delno@telkomsa.net	Tel No:	013-656 1212
					Fax No:	013-656 2233
					Cell No:	082 854 9538
					e-mail:	delno@telkomsa.net
					Signature:	

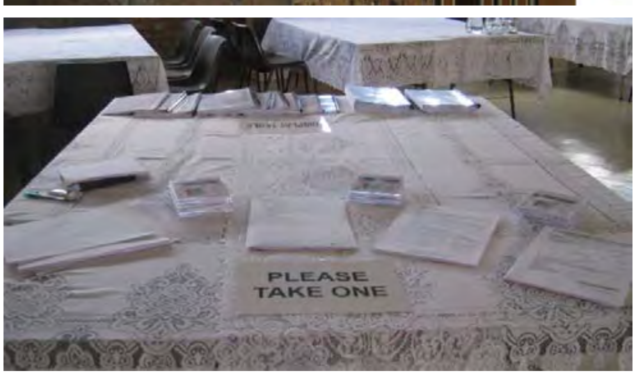

ARNOT LANDBOU - UNIESAAL


PUBLIC
MEETING


PUBLIC
MEETING


PUBLIC
MEETING


REGISTRATION
TABLE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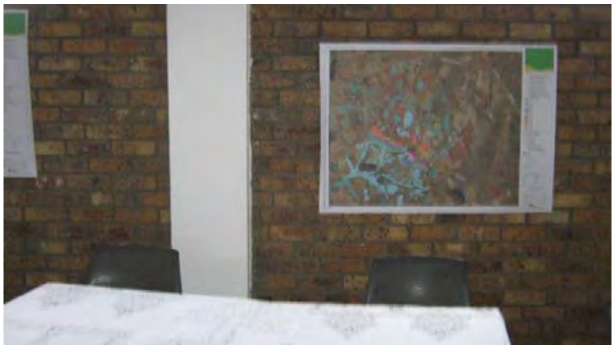
REFRESHMENTS






Ladies
Gents
PUBLIC MEETING

DISPLAY TABLE